N62661.AR.003112
NS NEWPORT
5090.3a

FINAL FEASIBILITY STUDY SITE 19 DERECKTOR SHIPYARD MARINE SEDIMENT NS NEWPORT RI
5/1/2014
TETRA TECH

Feasibility Study

for

Site 19 – Former Derecktor Shipyard Marine Sediment

Naval Station (NAVSTA) Newport, Rhode Island

Naval Facilities Engineering Command Mid-Atlantic

Contract Number N62470-08-D-1001
Contract Task Order WE61

MAY 2014

W5213850F

FEASIBILITY STUDY

FOR

SITE 19
FORMER DERECKTOR SHIPYARD MARINE SEDIMENT

NAVAL STATION (NAVSTA) NEWPORT, RHODE ISLAND

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

SUBMITTED TO:
NAVAL FACILITIES ENGINEERING COMMAND MID-ATLANTIC
9742 MARYLAND AVENUE
NORFOLK, VIRGINIA 23511-3095

SUBMITTED BY:
TETRA TECH, INC.
234 MALL BOULEVARD, SUITE 260
KING OF PRUSSIA, PENNSYLVANIA 19406

CONTRACT NUMBER N62470-08-D-1001
CONTRACT TASK ORDER WE61

MAY 2014

PREPARED UNDER THE DIRECTION OF:

STEPHEN S. PARKER, LSP
PROJECT MANAGER
TETRA TECH
WILMINGTON, MASSACHUSETTS

APPROVED FOR SUBMISSION BY:

JOHN J. TREPANOWSKI, P.E.
PROGRAM MANAGER
TETRA TECH
KING OF PRUSSIA, PENNSYLVANIA

TABLE OF CONTENTS

SECTION **PAGE**

EXECUTIVE SUMMARY ES-1

1.0 INTRODUCTION 1-1
1.1 SITE LOCATION AND DESCRIPTION 1-3
1.2 SITE HISTORY 1-3
1.3 PHYSICAL CHARACTERISTICS OF THE STUDY AREA 1-9
1.3.1 Regional Geology and Hydrogeology 1-9
1.3.2 Onshore Geology and Hydrogeology 1-10
1.3.3 Marine Hydrographics 1-10
1.3.4 Sediment Characteristics and Debris 1-11
1.3.5 Piers and Bulkheads 1-14
1.3.6 Historical Dredging and Surveys 1-15
1.4 PREVIOUS INVESTIGATIONS 1-16
1.4.1 URI Sediment Sampling - 1993 1-16
1.4.2 Marine Ecological Risk Assessment Investigations – 1995 through 1996 1-17
1.4.3 Risks to Human Health 1-26
1.4.4 Identification of COCs and Development of PRGs - 1998 1-31
1.4.5 Stillwater Basin Evaluation - 1998 1-32
1.4.6 Sediment Investigation - 2004 1-33
1.4.7 Supplemental Sediment Investigation (SSI) - 2011 1-35
1.5 SUMMARY OF INVESTIGATION FINDINGS 1-39
1.6 CONCEPTUAL SITE MODEL 1-40

2.0 DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES 2-1
2.1 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS 2-1
2.1.1 Definition of Applicable or Relevant and Appropriate Requirements 2-1
2.1.2 Classifications of Applicable or Relevant and Appropriate Requirements 2-2
2.1.3 To-Be-Considered Guidance 2-3
2.1.4 Identification of Applicable or Relevant and Appropriate Requirements 2-3
2.2 DEVELOPMENT OF PRGS 2-4
2.2.1 Identification of Media of Concern 2-4
2.2.2 Development of PRGs 2-6
2.2.3 Identification of Sample Stations Exceeding PRGs 2-12
2.3 FORMULATION OF SEDIMENT REMEDIAL ACTION OBJECTIVES 2-12
2.4 DETERMINATION OF AREAS REQUIRING REMEDIAL ACTION 2-13

3.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES 3-1
3.1 GENERAL RESPONSE ACTIONS 3-1
3.1.1 No Action 3-2
3.1.2 Administrative Actions 3-2
3.1.3 Containment 3-2
3.1.4 Removal and Disposal 3-3
3.1.5 Removal, Ex-Situ Treatment, and Disposal 3-4
3.1.6 In-Situ Treatment 3-4
3.2 SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS 3-4
3.2.1 Preliminary Screening 3-4
3.2.2 Representative Process Options 3-5

TABLE OF CONTENTS (cont.)

SECTION **PAGE**

3.2.3 Evaluation of Technologies and Process Options....3-5
3.3 EVALUATION OF TECHNOLOGIES AND REPRESENTATIVE PROCESS OPTIONS FOR SEDIMENT AT OU5....3-6
3.3.1 No Action....3-6
3.3.2 Administrative Actions....3-7
3.3.3 Enhanced Natural Recovery (ENR)....3-11
3.3.4 Containment....3-12
3.3.5 Removal....3-13
3.3.6 Materials Disposal and Handling....3-19
3.3.7 Treatment....3-25
3.3.8 Summary....3-26
3.4 SUMMARY OF SELECTION OF REPRESENTATIVE PROCESS OPTIONS....3-27
3.5 RATIONALE FOR DEVELOPMENT OF ALTERNATIVES....3-29
3.6 NATIONAL CONTINGENCY PLAN EVALUATION CRITERIA AND RELATIVE IMPORTANCE OF CRITERIA....3-30
3.6.1 Evaluation Criteria....3-30
3.6.2 Relative Importance of Criteria....3-33

4.0 DESCRIPTION AND DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES FOR MARINE SEDIMENT....4-1
4.1 DESCRIPTION OF REMEDIAL ALTERNATIVES....4-2
4.1.1 Alternative 1: No Action....4-3
4.1.2 Alternative 2: Enhance Natural Recovery through Thin Layer Cover, LUCs, and Monitoring....4-3
4.1.3 Alternative 3: In-Situ Cap (Engineered Barrier), LUCs, and Monitoring....4-9
4.1.4 Alternative 4: Combination Dredge / Backfill (open water), Cover (under Pier 2) and LUCs and Long-Term Monitoring....4-13
4.1.5 Alternative 5: Target Dredging (open water); Capping, LUCs, and Monitoring (beneath Pier 2)....4-18
4.2 NATIONAL CONTINGENCY PLAN EVALUATION CRITERIA AND RELATIVE IMPORTANCE OF CRITERIA....4-22
4.2.1 Evaluation Criteria....4-22
4.2.2 Relative Importance of Criteria....4-26
4.3 DETAILED ANALYSES OF REMEDIAL ALTERNATIVES....4-26
4.3.1 Alternative 1: No Action....4-27
4.3.2 Alternative 2: Enhance Natural Recovery through Thin Layer Cover, LUCs, and Monitoring....4-28
4.3.3 Alternative 3: In-Situ Cap (Engineered Barrier), LUCs, and Monitoring....4-34
4.3.4 Alternative 4: Combination Dredge / Backfill (open water), Cover (under Pier 2) and LUCs and LTM....4-38
4.3.5 Alternative 5: Target Dredging and Backfill....4-44
4.4 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES....4-48

TABLES

NUMBER

E-1 Summary of Remedial Alternatives
1-1 Historic Sediment Investigations
1-2 Historic PRG Exceedances for Sediment
1-3 Summary of the Findings of the Ecological Risk Assessment
1-4 Summary of Marine Human Health Risk Assessment Results
1-5 PRG Exceedances for SSI Sediment Samples
1-6 Tissue Screening Concentration Benchmarks for Evaluation of COC Impacts on Target Species
2-1 Summary of Chemical-Specific ARARs and TBCs
2-2 Summary of Location-Specific ARARs and TBCs
2-3 Summary of Action-Specific ARARs and TBCs
3-1 Preliminary Screening of Sediment Technologies and Process Options
3-2 Summary of Other Sites where Dredging Beneath Piers has been Proposed
4-1 Assessment of Chemical-Specific ARARs and TBCs – Sediment Alternative 1: No Action
4-2 Assessment of Location-Specific ARARs and TBCs – Sediment Alternative 1: No Action
4-3 Assessment of Action-Specific ARARs and TBCs – Sediment Alternative 1: No Action
4-4 Assessment of Chemical-Specific ARARs and TBCs – Sediment Alternative 2: Enhanced Natural Recovery through Thin Layer Cover, LUCs, and Monitoring
4-5 Assessment of Location-Specific ARARs and TBCs– Sediment Alternative 2: Enhanced Natural Recovery through Thin Layer Cover, LUCs, and Monitoring
4-6 Assessment of Action-Specific ARARs and TBCs– Sediment Alternative 2: Enhanced Natural Recovery through Thin Layer Cover, LUCs, and Monitoring
4-7 Assessment of Chemical-Specific ARARs and TBCs – Sediment Alternative 3: In Situ Cap (Engineered Barrier), LUCs, and Monitoring
4-8 Assessment of Location-Specific ARARs and TBCs – Sediment Alternative 3: In Situ Cap (Engineered Barrier), LUCs, and Monitoring
4-9 Assessment of Action-Specific ARARs and TBCs – Sediment Alternative 3: In Situ Cap (Engineered Barrier), LUCs, and Monitoring
4-10 Assessment of Chemical-Specific ARARs and TBCs – Sediment Alternative 4: Combination Dredge/Backfill (Open Water), Cover/LUCs (Under Pier 2) and Monitoring
4-11 Assessment of Location-Specific ARARs and TBCs – Sediment Alternative 4: Combination Dredge/Backfill (Open Water), Cover/LUCs (Under Pier 2) and Monitoring
4-12 Assessment of Action-Specific ARARs and TBCs – Sediment Alternative 4: Combination Dredge/Backfill (Open Water), Cover/LUCs (Under Pier 2) and Monitoring
4-13 Assessment of Chemical-Specific ARARs and TBCs – Sediment Alternative 5: Dredge (Open Water), CAP and Monitoring (Beneath Pier 2)
4-14 Assessment of Location-Specific ARARs and TBCs – Sediment Alternative 5: Dredge (Open Water), CAP and Monitoring (Beneath Pier 2)
4-15 Assessment of Action-Specific ARARs and TBCs – Sediment Alternative 5: Dredge (Open Water), CAP and Monitoring (Beneath Pier 2)
4-16 Summary of Detailed Analysis of Sediment Remedial Alternatives

FIGURES

NUMBER

ES-1 Location of Site Features
1-1 Site Location Map, Naval Station Newport
1-2 Site Locus
1-3 Historic Site Features

FIGURES (cont.)

NUMBER

1-4 Grain Size Characteristics of Surface Sediments 1996 (0-15 CM)
1-5 Bathymetric Survey Results
1-6 Historic Sediment Sample Stations
1-7 Historic Biota Sample Stations (ERA)
1-8 Reference Sediment Sample Locations
1-9 SSI Sampling Locations and Reference Grid
1-10 Historic Sediment Sample Stations Exceeding RPRGs
1-11A SSI Sediment Samples Exceeding RPRGs, 0-12 inch Interval
1-11B SSI Sediment Samples Exceeding RPRGs, 12-24 inch Interval
1-11C SSI Sediment Samples Exceeding RPRGs, 24-48 inch Interval
1-12 Conceptual Site Model
4-1 Alternative 2
4-2 Alternative 3
4-3 Alternative 4
4-4 Alternative 5

REFERENCES

APPENDICES

A Preliminary Remediation Goals (PRGs) for Derecktor Shipyard/Coddington Cove (Final, SAIC, November 1998)

B Historical Documents
B-1 – Load Restrictions on Piers 1 and 2
B-2 – Historic bathymetry and dredging records

C Analytical Results
C-1 Sediment Data 1993- 2004
C-2 Sediment data from 2011
C-3 Grain size data 2011

D Supporting Documents
D-1 Cohesive Sediment Erosion Field Study Coddington Cove February 2012
D-2 Current, Wave and Tidal Analysis, September 2011
D-3 Report on Lead-210 Accumulation Rates of Sediment Cores
D-4 Project Team Meeting notes August 16, 2012
D-5 Remedial Alternatives Package October 31, 2012
D-6 Project Team Meeting notes January 3, 2013
D-7 Project Team Meeting notes October 23, 2013
D-8 Development Of Surface-area Weighted Average Concentration (SWAC) calculations
D-9 Asbestos under Piers 1 and 2
D-10 Development of a PRG for Benzo(a)pyrene in Marine Sediment

E Cost Estimates for Remedial Alternatives
E-1 Alternative 1
E-2 Alternative 2
E-3 Alternative 3
E-4 Alternative 4
E-5 Alternative 5
E-6 Cost Backup (APEX, 2013)

LIST OF ACRONYMS

ADCP	Acoustic Doppler Current Profile
ARAR	applicable or relevant and appropriate requirement
AWQC	ambient water quality criteria
B&R	Brown and Root Environmental
bgs	below ground surface
BPRG	baseline preliminary remediation goal
CAA	Clean Air Act
CAD	confined aquatic disposal
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	Code of Federal Regulations
cm/sec	centimeter per second
COC	chemical of concern
CRMC	Coastal Resources Management Council
CSM	conceptual site model
CTE	central tendency exposure
CTO	contract task order
CWA	Clean Water Act
E/E	Exposure/Effect
ENR	Enhanced Natural Recovery
ERA	Ecological Risk Assessment
ERDC	Engineer Research and Development Center
ER-L	Effects Range-Low
ER-M	Effects Range-Medium
FFA	Federal Facility Agreement
FS	Feasibility Study
ft.	feet or foot
GRA	general response action
g/day	grams per day
GSO	Graduate School of Oceanography
HHRA	Human Health Risk Assessment
HI	Hazard Indices
HMW	high molecular weight
HQ	Hazard Quotient
IC	institutional control
IRP	Installation Restoration Program
JPC	James Potter Cove
LTM	Long-term Monitoring
LUC	land use control
mg/kg	milligram per kilogram
MLLW	mean lower low water
MOU	memorandum of understanding
NAVFAC	Naval Facilities Engineering Command
NAVSEA	Naval Sea Systems Command
NAVSTA	Naval Station
NAVY	U.S. Department of Navy

NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NETC	Naval Education and Training Center
NOAA	National Oceanic and Atmospheric Administration
NOEC	no observed effects concentration
NOS	National Ocean Survey
NPL	National Priorities List
NTCRA	Non-time critical removal action
NUWC	Naval Undersea Warfare Center
O&M	operation and maintenance
OU	operable unit
PA	preliminary assessment
Pa	pascal
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PDI	pre-design investigation
POTW	publicly-owned treatment works
PPE	personal protective equipment
PRAP	Proposed Remedial Action Plan
PRG	preliminary remediation goal
PWD	Public Works Department
QAPP	Quality Assurance Project Plan
RAB	Restoration Advisory Board
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RIDEM	Rhode Island Department of Environmental Management
RIPAEDC	Rhode Island Port Authority and Economic Development Corporation
RME	reasonable maximum exposure
ROD	Record of Decision
RPO	representative process option
RPRG	recommended preliminary remediation goal
SAIC	Science Applications International Corporation
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SASE	site assessment screening evaluation
SEM/AVS	simultaneously extracted metals/acid volatile sulfides
SER	Shore Establishment Realignment Program
sq. ft.	square feet
SSI	supplemental sediment investigation
SWAC	surface-area weighted average concentration
TAL	target analyte list
TBC	to-be-considered
TBT	tributyltin
Tetra Tech	Tetra Tech, Inc.
TEV	threshold effects value
TOC	total organic carbon
TSCA	Toxic Substances Control Act
µg Sn/kg	micrograms of tin per kilogram
µg/kg	microgram per kilogram

URI	University of Rhode Island
USFDA	United States Food and Drug Administration
USCG	United States Coast Guard
USEPA	United States Environmental Protection Agency
VWAC	volume weighted average concentration

EXECUTIVE SUMMARY

OVERVIEW

This feasibility study (FS) report presents the development and evaluation of remedial alternatives to address contaminated marine sediment near the former Robert E. Derecktor Shipyard (Site 19), located at the Naval Station (NAVSTA) Newport in Newport, Rhode Island (formerly the Naval Education and Training Center [NETC]). The marine sediment areas adjacent to the former Robert E. Derecktor Shipyard are identified by the United States Environmental Protection Agency (USEPA) as Operable Unit (OU) 5 of the NETC Superfund Site and is an area of NAVSTA Newport where ship construction and maintenance operations (including painting, welding, sandblasting etc.) resulted in discharge of chemicals to the marine environment. The Navy completed baseline ecological and human health risk assessments (HHRA) in 1998 and has conducted additional sediment evaluation studies while developing the FS.

Five alternatives are presented for consideration as the Navy's remedial strategy for the OU 5. Environmental concerns for the on-shore areas of the site were previously addressed through several removal actions, and further on-shore activities are being considered for that area, identified as OU 12.

This report makes no recommendation as to a preferred alternative, and is limited to the evaluation and costing of each alternative on an even scale so that the Navy can develop a proposed remedial action plan (PRAP) in discussion with USEPA and Rhode Island Department of Environmental Management (RIDEM).

BACKGROUND

The site was used by Robert E. Derecktor Shipyards of Rhode Island Inc. from 1979 until 1992 to repair, maintain, and construct private and military vessels. Repair and maintenance operations consisted of sandblasting and painting, hull inspections, and other on-board vessel repairs. The operations were conducted in several buildings on-shore as well as on two floating dry docks and a large ferry (the Greenport Ferry) moored in Coddington Cove adjacent to the shipyard. Construction included cutting and welding steel, sandblasting, priming and painting, and assembling vessels. Supporting the ship maintenance and construction operations were an engineering department, an electrical shop, pipe shop, and vehicle maintenance shop. Shipyard operations reportedly generated large quantities of hazardous wastes, including waste oil, paints, solvents, thinners, concentrated bases, and other waste solids and liquids; housekeeping practices and hazardous material handling practices at the facility were evidently poor; and waste materials, including spent sandblast grit and oily liquids from the dry dock, were known to be disposed of on the property.

In addition to the contaminant sources described above, asbestos covered steam lines once located beneath the piers deteriorated, and are known to have released asbestos to the sediment beneath Pier 1, and potentially to the sediment beneath Pier 2. Released asbestos is deemed unrecoverable, and remaining asbestos has since been removed from beneath both piers.

On-shore investigations were conducted from 1995 to 1998 and found little residual contamination on the land portions of the site and only trace chemicals in the groundwater at the site. Further investigation was conducted in 2011 to fill data gaps; the results of that investigation indicated that human health risks were present at various locations throughout the site due to metals in soil and groundwater, TCE in groundwater, PAHs in soil and PCBs in soil. These results are being addressed separately in the Site 19, Derecktor Shipyard On-Shore Feasibility Study (Tetra Tech, 2012). Work in the on-shore portions of the site are ongoing, and reported separately, tracked by the USEPA as OU 12.

Marine sediment sampling and risk assessments conducted between 1995 and 1998 identified polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs) and metals in surface sediments near the shoreline and piers that posed potential risk to human health and the environment. Lower concentrations of chemicals were found in the outer portions of Coddington Cove that were determined to pose an intermediate or low potential for risk to human health and the environment. Using this information, preliminary remediation goals (PRGs) were developed for a subset of chemicals, identified as limiting chemicals of concern (COCs). The PRGs were finalized with EPA review and input in November 1998. RIDEM reviewed but did not state concurrence with the PRGs; their concerns were summarized in a letter dated 1/2/2009.

After development of the PRGs, it was recognized that accurate evaluation and costing for remedial alternatives was not possible without additional chemical and physical data. Additional sampling conducted in 2004 found similar chemicals in the same locations, but at much lower concentrations, particularly around Pier 1 and near Building 234. To address uncertainties in sediment behavior, a detailed sampling effort was conducted in 2011; this sampling effort confirmed a pattern of contaminants that was previously reported and more accurately delineated impacted sediment.

Collectively, these studies confirmed that chemicals in the marine sediment, particularly in the near shore areas, are likely to be at least partly a result of discharges from vessels and from shipyard operations on shore and off shore (floating dry docks and Greenport Ferry). Subsurface soil and groundwater impacts at the site are limited and primary sediment chemicals are not present in groundwater, it is believed that the primary route of chemical transport from the shipyard operations into the marine sediment was via overland runoff of spilled materials discharging directly to Coddington Cove through the storm drainage

system and via direct release of contaminated materials into the cove from the shoreline, floating dry docks and Greenport Ferry. Figure ES-1 presents the locations of the site features described above.

Conclusions of Investigations Supporting FS Development

The Navy used information from five primary investigations to develop the FS:
A marine ecological risk assessment (ERA) was conducted for Coddington Cove during 1995 and 1996. Sediment, fish, lobster, mussels, and clams were sampled and analyzed by the University of Rhode Island (URI) and University of Mississippi Laboratories. Data were evaluated with input from federal and state agencies and natural resource trustees. The risk assessment found an increased potential for adverse effects to the ecological systems from their exposure to chemicals in sediment. In general, two stations were identified as high risk, nine stations were identified as intermediate risk (including one reference station), and eight stations were identified as low risk (including a reference station). The highest potential for risk at the Site was found near the property leased by Derecktor between 1979 and 1992.

A marine HHRA was performed in 1997 to estimate the potential for adverse effects to human health from the chemicals that are present in marine sediment and shellfish. This study found a potential for increased risk of cancer and non-cancer health effects to humans who might ingest 36 meals per year or more of shellfish or lobster taken from the site. The study also found negligible increases of risk from eating lesser amounts of shellfish taken from this area, and from recreational activities that could involve direct contact with the sediment such as swimming, wading, and fishing.

An evaluation of the so-called stillwater basin, a small boat basin which is a protected anchorage framed by a small stone breakwater and the T-wharf, was completed in 1998 to assess and determine the cause of the apparent lack of indigenous biota in this area. The findings of the evaluations indicated that the substrate (soft sand with low oxygen at depth) does not provide the optimum habitat for a substantial benthic community although a so-called "Stage 1" community was found to exist, living within the physical limitations that are present.

Supplemental sediment sampling was conducted in August 2004 to better understand the extent of impacted sediment at Derecktor Shipyard. Samples were collected from stations previously sampled during the ERA and earlier investigations to confirm the presence, concentration and distribution of chemicals previously found, and to attempt to identify the source of hydrocarbon chemicals present. The investigation results indicated that concentrations of chemicals in surface sediments decreased over time, possibly due to new sedimentation on top of previously sampled substrate.

A Supplemental Sediment Investigation (SSI) was conducted in 2011 to provide better resolution of COC distribution in marine sediments in Coddington Cove, and to evaluate the physical characteristics of those sediments. During this effort, higher densities of samples (vertical and horizontal) were collected for chemical analysis, and cores were collected to evaluate physical forces acting on these sediments. This study identified four areas where sample results indicated concentrations of COCs are present above PRGs: (1) north and south of the east end of Pier 1, elevated levels of lead, PAHs, and PCBs were reported in sediment to a depth of 4 feet (ft.); (2) north beneath and south of the east end of Pier 2 elevated levels of lead, PAHs and PCBs were reported in sediment to a depth of 4 ft.; (3) south of the west end of Pier 2 elevated levels of lead and PCBs were reported in the surface sediment; and lastly (4) south of the T-Wharf elevated levels of PAHs were reported to a depth of 2 ft.

Because asbestos insulation was found to have been lost to the seafloor from under Pier 1, sediment samples collected from beneath Pier 1 during the SSI were analyzed for asbestos. Results indicated that at one location (two depth intervals) asbestos is present at concentrations of 2 percent; results from the remaining samples indicated trace or non-detected concentrations. It has been determined that risk of exposure to this material in its current location is negligible (does not pose risk), but there would be some potential for exposure if sediment containing asbestos is removed and dried, and allowed to become respirable.

A comparison of these five studies illustrates that the areas of concern at the site have not changed significantly, and that COCs appear to be present in surface sediment at locations previously reported.

FEASIBILITY STUDY PROCESS

Based on potential risks and conditions determined at the site during the investigations conducted, remedial action objectives (RAOs) were developed for this site. These RAOs form the basis on which remedial action alternatives are developed.

- Reduce human health risk associated with ingestion of shellfish populations in sediment impacted by benzo(a)pyrene by reducing exposure concentrations on an area average basis.

- Reduce the risk to aquatic organism populations from sediment impacted by lead, PCB, and HMW PAHS by reducing exposure concentrations on an area average basis.

- Ensure minimal risk to human health associated with exposure to asbestos that may be present in shipyard sediment during remedial actions.

Integral to this FS is the methodology by which to identify the portions of the impacted sediment that need to be addressed to meet the RAOs. Through discussions with USEPA and RIDEM, the Navy identified the sediment that causes excessive risk as Sediment that causes the surface area-weighted average concentration (SWAC) of the COCs at the site to exceed their respective PRGs. Addressing the sediment by reducing the SWAC ensures that PRGs are met in the important benthic zone, where exposure could potentially occur.

The Navy used several conservative steps to make these determinations. First, the baseline was identified as only sediment that exceeded each PRG individually. A grid across the site sediment area was used for establishing these areas. To calculate the SWACs, concentrations measured for each COC only within areas exceeding the PRGs were used, guaranteeing a decision to address some sediment at the site. Remedial action target areas were modeled to determine which areas could be addressed to reduce the SWACs adequately, and the combination of these was selected as the action area for each alternative.

The next step of the FS evaluated a range of options to address the marine sediment that was identified for remediation. A variety of technologies were evaluated to determine whether they could be effectively used to protect human health and the environment by containing, removing, or treating the COCs, and whether they could be implemented in the areas where the COCs are present. General technology options assessed were: administrative actions; containment; removal and disposal; removal, ex-situ treatment, and disposal; and in-situ treatment.

Using the technologies evaluated, five remedial alternatives were developed to address the COCs in the marine sediment:

- Alternative 1 - no action (as required by the National Oil and Hazardous Substances Pollution Contingency Plan [NCP]).

- Alternative 2 - enhanced natural recovery through thin layer cover over target areas, land use controls (LUCs), and long-term monitoring (LTM).

- Alternative 3 - in-situ cap (engineered barrier) over target areas, LUCs, and monitoring.

- Alternative 4 – combination of (a) targeted dredging/backfilling with LUCs and monitoring (in open water areas) and (b) targeted capping with LUCs and monitoring (in under-pier areas).

- Alternative 5 – combination of (a) targeted dredging (in open water areas) and (b) targeted capping with LUCs and monitoring (in under-pier areas).

Separately, the Navy will prevent exposure to potential asbestos in dredged shipyard sediment through development of documented precautionary measures and safe work practices, and these work practices will be described in LUC documentation.

The five remedial action alternatives were evaluated against the following seven criteria that are identified in the NCP: overall protection of human health and the environment; compliance with other environmental laws; long-term effectiveness and permanence; reduction of toxicity, mobility, and volume through treatment; short-term effectiveness; implementability; and cost. Two additional criteria, state acceptance and public acceptance, are not addressed in the FS, but will be evaluated following receipt of state comments on the Final FS and Proposed Remedial Action Plan (PRAP), and public comments on the PRAP. The PRAP is to be developed at a later step in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process.

The FS describes each of these remedial alternatives in detail, discusses whether each meets the seven NCP criteria, and then evaluates how well each compares to one another. A brief description of each alternative, its cost, and its overall protectiveness is presented below. Table ES-1 presents a general comparison of the five remedial alternatives against the seven evaluation criteria.

SUMMARY OF ALTERNATIVES

Alternative 1 (no action) – Consideration of a no-action alternative is required under the NCP to provide a baseline against which other alternatives may be compared. This alternative would involve no remedial response activities with respect to impacted marine sediment in Coddington Cove. The costs for this alternative are considered to be negligible, and any 5-year review efforts for OU 05 would be covered by the comprehensive 5-year review prepared for the overall NETC Newport CERCLA site. The 30 year net present worth for this alternative is estimated at $0.

Alternative 2 (enhanced natural recovery through thin layer placement, ICs and monitoring) – This alternative would meet RAOs by placement of a thin layer of sand (approximately 0.5 to 1.0 ft. thick) over target areas to reduce SWACs to concentrations below PRGs. It would address the deeper sediment through implementation of ICs (in the form of LUCs) to partially restrict traffic by large ships (i.e. restriction of ships with draft depths greater than designed elevations for the thin layer cover). The thin layer placement would provide protection to ecological receptors by providing an initial layer on which possible ongoing deposition (monitored) and natural recovery of impacted sediment can continue. A LTM program

and 5-year reviews would be conducted to assure protectiveness over time. The thin layer placement would be installed over 340,012 square feet (sq. ft.) or 7.8 acres of sediment. For costing purposes, it is assumed that monitoring and 5-year reviews would be performed for 30 years. To address the potential for a future risk from exposure to asbestos in the marine sediment during the implementation of the proposed remedy and future dredging of site 19, the LUCs that would be implemented to protect the thin layer cover material from disturbance would describe precautionary measures and safe work practices that would be implemented for sediment in open water areas and under pier areas. The purpose of these safe work practices would be to protect receptors from potential asbestos exposure. The 30-year present worth of this alternative is $5,222,851.

Alternative 3 (in-situ cap, LUCs, and LTM) – This alternative would meet RAOs by capping target areas of sediment to achieve SWACs that are below PRGs. The target areas will receive a 1 to 2 ft. thick engineered barrier (designed to withstand a 100 year storm event) which would isolate this sediment and prevent impacted sediment from mobilization during ship traffic and storm events. Implementation of LUCs would provide for long-term protectiveness of the cover. To address the potential for a future risk from exposure to asbestos in the marine sediment during the implementation of the proposed remedy and future dredging of site 19, the LUCs that would be implemented to protect the cap material from disturbance would describe precautionary measures and safe work practices that would be implemented for the capped sediment in open water areas and under pier areas. The purpose of these safe work practices would be to protect receptors from potential asbestos exposure. A LTM program and 5-year reviews would be conducted to assure protectiveness of the cap over time. A cap would be installed over a total of 340,012 sq. ft. or 7.8 acres of sediment. For costing purposes, it is assumed that monitoring and 5-year reviews would be performed for 30 years. The 30-year present worth of this alternative is estimated at $7,708,390.

Alternative 4 (combination dredge/backfill [open water target areas], cover [sub-pier target areas], and LUCs and LTM) – This alternative would meet RAOs through a combination of dredging, backfilling, and covering target areas to achieve SWACs that are below PRGs. Target areas in the open water portions of the site would be dredged to a depth of one foot, and backfilled. Target areas beneath Pier 2 would be covered in place with an in-situ cap, which would be a minimum of 1 foot thick. Dredged sediment would be removed by mechanical and/or hydraulic dredging and backfilled using clean material. Because contaminants would be left behind (beneath a cap) beneath Pier 2, LTM and LUCs will be required for this area. LTM will ensure that RAOs continue to be met, while LUCs will ensure that the cap is not disturbed. Additionally, in open water areas where dredging and backfilling would be conducted confirmation sampling after dredging and backfilling activities, LTM of the backfill and LUCs will be conducted to ensure RAOs continue to be met. To address the potential for a future risk from exposure to asbestos in the marine sediment during the implementation of the proposed remedy and future dredging of site 19,

the LUC that would be implemented to protect the cover material and backfill areas from disturbance would describe precautionary measures and safe work practices that would be implemented for sediment in open water areas and under pier areas. The purpose of these safe work practices would be to protect receptors from potential asbestos exposure. This approach is projected to reduce SWACs to levels below PRGs. Alternative 4 involves dredging of 14,016 cubic yards of sediment in open water areas and capping of 83,574 sq. ft. under the pier. The 30-year present worth of this alternative is estimated at $13,795,406.

Alternative 5 (combination dredge [open water target areas], and cover, LUCs / LTM [sub-pier target areas], – This alternative would meet RAOs through a combination of dredging and covering target areas to achieve SWACs that are below PRGs. Target areas in the open water portions of the site would be dredged to a depth of one or two feet. Target areas beneath Pier 2 would be covered in place with an in-situ cap, which would be a minimum of 1 foot thick. Because contaminants would be left behind (beneath a cap) beneath Pier 2, LTM and LUCs will be required for this area. LTM would be conducted to ensure that RAOs continue to be met, while LUCs would ensure that the cap is not disturbed. To address the potential for a future risk from exposure to asbestos in the marine sediment during the implementation of the proposed remedy and future dredging of site 19, the LUC that would be implemented to protect the cover material under pier 2 from disturbance would describe precautionary measures and safe work practices that would be implemented for sediment in open water areas and under pier areas. The purpose of these safe work practices would be to protect receptors from potential asbestos exposure. Dredged sediment would be removed by mechanical and/or hydraulic dredging; no backfilling would occur as part of this alternative, and confirmation sampling will be conducted post-dredging to ensure that RAOs have been achieved on an area-average basis. This approach is projected to reduce SWACs to levels below PRGs. Alternative 5 involves dredging of 27,646 cubic yards of sediment in open water areas and capping of 83,574 sq. ft. under the pier. The 30-year present worth of this alternative is estimated at $18,328,150.

These alternatives are summarized in the tables below. The quantities of sediment addressed for each alternative are summarized with cost as follows:

QUANTITIES	Cap/Backfill Volume (cubic yards)	Dredge Volume (cubic yards)	Total Cost
Alternative 1	0	0	$ 0
Alternative 2	15,141	0	$ 5.2 M
Alternative 3	31,526	0	$ 7.7 M

QUANTITIES	Cap/Backfill Volume (cubic yards)	Dredge Volume (cubic yards)	Total Cost
Alternative 4	22,810	14,016	$ 13.8 M
Alternative 5	8,794	27,646	$ 18.3 M

The achievement of RAOs is projected by the modeled reduction in the SWACs that are calculated for each of the COCs based on the available data, as summarized below.

PROJECTED SWAC VALUES	Benzo(a)pyrene (µg/kg)	HMW PAHs (µg/kg)	PCBs (µg/kg)	Lead (mg/kg)	Achieve RAOs?
PRG	*539*	*13,903*	*1,060*	*168*	
Alternative 1	1,415	32,594	6,286	522	NO
Alternative 2	461	4,025	675	153	Long Term
Alternative 3	461	4,025	675	153	YES
Alternative 4	527	5,171	675	153	YES
Alternative 5	432	2,460	684	161	YES

As stated above, this report makes no recommendation as to a preferred alternative, and is limited to the evaluation and costing of each alternative on an even scale so that the Navy can develop a proposed remedial action plan (PRAP) in discussion with USEPA and Rhode Island Department of Environmental Management (RIDEM).

1.0 INTRODUCTION

At the request of the U.S. Department of Navy (Navy), Tetra Tech, Inc. (Tetra Tech) has completed a Feasibility Study (FS) for Marine Sediments at the Former Robert E. Derecktor Shipyard - Site 19 (referred to herein as the Site), located at the Naval Station (NAVSTA) Newport in Newport, Rhode Island. This FS has been prepared under the Navy's Installation Restoration Program (IRP) in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA). This work is being conducted under Contract Number N62470-08-D-1001 Contract Task Order (CTO) WE61, for the Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic.

The marine sediment at the Former Robert E. Derecktor Shipyard has been identified as Operable Unit (OU) 5 of the Naval Education and Training Center (NETC) Superfund Site, as tracked by United States Environmental Protection Agency (USEPA) in the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS). The on-shore portion of the Former Robert E. Derecktor Shipyard is tracked separately as OU 12 of the NETC Superfund Site. The boundary between the onshore and offshore portions of Derecktor shipyard is the shoreline (mean low water [MLW]), and/or bulkhead wall, as specific to the location. The Navy identifies both OU 5 and OU 12 as "Site 19 – Former Robert E. Derecktor Shipyard at NAVSTA Newport, Newport, Rhode Island".

A draft FS for this site was completed in 1998 and was resubmitted as a draft final in July 1999 (Tetra Tech, 1999). Preliminary remediation goals (PRGs) were identified and finalized as part of the draft FS (as stated in a letter dated 1/2/2009, RIDEM did not concur with PRGs). However, in response to USEPA and Rhode Island Department of Environmental Management (RIDEM) comments on the Draft Final FS, the Navy conducted additional sediment sampling and revised the FS report, although it was agreed at that time that the finalized PRGs were acceptable and would be retained. Field sampling was conducted in 2004 (report completed in 2005) and a Draft Final FS (Revision 1) was prepared and submitted in 2008 to reflect results of the new supplemental site data. Further comments from USEPA and RIDEM on Revision 1 were received and after discussion between the regulatory parties and the Navy, it was agreed that an additional supplemental investigation be conducted to further define the physical conditions at the site and to also better resolve areas of sediment that require remediation. A Supplemental Sediment Investigation (SSI) was subsequently conducted in 2010 and 2011 (final report completed in December 2012). The data from the SSI was utilized to prepare this report, the second revision of the FS.

Several investigative studies were conducted between 1993 and 2011 to determine if marine sediments near the site have been contaminated by site-related activities (reports pertaining to on-shore investigations have been developed but are addressed as a separate operable unit). Results of these

marine sediment studies were presented in the *Final Marine Ecological Risk Assessment (Marine ERA) Report, Former Robert E. Derecktor Shipyard* (prepared by Science Applications International Corporation [SAIC] and the University of Rhode Island [URI]) (SAIC and URI, 1997); the *Draft Final Site Assessment Screening Evaluation (SASE) Report* (Brown and Root Environmental [B&R Environmental], 1997); the *Human Health Risk Assessment (HHRA) for Off Shore Areas of the Derecktor Shipyard* (B&R Environmental, 1998); the *Final Marine Sediment Sampling and Analysis Report, Former Robert E. Derecktor Shipyard* (Tetra Tech, 2005); and the *Final SSI Report* (Tetra Tech, 2012a). Table 1-1 presents a summary of previous studies.

This FS was developed to address off-shore contamination issues at the site. Hot spot removals for the on-shore portion of the site have been largely completed (Foster Wheeler Environmental, 2001). A Draft FS for the on-shore portions of the Former Derecktor Shipyard (OU 12) was submitted to regulatory agencies in January, 2013. Since the On-shore portions of the site and the marine sediment portions of the site are separate operable units, the on-shore portions of the site will be addressed separately from this FS.

This FS report is presented in four sections. Section 1.0 provides background information on the Derecktor Shipyard, including the site location and description; site history; site geology and hydrogeology; chemical nature and distribution in the media of concern (marine sediment and biota); and the results of the site investigations and risk assessments.

Section 2.0 describes the development of remediation goals, including identification of potential applicable or relevant and appropriate requirements (ARARs) and media and chemicals of concern (COCs) for the FS, and development of remedial action objectives (RAOs) and associated PRGs.

Section 3.0 describes the general response actions (GRAs) and presents the identification and screening of potential remedial technologies. Candidate technologies and process options are identified that can be used to achieve the RAOs and PRGs for the site.

Section 4.0 describes the remedial alternative development process and provides detailed descriptions of the proposed remedial alternatives that will achieve the RAOs and PRGs while remaining in compliance with the ARARs. Section 4 also presents the detailed analysis of the remedial alternatives on the basis of the evaluation criteria specified by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) 40 Code of Federal Regulations (CFR) 300.

1.1 SITE LOCATION AND DESCRIPTION

NAVSTA Newport is located approximately 60 miles southwest of Boston, Massachusetts, and 25 miles south of Providence, Rhode Island. The installation occupies approximately 1,000 acres, with portions of the facility located in the City of Newport and Towns of Middletown and Portsmouth, Rhode Island. The facility layout is long and narrow, following the western shoreline of Aquidneck Island for nearly 6 miles facing the east passage of Narragansett Bay. A general location map of NAVSTA Newport is provided as Figure 1-1.

The Robert E. Derecktor Shipyard Site is located in Coddington Cove at the central portion of NAVSTA Newport, as illustrated in Figure 1-2. The site is comprised of approximately 41 acres of shoreline land and improvements (OU 12), and the adjacent deep water industrial port in Coddington Cove (OU 5). Physical features of the industrial port include two Piers, each extending approximately 1,500 feet (ft.) into Coddington Cove; an “L” shaped stone breakwater; and a T-wharf extending approximately 800 ft. into the cove, which formerly housed Building A18. Together, the breakwater and T-wharf form a protected small-boat anchorage south of Piers 1 and 2. A sheet pile wall defines the shoreline along the shipyard property and deep water port area as well as the T-wharf. The two 1,500-foot piers are constructed of concrete decking supported by concrete piles with steel jackets. The eastern shoreline of Coddington Cove, along and north of the Derecktor Shipyard property, is approximately 3,200 ft. long. Coddington Cove covers an area of approximately 400 acres, and the offshore investigation area is comprised of approximately 110 acres. The cove is protected to the north by the Coddington Cove breakwater. To the southwest the cove is surrounded by a combination of natural and altered shoreline, formed through natural erosion of landforms and Navy construction conducted over the period of their operational use of this area. The southern shore of the cove is characterized by a gravely and stony beach that has a very gradual grade to the off-shore areas. Figure 1-3 depicts primary on-shore and off-shore site features.

1.2 SITE HISTORY

The NAVSTA Newport facility (formerly known as the NETC) has been in use by the Navy since the Civil War era. During World Wars I and II, military activities at the facility increased significantly and the base provided housing for many servicemen. In subsequent peacetime years, use of on-site facilities were slowly phased out until NAVSTA Newport became the headquarters of the Commander Cruiser-Destroyer Force Atlantic in 1962. In April 1973, the Shore Establishment Realignment (SER) Program resulted in the reorganization of naval forces, and activity again declined. This reorganization resulted in the Navy excessing 1,629 of its former 2,420 acres.

The shoreline of Coddington Cove was acquired in 1940 for use as a Navy supply station. Prior to this time, the Coddington Cove area was farmland with few structures. During World War II, the Coddington

Cove area experienced major development, including construction of barracks, warehouse space, and hundreds of Quonset huts. Although naval activity diminished following the end of World War II, some construction at Coddington Cove continued. In 1955, Pier 1 was completed to replace pier space lost in 1954 during Hurricane Carol. The adjacent Pier 2 was added in 1957.

Newport became headquarters to the Commander Cruiser-Destroyer Force Atlantic in 1962. Dozens of naval warships and auxiliary support ships were home-ported at Newport. A 1962 aerial photograph of the Coddington Cove area shows 18 naval warships moored at Pier 1.

During the period between 1973 and 1979, buildings on-site were leased to Coddington Yachts, Inc. and Newport Shipyard, Inc. One building was used by the Newport Seafood Group as a fish processing plant. In 1979, the Navy leased 41 acres to the Rhode Island Port Authority and Economic Development Corporation (RIPAEDC), which in turn subleased the property to Robert E. Derecktor Shipyards of Rhode Island, Inc. (Derecktor). Derecktor operated at the site until January 1992, when the corporation filed for bankruptcy protection.

The site was used by Derecktor to repair, maintain, and construct private and military ships. Repair and maintenance operations were concentrated around Pier 1. These operations largely consisted of sandblasting and painting, hull inspections, and other on-board ship repairs. Two floating dry docks were moored at Pier 1, and a large ferry, known as the Greenport Ferry, was moored between Buildings A18 and 234 for use as work space and for power generation, as shown in Figure 1-3.

Derecktor also constructed new ships under contract to the United States Coast Guard (USCG) and the United States Army. These ships had steel structures, and were used as cutters and tugboats. Construction included cutting and welding steel, sandblasting, priming and painting the structure, and assembling the ship. Ship assembly was primarily conducted in Building 234, located at the southern portion of the site. Supporting the ship maintenance and construction operations were an engineering department (Buildings 6 and A-18), an electrical and pipe shop (Building 6), and a vehicle maintenance shop (Huts 1 and 2). Figure 1-3 depicts the locations of these historic structures.

During its lease period from 1979 until 1992, Derecktor dismantled, moved, and reassembled site buildings and constructed a large addition to Building 234 (Figure 1-3), which was used as a setup area so that ships could be constructed indoors. While the area around Piers 1 and 2, and the T-wharf were dredged by the Navy in earlier years (see Section 1.3.4), there is no record of maintenance dredging being conducted in Coddington Cove during or following Derecktor's lease period.

NAVSTA Newport was listed on the USEPA National Priorities List (NPL) of abandoned or uncontrolled hazardous waste sites in November 1989. The NPL identifies those sites that pose a significant threat to public health and the environment.

A Federal Facility Agreement (FFA) for NAVSTA Newport was signed by the Navy, the State of Rhode Island, and the USEPA on March 23, 1992. The FFA outlines response action requirements under the IRP at NAVSTA Newport. The IRP is similar to the USEPA's Superfund Program authorized under CERCLA in 1980, as amended by SARA in 1986. The FFA was developed, in part, to ensure that environmental impacts associated with past and present activities at NAVSTA Newport are thoroughly investigated and remediated, as necessary.

In 1992, the Derecktor Corporation filed for bankruptcy protection. There was a possibility of hazardous materials releases at the Site; the Navy performed a Preliminary Assessment (PA) of the site in May 1993 which concluded the following:

- Shipyard operations generated large quantities of hazardous wastes, including waste oil, paints, solvents, thinners, concentrated bases, and other waste solids and liquids.
- Housekeeping practices and hazardous material handling practices at the facility were poor.
- Waste materials, including spent sandblast grit and oily liquids from the dry dock, were known to be disposed of on the property.
- Sandblast grit and metals-contaminated marine sediments are present around Pier 1.
- Releases of hazardous material are suspected in the waterfront areas and around Building 6.
- Interiors of Buildings 42, 234, 6, and 40 require cleaning prior to re-use.
- Numerous unlabeled 55-gallon drums were present containing unknown liquids.
- Asbestos-containing materials were suspected in some buildings.
- Releases to the ground surface at the site would most likely cause chemicals to pass to the marine environment through groundwater flow or via storm drain systems.
- Sheet piling at the North waterfront had become undermined, and debris had been placed within the void spaces.

Based on these conclusions, the Navy added the site to the FFA list as a Study Area in 1994. Subsequently, more thorough investigations were performed. The SASE (B&R Environmental, 1997) was performed to identify and characterize chemicals in the on-shore portions of the site. A Marine ERA (SAIC and URI, 1997) was performed to characterize the risk posed by chemicals in the marine sediment to ecological receptors near the site. A follow-up study to the ERA was performed in the summer of 1998. This study was referred to as the Stillwater Basin Evaluation, and focused on the enclosed small boat basin at Building 42, which is formed by the small breakwater and T-wharf (Figure 1-3). Findings were

published in a draft report (B&R Environmental, 1998). A Marine HHRA report (B&R Environmental, 1998) was prepared using data collected as a part of the ERA to identify increased risks to humans from the chemicals in the marine environment. Based on the findings of the Marine ERA, the status was upgraded to a “Site” and given the designation of Site 19 under the FFA, and identified as OU 5 by the USEPA.

The Marine ERA, the HHRA, and the supporting secondary documents were used to develop an FS published in February 1999. However, due to a lack of concurrence on various technical aspects of the report, discussions on potential remedies were extended without the FS being finalized, though the PRGs (Appendix A of this FS) were considered final and carried forward (as stated in a letter dated 1/2/2009, RIDEM did not concur with PRGs). At the request of regulatory agencies, a marine sediment sampling and analysis event was conducted in August 2004 to confirm the presence, concentration, and distribution of chemicals previously found in the area and to also identify the source of hydrocarbons. This report prompted a revision to the FS which was published in 2008.

The 2008 FS also did not receive concurrence, and extensive discussions between the Navy and the regulatory parties resulted in an agreement to attempt to resolve some uncertainties in the site condition. It was agreed that the Navy would better determine the extent of limiting COCs exceeding calculated PRGs (Appendix A), determine whether a PRG needs to be calculated for tributyltin (TBT), provide sediment data for copper and zinc to the regulatory parties for their information, determine if asbestos is present at concentrations that may impact possible response actions, evaluate the mechanisms of sediment deposition and scouring under normal and extreme conditions, and determine the rate of sediment accumulation in order to refine the conceptual site model (CSM) (Tetra Tech, 2011). Based on these agreements, the SSI was performed in 2011 to further define the distribution of chemicals identified during previous investigations. Sections 1.4 through 1.6 of this report summarize the supporting studies as well as the various technical efforts documented in the SSI.

Between the publication of the PA report and completion of the subsequent investigations described above, other construction and site restoration activities have been completed at the site. On-shore, Building 234 was removed in 1993; the old “transit shed”, a separate portion of Building 234 was removed in 1997, leaving the slab foundations; Huts 3 and 4 were removed in 1993; Huts 1 and 2 were removed in 1997; Building A-18 on the T-Wharf south of Pier 1 was demolished in 1997, the wharf sheet piling has since deteriorated substantially. Off-shore, the dry docks located at Pier 1, and the Greenport Ferry, were removed in 1993.

In addition to the building demolitions and removals, several removal actions were also conducted in on-shore areas of the site after 1993 to address potential contaminant sources, as briefly described below.

Details on these actions and the areas described are presented in the FS report for OU12, (under preparation).

- NAVSTA Newport Public Works Department (PWD) performed a preliminary removal at the site in 1994 that consisted of removing remaining debris, surface cleaning grossly contaminated concrete, and closing and removing underground storage tanks.

- In 1996, NAVSTA Newport PWD contracted a removal of sandblast grit that was present on the ground to the north and east of Building 42. OHM Corporation removed approximately 16,600 cubic yards of this material and covered the ground with a crushed stone/gravel mix. Sandblast grit was transported and disposed of at McAllister Point Landfill.

- In 1997, the “soil berm”, a large quantity of stockpiled soil at the “south waterfront” portion of the site was removed. This material was found to contain excavated soils and debris from construction and expansion of Building 234. Some of this material was transported to Tank Farm 4 for fill material within the imploded fuel oil bunkers. The remainder underwent disposal at Rhode Island landfills.

- In 1998 and 1999, Sump Pit S42-1 at Building 42 and polychlorinated biphenyl (PCB) contaminated soil at TP-14 was removed. Also in 1999, excavation of the test pit area 7 ft. south of MW-09 was finalized.

- In August 2000, removal of the Building 42 S42-5 Sump Pit was completed.

- In 2007, a non-time critical removal action (NTCRA) was conducted to remove a small quantity of sandblast grit in a former drainage ditch that was identified in 2005 during excavations conducted for a new guard shack approximately 100 ft. northeast of Building 6.

A summary of the removal actions conducted through 2000 was completed and submitted in March 2001 (Foster-Wheeler, 2001). A summary of the 2007 removal action was presented in a draft report published by Tetra Tech EC on December 5, 2007. As noted above, the on-shore portion of Site 19 was separated and given its own CERCLIS identification, and is currently tracked as OU 12. For additional details on the conditions and activities in the onshore areas, the reader is referred to the FS for Site19 – On-Shore Derecktor Shipyard, Naval Station Newport (Tetra Tech 2012b).

In addition to the onshore removal actions, asbestos was removed from steam pipes located beneath Piers 1 and 2. Between 2005 and 2009, records indicate that pipe insulation assumed to contain asbestos (ACM) was released from piping under Pier 1 as pieces falling from the pipes or as sections of

piping falling after deterioration of pipe hangars. Diver inspections were conducted and it was determined that the material under water (approximately 15-30 feet in depth) had deteriorated substantially rendering the ACM as not recoverable.

Surveys in 2007 and 2008 found:

- Majority of abandoned steam line (still hanging) under Pier 1 was in poor condition and missing more than 75% of insulation.
- Limited but unrecoverable insulation on limited portions of piping was present on the seafloor under Pier 1.
- Steam piping under Pier 2 was in better condition than that under Pier 1.

During the 2007 and 2008 surveys ACM was removed from steam pipes beneath Pier 1 in order to ensure asbestos would not continue to be released to the environment.

In 2010 and 2011 an asbestos survey and abatement was performed beneath Pier 2 and all ACM has been removed. Documentation for these actions is provided Appendix D9 of this FS report.

In the late summer of 1998, three inactive warships were moved from the Philadelphia Naval Shipyard to be temporarily berthed at Pier 1. These ships included two aircraft carriers, the ex-Forrestal (south side of Pier 1) and ex-Saratoga (north side of Pier 1), and the battleship ex-Iowa (moored on the south side of the ex-Forrestal). Prior to these ships arrival, Captain Hall from Naval Sea Systems Command (NAVSEA) made a presentation to the February 18, 1998, Restoration Advisory Board (RAB) meeting. Captain Hall stated that the Naval Inactive Ship Maintenance Facility in Philadelphia remains responsible for the ships while present at Newport. Captain Hall stated that these ships were in experimental hold status (would not likely be returned to duty). He also stated that the ships were never painted with TBT paints, and the potential for copper to leach from the bottom paints was minimal. Captain Hall and his staff stated that the bottoms of these ships will not be repainted because they are inactive, and growth is not a concern. Prior to dockage, the vessels would be safety-cleaned and made watertight. Oil booms would be installed and maintained around the ships, and a security staff and site manager would be present at all times to assure safety and cooperate with Coddington Cove restoration efforts. The ex-Iowa was moved from the Site in 2003, the ex-Forrestal was removed from the site in 2010, while the ex-Saratoga remains moored on the north side of Pier 1 as of the date of this document.

Currently both Pier 1 and Pier 2 have limited use and have lifting weight and use restrictions. The sole use of Pier 1 is as a moorage for the aircraft carrier ex-Saratoga. The Inactive Ships group of the Navy reported in January 2014 that the ex-Saratoga is expected to be moved in FY 2014 to an undetermined

location, pending a contract award. Pier 2 is in active use by the Navy, the USCG, and the National Oceanic and Atmospheric Administration (NOAA) for limited purposes: Pier 2 houses the Naval Undersea Warfare Center (NUWC) Periscope Shop; is temporary homeport for three USCG buoy tenders, a USCG maintenance team, the USCG pursuit vessel Tigershark, and one NOAA fisheries research vessel. Pier 2 also occasionally supports visiting U.S. Navy and foreign Navy ships.

The future use of Pier 2 is more limited: Due to the deteriorating piling structure, there are weight limitations applied to different areas of Pier 2. A construction project is under way to improve the marginal wharf area (the bulkhead waterfront between Piers 1 and 2) to accommodate berthing of the three USCG ocean buoy tenders. Pier 2 is currently planned as permanent berth for the USCG Tigershark (80 ft. length, 6 ft. draft). Pier 2 is tentatively identified as potential temporary berthing for the NOAA ship Bigelow, although this is uncertain at this time.

There is no identified future use of Pier 1 following the departure of the ex-Saratoga. Both Piers 1 and 2 are identified for demolition by the NAVSTA Newport Planning group, however, there are no funds yet made available for such demolition, and no schedule is currently set for that action. Engineering evaluations documenting weight restrictions are presented in Appendix B-1.

1.3 PHYSICAL CHARACTERISTICS OF THE STUDY AREA

This sub-section summarizes the geologic, hydrogeologic, and marine characteristics of the site and region. This information is based on the investigations performed as a part of the SASE, SASE Addendum, Ecological Risk Assessment, Stillwater Basin Evaluation, Supplemental Sediment Investigation, and other published data and reports. Information regarding physical characteristics of the on-shore areas is presented to provide context for better understanding of the conceptual site model, and the transfer of contaminants from the release areas to the sediments, which are the focus of this report.

1.3.1 Regional Geology and Hydrogeology

The NAVSTA Newport property is located at the southeastern end of the Narragansett Basin. The rock types of the Narragansett Basin are non-marine sedimentary rocks of Pennsylvanian age. The bedrock at the NAVSTA Newport facility is almost entirely of the Rhode Island Formation. A few areas of thick conglomerates are present within the Rhode Island Formation which consist of pebbles, cobbles, and boulders inter-bedded with sandstone and graywacke. While no conglomerate rock has been identified at the Site, Coasters Harbor Island, south of the Site is mostly covered with this conglomerate material. Overlying the Pennsylvanian rock of the Narragansett Basin are surficial deposits of Pleistocene sediments. These unconsolidated, glacial sediments range in thickness from 1 to 150 ft. and consist of till, sand, gravel, and silt.

1.3.2 Onshore Geology and Hydrogeology

Surface material encountered on the on-shore portions of the Former Derecktor Shipyard Site are primarily gravely sands, silty sands and fine to medium poorly graded sands that are assumed to be fill material placed during the construction of the waterfront by the Navy. This surface layer ranges in depth from 4.3 ft. to 28 ft. below ground surface (bgs) depending on proximity to shore. Below the gravely surface layer is a till layer comprised of tight, dense silty gravely sand with trace clay. Bottom depths of this layer range from 4.3 ft. to 46 ft. bgs. Bedrock at the site is described as a highly weathered phyllite or schist that is encountered at depths ranging from 4.3 ft. to 46 ft. bgs.

A hydrogeologic investigation performed during the SASE determined that wells up to 100 ft. from the shoreline are influenced by tides; but that the low salinity readings from the water in those wells indicate that groundwater from the onshore areas of the site is discharging into the ocean. Hydraulic conductivity rates ranged from 0.48 ft. per day to 1.71 ft. per day. Groundwater on the base is federally regulated as a drinking water source, although it is currently not used for that purpose. On-shore groundwater will be addressed as part of the On-shore OU (OU12).

Further information on the on-shore portions of the site are provided in the FS for Site 19 – On-Shore Derecktor Shipyard, NAVSTA Newport (Tetra Tech, 2012b).

1.3.3 Marine Hydrographics

A hydrographic survey was performed by the URI in 1995, and secondary hydrographic measurements were conducted in 2011. The 1995 work was conducted to measure current velocity and water column profiling of conductivity, temperature, and depth to determine patterns of water circulation within Coddington Cove in support of the ERA. This study evaluated the area during several different wind and tidal pattern cycles, but did not account for seasonal variation of wind patterns and effect of winter storms. The complete results are reported in the ERA for Derecktor Shipyard Coddington Cove (SAIC and URI, 1997). The 2011 work was conducted to better predict depositional characteristics of the cove.

The 1995 hydrographic surveys showed that the characteristic flow pattern occurs as a net counter-clockwise circulation within the interior of Coddington Cove. On average, maximum bottom velocities were found to be highest at the mouth of the cove and decreased in a counterclockwise manner following a general circulation pattern around the cove. Flow was such that, in general, the water column appeared well mixed vertically. High bottom velocities extending into the southeastern section of the cove were expected to prevent deposition of silt-sized particles, while the interior sections of the region between the piers and the northeastern region were generally sluggish and expected to be depositional

zones (except nearshore and/or shallow areas that may be strongly affected by wave energy or propeller wash).

The 1995 study did not account for the localized disturbance of sediments from ship activity at the piers and bulkheads. It is recognized that, depending on depth of ship draft, propeller wash from ships maneuvering to and from the piers could disturb shallow surface sediments in and around these areas, and that some of the sediments could become resuspended during such activity. Later data assessments have been performed to identify expected areas of high energy and low energy, based on anticipated high traffic areas and on projected future use of the property (Wood, 1998). High energy areas are those areas of the cove where there is a possibility for deposited sediment to be resuspended either through natural wave action or shipping traffic. These include areas along the piers and bulkheads at the waterfront. Because of the intermittent nature of ship traffic, and decrease in use of the piers in recent years, direct effects of ship movement have not been measured in detail.

During the SSI in 2011, further measurements were collected on wave heights, tidal elevation, water temperature, and current profiles utilizing Acoustic Doppler Current Profile (ADCP) recording instruments. The ADCP instruments were deployed in target areas of Coddington Cove and left in the water for a period of 17 days. No extreme weather events occurred during the deployment period, but information was gathered on steady state conditions. The findings of this investigation are described in detail in the SSI Report (Tetra Tech, 2012a).

In general the findings indicated that during steady state conditions currents are tidally driven and mean flow velocities range from 0.1 to 2.9 centimeters per second (cm/sec), while maximum flow velocities range from 7.3 to 29.3 cm/sec. Tides ranged about 1.4 meters during spring tides, and about 0.8 during neap tides, which suggests an ebb-dominant system. Current speeds were found to be generally weak and wind effects on current during the study period were minimal. Current direction varied within the study area from location to location and seemed to be dependent upon the tidal cycle as well as physical characteristics of the area, but findings did not disagree with the URI study from 1995. Maximum wave heights during the deployment period did not exceed 0.4 meters in height (1.3 feet), and it was hypothesized that the shoreline and breakwater act to shelter the cove from the northeast and south, while the presence of Conanicut Island (Jamestown) prevents waves from developing significant heights when entering the cove from the western side.

1.3.4 Sediment Characteristics and Debris

Side-scan sonar, sub-bottom profiling sonar, and sediment vibracore surveys were undertaken to determine the characteristics of both surface and underlying sediments within the Derecktor Shipyard/Coddington Cove study area during the Marine ERA field investigation. This combination of

techniques was utilized as part of the Marine ERA to provide more complete information than surface and core samples alone. In addition, cursory debris surveys have been conducted proximate to the Piers for the purpose of locating asbestos insulation lost from under the piers. Sediment characterization results are contained in the Marine ERA for Derecktor Shipyard Coddington Cove (SAIC and URI, 1997). Further sediment characterization was conducted in 2011 as part of the SSI. Debris information is available as side scan information and videography recorded by Navy divers.

1.3.4.1 Debris

Between 2005 and 2009, the Navy identified deterioration of the steam supply system to the buildings on Piers 1 and 2, and noted that the deterioration of the pipes beneath Pier 1 was far more significant than the deterioration beneath Pier 2. This deterioration included weather damage to asbestos-containing insulation on steam supply and return piping which hung under both Pier 1 and Pier 2. This system supplied heat to buildings present on the piers. Further information on asbestos released from the piers is provided in Appendix D9.

In order to determine if recoverable ACM was present on the seafloor under the piers, inspectional dives were performed in 2008 by Navy divers. Section 1.4.3.2 of this report provides further information on the release of asbestos from under the piers. This and earlier videography (1993) provided by dive teams shows presence of large debris including concrete, rubble, metal structures, cable, wiring, piping and general refuse. It was reported that bicycles were used by workers at the shipyard and shopping carts were used for carrying parts on Pier 1 during ship construction operations, and that both may be present in quantity in the sediment.

The side scan survey conducted by SAIC as part of the ERA also identified an uneven seafloor near the piers, and this could be a result of either shipyard operations or loss of equipment over side of berthed ships during their tenure at Coddington Cove.

1.3.4.2 Sediment Characteristics

The information collected during the ERA indicated that sediments in the Derecktor Shipyard/Coddington Cove study area were predominantly fine-grained at some stations (less than 40 percent sand content) and predominantly sandy (sand greater than 70 percent) at other stations. Surface sediments in Coddington Cove tended to be finer-grained (contained more silt and clay) than underlying sandy sediments, probably due to the significantly decreased bottom energy and increased likelihood of fine-grained sediment deposition resulting from construction of the Coddington Cove breakwater in 1957. A “sub-bottom reflector”, which is a second reflection of the sonar pulse reflected off something below the surface of the sediment, was observed in some of the geophysical profiles. These second reflectors may

delineate different lithologic units. In other locations, no strong sub-bottom reflectors were observed, indicating a likely uniform lithology vertically or a very gradual change in lithology.

Figure 1-4 summarizes the grain size characteristics of Coddington Cove surface sediments inferred from the geotechnical and geophysical investigations performed at the site during the Marine ERA.

To attempt to locate any significant deposits of sandblast grit (a suspected contaminant source from the shipyard operations), a limited investigation was focused around the pier areas, using vibracore techniques to determine sediment characteristics at depth. The analysis of these cores was performed by URI and is presented in the Marine ERA report (SAIC and URI, 1997). The locations of the vibracore stations (V-1 through V-15) are presented on Figure 1-4. While some possible sandblast material was noted in some of the cores, no large deposits of this material were found in sediment during this or subsequent investigation program. However, due to the observed presence of minor amounts of sandblast grit observed by the field crew, samples from V-4 and V-9 were analyzed for metals and inorganic chemicals by a fixed laboratory. Results from laboratory analysis of sediment samples are discussed in Section 1.4 of this FS.

Evaluation of the cores provided specific grain size data. There was high sand content and a lower silt content in subsurface sediments north of the piers (V-1) and somewhat less sand content between the piers (V-2). Southwest of Pier 1 (V-3 and V-12), there was a higher silt content in the deeper sediments, as well as at V-10, 11, 13 and 14, which were placed along both sides of Pier 1. These observations of deeper sediment differ somewhat from surface sediments evaluated by geophysical techniques (Figure 1-4). Data from these samples were published with the ERA (URI and SAIC, 1997).

During the SSI conducted in 2011, sediment cores were collected from the 0 to 1 ft. interval for grain size analysis at ten locations. At all these ten locations the primary components were either sands (dominated by fine or medium grained sand) or silts. Three sample locations GP01, GP02, and GP10, had more sand than silt, with percentages of sand ranging from 37 to 63.5 percent. The remaining seven locations were dominated by silt, and percentages ranged from 48 percent at GP09 to 78.9 percent at GP08. Clay was detected in all samples at percentages ranging from 8.7 to 23.5 percent. While either sands or silts were always the major components of the sediment cores, there were three locations, GP04, GP07, and GP08, where clay was the second most dominant constituent. Complete laboratory results for grain size, including hydrometer and sieve analyses, are presented in Appendix C-3.

During the SSI field investigation sediment stability and cohesion testing was conducted on cores collected from ten locations within the study area. The results of this testing indicated that each core had an unconsolidated surface layer of recently deposited material with a critical shear stress of 0.2 pascals

(Pa). Below that, all cores were found to be vertically stratified and all subsurface layers had significantly higher shear stress values than the unconsolidated surface layer. The complete sediment stability report, prepared by the U.S. Army Engineer Research and Development Center (ERDC), is provided in Appendix D-1 of this FS report.

1.3.5 Piers and Bulkheads

Significant alterations of the shoreline were conducted during the period of 1951-1960. During this period, a bulkhead shoreline was constructed near the previously existing beach face, and two ship piers were constructed.

The piers at Coddington Cove are constructed of concrete decking standing on concrete piles with steel jackets (see drawings provided in Appendix B2 of this FS report). At both piers, vertical piles are 10 ft. apart on-center, allowing approximately 8 ft. of lateral clearance. At Pier 1, there are also “batter” piles installed on the sides of the pier, which are driven at an angle so as to provide better lateral stability. These batter piles offset the vertical piles so that there is less than four ft. of lateral clearance between the perimeter pilings.

The piers are both built such that the bottom of the deck and framing allow only 3 to 4 ft. of clearance above the surface of the water level at mean high water (high tide). Pier 2 (the northern Pier) is approximately 1,500 ft. long and 200 ft. wide. Pier 1 (The southern pier) is approximately 1,500 ft. long and 100 ft. wide.

The bulkhead shoreline extends from a point approximately 200 ft. north of Pier 2 south to the southern extent of the former Building 234 area (former transit shed). There is a gap in the bulkhead south of Pier 1 and north of the stone breakwater and this portion of shoreline is formed by a steep-slope boulder revetment. The bulkhead is constructed of interlocked steel sheet-piling driven into the subsurface (no as-built drawings were found), with fill placed behind the shore – side to create a level and paved standing surface. Storm drains and surface drains (scuppers) are cut within the bulkhead to allow discharge to Coddington cove at various points. The T-Wharf was constructed at some point prior to 1951, and is also constructed with sheet piling and fill, so that this wharf is a solid structure that does not allow water to pass underneath. On the north section of the bulkhead shoreline, between Pier 1 and Pier 2, there is a section approximately 900 ft. long and approximately 40 ft. wide that was an “apron” also standing on piles. However, this section of shoreline and apron is under construction to provide permanent berthing space for three USCG ocean buoy tenders. This project involves demolition of the apron, and reconstruction of the bulkhead between Pier 1 and Pier 2. As part of this project it is anticipated that some dredging will occur within 50 feet of the new shoreline. The Navy is working to

ensure that any dredging conducted within the study area will be conducted in accordance with the selected CERCLA remedy for OU5.

1.3.6 Historical Dredging and Surveys

A general history of the dredging operations at Coddington Cove, conducted during the period of the development of the piers and waterfront, is summarized below. Historic drawings and surveys are presented in Appendix B-2.

Based on a review of historical site plans, the first dredging event within the study area occurred in 1942, when the area to the west and south of the T-wharf was dredged to -24 ft. (elevation). In 1952, the shoreline area north of the T-wharf was dredged to an elevation of 10 ft., to allow for construction of the breakwater and the Stillwater Area.

Pier 1 construction plans dated 1954 indicate that the area to be dredged to an elevation of -35 ft., extended from the pier approximately 400 to 500 ft. to the south, 500 to 600 ft. to the north, and 1,000 to 2,000 ft. to the west. The plan indicates that Pier 1 had not yet been constructed, and specifies that no dredging should take place in the area where Pier 1 was to be located. Based on the depths to sediment which appear in a 1955 plan (from the results of a “sounding” survey), the dredging had apparently been completed by that time (the actual depths to sediment appear very similar to the planned depths).

Pier 2 construction plans dated 1956 indicate that the area to be dredged extended from the pier approximately 300 to 400 ft. to the south and 400 to 600 ft. north of its east end. This plan also specifies that no dredging should occur in the area where Pier 2 was to be constructed. Plans from 1962 appear to indicate that additional dredging took place in areas north and south of Pier 2, but only to remove localized areas of sediments that were not at the target elevation. A final dredging event apparently took place in 1968, when the extension to Pier 1 was planned. Areas that were to be dredged, as indicated in this plan, were north of the east end of Pier 1, along the slope.

A bathymetric survey of Coddington Cove was conducted by the National Ocean Survey (NOS) in 1957, and indicated that water depths ranged from less than 5 ft. in the northeastern and southern areas of the cove, to between 33 and 40 ft. in the areas adjacent to Piers 1 and 2, and gradually deepened to 50 ft. at the cove entrance. Another bathymetric study performed in 1986 in a portion of the cove south of Pier 1 was found to be in good agreement with the NOS survey (SAIC and URI, 1997).

A hydrographic survey was completed in 2006 in the vicinity of Pier 1, for the Naval Inactive Ships Maintenance Office, to obtain a better understanding of the bottom elevations in the vicinity of the two inactive aircraft carriers moored at Pier 1. The survey concluded that bottom elevations in the berth areas

generally ranged from 34 to 40 ft. below the NOAA Mean Lower Low Water (MLLW) Datum, findings that are consistent with the NOS survey. It was further concluded that the maximum draft of the carriers that were at that time berthed at Pier 1 ranged from 30 to 32 ft., and that the under-keel clearance ranged from 4 to 11 ft. (Sea Vision, 2006).

Another bathymetric survey was conducted during the SSI (June 2011), the results of which are presented on Figure 1-5. This survey was in agreement with the others that had been conducted. The survey area extended from the north side of Pier 2 to the south side of the T-Wharf. This most recent survey showed a shallow area (10 to 25 feet deep) surrounding the T-Wharf which shows evidence of disturbance, an area at the former location of the ex-Forrestal where deposition appeared to have occurred around the hull during its time docked at Pier 1, and the area surrounding and between piers 1 and 2 showing what appear to be patterns from the 1950s to 1960s dredging.

Collectively, the data indicates that minimum depths achieved during early dredging projects have remained consistent, and that there appear to be and stable conditions in the area surrounding the piers, whereas there is some evidence of disturbance in the shallower areas around the T-wharf.

1.4 PREVIOUS INVESTIGATIONS

The findings of the previous investigations are presented in various documents prepared for the Navy, including the Marine ERA (URI/SAIC, 1996), the Marine Human Health Risk Assessment (Tetra Tech 1998) the Marine Sediment Sampling and Analysis report (Tetra Tech, 2004), and the SSI report (Tetra Tech, 2012a). This section summarizes the results of the studies pertinent to contaminants within the media of concern for this FS (marine sediment and biota) and describes the nature and extent of the contamination. Analytical data for sediment and biota are presented in Appendix C. As previously stated, environmental concerns associated with on-shore areas of the site have been addressed by several removal actions (Section 1.2) and a separate FS report for the on-shore portions of the site (OU 12) (Tetra Tech, 2012b).

This section describes the investigations and their results chronologically. For ease of comparability, the discussions presented in this section compare data for COCs identified in the ERA to the PRGs that were calculated as part of the 1998 FS report for this site (Section 1.4.3). Further information is provided in Section 2.2.2 and the full development of the PRGs is provided in Appendix A of this FS report.

1.4.1 URI Sediment Sampling - 1993

In 1993 and 1994 sediment and biota samples from 24 stations within Coddington Cove were collected by URI. Stations were identified as DSY - 1 through DSY - 24 (Figure 1-6). Data are summarized in Table 1-2. Analytical results are presented in Appendix C-1. At each location a surface sediment (0 to 2.5

cm) sample was collected. Subsurface sediment core samples were collected at Stations DSY - 1, 3, and 12, and ranged in depth from 25 to 35 cm. Biota samples were collected at multiple locations but the only location where the biota sample was of sufficient size for analysis was Station DSY - 6. Samples were analyzed for polynuclear aromatic hydrocarbons (PAHs), PCBs, pesticides, and butyltins.

Data from the laboratory analysis of surface sediments indicated presence of elevated PCBs, PAHs, and low concentrations of pesticides and butyltins. The elevated PCB concentrations were detected in samples collected at Stations DSY-3 (733 microgram per kilogram [µg/kg]), DSY-11 (658 µg/kg), and DSY-20 (367 µg/kg). DDE was the most abundant pesticide reported in surface sediment samples and results ranged from 13.6 µg/kg (DSY-3) to non-detect (DSY-4), with an average result of 1.9 µg/kg. TBT was detected at concentrations between 372 µg/kg at Station DSY-2 to 32 µg/kg at station DSY-1, with an average result of 145 µg/kg. High molecular weight (HMW) PAH concentrations detected in samples collected at Stations DSY-2 and DSY-3 were considered elevated with concentrations of 64,600 µg/kg and 73,000 µg/kg respectively. Overall the highest concentrations of chemical contaminants in surface sediment were reported in samples collected at Stations DSY-2 and DSY-3. Station DSY-2 is located south of the east end of Pier 1, while Station DSY-3 is located south of the T-Wharf.

Cores were sampled for organic constituents at the 0 to 2 cm, 7 to 9 cm, 15 to 17 cm, and 22 to 24 cm (Station 12 only) intervals. The 0 to 2 cm interval results are described above. Analytical results in the subsurface intervals were very similar to what was reported in the surface interval. With the exception of PAHs, concentrations did not exceed PRGs developed by SAIC in 1998. PAH concentrations in the 15 to 17 cm interval at Station 3 were reported at 115,000 µg/kg.

A sample collected from DSY-6 (located west of the stillwater area breakwater) was the only biota sample analyzed as part of the 1993 data collection effort. Biota sample DSY-6 was analyzed for PCBs, pesticides, and PAHs. Total PCB concentration was reported at 342 µg/kg, DDE was detected at a concentration of 5.4 µg/kg, and total PAH was detected at a concentration of 516 µg/kg.

Most of the data gathered during this initial field effort is not considered comparable to more recent data discussed in sections that follow. The 2.5 cm surface sediment interval used in this initial study was significantly shallower than any other interval subsequently sampled at the site.

1.4.2 Marine Ecological Risk Assessment Investigations - 1995 through 1996

Sections 1.4.2.1 and 1.4.2.2 describe the investigations conducted in support of the Marine ERA for the site and were initially used to determine the nature and extent of contamination in marine sediment and biota in Coddington Cove. Figures 1-6 and 1-7 depict the locations of sample stations referenced in

these sections. Table 1-2 contains a summary of the results of risk assessment samples that had reported concentrations exceeding PRGs for selected chemicals. Complete analytical results are presented in Appendix C-1.

1.4.2.1 Marine ERA - Marine Sediment

Sediment samples were collected as a part of the Marine ERA for the site in 1995 and 1996 (Figure 1-6). Surface sediment samples were collected from the 0 to 18 cm interval (approximately 0 to 6 inches), and core sediments were collected from selected locations and depths, within 1 meter of the sediment – water interface. In addition, elutriate was prepared from sediment and seawater collected at selected locations to evaluate contaminant transfer from sediment to water in disturbed sediment. Elutriate samples were prepared using a 4:1 dilution of water to sediment. This test is typically used to determine toxicity during ocean disposal of dredge material, and was selected as a highly conservative method for determining toxicity to receptors from sediments resuspended from the bottom during weather or man-made disturbance events.

Samples were analyzed for target analyte list (TAL) metals, PCB congeners, total organic carbon (TOC), PAH, butyltins, and simultaneously extracted metals/acid volatile sulfides (SEM/AVS) using standard analytical methods. The following paragraphs describe the analytical results from sediment samples collected during this investigation.

Metals

Measurements of bulk sediment concentrations of nine metals were performed at 15 Coddington Cove stations and two reference locations as a part of the Marine ERA. These measurements were made as a means of assessing the degree of sediment contamination by trace metals and the potential availability/toxicity of the metals to biota. Ranges of concentrations (milligram per kilogram [mg/kg] dry wt.) observed at the site were as follows: arsenic - 3.0 to 12.5; cadmium - 0.1 to 1.5; chromium - 24 to 112; copper - 1.5 to 180; lead - 13 to 193; mercury - 0.02 to 1.1; nickel - 5 to 78; silver - 0.2 to 1.8; and zinc - 28 to 547.

Samples were also analyzed for metals from the subsurface stations (vibracore locations) that were suspected to contain sandblast grit. Samples from stations V-4 and V-9 (Figure 1-4) were analyzed, but only copper was found to be elevated (168 mg/kg at V-4 and 180 mg/kg at V-9). V-9 was located within 3 meters of surface sediment station DSY-27. V-4 was located within 3 meters of surface sediment station DSY-28 (Figure 1-4).

Three additional approaches to evaluate metals included: 1) aluminum normalization, 2) determination of the relative concentrations of AVS and SEM, and 3) measurement of chemical concentrations in sediment

elutriates. In general, the aluminum-normalized values for all measured anthropogenic trace metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc) demonstrated a decreasing trend moving offshore from the shipyard areas. This pattern suggested that the shipyard may be a source for these metals.

The SEM/AVS ratio is a method of assessing divalent metal bioavailability. SEM/AVS (ratio) values greater than 0.5 were assumed to be bioavailable and potentially toxic to biota. This can be considered a conservative assumption, as a value of 1.0 is many times used as a benchmark. The results showed that metals were likely to be bioavailable (ratio greater than 0.5) at only three stations in Coddington Cove (Stations 33, 35, and 37, Figure 1-6), as well as at the Jamestown Potter Cove (JPC) reference Station JPC-2. The remaining 14 Coddington Cove stations and analysis of sediment from reference station JPC-1 reported low SEM/AVS ratios and relatively abundant AVS, indicating that metals are likely to be sequestered in insoluble sulfides and therefore are not bioavailable within most of the study area under present reduced oxygen conditions (not posing risk).

Metals detected in surface sediment elutriates (analysis of water after mixing with sediment) were compared to USEPA marine ambient water quality criteria (AWQC) (1999, chronic). This comparison showed that the USEPA salt water chronic criterion for arsenic was exceeded at Coddington Cove stations DSY-36 and DSY-38, and the chronic criterion for lead was equaled or exceeded at all stations analyzed except for station DSY-36. In addition, the salt water acute criterion for arsenic was exceeded at station DSY-39. The salt water chronic criterion for copper was exceeded at DSY-31.

Organic Chemicals

Concentrations of organic chemicals at some subtidal stations in the Coddington Cove study area were found to exceed NOAA Effects Range-Low (ER-L) or Effects Range-Medium (ER-M) guidelines, indicating potential adverse impacts. Concentrations of total PCBs at all stations except DSY-35 and DSY-41 exceeded the ER-L benchmark value, while total PCB concentrations reported for stations DSY-27, -29, -30, -31, and -32 exceeded the ER-M benchmark value of 180 µg/kg.

Concentrations of total PAHs exceeded the ER-L benchmark of 4,022 µg/kg at approximately half of the Derecktor Shipyard/Coddington Cove stations, and the concentration of 46,400 µg/kg at station DSY-29 (field duplicate sample) exceeded the ER-M value.

Concentrations of TBT exceeded 5 micrograms of tin per kilogram (µg Sn/kg), a level considered indicative of a degraded ecological condition, at six stations (DSY-27, 28, 29, 30, 31, and 36). TBT values ranged from non-detected (less than 1 µg Sn/kg) to 228 µg Sn/kg at station DSY-31.

Concentrations of the pesticide p,p'-DDE exceeded the ER-L benchmark value of 2.2 µg/kg at five stations; overall values ranged from 0.1 µg/kg at stations DSY-35 and DSY-41 to slightly less than 7.0 µg/kg at stations DSY-27 and DSY-29 (including the field duplicate sample) (Figure 1-6).

Samples from the subsurface stations (vibracore locations) that were suspected to contain sandblast grit were also analyzed for organics. Samples from stations V-4 and V-9 (Figure 1-6) were analyzed, but only PAHs were found to be elevated at these locations, and concentrations decreased with depth. This correlates with the high PAH concentrations detected in surface sediment at station DSY-27, which is co-located with V-9. It should be noted that the core run at V-9 was 0 to 4 ft. below top of sediment. This was the third attempt for a core at this location, and refusal at 4 ft. below sediment surface indicates a hard-pan layer below this depth.

Petroleum odors were noted in cores collected at V-5 (top of the core), V-10, and V-13 (middle-bottom of the 10-foot core run). The top of the core at V-5 was not analyzed for organic chemicals because V-5 is co-located with surface station DSY-30, which already indicated the presence of elevated levels of PAHs. The subsurface core samples were not analyzed for organic chemicals because samples at this depth would not be available for exposure to ecological receptors, which was the main focus of the study.

TOC was measured during sediment analysis (SAIC and URI, 1997). The organic carbon content of surface sediment varied between 0.6 and 6.0 percent, typical for Narragansett Bay sediments (King et al., 1994). TOC concentrations were used to evaluate organic chemical levels because the two factors are interrelated.

Organic carbon-normalized concentrations of organic chemicals followed a similar trend as that for direct sediment concentration measurements. One exception was at station DSY-40, which had elevated ratios of all chemicals due to a combination of moderate chemical levels and low organic carbon concentrations. The mixtures of individual PCB congeners and PAH analytes in sediments in the Coddington Cove study area suggest certain substances as the main contributors of the contamination. The major PCB congeners were the 3- to 6-chlorine compounds (congeners 66, 101, 118, 153, and 138), which are probably derived from Aroclor 1254, the major Aroclor formulation found in Narragansett Bay surface sediments. Major sources of PCBs to Narragansett Bay include industrial sources in upstream streams and rivers, and combined sewer overflows/sewage discharges.

In general, it was presumed that the presence of these Aroclors in Coddington Cove sediments were also likely to be a result of past industrial and shipping activities which included storage and transfer of PCB transformers as part of site operations. However, the PCB composition at Coddington Cove station DSY-29 FD was different from that at the other stations, with congener 209 (decachlorobiphenyl)

accounting for approximately 60 percent of the total congeners measured in the sample. Congener 206 was also present in relatively large concentrations. This unique distribution of congeners is presumed to be indicative of the presence of a rare compound known in the chemical industry as "Deka". This compound is used as an ingredient in “investment casting wax,” and also may be present in sediment as the result of past activities at Derecktor Shipyard.

Concentrations of four- and five-ring pyrogenic PAH compounds (fluoranthene, pyrene, and benzo(b,j,k)fluoranthene) were consistently the highest PAH concentrations observed at stations in the Derecktor Shipyard/Coddington Cove study area. Concentrations were found to be highest near Pier 1. Sources of these compounds include combustion products of compounds in motor oil, atmospheric deposition, creosote/coal tar and asphalt from local activities, terrestrial runoff, and sewage effluent and overflows. There was no evidence of fresh (unweathered) fuel oil in any of the samples, as indicated by qualitative measurements of total petroleum hydrocarbons. However, some of these materials may be present as a result of historic fueling operations.

Analyses of elutriate samples showed the presence of PCBs, PAHs, and small amounts of p,p'-DDE. Elutriate from Station DSY-25 had the highest concentration of both total PAHs and total PCBs; several other stations showed elevated levels of one or both chemicals relative to reference station values (stations DSY-27, 29, 31 for PCBs; DSY-25, 27, 29, 32, 33, and 40 for PAHs). Additionally, eight of the elutriate samples exceeded the USEPA marine chronic criterion (30 mg/L) for total PCBs, including Jamestown Potter Cove reference station JPC-1.

1.4.2.2 Marine ERA - Marine Biota Tissue

Marine biota samples were collected as a part of the Marine ERA investigations. Samples were collected from local populations of indigenous blue mussels, hard clams, lobster, and finfish (mummichog and cunner). In addition, blue mussels collected from an unaffected area were deployed in the water (suspended off the bottom) at selected stations to test for chemical loading from exposure to the water column. Samples were collected from selected stations as depicted on Figure 1-7. The following paragraphs describe the highlights of the chemical analyses of these samples.

Metals

Indigenous blue mussels from the Derecktor Shipyard/Coddington Cove study area and reference stations at JPC and Castle Hill Cove were analyzed for trace metal chemicals. Tissue concentrations of cadmium, mercury, chromium, lead, and nickel at Coddington Cove stations were comparable to reference values and did not exhibit any distinct spatial patterns. Tissue concentrations of copper, silver, and arsenic exceeded reference levels at only a few stations in the study area, while zinc tissue concentrations were highest and exceeded the reference levels at stations DSY-25, 27, 28, 35, and 40.

Blue mussels from unaffected areas were deployed for approximately 30 days along a transect extending from the shoreline to the mouth of Coddington Cove, as well as at the two reference stations JPC-1 and CHC-1. Following the deployment period, tissue concentrations of arsenic, cadmium, copper, silver, and mercury in these deployed mussels were either lower than or comparable to mussels not deployed ("time-zero") mussels, while tissue concentrations of lead, nickel, and chromium concentrations were comparable to reference values. However, zinc concentrations exceeded both reference and time zero values at most stations, implying that shellfish might be loading zinc from the water column.

Tissue concentrations of arsenic, cadmium, copper, silver, mercury, lead, nickel, chromium, and zinc in the hard clams *Mercenaria mercenaria and Pitar morrhuana* collected from the Derecktor Shipyard/Coddington Cove study area were, in general, comparable to or only slightly higher than those from the reference stations, located in Newport and Jamestown RI. Metal concentrations in samples of the muscle tissue of American lobsters and fish (cunner and mummichog) from the Derecktor Shipyard/Coddington Cove study area similarly were mostly comparable to or only slightly higher than those from reference stations. Such minor increases can be a result of the depositional nature of the areas where samples were collected.

Organic Chemicals

Tissue concentrations of organic chemicals were analyzed in both indigenous and deployed (30-day deployment period) blue mussels. Generally, levels of organic chemicals (total PCBs, total PAHs) in the reference station samples were lower than in the study area samples. The highest tissue levels of organic chemicals in deployed mussels were generally observed at stations DSY-26 through -33 and stations DSY-38 through 40. Indigenous mussels showed high values relative to reference station values at a number of stations, including stations DSY-26, 27, 28, 35, 36, and 40.

Tissue concentrations of PCBs, PAHs, and TBT in hard clams from the reference site at JPC were generally lower than tissue concentrations in samples from the Derecktor Shipyard/Coddington Cove study area. The highest concentrations of organic chemicals in hard clams were observed at stations DSY-31, 32, 36, and 41. Concentrations of organic chemicals in the muscle tissue of both fish and lobsters from the study area generally were in the same range as those from the reference stations. TBT was not detected in any of the lobster muscle tissue samples.

1.4.2.3 Ecological Risk Characterization

The Marine ERA completed by SAIC and URI in 1997 evaluated the ecological risks to the marine environment within Coddington Cove. It was presumed that chemicals in the sediments near the Derecktor site were present from activities formerly occurring at that site before and during the Derecktor, lease. This section summarizes the risk characterization portion of the Marine ERA, which is based on

the data collected in 1995-1996 (presented above). Detailed information on the methodology, results, and conclusions are presented in the (Final) Marine ERA Report (SAIC and URI, 1997).

The Marine ERA incorporated the assessment of the exposure and effects endpoints within a line-of-evidence framework. There were eight lines of evidence in the exposure assessment, which are described below.

1. Sediment Hazard Quotient (HQ) Adverse Exposure Ranking. The sediment HQs were high (2x ER-M) at stations DSY-27, 29, and 31. None of the sediment HQs were assigned as intermediate (>ER-M and < 2xER-M). The remaining low adverse exposure stations had multiple COCs exceeding the ER-L but none exceeding the ER-M. Finally, baseline adverse exposures were assigned to stations DSY-33, 35, and 41, and the two reference stations, since no more than one COC exceeded the ER-L benchmark.

2. Elutriate HQ Adverse Exposure Ranking. COC concentrations measured in sediment elutriate preparations suggested low overall probability of adverse exposure at all stations (concentration of COCs in supernatant > AWQC-Chronic, <AWQC-Acute).

3. SEM Bioavailability Adverse Exposure Ranking. Measures of sediment AVS and SEM suggested possible but low adverse exposure from bioavailable metals at stations DSY-27 through 30 (high total SEM) and at stations DSY-33, 35, 37, and JPC-2. Intermediate or higher adverse exposure due to divalent SEM metals was not generally evident for the Derecktor Shipyard/Coddington Cove study area.

4. Tissue Concentration Ratio Adverse Exposure Ranking. COC concentrations in target species from site stations compared to tissue concentrations at reference station concentrations suggest the highest probability of adverse exposure for shoreline stations DSY-25 through 27, due to relatively high concentrations (ratio>=10) of chemicals in indigenous mussels and intermediate concentrations in cunner, deployed mussels, and/or lobster. Intermediate exposure ranking was assigned to DSY-24, 28, 29, and 36 (ratio>=3), and low exposure ranking was assigned to stations DSY-33 and 35 (ratio>=1).

5. Tissue Residue Adverse Effects Rankings. The highest probability of effects from tissue COCs was observed at stations DSY-27 and 29 due primarily to bioaccumulation of copper in lobster. Five stations were assigned intermediate probability for adverse effects (DSY-25, 33, 35, 38, and 39) while the remaining stations (DSY-24, 26, 28, 31, 32, 34, 36, 37, 40, and 41) were evaluated as low probability of adverse effects overall.

6. Laboratory Toxicity Adverse Effects Ranking. An overall intermediate adverse effects probability was assigned to Stations DSY-26, 28, and 29, while nine stations (stations DSY-25, 31 through 33, 37 through 39, and 41) were given a low adverse effects ranking. Baseline was assigned to DSY-34 through 36 and 40 and the two reference stations.

7. Field Effects Ranking. The overall adverse effects ranking for field effects indicators (benthic community structure, bivalve condition, hematopoietic neoplasia, Cytochrome P450 activity, and fecal pollution indicators) suggested high potential for adverse effects at stations DSY-29 and 40/41, and intermediate potential for adverse effects for stations DSY-25, 26, and 33, while low potential for adverse effects were observed for stations DSY-27, 28, 30, 31, 32, 36, 38, and 39. At the remaining stations, field effects indicators suggest no adverse effects to target species.

8. Avian Predator Effects Ranking. The food web modeling for avian aquatic predators assumed that the target bird species were feeding exclusively on the most contaminated of prey items available at a given station. Despite the conservative assumptions employed, high adverse effects were not apparent, and intermediate adverse effects were assigned to stations DSY-28, 29, and 36. The remaining stations were assigned to the low adverse effects category.

The lines of evidence described above were based on the analysis of exposure and effects data, as represented by the endpoints discussed in the previous sections. The lines of evidence were then evaluated in combination to categorize the overall risk for each station. The following categorization of ecological risks was developed for the Derecktor Shipyard Marine ERA:

Baseline risk is defined as the probability of adverse exposure and/or ecological affects equivalent to that from contamination and other environmental conditions not associated with the site.

A Low probability of ecological risks suggests possible, but minimal impacts based on some of the exposure or effects-based lines of evidence, while impacts are undetectable by the majority of exposure and effects-based lines of evidence. Conditions of low risk probability typically lack demonstrable exposure-response relationships.

An Intermediate probability of ecological risk is typically characterized by multiple exposure or effects lines of evidence suggesting that measurable exposure or effects, but not both, are occurring at the site. Typically, quantitative exposure-response relationships are lacking. Intermediate risk probability may also be indicated if the spatial extent of apparent impact is highly localized (a single station), or if the impact occurs for periods of very limited duration.

A *High* probability of ecological risk is assigned to areas where numerous lines of evidence suggest pronounced chemical exposure and effects, the spatial extent of apparent impact is great, the impact is likely to be persistent over long periods of time, and the available data support demonstrable exposure-response relationships.

A single ranking strategy for synthesizing the lines of evidence was used to obtain the probability of adverse Exposure/Effect (E/E) line designation to evaluate the data in a manner consistent with the risk definitions discussed above. The findings of exposure and effects lines are evaluated jointly by evaluating strength of exposure-response relationships and overall probability of adverse ecological risks by sampling station.

1.4.2.4 Conclusions of the Marine ERA

A summary of environmental risk for the Derecktor Shipyard/Coddington cove study area is presented in Table 1-3. The risks for each station are based on summaries of each line of evidence, with special attention paid to concurrence between the two endpoint groups. This evaluation only addresses current conditions at the time of the study and does not address potential future land or harbor use.

The conclusions from the Marine ERA are presented below:

- Stations DSY-27 and 29 were determined to pose a high probability of risk to fish, shellfish, and seabirds from shipyard-related chemicals including PCBs, PAHs, TBT, copper, lead, and zinc. Plausible exposure-response relationships were observed for benthic community structure possibly affected by PAHs in sediment, and indigenous mussel condition possibly affected by PCBs in sediment.

- Stations DSY-24, 25, 26, 28, 31, 33, 40, and 41, as well as the reference station CHC-1, were determined to pose an intermediate probability of risk to ecological receptors. Intermediate risk was assigned to these stations due to suggested but not quantifiable exposure response relationships. In general, the same receptors and COCs were observed at intermediate and high risk stations. However, elevated levels of PAHs were observed in mussels at stations DSY -25 and 26, north of the shipyard, and elevated TBT was present in sediment at station DSY -31. Seabirds may be at risk from PCBs in fish at station DSY-28. A review of the sample station map presented as Figure 1-6 shows that these stations, in conjunction with the high risk probability stations described above, combine the data set for the areas near the shoreline and piers of Coddington Cove, with one exception, station DSY-35.

- Stations DYS-30, 32, 34, 35, 36, 37, 38, and 39, as well as the reference station JPC-1 were determined to pose a low probability of risk to ecological receptors. Although data suggest possible adverse effects, COC concentrations were low, and definitive exposure-response relationships were not observed. These stations are outer harbor stations located away from the active areas.

- Station JPC-2, a reference station at Jamestown – Potter Cove, showed no evidence of adverse exposure or effects. These conditions were determined to be relatively pristine, and a "baseline" probability of risk was assigned.

1.4.3 Risks to Human Health

Risks to human health were evaluated in 1998 and revisited to address various issues raised since that time. Risks were evaluated for exposure to COCs through ingestion of shellfish and direct exposure to sediment. Developing risk for shellfish affected by sediment and subsequently developing cleanup goals from that risk for sediment from a food-tissue exposure point concentration requires additional conversions using Biological – Sediment Accumulation Factors (BSAFs), which is possibly atypical, though necessary for identifying a cleanup goal for the sediment. These accommodations are included in the PRG development steps described in Section 2.4 of this FS report.

A qualitative evaluation of the PRGs implementing EPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens for carcinogens with a mutagenic mode of action (i.e., PAHs) to demonstrate that the PRGs are protective of early life exposure is presented in Section 2.2.2 of this FS. It was noted in EPA correspondence March 24, 2008 that risks from child subsistence fisherman scenario are usually not quantified because it is unlikely that a child of a subsistence fisherman would only consume fish fillets/shellfish from a site as the sole source of dietary protein.

1.4.3.1 Marine Human Health Risk Assessment - 1998

This section summarizes the results of the marine HHRA performed to evaluate potential risks from human exposure to shellfish and, to a limited degree, sediment in the marine environment near the former Derecktor Shipyard. All data used for this assessment were collected and validated as a part of the 1995-1996 Marine ERA (Sections 1.4.2.1 through 1.4.2.2).

Risks to humans were evaluated under several exposure scenarios: ingestion of shellfish by recreational fishermen (adults and children) living at or near the site and ingestion of shellfish by subsistence fishermen (adults). In addition, exposure to sediments by trespassing adults and children swimming and wading was evaluated in a more qualitative manner. For this report, the term shellfish includes hard clams, mussels and lobster, which were sampled in 1995 and 1996. Samples were collected from stations depicted on Figures 1-6 and 1-7.

In general, cancer and non-cancer risks were highest for humans through ingestion of lobster taken from the waters of the site, because the chemical concentrations were highest in that species. This fact adds a level of uncertainty to the findings, because lobster are known to migrate and those that are big enough to be collected for human consumption may have been exposed to chemicals from other source areas. Additionally, chemical concentrations in lobsters collected from the site are similar to those found in reference stations, further suggesting that the risk is not entirely site related. Unacceptable cancer and non-cancer risks were identified under the subsistence fisherman scenario (36 meals per year taken from this area); however, this may be an overestimate of actual risk because collection of other shellfish (bivalves) in an industrial port such as this one is less likely to occur than in other locations, primarily due to the depth of the water and security restrictions.

Human exposure to sediment was evaluated because RIDEM was concerned about the possibility of trespassers using the beach area to the south of the site for swimming, wading, and shellfish harvesting. To address this, the HHRA selected a single sediment sample between the site and the beach (station DSY-29, Figure 1-6), and used the data from this station alone to estimate exposure to trespassers at this beach. This is a conservative approach, considering that surface sediments from station DSY-29 is much closer to the source area than where the exposure would occur, and considering this station had some of the highest concentrations of chemical constituents measured in the marine environment for this site. Additionally, the sediment collected from station DSY-35, on the south end of the beach area, had some of the lowest concentrations of chemical constituents measured in the area. By using only the sample with the high concentrations, the exposure concentrations are not “diluted” through calculating means of concentrations.

Results of the marine human health risk assessment are summarized on Table 1-4, and described below. The risk ranges presented represent the calculated risks for reasonable maximum exposure (RME) and central tendency exposure (CTE) assumptions.

Ingestion of Shellfish by Children (Resident Recreational Fishermen): The calculated cancer risks to the child receptor from shellfish ingestion were between 1.4E-5 and 1.1E-5 for lobster, 5.1E-6 and 3.4E-6 for clams, and 1.0E-5 and 4.2E-6 for mussels. These estimates were all within the USEPA target risk range of 1E-4 to 1E-6. Non-cancer Hazard Indices (HI) were below 1.0 for all chemicals detected. The HI for the scenario (sum of all the chemicals) was also below 1.0.

Ingestion of Shellfish by Adult Resident Recreational Fishermen: The calculated cancer risks to this receptor from shellfish ingestion were between 4.4E-5 and 3.4E-5 for lobster, 1.6E-5 and 1.1E-5 for clams, and 2.8E-5 and 1.3E-5 for mussels. These estimates were all within the USEPA target risk range

of 1E-4 to 1E-6. Non-cancer HIs were below 1.0 for all chemicals detected. The HI for the scenario was also below 1.0.

Ingestion of Shellfish by Adult Subsistence Fishermen: The calculated cancer risks to this receptor from shellfish ingestion were between 5.7E-4 and 4.4E-4 for lobster, 2.0E-4 and 1.4 E-4 for clams, and 3.3E-4 and 1.6 E-4 for mussels. Non-cancer HIs were between 3.9 and 2.9 for lobster, 3.3 and 1.6 for mussels, and 0.19 and 1.2 for clams. This is the only scenario under which risks exceeded USEPA's target risk range for carcinogens and exceeded a HI of 1.0 for non-carcinogens.

Exposure to Sediments (incidental ingestion and dermal contact) by Trespassers: The cancer risks to this receptor from incidental ingestion and contact with sediments were calculated to be 9.9E-7 for the child and 5.4E-7 for the adult for all chemicals detected in the sample used for evaluation. The HI for the scenario was also below 1.0 (0.06 - child, 0.0066 - adult).

The principal chemical contributing to the calculated risks from human exposure to shellfish and sediment described above (both cancer and non-cancer) is arsenic. This is a highly conservative evaluation for arsenic because of the toxicity criteria used: The toxicity value used for arsenic is derived from an inorganic form of arsenic in drinking water called arsenic trioxide. It has been documented that 80 to 99 percent of arsenic in shellfish tissue is in an organic form, which is not toxic (United States Food and Drug Administration [USFDA], 1993). In addition, arsenic concentrations have been noted to be elevated in natural soils at Aquidneck Island due to the geologic formations and parent material of the soils. This indicates that arsenic may not be a chemical specific to the industrial activities at the former Derecktor Shipyard.

The primary contributor to human health risk is from ingestion of lobster. Chemical concentrations in lobsters from the site are similar to those from reference stations, suggesting this risk is not entirely site related.

Secondary chemicals contributing to risk in the marine environment were PCBs and PAHs, both of which can be attributed to the site activities. Non-cancer risks from PCBs and PAHs were below 1.0 for all scenarios. The subsistence fisherman had the highest possibility for PCB and PAH-related non-cancer risk (from PCBs in mussels - 0.86 and PAHs less than 0.01) as well as cancer risk (from PCBs - 1.55E-5, and PAHs - 1.6E-4 in mussels). These results indicate an unacceptable risk to individuals ingesting shellfish from the study area at rates equal to or greater than 15.6 grams per day (g/day) as an annual consumption average.

Finally, the risk is based on the conservative assumptions associated with the shellfish scenarios themselves (particularly the ingestion rates). The rates used fall between the rates recommended by the USEPA and the RIDEM. The shellfish ingestion rates used for this site are 3 (recreational fisherman: 1.2 g/day) to 30 (subsistence fisherman: 15.6 g/day) times higher than those recommended by the USEPA for the national average (0.5 g/day), although the RIDEM recommends the use of a higher annual average rate of 20 g/day for the Narragansett Bay area. The risk assessment conservatively assumes that all the shellfish ingested by these individuals is collected from this one site. While it is recognized that shellfishing by residents of Rhode Island coastal areas is well above the national average, it is unlikely that shellfishing in such an industrial port could be productive enough to encourage harvesting in the area at this intensity.

The meal size of 150 g/day is comparable to the value of 142.4 g/day recommended for subsistence fisherman in EPA's Guidance for Assessing Chemical Contaminant Data for Use if Fish Advisories (USEPA, 2000). It is recognized that the number of meals for a "subsistence" fisherman was reduced for this HHRA to account for limited accessibility and likely success of catch within the study area, and the proximity to other, unaffected areas that have better accessibility and probable success rates for actual collection of shellfish. Additionally, the study area is located in an area that is closed to collection of bivalves (clams and mussels), indicating that the lobster ingestion risks may be the only active human exposure pathway.

1.4.3.2 Exposure to Asbestos in Sediment

Between 2005 and 2009, records indicate that pipe insulation, assumed to contain asbestos (ACM) was released from piping under Pier 1 as pieces falling from the pipes or as sections of piping falling after deterioration of pipe hangars. Diver inspections determined that the material under water (approximately 15-30 feet in depth) had deteriorated substantially rendering the ACM as not recoverable. Surveys in 2007 and 2008 found the majority of abandoned steam line (still hanging) under Pier 1 was in poor condition and missing more than 75% of insulation. Human Health Risk associated with this release is conservatively estimated to be less than 1E-4 through dust inhalation pathway based on risk assessments performed at sites with substantially greater contamination (e.g. Blackburn and Union; release of process waste, disposed of in ponds and posing high potential for exposure in the pond shallows).

Diver surveys dispatched after the release of piping from Derecktor Pier 1 in 2007 and 2008 noted piping with no insulation, as well as insulation deteriorating. In one report, a diver observed a piece of what was identified as ACM on the seafloor under the pier, but while attempting to recover a sample, it disintegrated into the water column. This survey noted that mechanical breakdown of the ACM was ongoing and deemed it unrecoverable. These observations are consistent with the relatively fast breakdown of the

ACM binder, the slower deterioration of the cloth jacket and the eventual dispersion of the ACM into the water. Rapid marine growth over any sections of piping & ACM that did not disperse would retain the asbestos fibers into the sediment and incorporate them into the subsurface matrix over time. Smaller asbestos fibers have very little mass, and may not settle out of the air, staying airborne for hours or even days in closed environments. Once suspended in the water, these smaller fibers would migrate with other suspended solids over time prohibiting any restoration/recovery efforts and if located, capture efficiency for filtration systems for single fibers is low; removal can be enhanced by incorporating fibers into flocculent prior to filtration, and this approach is used for drinking water supply. Removal of chrysotile fibers in water filtration to levels near detection limits (typically 105-106 fibers/L) is possible with specialized treatments to increase capture efficiency (Bales, et. al. 1984). Removal of asbestos fibers from water used in decontamination is typically conducted with by passing water through a 5 micron filter, typically enforceable by State regulations for abatement actions (Kaplan, undated).

Core sediment samples were collected and analyzed for asbestos under Pier 1 during 2010. This area was sampled because it was deemed the most likely to be the most heavily impacted, being directly under the ACM released and of the ten stations sampled, one resulted in asbestos fibers of 2% at 1-2 feet and 2-4 feet below the sediment surface.

Based on these data and observations, two potential exposures for asbestos in sediment were considered: incidental and dredging exposures. Incidental exposures by persons encountering sediment brought from the seafloor inadvertently e.g. residual sediment on anchors, fishing lures, etc. is considered highly unlikely. The ACM in samples the pier was found in more than 10 feet of water and more than one foot of sediment.

Qualitative modeling could project a potential for exposure with some gross assumptions, including the following: 1) The first foot of sediment under the pier (where there is relatively low water energy) would have to be stripped from the underlying sediment where asbestos fibers were found at 2%. 2) The sediment containing asbestos fibers at 2% would have to be shifted without dispersal to one side of the pier, where it could be encountered by a receptor. A 50% dispersal would result in a total concentration of 1% asbestos in the surface sediment in the new location. To be conservative, one would have to assume all the sediment >2% under the pier is located to one other grid cell next to the pier without dispersal or loss of concentration. 3) The shifted sediment with asbestos fibers would have to all settle out of the water within a brief time period prior to the residual water current moving them to another location, a behavior that is not expected. 4) A receptor (i.e. industrial port worker) would inadvertently drag some sediment onto a cable, chain, anchor or other piece of equipment, and it would have to be assumed that this sediment would not be rinsed off into the water, as part of the cable/anchor/chain withdrawal and 5) the receptor would allow the sediment to dry on the equipment, disturb it after drying

and respire the dust. The expected behavior of asbestos fibers entrained in water or sediment does not indicate that the above sequence is likely. The probability of these events to occur without dispersion (loss) of the asbestos fibers within the water or in the air is improbable. Energy required to move sediment to an area where it could be encountered would likely reduce the source concentration to a value not expected to pose a risk for exposure.

For dredging exposures, any sediment containing asbestos fibers would be assumed to be brought to the surface, allowed to dry, and then become airborne during handling/and disposal. This potential exposure can easily be minimized through land use controls to 1) sample any waste generated to confirm presence of asbestos fibers, 2) retain certain amount of moisture to prevent dust generation during handling and 3) use proper disposal processes and locations where adequate controls will remain.

1.4.4 Identification of COCs and Development of PRGs - 1998

In 1998, the Navy utilized the findings of the Ecological Risk Assessment and Human Health Risk Assessment to develop a list of COCs. The Navy also developed preliminary remediation goals for these COCs as a step in the development of the first draft FS report. Although the FS has been revised since the PRGs were developed in 1998, the PRGs have been retained and are still considered valid for the remedial action of Site 19 marine sediment.

The COCs and PRGs were developed by SAIC for the Navy with input from RIDEM and USEPA, based on the results of the marine ERA and HHRA. The details of PRG development and identification of PRGs is documented in the Final PRGs for Derecktor Shipyard/Coddington Cove (SAIC, 1998), which is presented in Appendix A of this FS. The development process is summarized in Section 2 of this FS report. Candidate risk based PRGs (Baseline PRGs or BPRGs) were identified and refined, and from those, a series of Recommended PRGs (RPRGs) were developed. The RPRGs were later accepted as the final PRGs to be used in this FS. The PRG development document was finalized in November of 1998; USEPA accepted this document in a letter dated December 21, 1998. RIDEM provided follow-up comments to the final document, which were resolved without revision to the document on May 11, 1999. However, RIDEM commented in 2013 that they did not provide concurrence on the PRGs.

PRGs are typically identified in Section 2 of the FS. However, the COCs and PRGs are both identified below since they are pertinent to the discussion of the subsequent sections describing further investigations conducted between 1999 and 2011.

The final PRGs selected for the site in the PRG development document are presented below.

COCs and PRGs for Marine Sediment*
Site 19 – Derecktor Shipyard Marine Sediment
NAVSTA Newport, Newport RI

COCs	PRG	Risk Endpoint
Lead	168 mg/kg	Toxicity to aquatic organisms from exposure to suspended sediment
Benzo(a)pyrene	539 µg/kg	Adverse human health effects from ingestion of shellfish
Total HMW PAHs	13,903 µg/kg	Toxicity to aquatic organisms from exposure to bedded sediment
Total PCBs	1,060 µg/kg	Toxicity to aquatic organisms from exposure to suspended sediment

*SAIC, 1998 (Final)

1.4.5 Stillwater Basin Evaluation - 1998

The so-called stillwater basin was identified during the development of the Marine ERA as the protected small-boat anchorage within Coddington Cove at Building 42, which is bounded to the North and partially to the west by a stone breakwater, to the east by the sheet-piling wall at Building 42, and to the south by a pier (T-Wharf) leading to the former location of Building A-18 (Figure 1-3).

The findings of the Marine ERA regarding the still water basin were inconclusive: while it appeared that there were low concentrations of chemicals present in the sediment, there appeared to be a lack of indigenous biota within the basin. The objectives of the Stillwater Basin Evaluation were to assess, and if possible, determine the cause of this apparent lack of indigenous biota in the still water basin near Building 42. The investigation objectives were achieved through a focused program of data collection that was based on previous investigation findings and site background information.

This investigation attempted to determine what factor(s) may be influencing the apparent lack of indigenous biota in the still water basin. The study included the placement of synthetic media growth plates (artificial structures) suspended in the water column within and outside the stillwater basin which were to provide suitable habitat area for plant and animal colonization. In addition, samples of water from outfalls that discharge into the basin were analyzed to determine chemical content and other biological and physical parameters. Finally, the habitat quality of the substrate was evaluated through plan-view and sediment profile photography. Results from this study were evaluated to determine if there are limiting factors within the basin that may be responsible for the biotic limitation.

The findings of these 1998 evaluations indicated that the substrate (soft sand with low oxygen at depth) does not provide the optimum habitat for a subtidal benthic community. However, a so-called "Stage 1" community does exist, living within the limitations that are present. Limitations include introduced

bacteria from outfalls, and low oxygen in sediment at depth, restricted circulation of water, and a sandy bottom substrate that is likely a result of the hydrodynamics.

In addition, the nature of the subtidal environment was previously altered from the natural condition by dredging and construction of the pier structures and breakwater. A less than optimal community in an area altered in this way should be expected.

The findings of the stillwater basin evaluation are presented in a separate report entitled "Stillwater Basin Evaluation Report, Former Robert E. Derecktor Shipyard, Tetra Tech, Inc., December 1998".

1.4.6 Sediment Investigation - 2004

Sediment sampling was conducted in August 2004 to confirm the presence, concentration and distribution of chemicals previously found in this area, and to attempt to identify a potential source of hydrocarbons that were previously found, prior to undertaking potential remedial actions at the site. Figure 1-6 depicts the sediment sample locations and Figure 1-8 depicts the reference sample stations. Appendix C-1 presents data results for samples collected. Table 1-2 presents data for samples exceeding PRGs.

Sediments were analyzed for TAL metals, PCB congeners, TOC, and SEM/AVS using standard analytical methods. In addition, replicate samples from each station were analyzed using forensic-type petroleum "fingerprinting." The results from the standard analyses were compared with the data from previously collected samples from this area (1993 – 1995 and reported in 1995).

Metals

AVS and SEM were measured in the sediment to determine bioavailability of metals present in the sediment. The presence of AVS has been found to bind metals in sedimentary environments and restrict them from being metabolized by the receptor organism. A ratio of SEM:AVS less than 1 indicates the presence of AVS that would thus restrict the metal from becoming available to benthic organisms. Ratios of >1 were observed for sediments at stations DSY-32 (399) 26 (7.4), 02 (10.7), 28 (19.4), 09 (1.9), and 31 (1.2). Stations where SEM:AVS ratios were close, but below 1.0 included DSY-101, 103, 20, 27, 04, 11, and 06. Stations where SEM:AVS ratios were well below 1.0 included DSY-03, 05, 08, and 29. Reference stations provided SEM:AVS ratios of between 0.2 to 13. Using these results for evaluating candidate PRGs, it was observed that the highest lead concentrations measured in surface sediments in 2004 were reported for stations DSY-103 (168 mg/kg), -27 (138 mg/kg), -03 (114 mg/kg) and -29 (113 mg/kg). All these stations had low SEM:AVS ratios, indicating the lead and other metals in those samples are not particularly bioavailable.

Organic Chemicals

TOC was measured in sediment samples collected in 2004. High levels of TOC indicate presence of natural organic materials (plant matter, etc.) in the sediment which tend to bind with some organic chemicals. PCBs and PAHs bind with high-TOC sediments inhibiting their transport except with those sediment particles. Organic chemicals preferentially bind with smaller organic sediment particles, and not larger and smooth sand particles, which are typically low in TOC. Therefore, these PCB and PAH compounds tend to accumulate with organic sediments and stay in place better than in locations where there are loose sands and gravels. Higher TOC was noted in the restricted areas of the site (stations 29, 03, 02) and the reference areas (particularly Castle Hill Cove [CHC] -01) than areas which are more subject to current flows (such as the Jamestown reference stations, and Site stations DSY-09, 11, and 32). Sample descriptions show organic sediments were found during sample collections around the carriers at Pier 1 (stations DSY-05, 04, 06, and 08), suggesting that the ships brought to the site in 1999 may be restricting flow and causing silts to settle.

The reference sediments contained varied hydrocarbon mixtures derived from petroleum (petrogenic), combustion (pyrogenic), and natural (diagenetic) origins (i.e. plant waxes). The dominant hydrocarbons consisted of weathered residual range petroleum mixed with plant waxes and pyrogenic PAHs. The concentration of the 16 USEPA Priority Pollutant PAHs plus methyl naphthalene ranged from 220 µg/kg to 6,500 µg/kg. Sediments from Jamestown Cranston Cove contained the highest levels of plant waxes while Castle Hill Cove contained the highest levels of pyrogenic PAHs.

Sediment samples from the shallow cores at sampling locations DSY-101 (total PAHs equal to 9,500 µg/kg in the 6 to 12-inch interval) and -103 (total PAHs from 11,000 µg/kg to 44,000 µg/kg in the first two 6-inch intervals, respectively) at Pier 1 resembled the Castle Hill Cove reference sediments with slightly higher levels of pyrogenic 4- to 6-ring PAHs. The high level of anthracene relative to phenanthrene in these sediments was consistent with creosote used to treat marine pilings and other wooden structures.

Sediment samples collected from locations DSY-03 and 29 also contained slightly higher pyrogenic 4- to 6-ring PAHs (total PAHs equal to 22,000 µg/kg to 15,000 µg/kg, respectively). These elevated PAHs are attributable to higher soot loadings from proximal storm drains, exhaust from ship engines, or local industry. The reader should note that this area receives storm water from a large storm drain outfall, originating from the Building 234 area, and Building 7, an operational heating plant.

The sediment sample from DSY-09 contained levels of total PAHs consistent with background (total PAHs equal to 490 µg/kg to 700 µg/kg). However, compared to other Coddington Cove and background samples, this sediment contained slightly higher levels of hydrocarbons associated with middle to heavy

residual range petroleum (e.g., slightly enriched petrogenic PAHs). This pattern was very similar to that at DSY-06 (total PAHs equal to 3,600 µg/kg). DSY-27 near Pier 2, contained a mixture of combustion derived PAHs plus slightly higher levels of hydrocarbons consistent with middle distillate (e.g., marine diesel) (total PAHs equal to 7,900 µg/kg).

The remaining sediment samples were indistinguishable from the background reference samples based on hydrocarbons concentration and composition. These samples included DSY-02, 04, 05, 08, 11, 20, 28, 31, 32, 26, 101, 104-0006, and 104-0612.

1.4.7 Supplemental Sediment Investigation (SSI) - 2011

Sediment sampling was conducted in September and October of 2011 to better understand the extent of contamination in the offshore marine sediments in Coddington Cove. Samples were collected to confirm the presence, concentration, and distribution of chemicals previously found in this area prior to selecting remedial actions at the site. Table 1-5 presents the results of samples where at least one exceedance of a PRG was reported at the location. Complete results from all samples collected during this investigation are provided in Appendix C-2.

As part of this investigation 119 sediment cores were collected to a maximum depth of four ft. below sediment surface throughout the study area. From each core three samples were collected for laboratory analysis. The intervals collected were surface (0 to 1 foot), immediately below the surface (1 to 2 ft.), and lastly a deep sample (2 to 4 ft.). These sample intervals were selected during team meetings to identify data quality objectives, and were adhered to whenever possible. On occasion core recovery or refusal limited samples to fewer per core, or different intervals than described above, and these were described in the SSI report.

All samples collected were submitted for laboratory analysis of HMW PAHs (including benzo(a)pyrene), PCBs, lead, and TBT, in an effort to determine presence of these constituents at concentrations exceeding PRGs. At the request of the regulatory agencies four additional “secondary” constituents were evaluated at select locations: analysis for copper and zinc was conducted on samples collected from beneath the piers, beneath or at the former locations or location of the aircraft carriers, and south of the T-wharf. The third analyte added at regulatory request was asbestos. Samples collected from beneath Pier 1 were analyzed for asbestos. Lastly, all surface samples were analyzed for TOC to assist determination of the bioavailability of metals.

Sediment coring locations were established using a modified grid pattern using the following rationale: a 100-foot sampling grid was used in areas of previously collected sediment samples, where analytical results indicated the presence of chemicals at elevated levels; a 200-foot grid pattern was used in areas

that had not been previously investigated, but where chemicals could possibly be present at elevated levels. Figure 1-9 depicts the sediment sample locations.

HMW PAHs

Total HMW PAHs were analyzed in all 349 samples collected, and only 20 had total HMW PAH concentrations greater than the PRG of 13,903 μg/kg. Of those 20 samples, only six had concentrations greater than twice the PRG, two from each interval. In the surface interval, analysis of samples from stations J30 and BE30 indicated the presence of total HMW PAH concentrations of 186,000 μg/kg and 117,000 μg/kg respectively; other surface exceedances of the PRG were identified in samples collected beneath the east end of Pier 2, at the former location of the ex-Forrestal, and the east end of Pier 1 in the surface sediment. These surface exceedances indicate agreement with previous investigations; HMW PAHs were previously found in 1993 and 2004 south of the T-Wharf, and in 1996 at the east end of Pier 2.

Exceedances of the PRG for HMW PAHs in the 1 to 2 foot interval were also identified in samples collected at the east ends of Pier 1 and Pier 2, and south of the T-Wharf. The only two samples collected from this interval that indicated concentrations greater than twice the PRG were located at the east end of Pier 1, and analysis reported concentrations of 31,100 μg/kg and 39,000 μg/kg.

HMW PAH concentrations that exceeded the PRG in the 2 to 4 foot interval were detected beneath Piers 1 and 2. Analysis of samples reported results less than twice the PRG were detected at the east ends of Piers 1 and 2, while PRG exceedances of 31,600 μg/kg and 41,000 μg/kg were observed at the western end of Pier 1, near where the dry docks were formerly located. It is likely that these elevated concentrations are observed in deeper sediment because of accelerated deposition (possibly caused by presence of the inactive aircraft carriers) over time.

Benzo(a)pyrene

Like HMW PAHs, all 349 sediment samples collected were analyzed for benzo(a)pyrene. Of those 349 samples, benzo(a)pyrene exceeded the PRG of 539 μg/kg in 46 samples. Analysis showed that benzo(a)pyrene exceeded the PRG in twenty samples collected from the surface interval (the most of any interval), and the reported concentration was greater than twice the PRG in 8 of those samples. The distribution of elevated benzo(a)pyrene concentrations was similar to the distribution of HMW PAHs in surface sediment, but encompassed a greater area overall: The highest concentrations were observed at stations J30 and BE30, where sample analysis indicated presence of benzo(a)pyrene at concentrations of 8,800 μg/kg and 9,000 μg/kg respectively. Unlike the HMW PAH concentrations that were relatively isolated, the elevated benzo(a)pyrene concentrations at these locations cover a greater area; near station

J30, the elevated levels extend north to the row of samples collected north of Pier 2 and south to the row of samples south of Pier 2. Near station BE30 samples indicating presence of elevated benzo(a)pyrene concentrations extend across the area south of the T-Wharf. Other surface locations where benzo(a)pyrene concentrations were observed at levels greater than twice the PRG were stations Y30, located at the east end of Pier 1, and AD13, located at the former location of the ex-Forrestal.

Areas with where sample analysis reported elevated benzo(a)pyrene concentrations in the 1 to 2 ft. interval followed a similar pattern as in the surface interval with exceedances of greater than twice the PRG observed at the east ends of Piers 1 and 2, as well as in the area south of the T-Wharf. In general the area covered by concentrations above the PRG was smaller than in the surface and the concentrations observed were lower. Notable elevated concentrations were reported in samples collected from stations G25 (2,200 µg/kg), Y25 (1,600 µg/kg), Y26 (1,200 µg/kg), Y28 (2,300 µg/kg), BC30 (2,100 µg/kg), BD26 (1,100 µg/kg), and BE30 (1,600 µg/kg).

Benzo(a)pyrene was observed in the 2 to 4 foot interval at levels exceeding the PRG again at the east ends of the piers, and south of the T-Wharf (very small area less than twice the PRG), but was also observed at the center and west end of Pier 1. Only four four samples reported concentrations of benzo(a)pyrene greater than twice the PRG: G25 (2,100 µg/kg), AA05 (1,600 µg/kg), AB11 (1,300 µg/kg), and AC28 (1,600 µg/kg).

PCBs

As was the case with HMW PAHs and benzo(a)pyrene, all 349 samples submitted to the analytical laboratory were analyzed for PCBs. Analysis of these samples indicated that the PCB PRG of 1,060 µg/kg was exceeded in only 17 of the 349 samples collected. In the surface sediment the PRG was exceeded in 8 samples of which only two exceeded by greater than twice the PRG. The most notable surface exceedance of PCBs was at K13 which had a result of 17,000 µg/kg. Samples surrounding this location had PCB concentrations below the PRG or were non-detect. The surface sample collected at L28 was the second sample with an elevated concentration with a result of 3,600 µg/kg.

In the 1 to 2 foot interval PCB concentrations drop significantly: Analysis indicated that samples from only 5 stations exceeded the PRG, and only one of those by more than twice the PRG value (Station L24). This observation was consistent with the results from samples collected from the 2 to 4 foot interval with only four exceedances, of which one exceeded by more than twice the PRG (AC30). It should be noted that there were no exceedances detected at depth at or near K13, which had the highest PCB result of all surface samples.

Lead

Lead analysis was performed on all 349 sediment samples that were submitted to the analytical laboratory. Analysis indicated the presence of lead at concentrations in excess of the PRG of 168 mg/kg in a total of 41 samples. In the surface interval, concentrations of lead exceeded the PRG in 15 samples, and eight of those reported concentrations greater than twice the PRG. The surface areas where these samples indicated the highest lead concentrations were the west end of Pier 2 (station G01, 368 mg/kg and station K05 - 1,410 mg/kg), south of the center and east end of Pier 2 (stations K13 - 598 mg/kg, J24 - 1,100 mg/kg, L24 - 884 mg/kg, and L26 - 878 mg/kg), and at the former locations of the floating drydocks (W24 904 mg/kg and AE24 1,020 mg/kg).

In the 1 to 2 foot interval lead was reported at elevated concentrations in samples collected from the area around the east end of Pier 2, and again at the former locations of the floating drydocks. In general, lead concentrations in the 1 to 2 foot layer were less than the surface layer. Notable concentrations were located at stations C29 (759 mg/kg), J24 (1,100 mg/kg), L24 (543 mg/kg), W24 (577 mg/kg), Y25 (918 mg/kg), and AC26 (473 mg/kg).

In the 2 to 4 foot interval lead was reported at concentrations exceeding the PRG in nine samples and four of those exceeded by greater than twice the PRG. Two of the samples with highest lead concentrations were collected from south of Pier 2 (stations N24 and N28, 842 mg/kg and 390 mg/kg respectively), and the other two were collected from the west and east ends of Pier 1 (AD09 and AC30, 788 mg/kg and 437 mg/kg respectively).

Copper and Zinc

Copper and zinc analysis was added to SSI samples collected at specific locations at the request of the regulatory agencies. These constituents do not have PRGs, so the candidate “BPRG”, established in the PRG Development Document (SAIC, 1998) was used for comparison for informational purposes. Samples collected from beneath Pier 2, surrounding and beneath Pier 1 and south of the T-Wharf were analyzed for copper and zinc.

Copper concentrations reported from analysis of samples collected from the surface interval ranged from 9.3 mg/kg to 208 mg/kg, with 17 out of 44 samples exceeding the candidate “BPRG” of 74 mg/kg. Most of the higher concentrations detected were reported in samples surrounding Pier 1, and in the area south of the T-Wharf. Analysis of samples collected from the 1 to 2 foot interval indicated concentrations of copper between 3.2 mg/kg and 282 mg/kg, with concentrations reported in 14 of 43 samples exceeding the BPRG. Most of the higher copper concentrations measured in this interval were identified in samples collected from the area surrounding and beneath Pier 1. Analysis of samples collected from the 2 to 4

foot interval indicated concentrations of copper between 2.5 mg/kg and 295 mg/kg. with concentrations reported in 17 of 42 samples exceeding the BPRG.

Zinc concentrations reported in most surface samples were greater than the BPRG of 118 mg/kg. Concentrations reported ranged from 48.4 mg/kg to 823 mg/kg in the 0-1 foot interval and concentrations exceeded the BPRG in 36 of 44 samples. Analysis of samples collected from the 1 to 2 foot and 2 to 4 foot intervals reported zinc concentrations above the BPRG in samples collected from the areas surrounding and beneath the Piers, while low concentrations were reported in samples collected south of the T-Wharf. The maximum concentration reported in the 1 to 2 foot interval was 675 mg/kg with 28 of 43 samples exceeding the BPRG; and the maximum concentration reported in the 2 to 4 foot interval was 931 mg/kg with 17 of 42 samples exceeding the BPRG.

Tributyltin

Analysis for TBT was performed on all 349 sediment samples collected during the SSI. Of those samples, TBT was detected in 146 samples, and exceeded the project-specific screening value of 228 µg/kg in two samples: Results from the analysis of the surface sample collected at station AD13 reported a concentration of 410 µg/kg. Results from the analysis of the 2-4 foot sample collected at station AA13 reported a concentration of 240 µg/kg. TBT is further discussed in Section 2 of this FS report.

Asbestos

Asbestos analysis was performed on all samples (27 total) collected from beneath Pier 1. Of those, asbestos was reported at trace levels (less than 1 percent) in 22 samples, and at a level of 2 percent in two samples. Those two samples were collected in the 12 to 24 inch and 24 to 48 inch interval at sample station AA26. Due to the low concentrations of asbestos reported, the project team determined that there is an extremely low probability of asbestos to pose risk to receptors; further discussion on this determination is provided in Appendix D9, and options for management of this low potential risk are addressed in Section 4.1

1.5 SUMMARY OF INVESTIGATION FINDINGS

Numerous investigations of the marine sediment have been conducted between 1993 and 2011 within Coddington Cove, and proximate to the former Derecktor Shipyard. The highest concentrations of COCs observed were found in samples collected during the SSI in 2011 (the most comprehensive sampling effort to date). Samples collected during the SSI were collected from three intervals (0 to 1 foot, 1 to 2 ft., and 2 to 4 ft.) and at a much greater density than previous investigations; most samples collected during previous investigations were collected at intervals of 0 to 0.5 ft. or less.

Many of the areas sampled previously were resampled during the 2011 SSI. SSI results indicate that the areas of contamination previously identified generally match those identified during in 2011, and the overall pattern remains unchanged. This is especially evident at the east end of Pier 2 were there are elevated PCBs, HWM PAHs (including benzo(a)pyrene) and lead concentrations; at the east end of Pier 1 where there are elevated levels of PCBs, HWM PAHs (including benzo(a)pyrene) and lead; and south of the T-Wharf elevated COC concentrations are located primarily in the top 1 foot of sediment, with only HWM PAHs (including benzo(a)pyrene) extending deeper than the 2 foot interval in a small area. These similarities are evident in comparison of Figures 1-10, and 1-11A, 1-11B & 1-11C. Additionally, elevated levels of lead and PCBs were reported in samples collected from the west end of Pier 2 that were not previously identified (area not previously sampled).

1.6 CONCEPTUAL SITE MODEL

The findings of the combined investigations suggest that chemical contaminants were discharged from the on-shore and Pier-based shipyard operation areas to the marine sediment along the bulkhead areas of Coddington Cove and around Pier 1. Contaminants have also been found to reside near Pier 2. The primary routes of contaminant transport from the shipyard operations into the marine sediment were likely overland runoff of spilled materials discharging to Coddington Cove through the storm drainage system, and direct release of contaminated materials into the cove from the shoreline, floating dry docks, and Greenport Ferry. Additional chemical contaminants concentrated under and around Pier 2 may have migrated there from shipyard operations or may have been discharged from Pier 2 Naval operations, but there are no data to differentiate those chemicals or risks.

Calculated risks suggest that site-related chemical contaminants in marine sediment and shellfish tissue are likely to adversely affect ecological receptors nearest to the probable release areas at the site. There may also be a risk to the health of persons collecting shellfish from this area if those persons are using the shellfish from this area as a regular food source. The HHRA and ERA were performed using data collected through 1997. Additional sampling conducted in 2004 and 2011 identified similar chemicals in the same areas as previously described, which indicates both confirmation of the risks measured, and overall stability of the site conditions. Therefore, it is confirmed that remedial alternatives can be developed using the available data to mitigate the predicted risks from the COCs identified.

The findings of the investigation efforts are summarized into a Conceptual Site Model (CSM) which is a graphic depiction of the site, the contaminant release patterns, and the risks that these contaminants pose. Figure 1-12 presents the CSM for the off-shore portions of the Derecktor Shipyard Site, which is the subject of this FS.

2.0 DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES

This section presents the initial steps in developing remedial alternatives to address the human health and ecological concerns identified at the site and to comply with all applicable regulations. Specific goals of this section are as follows:

- Identify ARARs and other environmental criteria that must be considered in developing RAOs (Section 2.1).
- Develop PRGs (Section 2.2).
- Develop RAOs that are protective of human health and the environment, and comply with ARARs (Section 2.3).
- Determine areas requiring remedial action and define the areas(s) and volume of sediment to be addressed by the remedial alternatives (Section 2.4).

After these steps are completed, GRAs that will satisfy the site-specific RAOs can be formulated, and applicable technologies are identified and evaluated. GRA development and technology identification, screening, and evaluation are presented in Section 3.0.

2.1 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

In recognition of the unique characteristics and circumstances associated with the remediation of individual sites, SARA and the NCP provide specific standards for the determination of whether a particular remedy provides sufficient cleanup at a given site. The NCP (40 CFR Part 300) specifies procedures to be employed in identifying, removing, or remedying releases of hazardous substances. In particular, the NCP specifies procedures for deciding the appropriate type and extent of remedial action at the Site to effectively mitigate and minimize the threat to, and provide adequate protection of, human health, welfare, and the environment.

The goal of remedy selection is to protect human health and the environment, to maintain human health and environmental protection over time, and to minimize untreated waste (40 CFR 300.430 of the NCP [55 FR 8846]). The remedial alternative must attain ARARs under federal environmental laws and more stringent state environmental and facility siting laws, or provide grounds for invoking one of the waivers permitted under the statute.

2.1.1 Definition of Applicable or Relevant and Appropriate Requirements

USEPA defines “applicable” and “relevant and appropriate” in the revised NCP, codified in 40 CFR 300.5 (1994), and has incorporated these definitions in its *CERCLA Compliance with Other Laws Manual*

(Interim Final–USEPA/540/G-89/006, Part II–USEPA/540/G-89/009). Site remediation must comply with ARARs, except where a waiver is granted according to Section 121(d) of CERCLA.

A requirement under CERCLA/SARA, as amended, may be either "applicable" or "relevant and appropriate" to a site-specific remedial action, but not both.

Applicable Requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

Relevant and Appropriate Requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws. Although not directly "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances at a CERCLA site, these requirements address problems or situations sufficiently similar to those encountered that their use is well-suited to that particular site. In some circumstances, a requirement may be relevant, but not appropriate, for the Site-specific situation. Only those state standards that are identified by a State in a timely manner and that are more stringent than federal requirements may be considered as relevant and appropriate requirements.

2.1.2 Classifications of Applicable or Relevant and Appropriate Requirements

ARARs for remedial action alternatives can be classified into one of the following three functional groups:

1. **Chemical-Specific –** Health or risk-based numerical values or methodologies that are used to develop cleanup levels for particular chemicals in designated media, as well as promulgated standards enforced by applicable regulations.

2. **Location-Specific –** Requirements that restrict remedial actions based on the characteristics of the Site or its immediate environment.

3. **Action-Specific –** Requirements that set controls or restrictions on the design, implementation, and performance levels (including discharge limits) of activities related to the management of hazardous substances, pollutants, or contaminants.

2.1.3 To-Be-Considered Guidance

Federal and state guidance and policy documents, advisories, and other criteria that do not have the status of ARARs and are not enforceable are classified as To-Be-Considered (TBC) guidance. Such guidance documents may be utilized when developing remedies that will be protective of human health and the environment. This is particularly the case for marine sediment which is a media that does not have promulgated standards by federal or state law, and for which remedial goals are often based on calculated ecological risk. Potential TBC guidance for the Site remedial alternatives is presented along with ARARs in Tables 2-1 through 2-3.

2.1.4 Identification of Applicable or Relevant and Appropriate Requirements

The following sections summarize the specific federal and state ARARs for remedial actions that may be conducted at the Site, and for the types of technologies that will be developed into remedial alternatives. Each ARAR has been chosen for its potential applicability or relevance and appropriateness in accordance with the procedures identified in the *CERCLA Compliance with Other Laws Manual* (Office of Solid Waste and Emergency Response Directive 9234.1-01) and *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (Office of Solid Waste and Emergency Response Directive 9355.3-01) (USEPA, 1988).

2.1.4.1 Chemical-Specific Applicable or Relevant and Appropriate Requirements

Chemical-specific requirements are established using health or risk-based numerical values or methodologies that establish cleanup levels in environmental media for specific substances or pollutants. In general, chemical-specific requirements are set for a single chemical or a closely related group of chemicals (including setting risk-based cleanup levels). These requirements do not consider the mixture of chemicals.

Chemical-specific ARARs are discussed below for marine sediment, due to measured risk to ecological receptors and to future recreational visitors, particularly persons taking shellfish for recreational or subsistence purposes. Soil and groundwater at Site 19 are addressed under OU 12 for the on-shore portions of the Former Derecktor Shipyard.

While there is risk to humans through ingestion of shellfish, the shellfish itself is not the media that is regulated or would be remediated; it is assumed that the chemical input is provided to the shellfish from the sediment, which is the media of concern for this risk endpoint.

Potential federal and state chemical-specific ARARs identified for the Site 19 marine sediment remedial alternatives are presented in Table 2-1. Currently, there are no promulgated chemical-specific state or

federal ARARs that would provide limits for the concentrations of COCs in marine sediment at the Site. Additionally, there are no promulgated federal or state chemical-specific ARARs that would provide limits for the concentrations of COCs in shellfish at the Site. The Navy has calculated site-specific, risk-based criteria for sediment utilizing federal TBC guidance described in Section 2.1.3, and the basis for these criteria are presented in Table 2-1.

2.1.4.2 Location-Specific Applicable or Relevant and Appropriate Requirements

Location-specific ARARs are restrictions placed on the concentrations of hazardous substances, or on the conduct of certain activities, solely because of the Site location. The general types of location-specific requirements that may be applied to Site 19 include water resources and wetlands regulations, in addition to special habitat and coastal resource protections. Potential location-specific ARARs for the Site 19 remedial alternatives include regulations pertaining to degradation of coastal areas, subtidal habitats, and marine resource areas and are presented in Table 2-2.

2.1.4.3 Action-Specific Applicable or Relevant and Appropriate Requirements

Action-specific ARARs are technology or activity-based requirements or limitations controlling remedial actions, with respect to managing hazardous substances, pollutants, or contaminants. These requirements generally set controls or restrictions on the design, implementation, and performance levels of activities to remediate, handle, treat, transport, or dispose of hazardous substances, pollutants, or contaminants. Action-specific ARARs may be used to help determine how a selected remedial alternative is implemented and can be unique to a particular remedial alternative being evaluated. One or more of these ARARs may be included for a particular remedial alternative under evaluation. Potential action-specific ARARs for the Site 19 remedial alternatives include regulations pertaining to filling navigable waters and requirements for potential dredging alternatives that would be appropriate to address contaminated sediment and working within coastal zones. These potential ARARs are listed in Table 2-3.

2.2 DEVELOPMENT OF PRGS

Sections 2.2.1 through 2.2.5 present the process of identifying the media of concern, developing PRGs for the COCs identified in Section 1, and identify area and volume requiring remedial action.

2.2.1 Identification of Media of Concern

The media of concern for OU 5 at NETC Newport are identified based on the results of site investigations, the site-specific Marine HHRA and Marine ERA, and an evaluation of compliance with chemical-specific ARARs. On-shore media (soil, groundwater) are addressed under separate cover as OU 12.

The investigations conducted have identified marine sediment as potential media of concern, as described below.

As discussed previously in Section 1.4.3, the Marine HHRA (B&R Environmental, 1998) evaluated human health risks associated with plausible exposure pathways for human contact with chemicals in the marine sediment and shellfish at the site. This assessment indicated that the human health risks from direct exposure to the sediment did not exceed the target risk range of 1E-04 to 1E-06 for cancer risk or the 1E+00 target for non-cancer HIs.

However, the HHRA identified unacceptable human health risks associated with ingestion of shellfish from the site, which are presumed to accumulate chemicals from site sediment. Cancer risks for shellfish ingestion under the subsistence fisherman exposure scenario exceeded the target risk range of 1E-04 to 1E-06 for cancer risk and the 1E+00 threshold for non-cancer HIs. Risks were evaluated on a site-wide basis, using maximum and average concentrations detected. Cancer and non-cancer risks under this exposure scenario exceeded the target levels under both maximum and average exposure assumptions.

As discussed in Section 1.4.2, the marine ERA identified two areas of Derecktor Shipyard as posing high probability of site-related risk to ecological receptors from COCs measured (station DSY-27, near Pier 2 and DSY-29, near the T-Wharf) (Figure 1-6). Intermediate probability of risk was identified for several other stations near the shoreline and piers. Low probability of risk to ecological receptors was identified for off-shore stations, west of the site shoreline. Ecological receptors included avian predators and aquatic organisms.

The results of the HHRA and Marine ERA indicate that the conditions in the site sediment are directly associated with increased probability for risks to ecological receptors and is indirectly associated with unacceptable risks to humans. COCs at the site are indirectly related to human health risk because the risk stems from ingestion of shellfish that have accumulated chemicals from the site sediment whereas there is little or no chance of direct human exposure to the sediments at the site. Therefore, Derecktor Shipyard marine sediments were identified as a medium of concern for the FS.

Shellfish are not identified as a media of concern for the FS because they are considered to be a receptor of COCs from site sediment and a vehicle for chemical transfer to other organisms rather than a contaminated media that can be addressed directly by a remedial action. It is assumed that by addressing contaminated site sediment, COC concentrations in shellfish will be reduced, which will translate to reduced risk to the human receptors that consume the shellfish.

2.2.2 Development of PRGs

PRGs were developed for the Site as target cleanup goals for remedial actions that would reduce concentrations of COCs in Site media of concern, and mitigate risks to human health and the environment. PRGs are concentrations established for the COCs identified in Section 1.4.4 (site–specific constituents that pose unacceptable risks to human health and ecological receptors). The final Remediation Goals (RGs) or "cleanup goals" will be established in the Record of Decision (ROD) for the selected Site 19 remedial action.

This section provides a summary of how the PRGs were developed for the marine sediment at the site. It is noted in Section 1.4.3 that the PRGs were developed in 1998 as a part of the first Feasibility study, and those PRGs have been retained for the development of this revised feasibility study.

The COCs and PRGs were developed by SAIC for the Navy with input from RIDEM and USEPA, based on the results of the marine ERA and HHRA. The details of PRG development and identification of PRGs is presented in the document: Final Preliminary Remediation Goals for Derecktor Shipyard/Coddington Cove (SAIC, 1998), which is provided as Appendix A to this FS report.

2.2.2.1 Overview of PRG Development

The process to develop PRGs for this site used a quotient method that measures the ratio of the concentration of the COC detected in the sediment over the threshold effects value (TEV), which is the concentration above which adverse effects to the receptor are possible. As described in Appendix A, the TEVs were developed for human and aquatic receptors based on the target acceptable risk values (human cancer risk of 1E-6, and non-cancer HQ of 0.1 or less; and ecological risk quotient of 1.0 or less) and reference station concentrations. The calculated values were identified as "Baseline" PRGs (BPRGs) which were then adjusted based on various factors to ensure that the PRGs target the areas that pose the greatest potential for increased risk. The resulting "recommended" PRGs (RPRGs) were then selected to achieve the greatest practical risk reduction among the identified receptor pathways.

These RPRGs were later accepted as the final PRGs to be used for development of the FS, and are presented here. The PRG development document was finalized in November of 1998; USEPA accepted this document in a letter dated December 21, 1998. RIDEM provided follow-up comments, which were resolved without revision to the document on May 11, 1999. As stated in a letter dated 1/2/2009, RIDEM did not concur with final PRGs.

PRGs for Marine Sediment[1]
Site 19 – Derecktor Shipyard Marine Sediment
NAVSTA Newport, Newport RI

COCs	PRG	Risk Endpoint
Lead	168 mg/kg	Toxicity to aquatic organisms from exposure to suspended sediment
Benzo(a)pyrene	539 µg/kg[2]	Adverse human health effects from ingestion of shellfish
Total HMW PAHs	13,903 µg/kg	Toxicity to aquatic organisms from exposure to bedded sediment
Total PCBs	1,060 µg/kg	Toxicity to aquatic organisms from exposure to suspended sediment

1 - SAIC, 1998 (Final)
2 – A detailed description/justification for the selection of the benzo(a)pyrene PRG can be found in Appendix D10

2.2.2.2 Process for Ecological PRG Development

The following steps were used in the PRG process to calculate the Ecological Risk Based PRGs for both suspended sediment (elutriate) and bedded sediment (porewater):

Aquatic Receptor PRG Development

Step 1: Identified the water quality screening value (WQSV) that were used for comparison to the pore water concentrations.

- USEPA Water Quality Criteria
- Other USEPA chronic values
- Convert sediment screening values (i.e., ER-L) to a WQSV using equilibrium partitioning

Step 2: Determined the pore water (PW)/elutriate (ELU) concentrations for the sediment samples.

- Predicted PW concentrations for organic chemicals using equilibrium partitioning
- Measured ELU concentrations for metals and organic chemicals in elutriate samples

Step 3: Classified the toxicity test samples as toxic or non-toxic.

- Divided the PW and ELU concentrations by the WQSVs to generate PW-Hazard Quotients (HQs) and ELU-HQs
- Amphipod toxicity test with sediment samples
    - Considered non-toxic if survival was $\geq$ 80%
- Sea urchin toxicity test with elutriate samples
    - Considered non-toxic if successful fertilization was $\geq$ 70%
    - Considered non-toxic if larval development IC_{10} was $\geq$ 50%

Step 4: Grouped the samples as toxic or non-toxic for each receptor. Reference station data was not used in these groupings.

- Calculated the 95% Upper Confidence Limit (UCL) of the PW-HQs and ELU-HQs for each group of samples (toxic and non-toxic) and endpoints (survival and development)
- Default to the maximum PW-HQ or ELU-HQ if there was an inadequate number of samples to calculate an ULC

Step 5: Summarized the results of the toxic and non-toxic samples. *The outcome of this step is to obtain the 95% UCL pore water concentration that is associated with a non-toxic sample.*

- Compared the 95% UCL (or maximum) PW-HQs or ELU-HQs of the non-toxic samples for each receptor to the WQSV
    - If the non-toxic PW-HQs or ELU-HQs exceeded 1.0, the value was considered the No Observed Effects Quotient (NOEQ) for that receptor
    - If the non-toxic PW-HQs or ELU-HQs were less than 1.0, then the NOEQ defaulted to 1.0.
- Compared the NOEQ to the 95% UCL (or maximum) PW-HQs or ELU-HQs of the toxic samples; this was done for both receptors
    - If the toxic PW-HQs or ELU-HQs exceeded the NOEQ, then the chemical was retained for PRG development for that receptor
    - If the toxic PW-HQs or ELU-HQs were less than the NOEQ, then the chemical was not retained for PRG development for that receptor
- Selected the lower of the two NOEQs (that were retained for PRG development) between the two receptors as the Aquatic NOEQ

Step 6: Compared the Aquatic NOEC (in Step 5) to the Reference Station pore water concentration (RSV) *This step is done to ensure that the PRGs will not be below the reference concentrations.*

- Multiplied the Aquatic NOEQ by the WQSV to calculate water concentration for each chemical (the Aquatic NOEC)
- If the Aquatic NOEC was greater than the RSV then the NOEC becomes the Toxicity Effect Value (TEV)
- If the Aquatic NOEC was less than the RSV then the RSV becomes the TEV

Step 7: Divided the pore water concentrations by the TEVs at each station (except the reference stations) to obtain the TEV-Hazard Quotient (TEV-HQ). *This step is done to limit the number of chemicals for which PRGs are developed to the chemicals that are causing the highest risk at each station.*

- The chemical with the highest TEV-HQ for a station was the limiting Chemical of Concern (COC) for that station
- The list of limiting COCs across all of the stations was the limiting COCs for the site

- Note that the same chemical may be a limiting COC at more than one station

Step 8: Calculated and developed the sediment baseline PRG*. This is performed to develop a sediment-based PRG that could be used across the site and to minimize unnecessary habitat disruption in lower risk areas.*

- The sediment PRGs were calculated using the following equation at each station and then averaging the values across all of the stations for the final PRG:

$$PRG = Cs * (TEV)/(PW)$$

Where:

TEV	=	Toxicity Effects Value (ug/L)
Cs	=	Chemical concentration in the sediment (ug/kg)
PW	=	Pore water concentration for the chemical (ug/L)

- The PRGs may be adjusted based on the constituents and their spatial distribution to focus the remedial actions on the locations that have the highest risks.

Avian Predator PRG Development

PRGs were initially developed for the avian predator exposure pathway using a tissue-based approach for the food items and converting the tissue concentrations to a sediment PRG protective of birds. However, during the assessment of PRGs for risk reduction step in the PRG development process, it was noted that the avian predator would have to spend its entire life feeding in the affected area for true risks from metals to occur. Therefore, it was recommended that PRGs for risk reduction for the avian predator aquatic exposure pathway not be adopted. It was also that the PRG for total PCBs to protect avian predator aquatic exposure pathway was not recommended for implementation because unacceptable risks to avian receptors or their food items was unlikely.

2.2.2.3 Process for Development of the Human Health PRG

In the development of PRGs for Site 19 marine sediment, one PRG was developed for protection of human health: benzo(a)pyrene was identified as a limiting COC based on risk from ingestion of shellfish. In this exposure scenario, it was assumed that the exposure point concentrations of benzo(a)pyrene measured in the fish tissue is taken up from the sediment by the shellfish and transferred in its toxic form to a fisherman consuming an annual average of 15.6 g/day of shellfish. This is an adequate quantity of shellfish to make up 36.5 meals per year for an adult 18 to 65 years of age. (This scenario is described in the HHRA as a subsistence scenario, where the fisherman would be collecting shellfish from this and other parts of Narragansett Bay, though it could be considered a recreational scenario with exclusive fishing activity within the study area only.) Using the measured risk, the PRG was back-calculated in four basic steps:

(1) Calculate an acceptable risk-based value (RBV) for COCs in shellfish tissue based on a cancer risk of 1E-6 and the exposure model provided in the HHRA.

(2) Compare the RBV to reference (background) tissue concentrations to assure RBVs are not above reference.

(3) Select "Limiting" COCs in the media by selecting the COCs which drive risk for the scenario, and which are predominantly present across the sample set.

(4) Calculate a sediment concentration for limiting COCs using Biological-Sediment Accumulation Factors (BSAFs) established in scientific literature.

A PRG of 53.9 µg/kg for benzo(a)pyrene in sediment was calculated using this approach. This PRG value was identified as a "Baseline PRG", meaning that it was purely a calculated value, with uncertainties of the conversions described and contaminant transfers between three media. The Baseline PRG was compared to site data available at the time and it was found to be exceeded in 34 of the 41 samples, including those well outside of what was understood to be an impact area for releases at the site. Exceedances extended outside of Coddington Cove into the east passage of Narragansett Bay, and were unbounded where no shoreline was present. Qualitative evaluation noted the depositional nature of Coddington Cove which is likely to encourage accumulation of PAHs, the concentrations that would be expected to exist in marine sediment within a commercial port and lack of comparability of this value to literature values indicating impacted marine sediment. It was determined that a value of 53.9 µg/kg benzo(a)pyrene in sediment could not be justified as a goal to direct a remedial action. Multipliers of this value (x2, x5, and x10) were all calculated and mapped against available data, and the x10 multiplier resulted in a COC concentration that indicated support of the conceptual site model: Exceedances of 10x the Baseline PRG (539 µg/kg) were evident along the waterfront where releases of contaminants from Site 19 are likely to have occurred. Similarly, it was a value that provided better comparison to literature based values indicative of impact to marine sediment within port areas.

The term that was used for the value ("PRG-HQ of 10") in the PRG development document, and carried forward in associated correspondence is a misnomer since the subject PRG is actually a value developed from a target ILCR of 1E-6 for this COC. In risk assessment, the term Hazard Quotient, or HQ, is a term associated only with a non-cancer risk, and in this context of a quotient-based PRG, the term is incorrectly used because it is not a non-cancer based PRG. The authors of the PRG document were utilizing quotients for development of ecological cleanup goals and the terminology seems to have been incorrectly carried forward from those comparisons.

The adjusted PRG (539 µg/kg) provides a justifiable match to the CSM, and its derivation by a 10x multiplier also equates it as a PRG developed from an ILCR of 1E-5. The value of 539 µg/kg also provides comparability to known effects concentrations in marine sediment, and allows for the real variations and uncertainties that should be expected in predicting the transfer of the chemical from sediment to shellfish and then to humans by ingestion. All these factors combine to agree that a PRG of 539 µg/kg for benzo(a)pyrene in depositional marine sediment is appropriate to support a remedial action.

2.2.2.4 Special Notes on Tributyltin (TBT)

In 2008, as the plan for the SSI (Section 1.4.7) was being developed, USEPA and RIDEM requested the Navy conduct a secondary evaluation of TBT, due to its presence in site sediment and its known toxicity. A PRG for TBT was not originally calculated in the SAIC PRG document because the risks measured from the concentrations detected during the ERA did not merit one. To satisfy the new request in 2008, the data from the baseline ERA was reevaluated to determine if a PRG for TBT should be added to the list above. The evaluation culminated in the team developing a No-Observed Effects Concentration (NOEC) for TBT at this site using the data from the baseline ERA. The following conclusions were reached:

- Comparison of site data to location - specific benchmarks for elutriate, sediment and tissue based on current literature still suggests that a PRG for TBT is not necessary at this site.

- Use of a TBT PRG calculated based on equilibrium partitioning using the most conservative AWQC value published is not supported by toxicity data collected as part of the ERA. The use of a NOEC based on toxicity data would result in no change to the areas already identified.

Based on the evaluations conducted, it was agreed that TBT data would be collected during the SSI and compared to the NOEC of 228 µg/kg. If the concentration of 228 µg/kg was exceeded, the team would meet and determine if a PRG should be developed. Two samples of 349 collected during the SSI were provided results above 228 µg/kg. Subsequently, in 2012 during the review of the SSI data and report, the team agreed that development of a PRG for TBT would not be required.

2.2.2.5 Early Life Stage Exposure to PAHs

Due to another request of the USEPA, the Navy also conducted an evaluation of the recommended PRGs to determine whether they are protective of early-life exposure to carcinogens in accordance with USEPA's *Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens,* which was implemented in March 2005, after the site risk assessments and PRG development were completed.

For this additional evaluation, a review of the adult subsistence fisherman scenario based PRGs was conducted: The adult subsistence fishermen scenario was selected as the basis for development of the human health risk-based PRGs because it presented the greatest potential risks of the scenarios evaluated. In general, implementation of USEPA's *Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens,* which requires an evaluation of children's cancer risk for a subset of carcinogens that operate by a mutagenic mode of action [*e.g.,* benzo(a)pyrene], does not impact evaluations of adult exposures and increases cancer risks for young child exposures to the subset of carcinogens by up to a factor of 10. Cancer risk results for exposures including young children at the Derecktor Shipyard site, are more than ten times less than cancer risks to the adult subsistence fisherman. Therefore, implementation of USEPA's *Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens,* which might increase young child risks up to 10-fold, would not alter the selection of the adult subsistence fishermen scenario as the basis for development of the human health risk-based PRGs. These PRGs would be expected to be protective of all scenarios with lower risk levels, including residential child exposures.

The conclusion of the evaluation is that the PRGs established in 1998 by SAIC are protective of both adult and early life exposures.

2.2.3 Identification of Sample Stations Exceeding PRGs

Historical sediment data from investigations conducted during the 1990s, sediment data gathered in 2004, and the most recent sediment data gathered in 2011 during the SSI, were compared to the PRGs to identify the locations that have exceeded PRGs in the past. Figure 1-10 presents the comparison of data collected between 1993 and 2004, and Figures 1-11A through 1-11C present the comparison of the data collected in 2011 as part of the SSI. Appendix C presents the sediment and biota data from all investigations in full. These data indicate that there are consistently three general areas where COC concentrations exceed PRGs: beneath and immediately surrounding Pier 1, beneath and immediately surrounding Pier 2, and the area immediately south of the T-wharf.

2.3 FORMULATION OF SEDIMENT REMEDIAL ACTION OBJECTIVES

RAOs for site sediment were formulated based on the site-specific marine risk assessments, site investigations, COC identification, and PRG development presented in the preceding sections. RAOs were identified for the marine portions of the site as one area, since, and although there are physical separations within the study area, the same exposure scenarios apply to all areas. Therefore, all off-shore areas were considered in developing RAOs and in developing and evaluating remedial alternatives.

The RAOs for the marine sediment address the COC-related risks identified in the Marine Sediment HHRA (B&R Environmental, 1998) and the Marine ERA (SAIC and URI, 1997). In accordance with

CERCLA, the RAOs developed for these areas address potential unacceptable risks to humans and to the environment and ecological receptors. The RAOs identified for the OU 5 marine sediment are presented below:

- Reduce human health risk associated with ingestion of shellfish populations in sediment impacted by benzo(a)pyrene by reducing exposure concentrations on an area average basis.

- Reduce the risk to aquatic organism populations from sediment impacted by lead, PCB, and HMW PAHS by reducing exposure concentrations on an area average basis.

To address the potential for a future risk from exposure to asbestos in the marine sediments during the implementation of the proposed remedy and future dredging of Site 19, the Navy will:

- Prevent exposure to potential asbestos in dredged shipyard sediment through development of documented precautionary measures and safe work practices.

2.4 DETERMINATION OF AREAS REQUIRING REMEDIAL ACTION

Using the data to determine the area and depth of contaminants above PRGs (Section 2.2.3 above), the area where a surface exceedance of a COC was reported, consists of 657,593 square feet, which equates to a volume for the surface interval (0 to 1 foot) of 24,355 cubic yards. However, it is recognized that locations where PRGs are exceeded are discontinuous and scattered. After careful evaluation, the project team agreed that to meet the RAOs, not all contaminated sediment would need to be addressed, since it is unlikely for a receptor to be exposed to only these limited contamination areas, and instead, risk could be reduced by targeting specific areas and reducing overall average concentrations across the affected area.

Areas requiring remedial action (target areas) were identified based on surface area – weighted average calculated for each COC. Because of the spatially discontinuous nature of the distribution of each COC exceeding the respective PRG, and because there is also spatial discontinuity in the manner in which receptor populations could be exposed to the COCs, it was determined by the project team during a meeting held on August 16, 2012 that Surface area – Weighted Average Concentrations (SWACs) should be used. These SWACs provide a conservative approach for representing risk to the study area as a whole. The use of the SWACs to determine target remedial action areas was confirmed during a subsequent meeting held October 23, 2013.

Before remedial action areas could be identified a baseline SWAC for each COC was first calculated. The approach for calculating the baseline SWACs (calculated separately for each COC) is as follows:

- Cells where the surface (0 to 1 foot) concentration of the COC exceeded its PRG were identified. Only those cells were included in the SWAC calculation.

- The COC concentration of each cell where an exceedance of the PRG was identified was then multiplied by the area of that cell. This effectively weighted each cell differently based on concentration and size.

- The sum of those products (concentration multiplied by area) was calculated, and this number was then divided by the sum of all cell areas where the COC exceeded the PRG.

- The final product was a baseline Surface area – Weighted Average Concentration, based on only those cells where that COC exceeded its PRG.

$$SWAC = \frac{(conc_1 * area_1) + (conc_2 * area_2) \ldots + (conc_n + area_n)}{area_1 + area_2 \ldots + area_n}$$

Remedial actions areas (target areas) were identified separately for each alternative, then these separate areas were combined to consider all four COCs. As target areas were selected the concentrations in the baseline SWAC calculation were manipulated based on the action specified in the Alternative; for example, if an area receives a 1 foot cover, the new surface concentration would be zero since it is assumed that the cover material is has a COC concentration not detected, or 0.0 ug/kg. Similarly, if an area was dredged and backfilled, the new surface concentration would also be zero. As additional target areas were selected for remedial action the SWACs were recalculated, and continued to decrease until they were projected to reach levels below PRGs, therefore achieving RAOs. Following this approach some sediment containing COCs greater than PRGs will be left behind, but the exposure area identified by the baseline SWAC approach is projected to achieve average COC concentrations below PRGs. The target area for each alternative is the combination of cells that were selected to reduce the SWAC for each COC to levels below PRGs. Appendix D8 presents example calculations for the SWACs.

Volumes presented in this FS are based on these target areas, bounded using the grid pattern developed during production of the SSI Sampling and Analysis Plan (SAP), and modified for this FS. The grid pattern is introduced in Section 1 (Figures 1-11A through 1-11C, and used for area and volume calculations as shown in Appendix D8).

3.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

Technology identification and screening are important preliminary steps in developing remedial alternatives. In this phase of the FS, potentially applicable technology types and process options are identified. The technologies and process options are then screened by evaluating each with respect to technical implementability, thereby further reducing the number considered. The technologies and process options considered to be implementable are then evaluated in greater detail, and representative options are selected for subsequent development and evaluation of remedial alternatives.

The identification, screening, and evaluation of technology types and process options are summarized below by completing the following steps:

- Developing GRAs for each medium of concern that satisfies the RAOs.
- Identifying and screening remedial technologies applicable to each GRA.
- Evaluating and selecting representative technology types and process options.

Section 3.1 identifies the GRAs that may be implemented for the marine sediment at Site 19. Section 3.2 discusses the technologies to be considered and provides a preliminary screening to identify the technology types deemed applicable given the specific challenges of the site location and physical conditions. Section 3.3 presents a discussion of the final evaluation and selection of representative technologies that will be carried forward for development of remedial alternatives. A summary of the technologies retained for further consideration as site-specific remedial alternatives is provided in Section 3.3.8.

3.1 GENERAL RESPONSE ACTIONS

GRAs describe categories of actions that could be implemented to satisfy the RAOs for each medium of concern at a site. GRAs may include treatment, containment, excavation, extraction, disposal, institutional controls, or a combination. Typically, in developing remedial alternatives, combinations of GRAs are identified to fully address all the RAOs.

GRAs and combinations of GRAs identified as potentially applicable for addressing the marine sediment at the site include the following:

- No Action
- Administrative Actions
- Containment
- Removal and Disposal

- Removal, Ex-Situ Treatment, and Disposal
- In-Situ Treatment

These GRAs are summarized below.

3.1.1 No Action

Under a no-action option, the site is left "as is," without implementing institutional controls, containment, removal, or treatment. This option does not provide for monitoring or placing access restrictions on contaminated media at the site. Examination of this option is retained throughout the FS process, as required by the NCP. Although this option involves no remedial action, it provides a baseline against which other GRAs can be evaluated.

3.1.2 Administrative Actions

Administrative actions are comprised primarily of institutional controls and access restrictions that limit use or access to the site to reduce or eliminate risks of exposure to hazardous materials. Administrative action options also include implementing a long-term monitoring program to assess changes in environmental conditions existing at the site. While institutional controls and access restrictions alone would not reduce the volume, mobility, or toxicity of contaminated media through direct treatment, they will provide temporary protection while naturally occurring recovery processes or long term treatment processes reduce concentrations or exposure to contaminated sediments by human and ecological receptors. Additionally, administrative actions can, on occasion, provide permanent use restrictions, in instances where marginal risk is present only to specific receptors from the widespread presence of chemicals at low concentrations.

Data generated from long-term monitoring activities would provide information to assist in determining the rate of attenuation, as well as any migration of COCs to, from, or within the areas of concern. Should migration be observed, monitoring would also provide information on which to base a decision regarding the need to implement additional remedial actions selected through changes to a ROD and documented appropriately.

3.1.3 Containment

Containment options reduce potential exposure risks through the application of physical means. Physical barriers prevent direct contact with and provide engineering controls to manage potential erosion/migration of contaminated media. Barriers may consist of permeable or impermeable cover systems and be comprised of natural and/or synthetic materials. Containment reduces the mobility of the contaminated media, and can prevent exposure, but does not affect volume or toxicity.

Containment of sediment in an underwater marine environment is a proven technology, but includes challenges that require consideration. It is necessary to assure broadcasting and settling the capping material adequately during placement, as well as the stability, permeability, and transmissivity of the cap once in place. At Site 19, a cap would need to be designed to integrate materials that would withstand predicted erosion forces of tides, waves, propeller wash, and localized currents over time, while maintaining a barrier to marine organisms. As a guideline, a cap would need to be designed to withstand a 100 year storm event, and material selected for capping would need to consider current conditions so as to mimic natural habitat while still working within the engineering constraints of providing adequate protection.

3.1.4 Removal and Disposal

Removal technologies are used to collect contaminated media from their present locations and move them for subsequent disposal. For marine sediment, removal is typically performed by the use of excavation and/or dredging equipment. Targeted (hot spot) removal would reduce the volume of contaminated media remaining on-site and allow overall site conditions to attenuate more rapidly than they would under natural conditions. Larger scale removal can be conducted to address exposure based on exposure units or “decision units” and wholesale removal of contaminated sediment would eliminate contaminated media from the site. When excavation/dredging is conducted, it typically involves relocation of that material to a controlled disposal area, though typically at high expense.

Removal of marine sediment at Site 19 would involve materials-handling issues related to sediment suspension, sediment dewatering, and residual water treatment/disposal as well as handling issues for debris that is anticipated to be present near the piers and bulkheads. The sediment removed would be handled under hazardous waste standards until the material can be tested to confirm whether it qualifies as either solid or hazardous waste for disposal purposes. Sediment dewatering would be necessary as a processing step to render the removed material suitable for disposal as a consolidated solid. Residual water generated from dewatering the sediment removed from the marine environment may require treatment prior to discharge back into Narragansett Bay or disposal at an off-site facility such as a local publicly-owned treatment works (POTW). Additionally, due to the former presence of asbestos covered steam lines beneath the piers, any sediment dredged from those areas would need to be handled/managed under relevant asbestos standards until it is determined, through laboratory analysis, that the sediment does not contain asbestos.

Sediment disposal technologies in combination with removal, or removal and treatment, comprise several potential alternatives to remediate the contaminated marine sediment. Based on the nature of the contaminated media and the constituents within, disposal options are likely limited to disposal on land off-base at appropriately permitted disposal facilities such as hazardous (Resource Conservation and

Recovery Act [RCRA] – C) or solid waste (RCRA-D) landfills. Disposal of dredge materials within contained aquatic disposal (CAD) cells in Narragansett Bay has been conducted for other projects and other sites; however, the State of Rhode Island has indicated that this is not an option that they would consider for Site 19.

3.1.5 Removal, Ex-Situ Treatment, and Disposal

Ex-Situ treatment technologies may be used in combination with removal and disposal options discussed above to reduce the volume, mobility, and/or toxicity of COCs in the removed sediment prior to disposal. Treatment options include technology types and process options using thermal, physical, chemical, and/or biological means. Ex-situ treatment may include both on-site/on-base and off-base treatment options.

Ex-situ treatment options are included for consideration in combination with disposal options. Based on existing analytical data, most of the marine sediments removed from the site are expected to be of acceptable quality for direct disposal in a solid waste landfill or CAD cell without pretreatment. However, because at the FS stage media are typically not yet sampled for all disposal parameters, a contingency is included for treating a fraction of the materials removed. In addition, use of a bulking agent is typically necessary for dredged materials due to free liquids that may be present.

3.1.6 In-Situ Treatment

In-situ treatment is used to treat chemicals in-place. Use of in-situ treatment eliminates the need for removal and disposal of the contaminated media. In-situ treatment options for sediment include technology types and process options using physical, chemical, and/or biological means. As with all in-situ treatment options, delivery of the treatment agents to the contaminated sediment is the greatest challenge. In-situ treatment options are included in the preliminary screening as a potential means to address the contaminated sediment without the need for excavation.

3.2 SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

Brief descriptions of preliminary screening, representative process options (RPOs), and evaluation of technologies and process options that remain after the preliminary screening are presented below.

3.2.1 Preliminary Screening

A variety of technologies and process options exist for each GRA described in Section 3.1. A range of these technology types and process options was identified and screened to focus evaluations on relevancy. Summaries of the identification and preliminary screening of remedial technologies and process options appropriate for the marine sediment at Site 19 are provided in Table 3-1. Some options were eliminated based on technology screening, as noted in the table.

3.2.2 Representative Process Options

USEPA guidance for conducting FSs recommends that one RPO be selected for each GRA to simplify the subsequent development and evaluation of alternatives without limiting flexibility during remedial design (RD) (USEPA, 1988). RPOs are selected from technologies remaining after preliminary screening based on effectiveness, implementability, and cost. The selected RPOs provide a basis for developing performance specifications during preliminary design. Although specific process options are selected for alternative development and evaluation, these process options are intended to represent the broader range of process options within a general technology type. The specific process for implementation of the remedial action may not be selected until the RD phase.

3.2.3 Evaluation of Technologies and Process Options

Following the preliminary screening of RPOs (Table 3-1), those technologies and process options identified as "retained" are evaluated in greater detail in Section 3.3 to determine if they are to be retained for use in developing remedial alternatives. One RPO is selected, if possible, from each technology category, to simplify subsequent development and evaluation of alternatives without limiting flexibility during remedy selection of RD. The evaluation criteria used to select the RPOs include effectiveness, implementability, and cost, with a focus on effectiveness. Brief descriptions of these criteria are as follows:

- Effectiveness: focuses on the potential feasibility of a process option to remediate the estimated areas or volumes of media. Specifically, it is considered whether the process option meets the remediation goals identified in the RAOs, limits the potential impacts to human health and the environment during construction and implementation, and is technically reliable (considering effectiveness of innovative versus well-proven technologies) with respect to the contaminants and conditions at a site.

- Implementability: encompasses both the technical and institutional feasibility of implementing a process. The preliminary screening of technology types and process options was based on an evaluation of technical implementability issues in order to eliminate options that were clearly ineffective or unworkable at the site. The subsequent, more detailed, evaluation places greater emphasis on the institutional aspects of implementability (coordination with various regulatory agencies and contractors; the availability of treatment, storage, and disposal services; and the availability of necessary equipment and skilled workers to provide long-term operation and maintenance [O&M] services, etc.).

- Cost: plays a limited role in the screening of process options. Options are simply evaluated based on relative capital and O&M costs, and whether those costs are high, medium, or low relative to the other options of the same technology type. At this point in the evaluation, the cost analysis is based on engineering judgment and not on detailed estimates.

3.3 EVALUATION OF TECHNOLOGIES AND REPRESENTATIVE PROCESS OPTIONS FOR SEDIMENT AT OU5

For the remediation of contaminated marine sediment, a variety of technologies and process options are available for each of the GRAs described in Section 3.1. A range of these technology types and process options was identified and screened to focus on relevant technologies and process options. A summary of the identification and preliminary screening of technologies and process options appropriate for sediment is provided in Table 3-1. Several options were eliminated based on technology screening.

Sediment remediation technologies and process options retained after the preliminary screening are presented in a table at the end of this section. The evaluation of the retained technologies and process options for sediment remediation is provided in the following subsections.

3.3.1 No Action

The no-action option consists of taking no remedial action at the site. It is included in the FS process to serve as a baseline against which other alternatives may be compared.

Assessment of this option is as follows:

- Effectiveness: The option would not be effective in achieving the RAOs for contaminated marine sediment. COCs would remain and could continue to pose a risk to the marine environment and human health.

- Implementability: The option would be readily implementable with no associated concerns.

- Cost: The option would have negligible capital costs, and any 5-year review efforts would be covered by the comprehensive 5-year review prepared for NETC Newport.

The no-action option is retained for further consideration, as required by the NCP, to provide a baseline comparison against which other GRAs can be evaluated for contaminated marine sediment at the site.

3.3.2 Administrative Actions

Administrative actions consist of activities designed to minimize potential risks to human health and the environment primarily by prohibiting or controlling access to impacted areas. The technology types/RPOs include institutional controls that restrict specific uses of the site, access restrictions, and long-term monitoring. These options may be conducted independently or in conjunction with other process options to protect human health and the environment.

3.3.2.1 Use Restrictions, or LUCs

Land Use Controls (LUCs) are institutional controls that place restrictions on the use of property based on the presence of a risk to human health or the environment. Typically, LUCs may also include the performance of regular follow-up inspections to verify their continued maintenance until cleanup goals have been reached. On non-federal property, the institutional controls that place restrictions are commonly recorded against property deeds. On federal property, such as NAVSTA Newport, the restrictions may be placed on the NAVSTA Newport's property management instruction. These restrictions are used to limit future activities or uses of a site to prevent human contact with contaminated media. LUCs commonly used to reduce exposure to contaminated media include prohibitions on installing water supply wells, restrictions on types of development allowed (e.g., no residential use), disturbing components of the remedy (digging into cover systems), and limitations on certain types of construction (e.g., excavation, construction of buildings with basements).

Use restrictions for marine sediment at Site 19 could be implemented to restrict access to the site by enforcing the "restricted zone" that is already set up for Coddington Cove under 33 CFR 334.81 for the purpose of security and use by Naval vessels. NAVSTA Newport currently allows lobster and finfish collection in Coddington Cove by certain groups and individuals (see additional details in Section 4.2.2). Restricting access would prevent activities that could result in disturbance of the sediment at the site. Use restrictions could also be implemented to restrict specific activities such as movement and berthing operations of deep – draft vessels. Because the subtidal areas are property of the State of Rhode Island, and because the waters are navigable, any legal changes to the restricted zone must be coordinated with the state and appropriate entities of the federal government.

In addition, if the Navy property is ever transferred out of federal control and restriction for Coddington Cove are deemed necessary to the continued viability of the remedy at that time, the Navy will as part of the transfer process coordinate with federal and state authorities to determine what use restriction can be imposed on the cove, which is state-owned, to prevent disturbance to areas with contaminated sediments managed under cover. If piers are included as part of the property to be transferred, Navy will include in the deed or transfer documentation a restriction requiring that if future owners intend to make alterations

to the pier (s) such as demolition, restoration or any other work that could undermine the integrity of the sediment remedy, the new owner must first obtain USEPA Region 1 concurrence, in consultation with RIDEM, and must conduct such work in a manner that does not compromise the remedy. Although the Navy may transfer the procedural LUC responsibilities to another party by contract, property transfer agreement, or through other means, the Navy will retain ultimate responsibility for remedy integrity, LUCs will be maintained until the concentration of hazardous substances in the sediment are at such levels to allow for unlimited use and unrestricted exposure.

Any LUCs would be implemented in accordance with the *Principles and Procedures for Specifying, Monitoring, and Enforcement of Land Use Controls and Other Post-ROD Actions*, (DoD, 2003). The manner in which LUCs are developed is currently through a document referred to as a LUC RD. This document would define the limitations of the control and the applicability, etc. LUC RDs will be developed in accordance with applicable current guidance and agreements between the USEPA and the Navy. The LUC RD drafted by the Navy is approved by USEPA and the State and is enforceable under the FFA.

Any time that the Navy retains the property, the "activity" (in most cases for Newport, the "activity" is the NAVSTA Newport PWD) enforces any LUC necessary. For this Site, the enforcement authority would be given to the Port Operations Group, which manages the activities of the waterfront at Coddington Cove, including the area at Site 19. Under the FFA, the Navy must allow access to the regulatory agencies to monitor and enforce LUCs; however, the manner in which the LUCs are to be enforced will be addressed in the ROD and the FFA. The Navy's policies for implementing LUCs and demonstrating that such controls remain protective at NAVSTA Newport were addressed in a letter from the Navy to RIDEM (NAVFAC MidLant, 2007). The letter affirms the FFA requirement for the Navy to allow access to the State and USEPA for inspection and enforcement activities.

The LUC RD is tracked by the Navy through a centralized system to assure each LUC is maintained appropriately. In the event that a property is sold or transferred, the Navy will create and record deed restrictions that will meet local and state requirements. The restrictions presented in the LUC RD may limit allowable activities such as development of the Site for residential or uncontrolled recreational use. Restrictions would also prevent the disturbance to any component of the remedy. In accordance with the ROD, LUCs would be monitored and enforced as long as COCs are present that pose a risk above CERCLA risk levels, as determined through the 5-year review process.

If the land at the waterfront is sold and released from Navy jurisdiction, the land use restriction that was incorporated into the base instruction is written into the deed for the new property and recorded against the property title. The format of the land use restriction would meet local or Rhode Island recording standards. The regulatory standards for institutional controls in the State of Rhode Island are termed

Environmental Land Use Restrictions (ELURs). Currently there is no plan for excess of Navy property at the waterfront at Coddington Cove.

In cases where LUCs, including base instructions or ELURs, are placed to address contamination at a site, the Navy must submit an annual report to the regulatory agencies documenting that all of the restrictions are being met. The Navy is also required to take immediate action to correct any violations identified. This report must be submitted every year and the obligations to enforce the restrictions remain as long as levels of contamination exceeding CERCLA risk levels remain on the property.

To address the potential for a future risk from exposure to asbestos in the marine sediments during the implementation of the proposed remedy and future dredging of Site 19, the Navy will prevent exposure to potential asbestos in dredged shipyard sediment through development of documented precautionary measures and safe work practices, which will be described in the LUC documentation established for the COCs that remain at the site under the various alternatives.

Assessment of this option is as follows:

- Effectiveness: Enacting LUCs to restrict access and berthing activities in the affected areas would offer no containment or removal of contaminated marine sediment; it would reduce sediment disturbance and could temporarily prevent collection of shellfish from the area. If effectively enforced by the Navy under 33 CFR 334.81, LUCs would deter fishermen and recreational users from fishing in affected areas and thus reduce human health risks associated with ingestion of contaminated aquatic organisms. Regardless, such controls would not be effective in the short term to address risk to ecological receptors. LUCs would not reduce toxicity, mobility or reduce contaminated sediment volume. No additional risks to human health and the environment would result from implementing use restrictions.

- Implementability: Institution of access restrictions within Coddington Cove is possible under the current restrictions enforceable under 33 CFR 334.81: NAVSTA Newport currently maintains and executes the authority to restrict access to Coddington Cove, implementing and enforcing an expanded access restriction would not pose significant difficulty as long as the Navy maintains presence. Specific activity restrictions for larger ships berthing at the piers (i.e., use of shallow draft tug vessels for berthing) are easily implementable through the Port Operations group. However, in the unlikely occurrence that the Navy excessed the waterfront and no longer used the cove for naval operations, the restricted zone would likely not be retained, and continuing that restriction solely for purposes of protection from the COCs present could only be implementable with USEPA and RIDEM support. Cooperation/coordination between the new shoreline property owner and Rhode Island

authorities on any restrictions would be required because the impacted marine sediment area is located on state property (land under water).

- Cost: The capital costs for implementing institutional controls would be low. Operating costs for the Navy to patrol the area year round would be moderate to high.

Use restrictions to prevent access and activities in affected areas of the site are retained for further consideration. These restrictions can be used to control ship traffic (reducing sediment resuspension) and use of Piers where higher concentrations of COCs are present are retained in combination with other technologies, such as containment in place.

3.3.2.2 Monitoring

Monitoring includes the assessment of sediment conditions at the site after the remedial action(s) has been implemented. The assessment could include one or all of the following actions depending on the alternative selected: bathymetric monitoring, sediment/cap material sampling for physical characteristics, or sediment/cap material sampling for chemical analysis to identify breaches in a cover. Monitoring would also provide a means of measuring changes over time and provide information to assess the potential need for future remedial action. Monitoring is typically required to support any remedy that leaves COCs in place after completion.

Assessment of this option is as follows:

- Effectiveness: Monitoring sediment conditions can be effective in measuring long term stability of a cover system, and data collected from monitoring activities would help to identify trends in COC concentrations and provide documentation of natural recovery. Monitoring would also provide information to assess the need for any future remedial action, in addition to characterizing the effectiveness of any conducted remedial action. Monitoring by itself would not offer environmental protection or attain the RAOs. Monitoring would not be effective in preventing COC migration or reducing toxicity, mobility, or volume of contaminated sediment.

- Implementability: A monitoring program would be readily implementable, since trained personnel are locally available for data and sample collection as well as analysis/reporting.

- Cost: The capital and O&M costs for a periodic sediment monitoring program would be relatively low, although cost would increase based on frequency, duration, and magnitude of the monitoring program.

The monitoring option is retained for use as a component of alternatives that do not include removal of all COCs present. While providing no direct protection of human health and the environment, monitoring would provide a means of assessing changes in COC concentrations and potential COC migration off-site. In addition, combined with other process options, monitoring would provide a means of determining the effectiveness of remedial action activities and the need for future remedial actions.

3.3.3 Enhanced Natural Recovery (ENR)

Enhanced Natural Recovery includes providing a condition which can be built upon by natural processes that will ultimately result in a protective remedy.

3.3.3.1 Enhanced Natural Recovery Using Thin Layer Cover

The thin layer cover option would consist of placing a thin (minimum 6 inch) layer of natural fill material (sand or gravel) over contaminated areas. The purpose of the thin layer cover would be to enhance the process of natural depositional recovery and reduce exposure both in the short term and long time. The Navy has some limited information regarding depositional rates and flow velocity characteristics, so the thin layer cover option would be implemented in an effort to reduce exposure to receptors while the natural recovery process is occurring.

Assessment of this option is as follows:

- Effectiveness: Thin layer cover would achieve the site-specific RAOs by accelerating the natural depositional recovery process that would ultimately isolate contaminated sediment from potential receptors. A thin layer cover would not reduce the volume of contaminated media at the site. There is some uncertainty regarding the effectiveness of this option due to data that has been collected; while there is data to suggest that during steady state conditions most of the site is a depositional environment, there is little current velocity and wave action data for storm events (see sections 1.3.3. and 1.3.4), when sediment could potentially be resuspended and transported to other areas within Coddington Cove. Monitoring and 5-year reviews pursuant to CERCLA would be required to ensure that the additional deposition required for protection is occurring, as well as to monitor the effectiveness of this technology.

- Implementability: Thin layer cover implementation would need to occur by slow, uniform placement of layers to minimize resuspension of the material being covered. Cover materials, comprised of common fill materials, are readily available for purchase and can be installed by marine contractors available in the local business community. The ocean floor would need to be suitable to support the weight of the cover, and exhibit suitable depth and slope (bathymetry) characteristics. This technology

is implementable by local marine contracting companies with trained personnel familiar with this process.

- Cost: The capital costs are moderate for installation of thin layer cover over the contaminated sediment. Moderate to high O&M costs are associated with this option due to the need for continued monitoring of the placed cover material, new naturally deposited material, and chemical parameters to document both continued natural recovery and to assure the remedy meets the RAOs.

The thin layer cover, providing enhanced natural recovery (ENR) is retained for further consideration. If selected for an alternative it will need to be used in combination with other GRAs to ensure protectiveness, most notably administrative actions.

3.3.4 Containment

Containment involves using an additional layer of material to limit potential risks to human health and the environment by preventing exposure to site COCs. For marine sediment at Site 19, it would consist of installing and maintaining a physical barrier to isolate and contain the contaminated marine sediment. The containment options presented in this section include thin layer cover, or subaqueous cover (engineered barrier); each of which is further described below

3.3.4.1 Subaqueous Cover System

The subaqueous cover would consist of an engineered barrier, or cap constructed by placing natural fill materials such as sand, gravel, and stone over the contaminated sediment. The cap would be thick enough to provide a permanent barrier to contain sediment and prevent exposure by burrowing marine organisms, and would be designed to withstand a 100 year storm event, as well as anticipated ship traffic. A full design and limited data collection would be required to make final determinations regarding design requirements for the cap (i.e. size and type of cap fill materials, cap thickness). In an effort to preserve current habitat within the shipyard, the cap material selected would be as similar as possible to native material while still considering engineering constraints to assure protectiveness of the remedy.

Assessment of this option is as follows:

- Effectiveness: Installation of an engineered barrier would achieve the site-specific RAOs by isolating the contaminated sediments from potential receptors. The cap thickness would need to be sufficient to prevent deep-burrowing organisms from accessing the sediments. Long-term inspections and maintenance would be required to maintain the cap's effectiveness. Capping would not reduce the volume of contaminated media on-site. The use of appropriate turbidity control measures during cap

installation would minimize COC migration during implementation. 5-year reviews pursuant to CERCLA would be required.

- Implementability: Capping is a proven and reliable technology, although underwater implementation would present additional challenges. Specifically, dispersion of the contaminated sediments could potentially occur during cap construction. Construction would need to occur by slow, uniform placement of layers to minimize resuspension. Cap materials, comprised of common fill materials, are readily available for purchase and can be installed by marine contractors available in the local business community. The ocean floor would need to be suitable to support the weight of the cap, and exhibit suitable depth and slope (bathymetry) characteristics. After cap placement, native subaquatic habitat restoration is expected to occur under natural processes. This alternative is implementable by local marine contracting companies with trained personnel familiar with this process.

- Cost: The capital costs are moderate to high for capping the contaminated sediment. Moderate to high O&M costs are associated with this option due to the need for continued monitoring of the placed cover material and chemical parameters to document both continued natural recovery and to assure the remedy meets the RAOs.

Containment using an engineered barrier option is retained for further consideration. By creating a physical barrier over the contaminated sediments, human health and the environment would be protected; however, no reduction in volume of contaminated sediments would occur.

3.3.5 Removal

Removal technologies are key components of both the removal/disposal and removal/treatment/disposal GRAs. Removal activities involve excavating and/or dredging contaminated marine sediment to reduce or eliminate on-site toxicity, mobility, and volume. These operations require instituting sediment resuspension/turbidity control measures, excavating or dredging, transporting removed materials, dewatering sediment, treating water generated during dewatering, and restoring altered intertidal and subtidal habitats. Additionally, in some instances, due to site specific requirements, backfill may be appropriate after removal has occurred; either as a residual management layer to blend residual contamination left behind, or to restore habitat (backfill is considered as part of the removal process in these instances and not a separate GRA).

There are different types of removal equipment available for marine sediment, and some design parameters would influence the selection of such equipment.

Any dredging performed at the Site would have to be performed with the understanding that there is a potential for dredge spoils to contain asbestos, and that material would have to be managed appropriately.

In general, selection of the most efficient and cost-effective excavation and/or dredging techniques depends on sediment required removal rates and target depths which, in turn, depend on the following factors:

- Volume and depth of contaminated material
- Sediment characteristics (amount of debris, sediment grain size, and water content)
- Location/navigational constraints (bridges, water depth, currents, etc.)
- Weather conditions
- Water depths (height of the water column above the sediment)
- Post-removal treatment requirements (dewatering, water treatment, and sediment treatment, etc.)
- Marine ecological concerns related to resuspension of contaminated sediments during removal and associated turbidity control (silt curtains, booms, etc.)
- Health and safety issues related to sediment handling
- Equipment (type and size) that can access the areas
- Mode of transport to disposal or treatment facility
- Method/location of disposal or treatment
- Permanent and floating obstructions present

Land-based removal could be conducted in some areas around existing piers and bulkheads; however weight restrictions are in place for both Piers 1 and 2, and bulkhead shoreline areas have limited availability. Contaminated sediment that cannot be reached from the shoreline would be removed using barge-mounted dredging equipment.

It is noted that at Site 19, some contaminated sediment is present beneath pier structures at the site. The piers at Site 19 are constructed of concrete decking standing on concrete piles (Section 1.3.5). Effectiveness of dredging beneath piers around pilings is limited, as evidenced by review of other, similarly attempted dredging programs. These similar projects are summarized in Table 3-2.

The sediment removal options may include the following excavation and dredging technology types.

3.3.5.1 Mechanical Dredging and Excavation

Mechanical dredging and excavation may be conducted using a number of techniques including clamshells, dippers, bucket ladders, drag lines, and conventional earth-moving equipment. This equipment operates by directly applying mechanical force to dislodge materials to be removed.

Clamshells. The most commonly used mechanical dredge for removing contaminated soils and sediment is the clamshell dredge. Clamshells can recover all types of material and debris, except highly consolidated sediment. This type of dredge is generally equipped with an open, hinged bucket with a capacity of 1 to 12 cubic yards. The bucket is attached by a cable to a land-based crane or flat-bottomed barge. The clamshell dredge can excavate to a target depth, restricted only by the crane-lifting capacity and penetration into the substrate.

The clamshell dredge is operated by opening the jaws of the bucket, lowering the bucket into the material to be removed, closing the jaws, and hoisting the bucket by means of the crane cable. The dredge removes a heaped bucket of material, part of which is excavated by drag forces during hoisting. If properly operated, conventional clamshell dredges can operate with limited loss of sediment and can efficiently remove a large volume of material. Debris can hinder both production and capture of sediment. For marine dredging applications, a modified, watertight bucket is sometimes used to minimize the resuspension of solids into the water column. The clamshell dredge would allow removal of sediment with limited removal of water. However, use of the watertight bucket would increase the water captured with the sediment. It is anticipated that 25 percent of the material removed would be water using the watertight bucket, and less using a non-watertight bucket.

Dippers. The dipper is a powered 8 to 12 cubic yard shovel designed for digging out rock and very hard, compacted material. Its use is suited for excavation of soft rock and highly consolidated sediment within a working depth of 50 feet. Since this technique operates with a violent digging action and tends to drop small particles, its application for marine dredging is often limited. Dippers allow removal of sediment with minimal water included with the dredge spoils. However, excessive resuspended sediment would be generated and not captured if fine-grained material, such as some of the material present at the site, is dredged.

Bucket Ladders. A bucket ladder dredge is comprised of a submersible ladder that supports a continuous chain of buckets that rotate around two pivots. When the buckets rotate around the underside of the ladder, they scoop up material and transport it up the ladder for discharge into a storage bin. These dredges are most commonly used in mining operations abroad, and for sand and gravel production. The bucket ladder dredge generates considerable turbidity because of the mechanical agitation of sediment and leakage from the bucket. The water captured by this method is equivalent to that of the clamshell dredge. Water content would be higher if dredging fine grained sediments, as the principal is to allow the sediment to displace water within each bucket as it is raised up the ladder. Fine-grained material would become suspended in water and not stay within the buckets as effectively as coarser grained sediment and gravel.

Drag lines. Drag lines use the same basic equipment as the clamshell dredge. However, the drag line operates by using a drag cable to pull the bucket through the material being excavated toward the crane. Drag line dredges typically provide for a longer reach than clamshell dredges operated by the same crane. Since drag lines cause a great deal of mechanical agitation of the material being removed and because the buckets are generally open, their use usually results in excessive sediment resuspension. The amount of water captured by this method would be equivalent to that of the clamshell dredge. It is anticipated that watertight and non-watertight buckets are available for this application.

A summary of the advantages and disadvantages of mechanical dredging follows:

> Advantages of mechanical dredging include the fact that excavation can be conducted to maximize the solids content (approximately 75 percent) and, thereby, minimize the scale of the dewatering and handling activities. Mechanical dredges are highly maneuverable, and are able to remove many types of debris and provide dredging accuracy. Clamshell dredges and excavators are capable of efficiently removing materials with depth. Many techniques are available for shoreline use, while fewer options are suited for barge-mounted operations.
>
> Disadvantages of mechanical dredging include the potential for resuspending large amounts of sediment, as well as offering a lower production capacity with typically higher costs than other dredging techniques. Mechanical dredging operations also require significant rehandling of materials. Finally, mechanical dredging equipment is not effective in removing shallow amounts of sediment; it is specifically designed to remove large vertical amounts of sediment.

Assessment of this option is as follows:

- Effectiveness: Mechanical dredging would be effective in removing debris and contaminated sediment at thicknesses of 2 feet or more from the marine environment. Removal would minimize future exposure risks to human health and the marine environment while preventing COC migration within Narragansett Bay. The effectiveness of mechanical dredging is limited by the difficulty of achieving precision removal in an underwater environment. Multiple passes over the contaminated area may be required to remove all contaminated materials, and excess sediment may be removed in the process through overdredging. The effectiveness can be improved by state-of-the-art positioning equipment, but not to 100 percent. The use of appropriate turbidity control measures during dredging of marine sediment would minimize COC migration during implementation. However, mechanical dredging activities could result in excessive resuspension of contaminated sediment that may be difficult to control, particularly in water 30 feet or more in depth.

- Implementability: Mechanical dredging is readily implementable by local companies with trained personnel familiar with the dredging of contaminated sediment. Additional vendors may be required for treatment of dewatered sediment; however, qualified companies are assumed to be readily available within the Rhode Island coastal business community.

  Mechanical dredging for open water areas is readily implementable by both shoreline and barge-mounted operations because of the nature of the site and surrounding shorelines. Mechanical dredging under the piers is not expected to be implementable. Some amount of dragline-type dredging could be conducted with specialized equipment approaching the piers from the north or south direction. However, this approach would have significantly limited effectiveness in acquiring sediment around the pilings. A summary of other sites where dredging beneath piers has been proposed is provided in Table 3-2.

- Cost: The capital costs are moderate to high for dredging contaminated materials. No O&M costs are associated with this option unless some contaminated sediment is left in inaccessible areas (e.g., under piers) or habitat restoration and monitoring are required.

Mechanical dredging is a viable removal option for the open water portions of this site and has, therefore, been retained for detailed consideration. Mechanical dredging under the piers areas at Site 19 is not likely to be possible given the width and obstructions provided by those piers. The final selection of the most appropriate mechanical dredging method would be made during design of the remedial action.

3.3.5.2 Hydraulic Dredging

Hydraulic dredges use centrifugal pumps to remove sediment in a liquid slurry form for transport by suction to a designated location on a barge or along the shoreline. Slurries of 10 to 20 percent solids by weight are typically achieved. A cutterhead, or similar device, is often fitted at the suction end of the dredge to assist in dislodging bottom materials and allow for transport of sediment to the suction pipe. The cutterhead is one of the most efficient and versatile type of hydraulic dredge available. However, new hydraulic dredge designs are available that attempt to increase the solids content of the pumped slurry while minimizing sediment resuspension caused by the dredging activity.

Both cutterhead and plain suction hydraulic dredges can efficiently remove large volumes of relatively fine materials. Typical hydraulic dredges cannot remove stones or debris larger than approximately 4 to 6 inches in diameter because they are limited by the size of the suction head and slurry pipeline. The plain suction dredges are capable of removing relatively free-flowing sediments (sand, gravel, and unconsolidated material), while cutterhead dredges are capable of removing free-flowing as well as very hard and cohesive sediments. Portable dredges (with or without a cutterhead) can be used to remove

moderate volumes of materials that are more surficial in nature (depths of up to approximately 18 inches). The cutterhead, plain suction, and portable dredges can all be operated from the shoreline or from barge-mounted equipment in relatively deep water.

A summary of the advantages and disadvantages of hydraulic dredging follows:

> Advantages of hydraulic dredging include limiting the resuspension of sediment in surrounding waters and minimizing the handling of dredged material by transporting the dredged slurries by suction through pipelines. The cutterhead can efficiently dredge and pump all types of alluvial materials or compacted deposits, such as clay or hardpan. The cutterhead is also capable of removing shallow intervals of sediment (minimum effective depth of 0.5 feet) and grading and finishing slopes efficiently. Suction dredge without use of a cutterhead can, in theory, be guided around pilings under piers, however, this would require assistance by multiple divers in the water and would be labor intensive.
>
> Disadvantages of hydraulic dredging include the fact that large volumes of water, which may require treatment prior to disposal or release, are typically removed along with the sediment (80 to 90 percent water by weight). The slurry pipelines used to transport dredged material may temporarily obstruct navigational traffic. Non-hopper dredges cannot be operated in rough water, and hopper dredges may require drafts of over 10 feet. The presence of debris such as wire, cable, conduit, and pipe, all of which are likely present at the site, may limit the effectiveness and suitability of hydraulic dredging. Hydraulic dredges cannot remove material with diameters greater than the diameter of the suction head or slurry pipeline; therefore, their use in areas where debris is present may be limited. Hydraulic dredging using cutter heads is not possible under piers because of the density of the pilings and the widths of the pier structures (100 to 200 feet wide).

Assessment of this option follows:

- Effectiveness: Hydraulic dredging would be effective in removing contaminated marine sediment at thicknesses of 0.5 feet and more. However, in areas where the marine environment contains obstructions or debris greater than the diameter of the dredge, mechanical excavation and dredging techniques may be required to prepare the area prior to hydraulic dredging. The effectiveness of hydraulic dredging is limited by difficulty of horizontal control in an underwater environment. The effectiveness can be improved, but not to 100 percent, by state-of-the-art positioning equipment. Removal of impacted sediment would minimize future exposure risks to human health and the marine environment, and prevent COC migration within Narragansett Bay. The use of appropriate turbidity control measures during dredging activities would minimize COC migration during implementation.

- Implementability: Hydraulic dredging in open water areas is readily implementable by local companies with trained personnel familiar with dredging contaminated sediment. Separate vendors would be required for treatment of water generated during dredging. However, qualified companies are available within the Rhode Island or New York/New England coastal business community. Dredging under the piers may not be implementable, particularly with large equipment. It is anticipated that suction dredging could be performed as long as it could be assisted by divers manually operating suction equipment. A summary of other sites where dredging beneath piers has been proposed is provided in Table 3-2.

  Hydraulic dredging is implementable by both shoreline and barge-mounted operations because of the industrial nature of the site and surrounding shorelines.

- Cost: The capital costs are moderate to high for hydraulic dredging of contaminated materials. No O&M costs are associated with this option unless some contaminated sediment is left in inaccessible areas (e.g., under piers) or habitat restoration and monitoring are required.

Hydraulic dredging using barge- and pier-mounted equipment is viable for this site, particularly for open water areas and target depth intervals that are shallow (within the upper 1 foot of the substrate). However, some debris is known to be present along the piers and bulkheads and therefore, limited mechanical dredging may be necessary to prepare the area first.

Hydraulic dredging at Site 19 is implementable in the open water areas, but some contaminated sediment is present beneath pier structures at the site. The piers at Site 19 are constructed of concrete decking standing on concrete piles (Section 1.3.5). Effectiveness of dredging beneath piers around pilings is limited, as evidenced by review of other, similarly attempted dredging programs summarized in Table 3-2. Overall, it is speculated that only using hydraulic dredging with diver assistance can be accomplished under piers and around pilings. Such an operation is difficult, will likely have limited effectiveness, and has inherent safety concerns.

Hydraulic dredging has been retained along with mechanical dredging for further consideration for use at Site 19.

3.3.6 Materials Disposal and Handling

Disposal technologies are included as key components of the removal GRAs. Disposal media include sediment excavated and/or dredged from the marine environment and debris removed near the piers. Disposal options may include both on-shore and off-shore facilities located off-base.

Additional activities associated with excavation/dredging operations are related to materials handling. These activities include transporting dredged materials for processing, screening, and dewatering sediment, and treating/disposing of both the residual water and the dewatered sediment.

3.3.6.1 Confined Aquatic Disposal

Confined Aquatic Disposal (CAD) is a type of sub-aqueous capping in which dredged sediment is placed within a natural or excavated depression at an underwater location, often situated away from the dredged area, and clean materials are placed on top to seal the CAD and prevent dispersion of the underlying contaminated material. CAD of site sediments would involve excavating the contaminated sediment, placing them into a bottom-dump scow for transport by tugboat to a designated CAD cell disposal location, and placing the contaminated sediments into the CAD cell. The CAD cell would then be capped with clean materials. Typically, the sediments would require minimal dewatering or other processing prior to disposal in a CAD unit. CAD cells can be used for disposal of contaminated or non-contaminated materials. CAD cells are not governed by RCRA Subtitle C or D land disposal facility requirements and may accept materials that would be classified as hazardous under RCRA provided the materials meet the requirements of the specific facility.

CAD was evaluated as a potential disposal option in 2008 to determine if there was sufficient storage capacity within a group of existing CAD cells located in the Providence River. This CAD facility was constructed by the U.S. Army Corps of Engineers for the Providence River Dredging Projects and is operated and maintained by the Rhode Island Coastal Resources Management Council (CRMC). Although CRMC operates the facility, RIDEM retains the authority for determining whether a waste is acceptable for disposal in the CAD facility. Determination of acceptability for CAD disposal is based primarily on the anti-degradation portion of the RIDEM water quality regulations. The basic regulatory requirement is that to protect the area surrounding the CAD unit from degradation, disposal of materials that have higher levels of contaminants or additional contaminants not present in the vicinity of the CAD is prohibited. Data available suggested site sediments could be placed in this CAD facility.

However, during a meeting held August 16, 2012, RIDEM stated that the state would not support a decision for this site that would, in any way reduce the usability of the resources of the State, both environmental and economic. RIDEM's view of use of the CAD cell in the Providence River CAD facility was that such disposal could potentially degrade the use of the bay as a resource. Additional testing would be necessary to determine the handling requirements.

Assessment of this option is as follows:

- Effectiveness: CAD is an effective means of off-base disposal. Disposal in a well-constructed and maintained CAD cell would effectively contain the contaminated sediment and prevent human or ecological exposure to the COCs. Although the sediments would be disposed underwater, dewatering may not be necessary prior to disposal or dewatering requirements may be minimal (i.e. removal of free water only). Prior to transport off-site, any water generated from passive or active dewatering of the contaminated sediments may need to be discharged for treatment and/or disposal. Any treatment processes necessary for sediment or water would be completed on the barge(s) used to conduct the work.

- Implementability: The implementability of CAD for contaminated sediment from the site is uncertain. The CAD facility constructed for the Providence River dredging project is reported to have more than sufficient capacity to accept the volume of sediment expected to be generated from the site (Goulet, 2007, 2008). This facility is in relatively close proximity to NAVSTA Newport and a sufficient fleet of scows and tugboats are expected to be available within the Rhode Island coastal business community to transport the material to the CAD and ensure that the work is not stalled due to lack of transport capacity.

  However, in discussions between the Navy and RIDEM, RIDEM has indicated that they would not support a decision to use CAD as a disposal technique for the contaminated sediment at the Site since it could further degrade the bay and its fisheries, which are valuable environmental and economic resources. Such a position suggests that although the solution has technical implementability, it is not implementable based on policy.

- Cost: The capital costs are expected to be moderate. No O&M costs are associated with disposal in an off-base CAD facility, because it is assumed that the operators of the CAD facility would be responsible for O&M costs.

The CAD option is eliminated for disposal of site sediment because of regulatory concerns described above.

3.3.6.2 Off-Base Landfill

Off-base landfill disposal would involve transporting contaminated marine sediments over the road or rail to a permitted on-shore landfill determined to be operating in compliance with the conditions of its permit and therefore acceptable for off-site disposal of waste from CERCLA sites. The disposal facility would be a solid waste (RCRA Subtitle D or equivalent) or hazardous waste landfill (RCRA Subtitle C or equivalent), constructed with a liner and leachate collection system, and operated and maintained in accordance with RCRA or equivalent requirements.

Disposal of contaminated sediments at an off-site landfill would require dewatering and possibly addition of a bulking agent to make the sediment suitable for land disposal. The material would also require testing for hazardous characteristics to determine the appropriate type of disposal facility. It is expected that most or all of the material would be acceptable for disposal at a solid waste landfill (RCRA Subtitle D or equivalent). If any of the sediment is determined to be classified as hazardous, it would require treatment and/or disposal in a hazardous waste landfill (RCRA Subtitle C or equivalent). If material is dredged from beneath the piers it will be managed with consideration of the possible presence of asbestos fibers within the waste dredged material.

Assessment of this option is as follows:

- Effectiveness: Disposal at a licensed solid or hazardous waste landfill is an effective means of off-base disposal. These facilities would effectively contain the contaminated sediments and prevent exposure to or migration of COCs. Furthermore, these facilities may be capable of providing treatment of selected materials if required prior to disposal.

- Implementability: RCRA Subtitle D landfills are available locally, but a single location may not be able to accept the volume of materials removed from the site. RCRA Subtitle C facilities are available for disposing and/or treating a small volume. Therefore, a number of disposal facilities may have to be used, and some or all of the material may need to be shipped out of state. Proper handling and transport of contaminated materials complete with bill of lading or hazardous waste manifest would be required. Although it is not anticipated, in the event that material to be disposed of is classified as asbestos-containing material, adjustments to the location for landfill disposal will be made as required. Some stabilization of the materials may be required prior to transport to minimize the presence of free liquids. Disposal in landfills would be more difficult than disposal in a CAD cell because of the additional dewatering, treatment, and testing requirements and load limitations for truck transport.

- Cost: The capital costs of landfill disposal and the associated treatment and transport are expected to be high. No O&M costs are associated with this option because O&M would be conducted by the owner/operator of the disposal facility.

Off-site disposal of sediment in licensed landfills is retained for further consideration.

3.3.6.3 Dredged Materials Processing

Processing of dredged materials would take place either at a designated shoreline location or on a barge or scow located near the removal location. All excavated/dredged materials would be placed directly on a barge or scow, or on a staging area at the site waterfront for processing. Processing can include

dewatering, mechanically separating solid debris from sediment, and/or treatment prior to shipping off site for disposal. Material dredged from beneath the piers will be managed with consideration of the possible presence of asbestos.

Dewatering Activities. Dewatering is the first step in processing dredged materials. This is generally required to reduce the moisture content of the sediment, enhance the handling characteristics, and prepare the sediment for further treatment, transportation, and disposal. Typically, dredged material is first screened to remove large objects and debris that may plug or foul the dewatering equipment.

Dewatering technologies appropriate for marine sediment include centrifuging, filtration, gravity filtering, and gravity thickening. The effectiveness of these technologies is influenced by the relative concentrations of clay, silt, and organic matter in the sediment.

Centrifuging techniques use the force developed by fast rotation of a cylindrical drum or bowl to separate solids and liquids based on differences in densities. They generally achieve a product composed of 10 to 35 percent solids. The effectiveness of using centrifuges is limited by sediments containing tars, small particle sizes, low density particles, large objects, or fibrous materials. Centrifuges are generally compact and, therefore, well-suited for use in areas with space limitations.

Filtration is a physical process whereby liquid is forced through a permeable medium and dewatered solids are retained. Filtration techniques are able to dewater fine-grained sediment over a wide range of solids concentrations. The effectiveness depends on the type of filter, particle size, and water content of the sediment. Three commonly used filtration systems include belt press filtration, vacuum filtration, and pressure filtration. The achievable solids content of dewatered sediment is expected to be in the range of 10 to 50 percent.

Gravity thickeners concentrate solids in a tank, similar to a conventional sedimentation tank or clarifier. They concentrate dredged sediment slurries of nearly any grain size down to approximately 2 to 15 percent solids. Heavier material dewaters quickly and more efficiently than fine-grained material. Thickened material is typically further dewatered by other methods.

Gravity filtration is the process by which Geotubes® are utilized during hydraulic dredging to filter the water within the sediment while the sediment condenses via gravity. Geotubes® consist of a long tube made of textiles that can come in a variety of forms depending on the application. The tube is enclosed all around except for a small opening that the dredged material is pumped in through. While the dredged material is being pumped into the Geotube® environmentally-safe polymers are added to the dredged material, which makes the solids bind together and water separate. Clear effluent water simply drains from the Geotube® container through the small pores in the specially engineered textile.

Gravity dewatering may also be conducted in piles, simply stacking material and allowing the weight of the sediment to force the water out of the pile. Typically the excavated or dredged material would be placed in a bermed area and allowed to drain by gravity. Accumulated water is typically collected in a sump within the bermed area, and then pumped away for treatment and/or disposal. The use of gravity dewatering techniques for dewatering marine sediment may have limited applicability if land disposal is planned, though it may be used as a preliminary dewatering technique in cases when the solids content is very low, as in the case of slurries generated from hydraulic dredging operations.

The selection of a dewatering process or combination of processes depends on the sediment volume and solids content (a function of the dredging technique), available treatment area, and degree of dewatering required. The system may be operated on the barge or scow, or at on-shore portions of the site in the vicinity of the removal activities. Final selection will take place during the RD.

Treatment/Disposal of Residual Water. The water generated from sediment dewatering processes may require treatment to remove dissolved and colloidal contaminants prior to discharge/disposal.

Treatment could take place on the dredging platform or at a NAVSTA-owned shoreline property, using a skid-mounted clarifier and membrane filter prior to discharge into Narragansett Bay. The clarifier would remove inorganic constituents by metals precipitation. Unsettled metals precipitant and other suspended particles would be removed by sedimentation and/or filtration. Organic constituents (PAHs and PCBs) are expected to be adsorbed onto the surface of the suspended particles, and thereby removed along with these particles. However, should a need arise to further reduce the concentrations of these organic constituents, additional process units may be added to the treatment train. These may include dissolved air flotation and/or granulated activated carbon process units. The treated effluent would be required to meet specific contaminant concentration limits prior to discharge into Narragansett Bay or POTW.

Selection of materials that would be used for precipitation (alum, etc.) and the volumes required would be determined based treatment requirements and on the performance of a pilot scale test. This is appropriate for design of any treatment plant. The volume of water to be treated would be determined based on the dredging equipment to be used and recovery rate of the dredged sediments. The water treatment plant would be designed to keep pace with the dredging schedule, once it is determined. Current estimates indicate that under optimal conditions, dredging could progress at a rate of 435 cubic yards per day.

Assuming dredge spoils are 80 percent water, the plant may need to treat and discharge up to 75,000 gallons per day. Backup storage would need to be available to store as much pretreatment water as could be produced during a full day of dredging at the optimal rate. This safeguard will assure that the treatment plant is not over-taxed at any time, and that dredging could be delayed if there is a delay in treatment

production. It is anticipated that the piers and North Waterfront areas of the former shipyard would be available for handling and treatment of water and sediment.

3.3.6.4 Transportation of Excavated/Dredged Materials

Marine sediment removed from the impacted areas would be transported for processing (removal of debris, dewatering, etc.) prior to disposal. The type of transport would depend on the method of excavation/dredging, treatment required, and where the material is being moved to for disposal. At the site, the proximity of the piers and bulkheads to the areas evaluated for remedial action is such that transportation should not be difficult, although there is a significant preference to avoid over the road transportation and promote rail transport where possible due to lower energy cost. Final transportation methods would be developed and selected after the dredging method and disposal locations are selected.

3.3.7 Treatment

Sediment treatment is included as a potentially required component of the removal/treatment/disposal GRA. Treatment would ensure that all contaminated solids are of acceptable quality for disposal at the selected off-base facility. Treatment may include stabilization or solidification to immobilize COCs within the material, or use of bulking agents to remove excess water for transportation and land disposal.

Landfill disposal is likely to require treatment prior to disposal, but primarily for removal of free water. Potential treatment technologies are discussed below.

3.3.7.1 On-Base Treatment

If landfill disposal is employed, on-site treatment may be required for sediment contaminated with elevated concentrations of metals. Potential on-base treatment technologies include chemical/physical (stabilization/solidification) options. Additional thermal, physical, chemical, and biological options were eliminated during preliminary screening (Table 3-1).

Chemical/Physical Treatment (Solidification/Stabilization). Solidification/stabilization is a technique that mixes reactive materials with contaminated solids, semi-solids, and sludge to immobilize the COCs by forming a chemically-stable matrix of limited permeability. Volume increases exceeding 20 percent can result. Solidification/stabilization agents may include cement, siliceous materials, lime, or proprietary agents. Bulking agents may also be used to reduce free liquids in dewatered sediment to make it suitable for transport and land disposal. Selection of the most appropriate agent, the waste-to-additive ratio, mixing variables, and curing conditions all depend on the chemical and physical characteristics of the waste and the requirements of the disposal facility. Solidification/stabilization techniques are most successful in treating wastes containing inorganics.

Assessment of this option is as follows:

- Effectiveness: Solidification/stabilization is a well accepted technique to treat inorganic COCs and reduce free liquids in sediment. Success in forming a chemically stable matrix depends on the selection of the stabilizing agents, the mix ratios of waste to agent, and proper mixing and curing. The effectiveness of solidification/stabilization in treating organics is inconclusive. Treatability studies would be required to confirm the effectiveness in treating the COCs, as well as to determine the optimum processing steps to reduce leaching of constituents from the solidified/stabilized medium. Addition of stabilizing agents can reduce the amount of free liquid present in sediment that is otherwise of acceptable quality for disposal without additional treatment.

- Implementability: The implementation of the solidification/stabilization process may prove difficult for sediment or sediment slurries with high water content. Initial dewatering of these materials would be necessary to minimize the amount of stabilizing agent required. This preparatory step would reduce the time required to stabilize the contaminants and minimize volume increases associated with bulking of the contaminated material. Treatability studies would be required to determine appropriate treatment processes. Although there is limited space available, it is assumed for the purpose of this FS that adequate space will be made available for these processes on-site.

- Cost: The capital costs are expected to be relatively low. Dredged and dewatered sediment requiring solidification/stabilization is expected to be treatable on-site for a minimal cost per cubic yard. The volume of contaminated sediment expected to require treatment is approximately 20 percent of the dredged materials, quantified in following sections. No O&M costs are associated with this option.

Solidification/stabilization is a viable treatment option for immobilizing inorganic contaminants and for removal of free liquid. It is retained for further consideration if the need to immobilize contaminants or remove free liquid before disposal arises.

3.3.8 Summary

The table below presents a summary of the technologies and process options that have been retained for inclusion in remedial alternative development.

General Response Action	Technology	Representative Process Option
No Action	None	Not Applicable.
Administrative Action	Use Restrictions	LUCs, to control access and activities (i.e. shellfishing, or dredging), and require remediation of sediment if construction on the piers occurs.
	Access Restrictions	Institutional Controls (ICs) to restrict traffic from deep draft vessels.
	Monitoring	Diver inspections, periodic sampling, and Multibeam Elevation Surveys.
Containment	Onsite Containment	Subaqueous Cover System using an engineered barrier to isolate COCs in target sediment area.
Enhanced Natural Recovery	Enhanced Natural Recovery	Thin layer cover
Removal	Dredging	Dredging with mechanical equipment.
		Dredging with hydraulic pumps.
Disposal	Landfilling Offsite	Off-site Disposal (Hazardous, Non-Hazardous, or Toxic Substance Control Act [TSCA] Regulated Waste Landfill).
Treatment	Ex-Situ, On-Site	Treat sediment for fluid reduction before off-site disposal. Treatment of dewatering liquid before discharge or disposal to surface waters or POTW.

3.4 SUMMARY OF SELECTION OF REPRESENTATIVE PROCESS OPTIONS

Development and screening of alternatives is conducted to assemble an appropriate range of remedial options to achieve the site RAOs. In this phase of the FS, remedial technologies retained for further consideration in Section 3.3 are combined to form remedial alternatives for the sediment, which has been identified as the medium of concern. The alternatives are then screened as necessary to eliminate alternatives that would not be protective or do not enhance the range of available alternatives. This screening narrows the field of potential alternatives to be selected for subsequent detailed evaluation.

The remedial alternatives are developed to comply with regulatory criteria applicable to the site conditions and media of concern, as directed by the following regulations and guidance:

- Navy/Marine Corps Installation Restoration Manual (February 1992), which dictates that remedial alternatives be consistent with the procedures outlined in the NCP (40 CFR 300.430).

- NCP (40 CFR 300): Regulations establishing criteria for implementing CERCLA response actions.
- Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (USEPA, 1988).

These documents require that a range of alternatives be developed to eliminate, reduce, or control human and ecological risks. The goal is to select remedies that protect human health and the environment, maintain protection over time, and minimize untreated waste. According to Section 121 of CERCLA, as amended by SARA, the statutory preference is for remedies that result in permanent and significant decrease in toxicity, mobility, or volume of contaminants and provide long-term protection. In addition, the NCP specifies that certain expectations be considered while developing and screening remedial alternatives. These expectations are as follows:

- Treatment will address the principal threats posed by the site, wherever practical. Principal threats are considered to be liquids, areas contaminated with high concentrations of toxic compounds, and highly mobile materials.

- Engineering controls, such as containment, will be used for waste that poses a relatively low, long-term threat and for which treatment is impractical.

- A combination of methods will be used, as appropriate, to achieve protection of the environment. In appropriate solutions, treatment of principal threats will be combined with engineering and institutional controls for dealing with residuals and relatively low, long-term threats.

- ICs, such as deed restrictions, will supplement engineering controls for short and long-term management to prevent or limit exposure to hazardous substances, pollutants, or contaminants.

- The use of innovative technologies will be considered when such use offers the potential for comparable or superior treatment performance or implementability, fewer or lesser adverse impacts, or lower costs for similar levels of performance compared to previously demonstrated technologies.

- Environmental media will be returned to their beneficial uses, when practical, within a reasonable time frame. When restoration of a medium is not practical, actions are expected to prevent further migration and exposure to contaminated media, and evaluate further risk reduction measures.

The remedial alternatives developed for the marine sediment at Site 19 are described in Section 4.2 and evaluated in detail in Section 4.3.

3.5 RATIONALE FOR DEVELOPMENT OF ALTERNATIVES

To select the remedial alternatives, the GRAs and process options chosen to be representative of the various technology types (see Section 3.3) were combined to form alternatives that represent a range of possible options to reduce human health and ecological risks posed by COCs in site sediment. The alternatives developed include a range of risk reduction measures and future land use restrictions. These alternatives also achieve compliance with ARARs and the site RAOs.

The remedial alternatives developed to address marine sediment contamination consist of combinations of no action, monitoring, institutional controls, access restrictions, containment (capping), removal, disposal, and treatment technologies. The purpose of each remedial alternative is to prevent or control receptor contact with the contaminated media in order to reduce exposure risks. A range of remedial alternatives from no action to complete removal and off-base disposal of impacted media were developed for detailed evaluation.

Five remedial alternatives have been developed to address COCs present in sediment at the site. The alternatives include:

- Alternative 1: No Action.

- Alternative 2: Thin layer cover of target areas selected to reduce SWACs to levels below PRGs for each COC. This alternative would include ICs (implemented as LUCs), long term monitoring (LTM) throughout the entire site, and 5 year reviews. Use of precautionary measures and safe work practices described in the LUC RD documentation would prevent potential for exposure to asbestos in sediment.

- Alternative 3: Containment in place (engineered barrier) over target areas selected to reduce SWACs to levels below PRGs for each COC. This alternative would include ICs (implemented as LUCs), LTM throughout the entire site, 5 year reviews, and cover maintenance. Use of precautionary measures and safe work practices described in the LUC RD documentation would prevent potential for exposure to asbestos in sediment.

- Alternative 4: Dredging and backfill, in target open water areas selected to reduce SWACs to levels below PRGs for each COC, and containment in place for other target areas under Pier 2. This alternative would include ICs (implemented as LUCs), LTM and 5 year reviews for all areas to ensure RAOs continue to be met. Use of precautionary measures and safe work practices described in the LUC RD documentation would prevent potential for exposure to asbestos in sediment.

- Alternative 5: Dredging in target open water areas selected to reduce SWACs to levels below PRGs for each COC, and containment in place for other target areas beneath Pier 2. This alternative would include ICs, LTM and 5 year reviews for containment areas located beneath Pier 2 only. Use of precautionary measures and safe work practices described in the LUC RD documentation would prevent potential for exposure to asbestos in sediment.

Note that any alternative that requires removal and disposal may require treatment prior to disposal as described in Section 3.3.7. The alternatives listed above are described in detail in Section 4 of this FS.

3.6 NATIONAL CONTINGENCY PLAN EVALUATION CRITERIA AND RELATIVE IMPORTANCE OF CRITERIA

The evaluation criteria, as required by the NCP, and the relative importance of these criteria in the CERCLA process, are described in the following sections and are applicable to all monitoring stations at Site 19.

3.6.1 Evaluation Criteria

In accordance with the NCP (40 CFR 300.430), the following nine criteria are used for the evaluation of remedial alternatives:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs
- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume through Treatment
- Short-Term Effectiveness
- Implementability
- Cost
- State Acceptance
- Community Acceptance

Overall Protection of Human Health and the Environment

Remedial alternatives must be assessed for adequate protection of human health and the environment in both the short and long term. The remedial alternatives must be able to diminish the unacceptable risks posed by hazardous substances or contaminants present at the Site by eliminating, reducing, or controlling exposure to levels exceeding remediation goals.

Compliance with ARARs and TBCs

Remedial alternatives must be assessed to determine whether they attain ARARs and TBCs under federal environmental laws and state environmental or facility citing laws. If one or more regulations that are applicable cannot be complied with, a waiver must be invoked.

Long-Term Effectiveness and Permanence

Remedial alternatives must be assessed for the long-term effectiveness and permanence they offer, along with the degree of certainty that the alternative would prove successful. Factors that are considered, as appropriate, include the following:

- Magnitude of Residual Risk – Risk posed by untreated waste or treatment residuals at the conclusion of remedial activities. The characteristics of residuals are considered to the degree that they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bioaccumulate.

- Adequacy and Reliability of Controls – Controls, such as containment systems and LUCs, that are necessary to manage treatment residuals and untreated waste must be shown to be reliable. In particular, this evaluation considers the uncertainties associated with land disposal for providing long-term protection from residual contamination, assessment of the potential need to replace technical components of the alternative (such as a surface cover, sign, or treatment system), and the potential exposure pathways and risks posed, if technical components or the entire remedial action needs to be replaced.

Reduction of Toxicity, Mobility, or Volume through Treatment

The degree to which the remedial alternative employs recycling or treatment that reduces the toxicity, mobility, or volume is assessed. This assessment includes how treatment is used to address threats posed by the Site. Factors to be considered, as appropriate, include the following:

- Treatment or recycling processes that the remedial alternative employs and the materials that they will treat.

- Amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled.

- Degree of expected reduction in toxicity, mobility, or volume of waste caused by treatment or recycling, and the specification of which reduction(s) is occurring.

- Degree to which the treatment is irreversible.

- Type and quantity of residual contamination that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bioaccumulate of such hazardous substances and their constituents.

- Degree to which treatment reduces the inherent hazards posed by principal threats at the Site.

Short-Term Effectiveness

The short-term impacts of the remedial alternative are assessed considering the following:

- Short-term risks that might be posed to the community during implementation.
- Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures taken to minimize these impacts.
- Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigating measures during implementation.
- Time until protection is achieved.

Implementability

The ease or difficulty of implementing the alternative is assessed, considering the following types of factors, as appropriate:

- Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, reliability of the technology, ease of undertaking additional remedial actions, and ability to monitor the effectiveness of the remedy.

- Administrative feasibility, including activities needed to coordinate with other offices and agencies and the time required to obtain approvals from other agencies.

- Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; availability of necessary equipment, specialists, and additional resources; availability of services and materials; and availability of prospective technologies.

- Sustainability of an alternative is discussed and includes consideration of the relative size of the associated carbon footprint, material usage, and environmental benefit.

Cost

Costs for remedial alternatives include both capital costs and annual O&M costs. Capital costs include both direct and indirect costs expected at the time of alternative implementation. Annual O&M costs

include periodic costs that occur following alternative implementation. Typical O&M costs include periodic Long Term Monitoring (LTM) and inspections. A present worth of the capital and O&M costs is also provided. The present worth of a remedial alternative is the total of all capital and O&M costs expressed in today's dollars. Typically, the cost estimate accuracy range during the FS stage is +50 percent to -30 percent of the actual remedial action cost.

State Acceptance

This criterion reflects the statutory requirements to provide for substantial and meaningful regulatory involvement. Formal assessment of regulatory acceptance is completed during the ROD phase, occurring after the public comment period on the proposed remedial action plan (PRAP). In addition, regulatory concerns are continually considered through resolution of regulatory comments received on the FS Report and PRAP.

Community Acceptance

This criterion refers to comments from community members on the remedial alternatives under consideration, where "community" is broadly defined to include all interested parties. These comments are considered throughout the CERCLA process. The community acceptance criterion is evaluated as part of the responsiveness summary presented in the ROD after the public comment period on the PRAP is held.

3.6.2 Relative Importance of Criteria

Among the nine criteria, the threshold criteria are considered to be:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs and TBCs

The threshold criteria must be satisfied for an alternative to be eligible for selection.

Among the remaining criteria, the following five criteria are considered to be the primary balancing criteria:

- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume through Treatment
- Short-Term Effectiveness
- Implementability
- Cost

The balancing criteria are used to weigh the relative merits of alternatives.

The remaining two criteria, State Acceptance and Community Acceptance, are considered to be modifying criteria that must be considered during remedy selection. These last two criteria are evaluated after the end of the public comment period on the PRAP. Therefore, Section 4 of this FS evaluates seven of the nine criteria for marine sediment.

4.0 DESCRIPTION AND DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES FOR MARINE SEDIMENT

The purpose of this section is to describe the remedial alternatives developed in Section 3.0 for the remediation of the Site 19 marine sediment, evaluate the alternatives individually against the NCP evaluation criteria, and then compare each of the alternatives to one another with respect to the NCP evaluation criteria. The remedial alternatives retained for this detailed analysis include:

Alternative 1 - No Action:

- No remedial action would be conducted.

Alternative 2 - ENR through Thin Layer Cover, LUCs, and Monitoring:

- Placement of 6 to 12 inches of natural materials over target areas to blend with existing sediment and enhance the natural depositional process.
- Conduct post backfill sampling to ensure SWAC is below PRGs for each COC.
- Institute and enforce LUCs to limit activity of deep draft vessels and access by recreational and commercial fishing vessels.
- Institute a LTM program that includes requirements to collect and analyze sediment samples to verify that the RAOs continue to be met over time, and conduct bathymetric surveys of the covered areas to ensure that the thin layer cover is not compromised over time due to storm events or port activities;
- Conduct 5-year reviews as required by the NCP.

Alternative 3 - In-Situ Cap (Engineered Barrier), LUCs and Monitoring:

- Placement of a 1 to 2 foot-thick engineered cap over target areas.
- Conduct post backfill sampling to ensure SWAC is below PRGs for each COC.
- Institute and enforce LUCs to limit activity of deep draft vessels and access by recreational and commercial fishing vessels.
- Institute a LTM program to collect and analyze sediment samples to confirm that the RAOs continue to be met over time, and conduct bathymetric surveys of the capped areas to ensure that the cap is not compromised over time due to storm events, construction/demolition, or port activities.
- Perform maintenance on cap as required.
- Conduct 5-year reviews as required by the NCP.

Alternative 4 - Combination Dredge / Backfill (open water); Cover (under Pier 2); LUCs and Monitoring:

- Dredge target open water areas to a depth of 1 foot, and backfill with clean substrate.
- Conduct post backfill sampling to ensure SWAC is below PRGs for each COC.
- Placement of a 1 to 2 foot-thick engineered cap on target areas that are located beneath Pier 2.

- Institute and enforce LUCs to limit access to capped areas beneath Pier 2, and to require remedial action on these areas (identified as G25 and G29) upon reconstruction or demolition of Pier 2 if this work is intrusive or could undermine the cap's integrity.
- Institute a LTM program to collect and analyze sediment samples at capped areas beneath Pier 2 to verify that the RAOs continue to be met over time, and conduct bathymetric surveys of the capped areas to confirm that the cap is not compromised over time due to storm surges, construction/demolition, or port activities.
- Implement LUCs and a LTM program to ensure that the backfilled area does not exceed PRGs over time on an area-average basis.
- Conduct 5-year reviews as required by the NCP.

Alternative 5 – Target Dredging (open water); Cover, LUCs and Monitoring (beneath Pier 2):

- Dredge target open water areas to depths of 1 or 2 feet.
- Conduct confirmation sampling within and surrounding dredged areas to ensure SWAC is below PRGs for each COC.
- Placement of a 1 to 2 foot-thick engineered cap on target areas that are located beneath Pier 2.
- Institute and enforce LUCs to limit access to capped areas beneath Pier 2, and to require remedial action on these areas identified as G25 and G29 upon reconstruction or demolition of Pier 2 if this work is intrusive or could undermine the cap's integrity.
- Institute a LTM program to collect and analyze sediment samples at capped areas beneath Pier 2 to verify that the RAOs continue to be met over time, and conduct bathymetric surveys of the capped areas to confirm that the cap is not compromised over time due to storm surges, construction/demolition activities, or port activities.
- Conduct 5-year reviews as required by the NCP for the capped area beneath Pier 2.
- No LUCs, LTM, or 5-year reviews would be required in open water areas.

The LUCs that would be implemented under the alternatives above except No Action would describe precautionary measures and safe work practices that would be implemented for sediment in open water areas and under pier areas.

4.1 DESCRIPTION OF REMEDIAL ALTERNATIVES

The alternatives described in this section were developed to address sediments at Site 19 identified by the risk assessments as presenting elevated risks to human health and ecological receptors due to concentrations of HMW PAHs (including benzo(a)pyrene), PCBs, and lead. The presence of these COCs is presumed to be associated with industrial activities at the shipyard as described in Section 1. The risk assessment results and inputs were used to determine PRGs, which are concentrations of COCs above which these ecological and human receptors are likely to be adversely affected.

In general, sediments were found at levels exceeding PRGs in four main areas: the east end of Pier 1, the east end of Pier 2, the west end of Pier 2, and south of the T-Wharf. Sediment at concentrations above PRGs was reported in these areas at depths ranging from 0 to 4 feet below the sediment surface. Remedial alternatives presented in this FS are designed to address sediment by meeting RAOs established in Section 2. This was accomplished with each alternative by developing alternatives that reduce the exposure concentrations of each COC on an area average basis. Exposure concentrations are measured as Surface area-Weighted Average Concentrations (SWACs), as described in Section 2.

As described in Section 2, the development process for these alternatives (with the exception of Alternative 1) was based on meeting RAOs by addressing target areas that were identified as being the greatest contributors to elevated SWACs. It is projected that by addressing these areas in the manner described in the following alternatives, risk will be reduced to acceptable levels through a reduction of exposure, and/or a reduction of contaminant volume.

4.1.1 Alternative 1: No Action

Evaluation of the no-action alternative is required under the NCP because it provides a baseline against which other alternatives may be compared. No remedial actions would be performed, no ICs or LUCs would be implemented to restrict access or use of the affected areas, and no direct actions to protect human or ecological receptors would be provided. No maintenance, monitoring, or inspections of the site would be conducted under the No Action Alternative.

The table below presents the baseline SWAC (SWAC in the current state, given no remedial actions) for COCs that would be present at the site following the execution of this remedial action. These values can be used for comparison to the outcomes of the other alternatives presented in this section. A table presenting the complete SWAC calculation for this alternative is presented in Appendix D8.

Scenario	Benzo(a)pyrene (µg/kg)	Total HMW PAHs (µg/kg)	Total PCBs (µg/kg)	Lead (mg/kg)
PRGs=	*539*	*13,903*	*1,060*	*168*
Alt. 1 – SWAC	1,415	32,465	6,286	522

4.1.2 Alternative 2: Enhanced Natural Recovery through Thin Layer Cover, LUCs, and Monitoring

Alternative SD 2 was developed to provide a minimally intrusive/intensive remedial action for marine sediment at the site. It is deemed to be worth consideration due to the concentrations of COCs present in

the sediment at the site and the widespread and discontinuous nature of the PRG exceedances. However, there are uncertainties associated with the success of this alternative to meet RAOs. These focus on the future use of the site and the stability of sediment within the cove both presently, and after possible demolition or reconfiguration of pier structures.

Regarding future use of the site, a protective cover placed and maintained over sediment presents potential future limitations on the use and deepening of the port. Additionally, removal or modification of the pier structures can impact covered sediment through mechanical efforts during construction and demolition, and by changing current and wave patterns within Coddington Cove. This is not to say that the port cannot be deepened or the piers cannot have work performed on them, it is simply a consideration that needs to be given to future maintenance dredging or construction operations: If deepening were later required that effort would need to account for the contamination, and be addressed with a formal change to the ROD for this site.

As part of any cover alternative, a land use control would be established for the cover areas to identify those areas in case any intrusive work was identified, and that LUC would also identify the appropriate handling and disposal requirements that would be required. Because waste is left in place, monitoring would be required and the remedy would be reviewed on the five year cycle to assure that the remedy remains protective.

Another uncertainty is the stability of sediment and continuing energy from water currents in the cove that could impact a cover system. Regarding stability of sediment, the physical characteristics of the study area were evaluated as a part of the Supplemental Sediment Investigation (SSI - *Tetra Tech 2012*) by measuring current and wave energies (Appendix D-2 of this report), conducting grain size analysis, radioisotope analysis (Appendix D-3), and cohesion/sediment stability testing (Appendix D-1). While the report concluded that Coddington Cove is an area of sediment accumulation, it was recognized that the current flows were measured during a calm period of weather, and further current profiling may be appropriate to support determination of cover material and to assure that ENR is adequately protective during more extreme weather conditions. In addition, while core analysis shows sediment accumulation rates between 0.02 and 2.23 cm/year, this is a rate based on past deposition, and it is possible that the suspended sediment load in the water column is currently lower than it has been during past periods when there was more active agriculture in the upper reaches of the estuary, and fewer regulatory restrictions on shorelines and wetland resource areas.

During review for the SSI, EPA cited concerns regarding the data developed, and these are summarized below:

- EPA disagreed that the area is depositional based on their interpretation of data presented. Comments stated that features shown on bathymetric maps provide empirical evidence that the site is not a place of active burial.

- EPA stated that lead-210 analyses did not indicate deposition: 60% of the samples did not provide definitive data and surface concentrations actually increased in some cases.

- EPA noted that the study did not account for ship traffic or prop scour during movement of large ships, and in the case of any future pier removal or restoration. Comments cited unsteady conditions inherent in port activities that can disrupt the artificial depositional areas identified.

- EPA noted large areas of contaminated surface sediment were found near the center and western end of Pier 2 without any deep contamination and concluded that this indicates that burial is not a significant process farther from shore.

- EPA stated that the sediment stability modeling did not account for the uncertainty associated with the determination of the critical shear stress for erosion or the uncertainty in the measurements of the currents using an ADCP.

- EPA observed that sediment bed stability tests were very limited and performed during a quiescent period. Impacts from storms were not evaluated and should be accounted for.

The Navy recognized some of these uncertainties, and in lieu of conducting exhaustive tests of the energy and sediment dynamics within the cove area at that time, the project team agreed that an ENR alternative could remain in the FS as a “less protective” alternative, with the understanding that further long term data showing trends of decreasing concentrations in sediment and biota would be needed to support its selection.

Alternative 2 would meet RAOs using a 6 inch minimum, thin layer sand cover, placed on target areas identified by SWAC calculations. Target areas under Alternative 2 include stations G25, G29, J24, J30, K05, K13, L24, L28, W24, Y30, AE24, BC28, BC30, BD26, BE28, BE30, and BG28 (Figure 4-1). The purpose of the thin layer cover would be to enhance the natural depositional recovery process that would, over time, contain the target area sediment beneath a layer of clean substrate. The six inches of cover should serve to immediately reduce risk in the bioturbation zone for receptors. Although a minimum 6 inch cover would be required, the design would specify a 12 inch cover to ensure that the 6 inch minimum cover requirement is achieved. Additional protection would be provided by establishing and enforcing LUCs to minimize the potential for damage to the cover and monitoring to confirm protectiveness as well

as required natural deposition. Figure 4-1 illustrates the target areas of Alternative 2 where the thin layer cover would be placed. Lastly, bathymetric surveys would be conducted every 5 years to ensure that damage to the thin layer cover has not occurred, and to document the amount of natural deposition that has occurred.

This alternative would include five primary elements:

- Establishing LUCs (entire study area).
- Constructing a thin layer cover over target areas.
- Implementing a monitoring program that includes bathymetry mapping (anticipated every 5 years) and COC sampling to verify that RAOs are being met.
- Conducting 5-year reviews.

Implementation of these actions would achieve RAOs in that (a) risk to human health would be eliminated through enactment of ICs established as LUCs, and (b) risk to ecological receptors would be reduced to acceptable levels by reducing site SWACs to levels below PRGs after placement of the thin layer cover, and additional protection through establishing ICs (described below).

The table below presents projected SWACs for each COC after implementation of Alternative 2 and natural deposition of an additional 6 inches of newly deposited sediment over the thin layer cover (for a total of 12 inches minimum cover). Tables presenting the complete SWAC calculations for this alternative are presented in Appendix D-8. Following the methods described Section 2.4, the baseline SWAC calculation reflects post remedy conditions under Alternative 2 by changing the surface concentrations in the covered cells to zero.

Scenario	Benzo(a)pyrene (µg/kg)	Total HMW PAHs (µg/kg)	Total PCBs (µg/kg)	Lead (mg/kg)
PRGs	*539*	*13,903*	*1,060*	*168*
Alt. 2 – SWAC*	461	4,024	675	153

* These SWAC concentrations represent predicted conditions after thin layer cover placement and any additional depositional cover required to reach the goal of a 1 foot-thick cover, which would provide adequate protection for receptors assuming that scouring and resuspension due to currents and wave action at the Site do not occur.

Institutional Controls

ICs would be established in the form of Navy LUCs through the development of a LUC RD document. LUCs would be implemented to prevent disturbance of the thin layer cap and, at least temporarily, to restrict traffic within Coddington Cove. This could include limiting operational actions by large, deep draft vessels under their own power that could disturb sediment and scour off the thin layer cover substrate from the areas where it is placed. Such a restriction would not necessarily eliminate accessibility by such

vessels, though it would require berthing with shallow draft tug support. In addition, it would include restricting recreational and commercial fishing vessels, so as to assure that their activities (use of trawls, drag nets used to collect ground fish, fishing dredges and rakes used to collect shellfish, and traps and cages placed on sediment surface) also do not compromise the protectiveness of the thin layer cover material.

To address the potential for a future risk from exposure to asbestos in the marine sediments during the implementation of the proposed remedy and future dredging of Site 19, the Navy will prevent exposure to potential asbestos in dredged shipyard sediment through development of documented precautionary measures and safe work practices. These safe work practices will be described in the LUC documentation established for the COCs that remain at the site under this alternative.

NAVSTA Newport currently maintains and executes the authority to restrict access to portions of Coddington Cove under the current safety zone established under 33 CFR 334.81; however, members of certain fishing/lobstering associations, including Rhode Island Lobsterman's Association and the Ocean State Fisherman's Association, are granted access to the area for commercial fishing, under the conditions identified in a Memorandum of Understanding (MOU) between the Commanding Officer of NAVSTA Newport, pertinent federal and state agencies, and the lobsterman's and fisherman's associations (NAVSTA Newport, 2002). In order to effectively restrict all fishing activities in the affected areas, the MOU would have to be revised or rescinded. Enforcement of the restrictions would be conducted by NAVSTA Newport Port Operations and NAVSTA Newport police.

In addition, if the Navy property is ever transferred out of federal control and restrictions for Coddington Cove are deemed necessary to the continued viability of the remedy at that time, the Navy will as part of the transfer process coordinate with federal and state authorities to determine what use restrictions can be imposed on the cove, which is state-owned, to prevent disturbance to areas with contaminated sediments managed under cover. If piers are included as part of the property to be transferred, Navy will include in the deed or transfer documentation a restriction requiring that if future owners intend to make alterations to the pier (s) such as demolition, restoration or any other work that could undermine the integrity of the sediment remedy, the new owner must first obtain USEPA Region 1 concurrence, in consultation with RIDEM, and must conduct such work in a manner that does not compromise the remedy. Although the Navy may transfer the procedural LUC responsibilities to another party by contract, property transfer agreement, or through other means, the Navy will retain ultimate responsibility for remedy integrity. LUCs will be maintained until the concentrations of hazardous substances in the sediment are at such levels to allow for unlimited use and unrestricted exposure.

Thin Layer Cover

For implementation of this alternative a thin, 6 inch layer of native sand or gravel material would be placed over top of target areas, to ultimately (after additional natural deposition) reduce SWACs to concentrations below PRGs. It is anticipated that this cover material would be brought by barge to the target areas, and pumped through tremie pipes as a slurry mixture. Use of silt curtains would likely be required for control of turbidity. For costing purposes this area has been estimated as a total of approximately 340,012 square feet and would require approximately 15,141 cubic yards of natural material (this quantity is calculated for a 12 inch-thick cover to assure a minimum of 6 inches). The areas to receive thin layer cover under this alternative are presented in Figure 4-1.

Placement of a thin layer cover in any of these areas is not expected to convert sub-tidal areas into inter-tidal areas. During placement of the cover material, silt curtains or other appropriate resuspension/particulate control systems will be utilized. These measures will help minimize potential adverse environmental effects that may occur due to resuspension of fine grained sediments during covering activities. Bathymetric surveys will also be conducted at all areas receiving cover material before and after placement to confirm proper placement of the cover materials, and to document final placement grades.

Placing a thin layer cover in any of these areas will require ICs as described above to minimize the potential that the cover will be disturbed due to fishing activities or vessel traffic. While the ICs would be implemented for the entire study area, the only area where these activities are currently a concern are the areas at Pier 2 because of its use as berths for USCG, NOAA, and visiting Navy vessels. Pier 1 berths the inactive aircraft carrier ex-Saratoga, and the area south of the T-Wharf is unlikely to receive ship traffic. No future use is identified for Pier 1 or the bulkheads to the south.

The most appropriate cap material would be selected during the final design of the remedial alternative and would take into account flow characteristics in the cover areas as well as sediment physical characteristics and bathymetry. The final thickness of the cover would be between 6 and 12 inches (the goal being a minimum of 6 inches, but design for placement of 12 inches to allow for inconsistency during application in deep water). The cover would extend slightly beyond the target areas due to sloping at the edges. Placement of the thin layer cover would support the natural depositional recovery process by providing a minimum quantity of material over which further depositional sediment can gather and over time that would ultimately lead to complete isolation of contaminated sediment below a thicker layer of cap material and naturally deposited sediment.

Long-Term Monitoring and 5-Year Reviews

Since COCs exceeding PRGs would remain on-site underlying the covered area, and because of the need to monitor the natural recovery processes, LTM and 5-year reviews would be required to ensure long term protectiveness of the alternative. As part of LTM, annual sampling of sediment from the covered areas throughout the entire site would be conducted to ensure the continued effectiveness of the cover. For costing purposes, it is estimated that samples would be collected from locations where the thin layer cover was placed. Analysis would include sediment COCs (PCBs, HMW PAHs including benzo(a)pyrene, and lead). The specific sediment sample locations would be determined during the RD phase.

Given the nature of the sediment contamination and slow changes in sediment deposition anticipated, a single sampling event per year is anticipated to be sufficient to monitor long-term sediment quality trends for the duration of the monitoring effort. The results of the monitoring would be compiled and an evaluation of the contamination and its associated risks would be conducted as a part of the 5-year reviews, which are required by CERCLA for sites where COCs exceeding PRGs are allowed to remain. The monitoring data would be used to identify any changes in the COC concentrations and determine the need to increase or decrease the frequency of monitoring events, or implement more aggressive response actions at the site.

As part of the ongoing maintenance activities, a bathymetric survey would be conducted every 5 years to ensure that no substantial damage has occurred to the cover. If annual sampling or natural occurrences, such as significant storm events, indicate or suggest that change has occurred, additional bathymetric monitoring may be required so repairs could be made as necessary. In addition to identifying damage, these bathymetric surveys would serve to document deposition rates throughout the covered areas. At least annual inspections would ensure that the LUCs to maintain cap integrity continue to be implemented and enforced. The 5-year reviews would summarize the results of the monitoring activities. For cost estimating purposes of this FS, it is assumed that LTM, maintenance, and 5-year reviews would be performed over a period of 30 years.

4.1.3 Alternative 3: In-Situ Cap (Engineered Barrier), LUCs, and Monitoring

The in-situ cap alternative would include placement of a 1 foot minimum thick engineered cap over target areas, in addition to implementation of ICs, established as LUCs. The purpose of the cap would be to prevent receptor exposure to target areas and isolate target area sediment beneath a permanent layer of clean substrate. The engineered cap is planned for stations G25, G29, J24, J30, K05, K13, L24, L28, W24, Y30, AE24, BC28, BC30, BD26, BE28, BE30, and BG28 (Figure 4-2). Implementation of Alternative 3 would include the following primary elements:

- Establishing LUCs (entire study area).
- Constructing an in-situ cap over target areas.
- Implementing a LTM program that includes bathymetry mapping, and COC sampling to verify that RAOs are being met.
- Cap maintenance and repair as necessary.
- Conducting 5-year reviews.

Implementation of these actions would achieve RAOs through isolation of COCs using an in-situ cap, and protection of the cap through establishing and enforcing ICs. The resulting SWACs of COCs would be below PRGs by using suitable and clean material as cap material.

The table below presents projected SWACs for each COC after implementation of Alternative 3. A table presenting the complete SWAC calculations for this alternative is presented in Appendix D8. Following the methods described Section 2.4, the baseline SWAC calculation reflects post remedy conditions under Alternative 3 by changing the surface concentrations in the capped cells to zero.

Scenario	Benzo(a)pyrene (µg/kg)	Total HMW PAHs (µg/kg)	Total PCBs (µg/kg)	Lead (mg/kg)
PRG	*539*	*13,903*	*1,060*	*168*
Alt. 3 – SWAC*	461	4,024	675	153

* These SWAC concentrations assume that scouring and resuspension will not occur due to currents and wave action at the Site.

Institutional Controls

ICs would be established in the form of Navy LUCs through the development of a LUC RD document. LUCs would be implemented to prevent disturbance of the cap and, to restrict specific activities within Coddington Cove. This could include limiting operational actions by large, deep draft vessels, and preventing them from operating under their own power which could disturb sediment or the cap. Such a restriction would not necessarily eliminate accessibility by such vessels, though it would require berthing operations be conducted with shallow draft tug support. In addition, it would include restricting recreational and commercial fishing vessels, so as to assure that their activities (use of trawls and drag nets used to collect ground fish, fishing dredges and rakes used to collect shellfish, and traps) also do not compromise the protectiveness of the cap.

To address the potential for a future risk from exposure to asbestos in the marine sediments during the implementation of the proposed remedy and future dredging of Site 19, the Navy will prevent exposure to potential asbestos in dredged shipyard sediment through development of documented precautionary measures and safe work practices. These safe work practices will be described in the LUC documentation established for the COCs that remain at the site under this alternative.

NAVSTA Newport currently maintains and executes the authority to restrict access to portions of Coddington Cove under the current safety zone established under 33 CFR 334.81; however, members of certain fishing/lobstering associations, including Rhode Island Lobsterman's Association and the Ocean State Fisherman's Association, are granted access to the area for commercial fishing, under the conditions identified in a Memorandum of Understanding (MOU) between the Commanding Officer of NAVSTA Newport, pertinent federal and state agencies, and the lobsterman's and fisherman's associations (NAVSTA Newport, 2002). In order to effectively restrict all fishing activities in the affected areas, the MOU would have to be revised or rescinded. Enforcement of the restrictions would be conducted by NAVSTA Newport Port Operations and NAVSTA Newport police.

In addition, if the Navy property is ever transferred out of federal control and restrictions for Coddington Cove are deemed necessary to the continued viability of the remedy at that time, the Navy will as part of the transfer process coordinate with federal and state authorities to determine what use restrictions can be imposed on the cove, which is state-owned, to prevent disturbance to areas with contaminated sediments managed under cover. If piers are included as part of the property to be transferred, Navy will include in the deed or transfer documentation a restriction requiring that if future owners intend to make alterations to the pier (s) such as demolition, restoration or any other work that could undermine the integrity of the sediment remedy, the new owner must first obtain USEPA Region 1 concurrence, in consultation with RIDEM, and must conduct such work in a manner that does not compromise the remedy. Although the Navy may transfer the procedural LUC responsibilities to another party by contract, property transfer agreement, or through other means, the Navy will retain ultimate responsibility for remedy integrity. LUCs will be maintained until the concentrations of hazardous substances in the sediment are at such levels to allow for unlimited use and unrestricted exposure.

Engineered Cap

For implementation of this alternative a 1 foot minimum engineered layer of natural or synthetic material would be placed over top of target areas. This cover will serve to isolate the COCs in the target areas and will also reduce SWACs to levels below PRGs. Design would require a 2 foot cap thickness to ensure that the minimum 1 foot thickness is achieved. It is anticipated that this cover material would be brought by barge to the target areas, and either pumped through tremie pipes as a slurry mixture, or placed mechanically, depending on the size of the material used and the nature of the area capped. For areas under the piers, a slurry of sand and water will be pumped through a tremmie pipe to the broadcast area, and the sand will be allowed to settle to the bottom. There is a higher level of uncertainty in distribution of the cover material in these areas due to limited accessibility posed by the piling structure of the pier, and additional design elements will need to be utilized to compensate, Ultimately leading to the potential for a thicker cover in this area.

For costing purposes it is estimated that the cap area would be approximately 340,012 square feet and would require approximately 31,526 cubic yards of natural material (this quantity is calculated for a 2 foot thick cap). The target areas that would be capped under this alternative are presented in Figure 4-2.

Placement of an in-situ cap in any of these areas is not expected to convert sub-tidal areas into inter-tidal areas since the water depths are greater than 30 feet in open water areas, and greater than 15 feet in under-pier areas. During placement of the cap material, silt curtains, or other appropriate resuspension/particulate control systems, will be utilized. These measures will help minimize potential adverse environmental effects that may occur due to resuspension of fine grained sediments during capping activities. Bathymetric surveys will also be completed at all areas receiving a cap before and after placement. These surveys will be used to confirm proper placement of the cap, and to document the final grade.

Placing an engineered cap in any of these areas will require LUCs as described above to reduce the chances that the cap will be disturbed or compromised, and because the depth of the water column after capping would be slightly less than what it is currently.

The most appropriate cap material would be selected during the RD phase and would take into account flow characteristics in the cover areas, sediment physical characteristics and bathymetry, and the requirement to design the cap to withstand a 100 year storm event. The final thickness of the cap would range from 1 to 2 feet (the goal being 1 foot, but design for placement of 2 feet to allow for inconsistency in the application in deep water). The cap would extend slightly beyond the areas or cells depicted on Figure 4-2 due to sloping at the edges. Placement of the cap would act to contain contaminated sediment, and prevent exposure to human and ecological receptors.

Long-Term Monitoring and 5-Year Reviews

Since the remedy is reliant on a cap installed to cover sediment in place, LTM and 5-year reviews would be required to ensure long term protectiveness of the alternative. As part of LTM, annual sampling of sediment from the capped areas throughout the entire site would be conducted to ensure the continued effectiveness of the cap. For costing purposes in this FS, it is estimated that samples would be collected from locations in the vicinity of the capped areas. Analysis would include sediment COCs (PCBs, HMW PAHs including benzo(a)pyrene, and lead). The specific sediment sample locations would be determined during the RD phase.

Given the nature of the sediment contamination and slow changes in sediment quality anticipated, a single sampling event per year is anticipated to be sufficient to monitor long-term sediment quality trends for the duration of the monitoring effort. The results of the monitoring would be compiled and an evaluation of the

contamination and its associated risks would be conducted as a part of the 5-year reviews, which are required by CERCLA for sites where COCs exceeding PRGs are allowed to remain. The monitoring data would be used to identify any changes in the contaminant concentrations and determine the need to increase or decrease the frequency of monitoring events, or implement more aggressive response actions at the site.

As part of the ongoing maintenance activities, a bathymetric survey would be conducted every 5 years to ensure that no damage has occurred to the cover, and repairs would be made as necessary. If annual sampling or natural occurrences, such as significant storm events, indicate or suggest that change has occurred, additional bathymetric monitoring may be required. At least annual inspections would ensure t that the LUCs to maintain cap integrity continue to be implemented and enforced. The 5-year reviews would summarize the results of the monitoring activities. For cost estimating purposes of this FS, it is assumed that LTM, maintenance, and 5-year reviews would be performed over a period of 30 years.

4.1.4 Alternative 4: Combination Dredge / Backfill (open water), Cover (under Pier 2) and LUCs and Long-Term Monitoring

This alternative would include dredging of target open water cells to a depth of 1 foot and backfilling those dredged areas with clean fill; this approach reduces exposure while also maintaining the current operational depth of the cove and not limiting shipyard activities. Dredge and backfill is identified for stations J24, J30, K05, K13, L24, L28, W24, Y30, AE24, BC28, BC30, BE28, and BE30, (Figure 4-3) Additionally, two target areas beneath Pier 2 (G25 and G29) would be addressed through placement of a 1 foot engineered cap. Sediment in target areas located in open water would be removed by an appropriate dredging technique, selected by its effectiveness, and also by its ability to limit resuspension of solids in the water column during operation; these areas would then be backfilled using clean material. Dredged sediments would be transported off base for disposal at an approved on-shore landfill. The disposal location would be selected based on the chemical characteristics of the sediment dredged. A summary of Alternative 4 actions and target areas are illustrated on Figure 4-3. The primary elements of Alternative 4 include:

- Establishing ICs (LUCs) using a LUC RD for both capped areas beneath Pier 2 and open water areas.
- Dredge and backfill target areas located in open water, and off-site land disposal of the dredged material.
- Construction of an engineered cap over target areas beneath Pier 2.
- LTM in both capped areas (beneath Pier 2) and backfilled areas (open water areas) that includes bathymetry mapping, and COC sampling to document that RAOs are being met.
- Conducting 5-year reviews for capped areas beneath Pier 2.

Implementation of these actions would achieve RAOs through removal and isolation of the most heavily contaminated sediment. Using this combination of techniques, the resulting SWAC is projected to reach levels below PRGs, reducing risk as described in the RAOs. The table below presents projected SWACs for site sediment after implementation of the actions described in Alternative 4. Following the methods described Section 2.4, the baseline SWAC calculation reflects post remedy conditions under Alternative 4 by changing the surface concentrations in the dredged and backfilled cells to zero.

Scenario	Benzo(a)pyrene (µg/kg)	Total HMW PAHs (µg/kg)	Total PCBs (µg/kg)	Lead (mg/kg)
PRG	*539*	*13,903*	*1,060*	*168*
Alt. 4 – SWAC	527	5,171	675	153

Institutional Controls

ICs would be established in the form of Navy LUCs through the development of a LUC RD document. ICs would be designed to prevent disturbance of the cap beneath Pier 2 if alterations are made to the pier. Any future proposed work to demolish or restore the pier that is determined to be intrusive, or could undermine the cap's integrity, would require the Navy to obtain concurrence before taking these actions since they could compromise the cap (i.e. The Navy would need to obtain USEPA Region I concurrence, in consultation with the State of Rhode Island, prior to modifying or terminating the LUCs or implementation actions. The Navy or other entity shall seek prior concurrence from USEPA Region I, in consultation with the State, before taking any anticipated action that may disrupt the effectiveness of the LUCs or before taking any action that may alter or negate the need for LUCs.)

LUCs would be implemented to ensure the areas that would be dredged and backfilled are not altered significantly, disturbing sediment and potentially changing the exposures concentrations to the receptors on an area average basis.

The height of the water column in open water areas would not change under Alternative 4 as it would with a cover-in place alternative so there would be no restrictions on deep draft vessels or traffic.

To address the potential for a future risk from exposure to asbestos in the marine sediments during the implementation of the proposed remedy and future dredging of Site 19, the Navy will prevent exposure to potential asbestos in dredged shipyard sediment through development of documented precautionary measures and safe work practices. These safe work practices will be described in the LUC documentation established for the COCs that remain at the site under this alternative.

In addition, if the Navy property is ever transferred out of federal control and restrictions for Coddington Cove are deemed necessary to the continued viability of the remedy at that time, the Navy will as part of the transfer process coordinate with federal and state authorities to determine what use restrictions can be imposed on the cove, which is state-owned, to prevent disturbance to areas with contaminated sediments managed under cover. If piers are included as part of the property to be transferred, Navy will include in the deed or transfer documentation a restriction requiring that if future owners intend to make alterations to the pier (s) such as demolition, restoration or any other work that could undermine the integrity of the sediment remedy, the new owner must first obtain USEPA Region 1 concurrence, in consultation with RIDEM, and must conduct such work in a manner that does not compromise the remedy. Although the Navy may transfer the procedural LUC responsibilities to another party by contract, property transfer agreement, or through other means, the Navy will retain ultimate responsibility for remedy integrity. LUCs will be maintained until the concentrations of hazardous substances in the sediment are at such levels to allow for unlimited use and unrestricted exposure.

Dredging and Disposal

For implementation of this alternative, sediment would be dredged from target areas to the depth identified on Figure 4-3, and target areas beneath Pier 2 would receive an engineered 1 foot barrier. For costing purposes, it is estimated that the open water area dredging would consist of approximately 191,655 square feet and would amount to approximately 14,016 cubic yards of excavated dredge material. The same volume of clean sand, gravel, and fine sand would be placed as backfill. Dredging and backfill in any of these areas will not significantly alter existing water depths. During dredge and backfill operations, silt curtains, or other appropriate resuspension/particulate control systems, will be utilized. These measures will help minimize potential adverse environmental effects that may occur due to resuspension of fine grained sediments during remedial activities. Bathymetric surveys will also be completed before dredging, after dredging but before backfilling, and after backfilling. These surveys will be used to confirm that targeted dredging depths were reached and that backfilling returns the sediment surface to original grade.

Contaminated sediment would be dredged using methods selected to minimize water column turbidity. The final determination of the most appropriate technique would be made during development of the RD. For the purposes of this FS, it is assumed that removal would be accomplished by a combination of mechanical and hydraulic (suction) dredging conducted from a barge.

The dredged sediments would require landfill disposal. Dewatered and stabilized sediment samples would be collected and analyzed to verify that the material meets applicable criteria before being transported for landfill disposal. Evaluation of the existing sediment analytical data indicates that the COC

concentrations are low enough that the material would likely meet requirements for disposal in a RCRA Subtitle D landfill without treatment.

Dredged materials to be transported off-base for disposal would be dewatered on shore by gravity thickening and then solidified with Portland cement, lime, or other pozzolanic material.

The resultant water from the dewatering process would be treated as necessary to meet applicable state and federal discharge standards prior to discharge either into Narragansett Bay or to a POTW. If necessary, water would be treated by means of a skid-mounted clarifier and filtration system – either on a barge or on-shore. The clarifier would remove inorganic constituents by precipitation. Unsettled metals precipitant and other suspended particles and fines would be removed by filtration. Any organic constituents (PAHs and PCBs) present are expected to be adsorbed onto the surface of the suspended particles, and thereby be removed by filtration along with these particles. Based on available data, the need for additional treatment for dissolved COCs is not anticipated; however, treatment requirements could be more completely evaluated through a pilot test, conducted as part of the design.

Engineered Cap Under Pier 2

This alternative also includes placement of a 1 foot engineered barrier (in-situ cap) in two target areas located beneath the east end of Pier 2 (Figure 4-3). For costing purposes this would be an area of approximately 83,574 square feet, and would require 8,794 cubic yards of cap material (this volume is estimated for a 2 foot thick barrier that would be required to ensure a minimum of 1 foot during placement). Placement of an in-situ cap beneath Pier 2 is not expected to convert sub-tidal areas into inter-tidal areas. To place the cap a slurry of sand and water will be pumped through a tremmie pipe to the broadcast area and the sand will be allowed to settle to the bottom. There is a high level of uncertainty in distribution of the cover material in these areas due to limited accessibility posed by the piling structure of the pier and additional design elements will need to be utilized to compensate, ultimately leading to the potential for a thicker cover in this area. During placement of the cap material, silt curtains, or other appropriate resuspension/ particulate control systems, will be utilized. These measures will help minimize potential adverse environmental effects that may occur due to resuspension of fine grained sediments during capping activities.

Bathymetric surveys will also be completed at all areas receiving a cap before and after placement. These surveys will be used to confirm proper placement and thickness of the cap.

The most appropriate cap material would be selected during development of the remedial alternative and would account for flow characteristics in the cover areas as well as the sediment's physical characteristics and bathymetry. The final thickness of the cap would range from 1 to 2 ft. and would extend slightly

beyond the SWAC cells due to sloping at the edges. Placement of the cap would act to contain contaminated sediment, and prevent exposure to humans and ecological receptors.

Long-Term Monitoring and 5-Year Reviews

Since the remedy is reliant on use of a cap for sediment beneath Pier 2, LTM and 5-year reviews would be required to ensure long term protectiveness of the alternative at the capped areas beneath Pier 2 (LTM would not extend to areas of the site beyond the capped portion beneath Pier 2). Conceptually as part of LTM, annual sampling and analysis of sediment around the cap would be conducted to ensure that the site continues to meet RAOs. LTM would also be conducted on dredged and backfilled areas to ensure that the exposure concentrations to the receptors remain below PRGs on an area average basis.

It is assumed that samples would be collected from the two capped areas under Pier 2 as well as the open water dredged and backfilled areas. Analysis would include sediment COCs (PCBs, HMW PAHs [including benzo(a)pyrene], and lead). Actual sediment sample locations and analysis would be determined during the RD phase.

Given the nature of the sediment contamination and slow changes in sediment quality anticipated, a single sampling event per year is anticipated to be sufficient to assure that the cap is not compromised. The results of the monitoring would be compiled and an evaluation of the contamination and its associated risks would be conducted as a part of the 5-year reviews, which are required by CERCLA for sites where COCs exceeding PRGs are allowed to remain. The monitoring data would be used to identify any changes in the COC concentrations and determine the need to increase or decrease the frequency of monitoring events, or implement more aggressive response actions at the site.

As part of the ongoing maintenance activities, a bathymetric survey would be conducted every five years to ensure that typical activities at the site, or wave action due to storms, are not disturbing, or compromising the cap beneath Pier 2. LTM would also include ensuring that the institutional controls to maintain cap integrity beneath the pier continue to be implemented and enforced, and to ensure that SWAC remains below PRGs. At least annual inspections would ensure that the LUCs to maintain cap integrity continue to be implemented and enforced. The 5-year reviews would summarize the results of the monitoring activities. For cost estimating purposes of this FS, it is assumed that LTM, maintenance, and 5-year reviews would be performed over a period of 30 years.

4.1.5 Alternative 5: Target Dredging (open water); Capping, LUCs, and Monitoring (beneath Pier 2)

Alternative 5 was developed to provide an option that does not include backfilling or LUCs in open water areas. Under Alternative 5 target open water areas will be dredged to a depth of either 1 or 2 feet; this approach reduces exposure through removal of contaminated sediment. Dredging to 1 foot is planned for stations C21, J24, J30, K05, K13, L26, L28, W24, AD13, and AE24; dredging to 2 feet is planned for stations L24, Y25, Y26, Y28, Y30, BC30, BD26, and BE30 (Figure 4-4). Confirmation sampling will be performed within and surrounding the dredged areas to confirm that SWACs are below PRGs after completion of the dredging effort. The target areas beneath Pier 2 (G25 and G29) will be addressed by placement of a 1 foot thick cap, as described in Alternatives 3 and 4. The primary elements of Alternative 5 include:

- Dredge target areas in the open water, and dispose of the dredged material at an onshore landfill, and confirmation sampling following dredging activities.
- Cap target areas beneath Pier 2, institute LUCs and Monitoring for those areas.

The table below presents projected SWACs for site sediment after implementation of the actions described for Alternative 5. Appendix D-8 presents tables that detail the SWAC calculations for each COC. Following the methods described Section 2.4, the baseline SWAC calculation reflects post remedy conditions under Alternative 5 by changing the surface concentrations in the dredged cells to the concentration of the interval immediately below the dredged interval; if concentration data was not available for an interval below a dredged interval the COC concentration was assumed to be zero.

Scenario	Benzo(a)pyrene (µg/kg)	Total HMW PAHs (µg/kg)	Total PCBs (µg/kg)	Lead (mg/kg)
PRG	*539*	*13,903*	*1,060*	*168*
Alt. 5 – SWAC	432	2,460	684	161

Institutional Controls

Institutional Controls (ICs) would be established in the form of Navy LUCs through the development of a LUC RD document. ICs would be designed to prevent disturbance of the cap beneath Pier 2 if alterations are made to the pier. Any future proposed work to demolish or restore the pier that is determined to be intrusive, or could undermine the cap's integrity, would require the Navy to obtain concurrence before taking these actions since they could compromise the cap (i.e. The Navy would need to obtain USEPA Region I concurrence, in consultation with the State of Rhode Island, prior to modifying or terminating the LUCs or implementation actions. The Navy or other entity shall seek prior concurrence from USEPA

Region I, in consultation with the State, before taking any anticipated action that may disrupt the effectiveness of the LUCs or before taking any action that may alter or negate the need for LUCs).

To address the potential for a future risk from exposure to asbestos in the marine sediments during the implementation of the proposed remedy and future dredging of Site 19, the Navy will prevent exposure to potential asbestos in dredged shipyard sediment through development of documented precautionary measures and safe work practices. These safe work practices will be described in the LUC documentation established for the COCs that remain at the site under this alternative.

In addition, if the Navy property is ever transferred out of federal control and restrictions for Coddington Cove are deemed necessary to the continued viability of the remedy at that time, the Navy will as part of the transfer process coordinate with federal and state authorities to determine what use restrictions can be imposed on the cove, which is state-owned, to prevent disturbance to areas with contaminated sediments managed under thecap. If piers are included as part of the property to be transferred, Navy will include in the deed or transfer documentation a restriction requiring that if future owners intend to make alterations to the pier (s) such as demolition, restoration or any other work that could undermine the integrity of the sediment remedy, the new owner must first obtain USEPA Region 1 concurrence, in consultation with RIDEM, and must conduct such work in a manner that does not compromise the remedy. Although the Navy may transfer the procedural LUC responsibilities to another party by contract, property transfer agreement, or through other means, the Navy will retain ultimate responsibility for remedy integrity. LUCs will be maintained until the concentrations of hazardous substances in the sediment are at such levels to allow for unlimited use and unrestricted exposure.

Dredging and Disposal

For implementation of this alternative, dredging would be conducted in target areas to various depths (Figure 4-4). For costing purposes in this FS, the area that would be dredged is estimated at approximately 251,279 sq. ft., with an associated dredged volume of approximately 27,646 cubic yards.

Under this alternative, dredging would be conducted in the target areas identified in Figure 4-4. Dredging in any of these areas is expected to increase the water depths from the current condition. During dredge operations, silt curtains, or other appropriate resuspension/particulate control systems, will be utilized. These measures will help minimize potential adverse environmental effects that may occur due to resuspension of fine grained sediments during remedial activities. Bathymetric surveys will also be completed before dredging, and after dredging. These surveys will be used to confirm that targeted dredging depths were reached. Sediment would be dredged using methods selected based on effectiveness and to minimize water column turbidity. The final determination of the most appropriate technique would be made during development of the RD. For the purposes of this FS, it is assumed that

removal would be accomplished by a combination of mechanical and hydraulic (suction) dredging conducted from a barge.

The dredged sediments would require landfill disposal. Dewatered and stabilized sediment samples would be collected and analyzed to verify that the material meets applicable criteria before being transported for landfill disposal. Evaluation of the existing sediment analytical data indicates that the contaminant levels are low enough that the material would likely meet requirements for disposal in a RCRA Subtitle D landfill without treatment.

Dredged materials to be transported off-base for disposal would be dewatered on shore by gravity thickening and then solidified with Portland cement, lime, or other pozzolanic material. The resultant water from the dewatering process would be treated as necessary to meet applicable state and federal discharge standards prior to discharge into Narragansett Bay or POTW. If necessary, water would be treated by means of a skid-mounted clarifier and filtration system – either on a barge or on-shore. The clarifier would remove inorganic constituents by precipitation. Unsettled metals precipitant and other suspended particles and fines would be removed by filtration. Any organic constituents (PAHs and PCBs) present are expected to be adsorbed onto the surface of the suspended particles, and thereby be removed by filtration along with these particles. Based on available data, the need for additional treatment for dissolved chemicals is not anticipated; however, treatment requirements could be more completely evaluated through a pilot test, conducted as part of the design.

Confirmation Sampling

Following the dredging activities, confirmation sampling would be conducted to ensure that the RAOs are met. Confirmation sampling would be conducted within dredged cells as well as within cells adjacent (north, south, east, and west) to the dredged cells. These data would be used to recalculate SWACs that represent post dredging conditions. Specifically, confirmation sampling data from dredged cells would be combined with data from the remainder of the original SWAC calculation that was used to select the dredge areas (areas which were in excess of the PRGs but not dredged), and the confirmation data from adjacent cells would be added to the SWAC calculation to moderate heterogeneity in sediment. In this manner two distinct results can be evaluated: First, the original SWAC calculation would be duplicated with the same areas included but reflecting the post dredge conditions. Second, data from the surrounding area (adjacent cells) would be utilized to account for variability. If either of these SWAC calculations result in SWACs less than PRGs, then the RAOs will have been met.

If the area surrounding any of the dredge cells was not previously sampled, a new cell (either 100 feet by 100 feet, or 200 feet by 200 feet, to be consistent with the dredged cell) will be created at the appropriate position. If the adjacent area is a landform with no sediment present, no adjacent sample in that direction

will be collected. Exact locations for post-dredge sampling are not mapped for this FS since the locations will be determined based on the actual limits of dredging after it is completed. Confirmation samples will be collected from the 0 to 1 foot interval at each sample station. Samples will be analyzed for COCs (HMW PAHs (including benzo(a)pyrene), PCBs, and lead).

This post excavation sampling and analysis approach is believed to be adequate to provide acceptable conservativeness in determining that the RAOs have been reached. Using the adjacent areas is an approach that is consistent with consideration for the origins of the contaminants as described in the Conceptual Site Model, considers potential for migration of contaminants during dredging, and compensates for the heterogeneity and variability of sediment.

Engineered Cap Under Pier 2

This alternative also includes placement of a 1 foot engineered barrier (in-situ cap) in two target areas located beneath the east end of Pier 2 (Figure 4-4). For costing purposes this would be an area of approximately 83,574 square feet, and would require 8,794 cubic yards of cap material (this volume is estimated for a 2 foot - thick barrier which will be required in the design to ensure a minimum 1 foot thickness). Placement of an in-situ cap beneath Pier 2 is not expected to convert sub-tidal areas into inter-tidal areas. To place the cap, a slurry of sand and water will be pumped through a tremmie pipe to the broadcast area, and the sand will be allowed to settle to the bottom. There is a high level of uncertainty in distribution of the cover material in these areas due to limited accessibility posed by the piling structure of the pier, and additional design elements will need to be utilized to compensate, ultimately leading to the potential for a thicker cover in this area. During placement of the cap material, silt curtains, or other appropriate resuspension/ particulate control systems, will be utilized. These measures will help minimize potential adverse environmental effects that may occur due to resuspension of fine grained sediments during capping activities.

Bathymetric surveys will also be completed at all areas receiving a cap before and after placement. These surveys will be used to confirm proper placement and thickness of the cap.

The most appropriate cap material would be selected during development of the remedial alternative and would account for flow characteristics in the cover areas, the sediment's physical characteristics and bathymetry, and would consider the requirement to withstand the force of a 100 year storm event. The final thickness of the cap would range from 1 to 2 ft. and would extend slightly beyond the target area due to sloping at the edges. Placement of the cap would act to contain contaminated sediment, and prevent exposure to humans and ecological receptors.

Long-Term Monitoring and 5-Year Reviews

Since the remedy is reliant on use of a cap for sediment beneath Pier 2 to isolate sediment, LTM and 5-year reviews would be required to ensure long term protectiveness of the alternative in this area (LTM would not extend to areas of the site beyond the capped area beneath Pier 2). Conceptually as part of LTM, annual sampling and analysis of sediment around the cap would be conducted to ensure that the site continues to meet RAOs. For costing purposes, it is estimated that samples would be collected from the two capped areas under Pier 2. Analysis would include sediment COCs (PCBs, HMW PAHs [including benzo(a)pyrene], and lead). Actual sediment sample locations and analysis would be determined during the RD phase.

Given the nature of the sediment contamination and slow changes in sediment quality anticipated, a single sampling event per year is anticipated to be sufficient to assure that the cap material is not compromised. The results of the monitoring would be compiled and an evaluation of the contamination and its associated risks would be conducted as a part of the 5-year reviews, which are required by CERCLA for sites where COCs exceeding PRGs are allowed to remain. The monitoring data would be used to identify any changes in the COC concentrations and determine the need to increase or decrease the frequency of monitoring events, or implement more aggressive response actions at the site.

As part of the ongoing maintenance activities, a bathymetric survey would be conducted every five years to ensure that typical activities at the site, or wave action due to storms, are not disturbing, or compromising the cap beneath Pier 2. At least annual inspections would ensure that the LUCs to maintain cap integrity continue to be implemented and enforced. LTM would also ensure that the institutional controls to maintain cap integrity beneath the pier continue to be implemented and enforced. The 5-year reviews would summarize the results of the monitoring activities. For cost estimating purposes of this FS, it is assumed that LTM, maintenance, and 5-year reviews would be performed over a period of 30 years.

4.2 NATIONAL CONTINGENCY PLAN EVALUATION CRITERIA AND RELATIVE IMPORTANCE OF CRITERIA

The evaluation criteria, as required by the NCP, and the relative importance of these criteria in the CERCLA process, are described in the following sections and are applicable to all monitoring stations at Site 19.

4.2.1 Evaluation Criteria

In accordance with the NCP (40 CFR 300.430), the following nine criteria are used for the evaluation of remedial alternatives:

- Overall Protection of Human Health and the Environment.
- Compliance with ARARs.
- Long-Term Effectiveness and Permanence.
- Reduction of Toxicity, Mobility, or Volume through Treatment.
- Short-Term Effectiveness.
- Implementability.
- Cost.
- State Acceptance.
- Community Acceptance.

Overall Protection of Human Health and the Environment

Remedial alternatives must be assessed for adequate protection of human health and the environment in both the short and long term. The remedial alternatives must be able to diminish the unacceptable risks posed by hazardous substances or contaminants present at the Site by eliminating, reducing, or controlling exposure to levels exceeding remediation goals.

Compliance with ARARs and TBCs

Remedial alternatives must be assessed to determine whether they attain ARARs and TBCs under federal environmental laws and state environmental or facility citing laws. If one or more regulations that are applicable cannot be complied with, a waiver must be invoked.

Long-Term Effectiveness and Permanence

Remedial alternatives must be assessed for the long-term effectiveness and permanence they offer, along with the degree of certainty that the alternative would prove successful. Factors that are considered, as appropriate, include the following:

- Magnitude of Residual Risk – Risk posed by untreated waste or treatment residuals at the conclusion of remedial activities. The characteristics of residuals are considered to the degree that they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bioaccumulate.

- Adequacy and Reliability of Controls – Controls, such as containment systems and LUCs, that are necessary to manage treatment residuals and untreated waste must be shown to be reliable. In particular, this evaluation considers the uncertainties associated with land disposal for providing long-term protection from residual contamination, assessment of the potential need to replace technical components of the alternative (such as a surface cover, sign, or treatment system), and the potential exposure pathways and risks posed, if technical components or the entire remedial action needs to be replaced.

Reduction of Toxicity, Mobility, or Volume through Treatment

The degree to which the remedial alternative employs recycling or treatment that reduces the toxicity, mobility, or volume is assessed. This assessment includes how treatment is used to address threats posed by the Site. Factors to be considered, as appropriate, include the following:

- Treatment or recycling processes that the remedial alternative employs and the materials that they will treat.
- Amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled.
- Degree of expected reduction in toxicity, mobility, or volume of waste caused by treatment or recycling, and the specification of which reduction(s) is occurring.
- Degree to which the treatment is irreversible.
- Type and quantity of residual contamination that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bioaccumulate of such hazardous substances and their constituents.
- Degree to which treatment reduces the inherent hazards posed by principal threats at the Site.

Short-Term Effectiveness

The short-term impacts of the remedial alternative are assessed considering the following:

- Short-term risks that might be posed to the community during implementation.
- Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures taken to minimize these impacts.
- Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigating measures during implementation.
- Time until protection is achieved.

Implementability

The ease or difficulty of implementing the alternative is assessed, considering the following types of factors, as appropriate:

- Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, reliability of the technology, ease of undertaking additional remedial actions, and ability to monitor the effectiveness of the remedy.

- Administrative feasibility, including activities needed to coordinate with other offices and agencies and the time required to obtain approvals from other agencies.

- Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; availability of necessary equipment, specialists, and additional resources; availability of services and materials; and availability of prospective technologies.

- Sustainability of an alternative is discussed and includes consideration of the relative size of the associated carbon footprint, material usage, and environmental benefit.

Cost

Costs for remedial alternatives include both capital costs and annual O&M costs. Capital costs include both direct and indirect costs expected at the time of alternative implementation. Annual O&M costs include periodic costs that occur following alternative implementation. Typical O&M costs include periodic LTM and inspections. A present worth of the capital and O&M costs is also provided. The present worth of a remedial alternative is the total of all capital and O&M costs expressed in today's dollars. In accordance with USEPA guidance, the cost estimate accuracy range during the FS stage is projected to be +50 percent to -30 percent of the actual remedial action cost.

State Acceptance

This criterion reflects the statutory requirements to provide for substantial and meaningful regulatory involvement. Formal assessment of regulatory acceptance is completed during the ROD phase, occurring after the public comment period on the PRAP. In addition, regulatory concerns are continually considered through resolution of regulatory comments received on the FS Report and PRAP.

Community Acceptance

This criterion refers to comments from community members on the remedial alternatives under consideration, where "community" is broadly defined to include all interested parties. These comments are considered throughout the CERCLA process. The community acceptance criterion is evaluated as

part of the responsiveness summary presented in the ROD after the public comment period on the PRAP is held.

4.2.2 Relative Importance of Criteria

Among the nine criteria, the threshold criteria are considered to be:

- Overall Protection of Human Health and the Environment.
- Compliance with ARARs and TBCs.

The threshold criteria must be satisfied for an alternative to be eligible for selection.

Among the remaining criteria, the following five criteria are considered to be the primary balancing criteria:

- Long-Term Effectiveness and Permanence.
- Reduction of Toxicity, Mobility, or Volume through Treatment.
- Short-Term Effectiveness.
- Implementability.
- Cost.

The balancing criteria are used to weigh the relative merits of alternatives.

The remaining two criteria, State Acceptance and Community Acceptance, are considered to be modifying criteria that must be considered during remedy selection. These last two criteria are evaluated after the end of the public comment period on the PRAP. Therefore, the following section evaluates seven of the nine criteria for marine sediment.

4.3 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

The five remedial alternatives developed in Section 3.5 and described in Section 4.1 are evaluated against the seven NCP evaluation criteria described in Section 4.2. The evaluation of the alternatives provides information to facilitate selection of a specific remedy or combination of remedies. The detailed evaluation of alternatives was developed in accordance with the NCP (40CFR 200.430(e)) and the *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA, 1988).

These alternatives were developed to address risks to the environment (exposure of aquatic receptors to COCs in bedded and resuspended sediment) and human health (exposure of persons ingesting shellfish

and lobsters taken from the area). Detailed cost estimates and associated assumptions for each alternative are presented in Appendix E.

4.3.1 Alternative 1: No Action

Consideration of a no-action alternative is required under the NCP to provide a baseline against which other alternatives may be compared. This alternative would involve no remedial response activities with respect to impacted marine sediment in Coddington Cove. No containment, removal, or treatment of sediment COCs would be conducted. The alternative would provide no mechanism to minimize potential risks to ecological or human receptors or evaluate changes in risk due to increases or decreases in COC concentrations. Any 5-year review efforts would be covered by the comprehensive 5-year review prepared for NETC-Newport.

An analysis of this alternative with respect to the evaluation criteria is as follows:

Overall Protection of Human Health and the Environment: Alternative 1 would not meet the RAOs for the protection of the human health or the environment. This alternative would offer little or no protection of the environment, because it would not address potential risks by eliminating, reducing, or controlling human or ecological exposures to impacted site sediment. Sediment COCs would not be contained or removed and no institutional controls or use restrictions would be enacted to limit exposures. There is a current restriction for access to Coddington Cove as a component of base security and force protection; however, approved members of certain groups including the Rhode Island Lobsterman's Association and the Ocean State Fisherman's Association have been provided access to otherwise restricted areas for commercial fishing under the conditions identified in a MOU between the Commanding Officer of NAVSTA Newport, pertinent Federal and State Agencies, and the lobsterman's and fisherman's associations (NAVSTA Newport, 2002).

Potential for exposure to COCs in excess of the PRGs identified in Section 2 would continue. Ecological receptors would continue to be exposed to sediment with COC concentrations exceeding PRGs.

Compliance with ARARs: Tables 4-1, 4-2, and 4-3 identify chemical-, location-, and action-specific ARARs and TBCs, for Alternative 1. Alternative 1 fails to meet sediment PRGs that have been derived, in part, from federal and state water quality chemical specific ARARs. There are no location-specific or action-specific ARARs identified for this alternative because no remedial actions are specified.

Long-Term Effectiveness and Permanence: The no-action alternative would offer no long-term effectiveness or permanence in addressing sediment contamination at the site. The existing risks to human and ecological receptors through resuspended or bedded sediment would remain, and no controls would be provided to manage future exposures to sediment COCs or to evaluate changing site conditions.

Reduction of Toxicity, Mobility, or Volume through Treatment: This alternative would not include any sediment treatment processes or, sediment removal. Therefore, the alternative would offer no reduction in toxicity, mobility, or volume of contamination through treatment.

Short-Term Effectiveness: Since no remedial activities are associated with implementation of this alternative, no short-term effects would occur. No increase or reduction in short-term risks would be offered to the local community, the personnel at NAVSTA Newport, or the environment. RAOs would not be achieved.

Implementability: This alternative would require no implementation other than completion of the 5-year reviews. This activity would not require any permits, but it may require a minimal amount of coordination between regulatory agencies. Implementation of the no-action alternative would not limit future implementation of additional remedial actions at the site.

Cost: A detailed estimate of capital, O&M, and present-worth costs for Alternative 1 is provided in Appendix E and is summarized below. Present-worth costs are calculated for a 30-year period at a 2.0 percent discount rate (30-year real interest rate per OMB Circular No. A-94, December 2010). Because there is no activity under this alternative, there is no cost associated. Any 5-year review efforts are assumed to be included in the NAVSTA Newport (NETC) basewide 5-year review documentation, and cost specific to this site for those reviews would be negligible.

Cost Item	Estimated Cost
Capital Costs	$0
O&M/LTM	$0
5-Year Reviews	$0
30-Year Present Worth	$0

4.3.2 Alternative 2: Enhanced Natural Recovery through Thin Layer Cover, LUCs and Monitoring

Alternative 2 relies on a combination of thin layer cover, natural deposition, and implementation of institutional controls, implemented as LUCs to achieve RAOs, and LTM to assure protectiveness over time. This alternative would involve placement of a thin layer cover (6 inches minimum thickness) over

target areas of sediment. LUCs would prohibit self-maneuvering by deep draft vessels within the port area, and prohibit access by fishing vessels whose activities could compromise the effectiveness of the thin layer cover. The Navy would prevent exposure to potential asbestos in shipyard sediment through development of documented precautionary measures and safe work practices, which would be described in the LUC documentation established for the COCs remaining at the site. Lastly, bathymetric surveys would be conducted every 5 years to ensure that damage to the thin layer cover has not occurred, and to document the amount of natural deposition that has occurred.

The placement of the cover would serve to immediately isolate contaminated sediment from receptors while natural depositional processes augment this initial layer and create a natural cap over time. Implementation of the ICs would ensure that the cover and naturally deposited sediment are not disturbed by port activities, and that there would be no short term human health exposure through ingestion of shellfish collected from the site. A LTM program and 5-year reviews would be conducted to evaluate any changes in COC concentrations and associated risks posed by the sediment COCs. For costing purposes, it is assumed that monitoring and 5-year reviews will be performed for 30 years. Details are provided in Section 4.1.2.

An analysis of this alternative with respect to the evaluation criteria is as follows:

Overall Protection of Human Health and the Environment: Alternative 2 may meet the RAOs for protection of human health and the environment by achieving a reduction of exposure.

Human health risk would be addressed through institutional controls (LUCs) that prevent access to some parties and reduce traffic in target areas. Through enforcement of the access limitation, this alternative would reduce the likelihood of shellfish and lobster collection from this site at a volume that would pose unacceptable risk to persons ingesting shellfish and lobster taken from the site. Additionally, the possibility of the cover being compromised would be reduced greatly and would encourage continued deposition of natural materials to augment the cover over time.

Alternative 2 may achieve RAOs for protection of the environment and ecological receptors through reduction of exposure by placement of the thin layer cover and a moderate amount of blending of clean sediment with existing sediment that would occur during the cover placement owing to uncertainty concerning the long-term effectiveness of the cover to prevent releases in the event of major disturbances, such as storm events. Over time, this thin layer cover would be augmented through natural deposition providing additional cover material. The thin layer cover would serve to reduce some of the immediate risk to ecological receptors, and over time natural deposition should effectively isolate contamination from ecological receptors. There is some uncertainty as to the reliability of the long term protection since it depends on natural depositional processes and rates of deposition, but the LTM and

bathymetric surveys conducted every 5 years will serve to document the progress and ensure that the remedy is protective over time.

Adequate enforcement of the access restrictions by NAVSTA Newport would be necessary to ensure the effectiveness of this alternative. NAVSTA Newport currently restricts access to Coddington Cove as a component of base security and force protection, there is a high likelihood of successful enforcement of any implemented restrictions. Furthermore, LUCs will require proper management of sediments to prevent exposure to contaminated sediments and meet RAO requirements.

The ENR alternative would provide a means of evaluating changing conditions and risks on a continual basis through implementation of the LTM program. LTM would document changes in sediment quality that may affect future exposure and associated risks to ecological receptors. Five-year reviews would be conducted to assess changing site conditions, changing risks, and the adequacy of enforcement of use and access restrictions. Results of the reviews would be used to assess the long-term protectiveness of the remedy and determine the need to implement future remedial actions at the site.

Compliance with ARARs: Tables 4-4, 4-5, and 4-6 summarize chemical-, location-, and action-specific ARARs and TBCs, respectively for Alternative 2. Alternative 2 will initially meet the sediment PRGs that are derived in part from federal and state water quality chemical-specific ARARs. However, over the long-term it is unclear if these standards can be maintained if the cover is disturbed by storm events or other factors. Monitoring requirements specified under this alternative would serve to ensure that these standards are maintained.

Alternative 2 will initially meet all state and federal location-specific ARARs by conducting the activities in accordance with wetlands, coastal resource management, endangered species, fish and wildlife protection, and historic preservation regulations. However, over the long-term it is unclear if these standards can be maintained if the cover is disturbed by storm events or other factors. Monitoring requirements specified under this alternative would serve to ensure that these standards are maintained. Intertidal areas will not be impacted. Mitigation of subtidal areas with special habitats such as eelgrass beds would be required if any are damaged by the action.

Alternative 2 would be conducted in accordance with all identified state and federal action-specific ARARs as long as the cover remains intact, and the remedy thus remains protective. The action-specific ARARs identified for this alternative include federal and state requirements for identification, listing, and disposal of hazardous and non-hazardous wastes, Clean Water Act (CWA) requirements for discharges to surface water, and Clean Air Act (CAA) requirements for emissions monitoring.

Best engineering practices would be used to minimize sediment suspension and COC migration during placement of the thin layer cover. Federal and state hazardous and toxic waste handling requirements would be used to determine if any waste generated by the remedy is hazardous waste. It is presumed that sediments are not regulated by RCRA because none of the materials are listed or characterized as RCRA hazardous waste. The remedy will meet the TSCA standards as long as the cover remains intact and the remedy remains protective. A finding on whether the remedy is protective under TSCA will be provided in the ROD.

Long-Term Effectiveness and Permanence: The access restrictions and institutional controls would offer long-term protection of human health, provided that the LUC is adequately enforced. Because COCs would remain in place above the PRGs, enforcement of LUCs would be essential to maintaining the level of protectiveness. NAVSTA Newport currently restricts access to Coddington Cove as a component of base security and force protection, there is a high likelihood of successful enforcement of any implemented restrictions.

There is consideration for future use of the site as a commercial or military port. While thin layer cover is deemed to be protective overall (reduces exposure to receptors), and though the thin layer cover is anticipated to be stable even during weather events and during expected traffic by home-ported vessels, there is uncertainty as to the permanence given that the effects of violent storms on the sediment have not been measured or observed.

The thin layer cover would offer some immediate protection to ecological receptors while natural depositional processes would provide long-term protection; again, there is some uncertainty as to the reliability of natural deposition occurring at this site since little data has been gathered regarding this topic. Additionally, the LTM program will provide a means to evaluate changes in site conditions and determine whether RAOs are met over time or whether other actions are needed. Since sediments containing COCs at concentrations in excess of the PRGs would remain on-site, 5-year reviews of this alternative would be required to evaluate its long-term effectiveness. Ultimately, the adequacy of long term protection will depend on the continued deposition of sediments in the cover areas, the long term stability of that sediment and the use requirements of the port operation.

Reduction in Toxicity, Mobility, or Volume through Treatment: This alternative would not include any treatment as a principal element in the action; therefore, it would not reduce the toxicity, mobility, or volume through treatment.

Short-Term Effectiveness: Implementation of this alternative would result in increased short-term impacts to the environment, including the destruction (burial) of existing biota within the cover areas and some suspension of sediment that may degrade aquatic habitat or affect biota in the surrounding area in the

short term. These impacts would be partially mitigated through proper design and effective implementation (selection of the least disruptive capping methods possible for the site conditions and effective use of turbidity control measures).

Restoration of the aquatic habitat within the covered areas would occur naturally. The time required for restoration of the covered areas would be dependent on the materials used for the thin layer cover. If cover materials similar to the existing substrate can be used, the habitat may regenerate more quickly than in dredged areas (USEPA, 2005). However, if cover materials more coarse than the native materials are required for erosion protection, habitat restoration may take longer or habitat could be permanently altered (USEPA, 2005), though such alterations could be deemed an improvement for this previously dredged industrial port. The area to be covered is a low-energy environment, it is likely that cap materials can be selected that will allow full restoration or even enhancement of the existing habitat. In the long-term, natural repopulation is expected to replace whatever aquatic habitat functions and values that the area supports.

Implementability: Implementation of Alternative 2 would involve placement of a thin layer cover and placing access restrictions and use restrictions. A LTM program and 5-year reviews would be conducted to evaluate changing conditions and risks to human and aquatic ecological receptors posed by the sediment COCs.

NAVSTA Newport currently maintains and executes the authority to restrict access to portions of Coddington Cove under the current safety zone established under 33 CFR 334.81; however, members of certain fishing/lobstering associations, including Rhode Island Lobsterman's Association and the Ocean State Fisherman's Association, are granted access to the area for commercial fishing, under the conditions identified in a Memorandum of Understanding (MOU) between the Commanding Officer of NAVSTA Newport, pertinent federal and state agencies, and the lobsterman's and fisherman's associations (NAVSTA Newport, 2002). In order to effectively restrict all fishing activities in the affected areas, the MOU would have to be revised or rescinded. Enforcement of the restrictions would be conducted by NAVSTA Newport Port Operations and NAVSTA Newport police.

In addition, if the Navy property is ever transferred out of federal control and restrictions for Coddington Cove are deemed necessary to the continued viability of the remedy at that time, the Navy will as part of the transfer process coordinate with federal and state authorities to determine what use restrictions can be imposed on the cove, which is state-owned, to prevent disturbance to areas with contaminated sediments managed under the cover. If piers are included as part of the property to be transferred, Navy will include in the deed or transfer documentation a restriction requiring that if future owners intend to make alterations to the pier (s) such as demolition, restoration or any other work that could undermine the integrity of the sediment remedy, the new owner must first obtain USEPA Region 1 concurrence, in

consultation with RIDEM, and must conduct such work in a manner that does not compromise the remedy. Although the Navy may transfer the procedural LUC responsibilities to another party by contract, property transfer agreement, or through other means, the Navy will retain ultimate responsibility for remedy integrity. LUCs will be maintained until the concentrations of hazardous substances in the sediment are at such levels to allow for unlimited use and unrestricted exposure.

Implementation of the thin layer cover would require a moderate effort, both administratively and technically. The major factor affecting ease of implementation includes securing site access and a shoreline staging area. It is assumed that there would be easy access to the affected areas from the shore and with barge-mounted equipment. Piers may be available for minor activities, however, there are lifting and weight restrictions imposed on the piers, which would require much of the work to be conducted by barge operation.

Implementation of the thin layer cover is complicated by the imprecision of the action and the subaqueous location in waters of depth between 15 and 35 ft. Equipment must be guided remotely, and visual confirmation of completion is difficult due to low visibility at depth. For covering, a minimum depth of cover throughout the covered area must be achieved and would have to be verified by multibeam surveys before and after application. To minimize dispersion of the contaminated sediments during cover installation, placement of cover materials would need to occur by slow, uniform placement of layers to minimize resuspension. Cover materials, comprised of common fill materials, are readily available for purchase. The type and size of fill materials would be selected based on the characteristics of the native sediment and the area to be covered.

Because the area proposed for covering is in a low-energy marine environment, thin layer cover construction will not be hampered by currents or wave action, and there is a high potential that the thin layer cover in addition to the natural depositional process will remain effective for long-term containment of COCs. Construction is implementable by local marine contracting companies with trained personnel familiar with this process.

There is consideration of loss of depth during cover system installation. The depth of the port was mapped in 2011 to be approximately 35 to 40 ft. (MLW), and is reported as 30 ft. (MLW) on NOAA navigation charts. Adding a thin layer cover in some areas would not affect this depth significantly, but would need to be monitored over time through multi-beam or similar survey operations. Covering under-pier areas would not hinder port operations.

The establishment of a LTM program to assess sediment quality would be easily implementable, given the availability of area services. The results of the sediment sampling would be reported annually and summarized as part of the 5-year reviews.

Cost: A detailed estimate of capital, O&M, and present-worth costs for Alternative 2 is provided in Appendix E and is summarized below. For the purposes of costing, it was assumed that LTM and 5-year reviews would be required for a 30-year period. The 5-year review costs are assumed to include a bathymetric survey of the capped areas. Present-worth costs were developed for a 30-year period at a 2.0 percent discount rate (30-year real interest rate per OMB circular No. A-94, December 2010).

Cost Item	Estimated Cost
Capital Item	$ 3,108,057
O&M/LTM	$ 39,182
5-Year Reviews/Survey	$ 287,489
30-Year Present Worth	$ 5,222,851

4.3.3 Alternative 3: In-Situ Cap (Engineered Barrier), LUCs and Monitoring

Alternative 3 utilizes a combination of an engineered cap and implementation of institutional controls (LUCs and LTM) to achieve RAOs. The target areas are all within the designated port and are likely to be within areas that have been previously altered by port construction or maintenance activities. However, if wetland resource areas or special habitats are damaged either directly or inadvertently through the execution of the capping or dredging efforts, those resource areas would be mitigated following completion of the remedial action. The in-situ cap would be designed to withstand a 100 year storm event. The Navy would prevent exposure to potential asbestos in shipyard sediment through development of precautionary measures and safe work practices, which would be described in the LUC documentation.

COC concentrations in excess of the PRGs would remain in the capped areas, 5-year reviews and long-term O&M of the capped areas would be required. An analysis of this alternative with respect to the evaluation criteria is as follows:

Overall Protection of Human Health and the Environment: Alternative 3 would meet the RAOs for the protection of human health and the environment through isolation of target areas and implementation of LUCs. Because sediment with COC concentrations exceeding the PRGs in the capped areas would be isolated but not removed, long-term maintenance of the cap system would be required to ensure the long-term effectiveness and permanence of the remedy. Institutional controls would need to be implemented and enforced to ensure long term protection.

Implementation of this alternative would result in increased short-term impacts to the environment due to the potential for suspension and migration of contaminated sediment during the capping operations. Implementation of this alternative would destroy existing biota within the impacted areas through burial and may temporarily degrade the surrounding habitat. The capping of selected areas may cause

permanent alteration of the existing habitat depending on the composition of the capping materials, which would be determined during design based on characterization of the existing materials and construction and performance requirements of the cap. The area is anticipated to recover with natural repopulation of ecological communities that would be expected in this type of area.

Compliance with ARARs: Tables 4-7, 4-8, and 4-9 summarize chemical, location, and action-specific ARARs and TBCs, respectively for Alternative 3. Alternative 3, which involves capping, meets the RAOs and reduces COC concentrations to below PRGs (on a SWAC basis) which are derived, in part, from federal and state water quality chemical-specific ARARs.

Implementation of Alternative 3 would meet all state and federal location-specific ARARs by conducting the activities in accordance with wetlands, coastal resource management, endangered species, fish and wildlife protection, and historic preservation regulations. Intertidal areas will not be impacted. Mitigation of subtidal areas with special habitats such as eelgrass beds that are damaged either directly or inadvertently may be required.

Alternative 3 would be conducted in accordance with all identified state and federal action-specific ARARs. The action-specific ARARs identified for this alternative include federal and state requirements for identification, listing, and disposal of hazardous and non-hazardous wastes, CWA requirements for discharges to surface water, and CAA requirements for emissions monitoring.

Best engineering practices would be used to minimize sediment suspension and COC migration during capping. Federal and state hazardous and toxic waste handling requirements would be used to determine if any waste generated is hazardous waste. It is presumed that sediments are not regulated by RCRA because none of the materials are listed or characterized as RCRA hazardous waste. The remedy will meet the TSCA standards as long as the cover remains intact and the remedy remains protective. A finding on whether the remedy is protective under TSCA will be provided in the ROD.

Long-Term Effectiveness and Permanence: This alternative would eliminate risks to humans and marine biota by isolating (capping) target areas to achieve SWAC goals, and implementation of ICs. Contaminated sediments are isolated and not permanently removed so the need for long-term management would exist. The cap would be designed to ensure that contaminated sediment is fully contained, not vulnerable to bioturbation by deep burrowing organisms, and resistant to erosion. The area proposed for capping is a low-energy marine environment, cap construction should not pose great difficulty, and there is a high potential that the cap will remain effective for long-term containment of COCs. The cap can be designed to be stable even during weather events (100 year storm, as described previously) and during expected traffic by home-ported vessels. Collection of physical and chemical

characterization data for the sediments and area to be capped would help ensure the cap design is adequate.

Following installation, the cap would have to be routinely monitored and maintained to ensure that it is not compromised and that the contaminated sediments are effectively isolated to prevent exposure and reduce overall site risks to acceptable levels. Routine monitoring and maintenance described in Section 4.1.3 will allow the long-term effectiveness to be evaluated and ensured.

Reduction in Toxicity, Mobility, or Volume through Treatment: This alternative would not include any treatment as a principal element in the action; therefore, it would not reduce the toxicity, mobility, or volume through treatment.

Short-Term Effectiveness: Implementation of this alternative would result in increased short-term impacts to the environment, including the destruction of existing biota within the capping areas (through burial) and limited suspension of contaminated sediment that may degrade aquatic habitat or affect biota in the surrounding area. These impacts would be partially mitigated through proper RD and effective execution of that design (selection of the least disruptive capping methods possible for the site conditions and effective use of turbidity control measures).

Restoration of the aquatic habitat within the capped areas would occur naturally. The time required for restoration of the capped areas would be dependent on the materials used for capping. If capping materials similar to the existing substrate can be used, the habitat may regenerate more quickly than in dredged areas (USEPA, 2005). However, if cap materials more coarse than the native materials are required for erosion protection, habitat restoration may take longer or habitat could be permanently altered (USEPA, 2005), though such alterations could be deemed an improvement for this previously dredged industrial port. Because the area to be capped is a low-energy environment, it is likely that cap materials can be selected that will allow full restoration or even enhancement of the existing habitat. In the long-term, natural colonization is expected to replace whatever aquatic habitat functions and values that the area supports.

Implementability: Factors affecting ease of implementation include securing site access and a shoreline staging area. It is assumed that there would be relatively easy access to the target areas (to be capped) from the shore and with barge-mounted equipment with easy access in and out of the cove. Use of piers is expected to be limited due to weight handling and lifting restrictions.

The establishment of access restrictions is readily implementable, based on the current use of the port and current safety restrictions enforceable under 33 CFR 334.81. Additionally, NAVSTA Newport security has patrol operations in place already and the NAVSTA Newport Port Operations office manages activities

at the Piers. Implementing access restrictions could be augmented by use of hazard warning buoys along the site boundary. However, effectiveness would ultimately require NAVSTA Newport police to patrol and restrict boating activity within the restricted area, as is currently done. Because NAVSTA Newport currently restricts access to Coddington Cove as a component of base security and force protection, there is a high likelihood that these restrictions could be adequately enforced.

If the Navy property is ever transferred out of federal control and restrictions for Coddington Cove are deemed necessary to the continued viability of the remedy at that time, the Navy will as part of the transfer process coordinate with federal and state authorities to determine what use restrictions can be imposed on the cove, which is state-owned, to prevent disturbance to areas with contaminated sediments managed under the cap. If piers are included as part of the property to be transferred, Navy will include in the deed or transfer documentation a restriction requiring that if future owners intend to make alterations to the pier (s) such as demolition, restoration or any other work that could undermine the integrity of the sediment remedy, the new owner must first obtain USEPA Region 1 concurrence, in consultation with RIDEM, and must conduct such work in a manner that does not compromise the remedy. Although the Navy may transfer the procedural LUC responsibilities to another party by contract, property transfer agreement, or through other means, the Navy will retain ultimate responsibility for remedy integrity. LUCs will be maintained until the concentrations of hazardous substances in the sediment are at such levels to allow for unlimited use and unrestricted exposure.

Implementation of an engineered barrier would require a moderate effort, both administratively and technically. The major factor affecting ease of implementation includes securing site access and a shoreline staging area. It is assumed that there would be easy access to the affected areas from the shore and with barge-mounted equipment. Piers may be available for minor activities, however, there are lifting and weight restrictions, which would require much of the work to be conducted by barge operation. Construction of the engineered barrier is complicated given the imprecision of the action and the subaqueous location in waters of depth between 15 and 35 ft. Equipment must be guided remotely, and visual confirmation of completion is difficult due to low visibility at depth. For capping, a minimum depth (thickness) of cover throughout the capped area must be achieved and would have to be verified by multibeam surveys before and after construction. Underwater placement of cover materials presents challenges. To minimize dispersion of the contaminated sediments during cover installation, placement of cover materials would need to occur by slow, uniform placement of layers to minimize resuspension. Cover materials, comprised of common fill materials, are readily available for purchase. The type and size of cover materials would be selected based on the characteristics of the native sediment and the area to be covered.

The area proposed for covering is in a low-energy marine environment, cap construction will not be hampered by currents or wave action, and there is a high potential that the cover will remain effective for

long-term containment of COCs. Covering is implementable by local marine contracting companies with trained personnel familiar with this process.

Consideration of loss of water depth during cover system installation has been given. The depth of the port was mapped in 2011 to be approximately 35 to 40 ft. (MLW), and is reported as 30 ft. (MLW) on NOAA navigation charts. Adding up to two feet of cover in some areas could affect this depth if the cover material is not placed carefully, and depths would need to be monitored over time through multi-beam or similar survey operations. Covering under pier areas would not hinder port operations.

The establishment of a LTM program to assess sediment quality would be easily implementable, given the availability of area services. The results of the sediment sampling would be reported annually and summarized as part of the 5-year reviews.

Cost: A detailed estimate of capital, O&M, and present-worth costs for Alternative 3 is provided in Appendix E and summarized below. Present-worth costs were developed for a 30-year period at a 2 percent discount rate (30-year real interest rate per OMB circular No. A-94, December 2010). The baseline assumptions for estimating the cost of this alternative are that approximately 340,000 sq. ft. (7.8 acres) would be capped, requiring approximately 32,000 cubic yards of capping material. The 5-year review costs are assumed to include a bathymetric survey of the capped areas.

Cost Item	Alternative 3
Capital Costs	$ 4,939,678
O&M/LTM (annual)	$ 39,182
5-Year Reviews	$ 439,433
Total Present Worth	$ 7,708,390

4.3.4 Alternative 4: Combination Dredge / Backfill (open water); Cover (under Pier 2); and LUCs and LTM

Alternative 4 utilizes a combination of dredging/backfilling in open port areas and construction of a cap in target areas beneath Pier 2, as well as implementation of institutional controls, implemented as LUCs to achieve RAOs, and LTM to assure protectiveness over time. The combination of removing or capping surface sediment in target areas is projected to reduce SWACs to levels below PRGs.

This activity would involve removing the sediment from target areas located in open water, transporting it off base for disposal at an approved facility, backfilling dredged areas with clean backfill, capping target areas located beneath Pier 2 with an engineered barrier, and implementing LUCs for backfilled and capped areas. Figure 4-3 presents the planned dredging areas. Dredged sediment would be tested and

dewatered as necessary for disposal, and disposed of at an approved on-shore landfill. Treatment of water removed from the sediment will be conducted as necessary prior to discharge to the bay or to a POTW. Capping would be conducted for stations G25 and G29 (Figure 4-3) because these areas are beneath Pier 2 and dredging of these cells would likely prove to be extremely difficult and possibly ineffective.

LUCs would be implemented for capped cells beneath Pier 2 to ensure that if future proposed work to demolish or restore the pier is intrusive or could undermine the cap's integrity the Navy would be required to obtain concurrence before taking actions that may compromise the cap (i.e. obtain USEPA Region I concurrence, in consultation with the State of Rhode Island, prior to modifying or terminating the LUCs or implementation actions). Additionally, LUCs and LTM would be implemented throughout the entire study area to ensure RAOs continue to be met over time. The Navy would prevent exposure to potential asbestos in shipyard sediment through development of precautionary measures and safe work practices, which would be described in the LUC documentation established for other COCs remaining at the site.

If the Navy property is ever transferred out of federal control and restrictions for Coddington Cove are deemed necessary to the continued viability of the remedy at that time, the Navy will as part of the transfer process coordinate with federal and state authorities to determine what use restrictions can be imposed on the cove, which is state-owned, to prevent disturbance to areas with contaminated sediments managed under the cap. If piers are included as part of the property to be transferred, Navy will include in the deed or transfer documentation a restriction requiring that if future owners intend to make alterations to the pier (s) such as demolition, restoration or any other work that could undermine the integrity of the sediment remedy, the new owner must first obtain USEPA Region 1 concurrence, in consultation with RIDEM, and must conduct such work in a manner that does not compromise the remedy. Although the Navy may transfer the procedural LUC responsibilities to another party by contract, property transfer agreement, or through other means, the Navy will retain ultimate responsibility for remedy integrity. LUCs will be maintained until the concentrations of hazardous substances in the sediment are at such levels to allow for unlimited use and unrestricted exposure.

The disposal location for the dredged sediment would be selected based on the chemical characteristics of the sediment determined during the SSI and the disposal facilities' requirements for accepting the sediment. The sediment will be transported by truck or rail to an on-shore landfill(s) licensed to accept the waste.

The affected areas are all within the designated port and are likely to be within areas that have been previously altered by port construction or maintenance activities. However, if wetland resource areas or special habitats are damaged either directly or inadvertently through the execution of the dredging and

backfill efforts or the cap construction, those resource areas would be mitigated following completion of the remedial action.

Because COC concentrations in excess of the PRGs would remain in the capped areas under Pier 2, 5-year reviews and long-term O&M of the capped areas would be required. LTM would be conducted on the open water areas to ensure that concentrations of COCs remain below PRGs over time. An analysis of this alternative with respect to the evaluation criteria is as follows:

Overall Protection of Human Health and the Environment: Alternative 4 would meet the RAOs for the protection of human health and the environment through isolation or removal and appropriate disposal of target sediments. Sediment with COC concentrations exceeding the PRGs in the capped area beneath Pier 2 would be isolated but not removed, long-term maintenance of the cap system would be required to ensure the long-term effectiveness and permanence of the remedy. Off-site, the long-term protection of the environment and human health would ultimately depend on the long-term maintenance of the disposal facility by its operators. To help ensure the overall long-term protectiveness of the alternative, the waste disposed of off-site would be sent only to disposal facilities that are in compliance with all applicable permits.

Implementation of this alternative would result in increased short-term impacts to the environment due to the potential for suspension and migration of contaminated sediment during the capping and dredging operations would destroy existing biota within the impacted areas and may temporarily degrade the surrounding habitat. However these areas are anticipated to recover naturally.

Compliance with ARARs: Tables 4-10, 4-11, and 4-12 summarize chemical-, location-, and action-specific ARARs and TBCs, respectively for Alternative 4. Alternative 4, which involves capping, LUCs, and dredging for off-site disposal, achieves the RAOs and is projected to reduce COC concentrations to levels below PRGs (on a SWAC basis) which are derived, in part, from federal and state water quality chemical-specific ARARs.

Implementation of Alternative 4 would meet all state and federal location-specific ARARs by conducting the activities in accordance with wetlands, coastal resource management, endangered species, fish and wildlife protection, and historic preservation regulations. Intertidal areas will not be impacted. Mitigation of subtidal areas with special habitats such as eelgrass beds that are damaged either directly or inadvertently may be required if they are found during the work conducted.

Alternative 4 would be conducted in accordance with all identified state and federal action-specific ARARs. The action-specific ARARs identified for this alternative include federal and state requirements for

identification, listing, and disposal of hazardous wastes, CWA requirements for discharges to surface water, and CAA requirements for emissions monitoring.

Best engineering practices would be used to minimize sediment suspension and COC migration during capping and dredging. Federal and state hazardous and toxic waste handling requirements would be used to determine if any of the dredged sediment is hazardous waste. It is presumed that sediments are not regulated by RCRA based on the concentrations of contaminants measured in samples from the site. The remedy will meet the TSCA standards as long as the remedy remains protective. A finding on whether the remedy is protective under TSCA will be provided in the ROD.

Long-Term Effectiveness and Permanence: This alternative would reduce risks to humans and marine biota by removing or isolating (capping) target sediment to achieve RAOs. Confirmation sampling, LUCs and monitoring are included to address uncertainty in the success of the remedy.

For sediments disposed of off-site, the long-term protection of the environment and human health would ultimately depend on the long-term maintenance of the disposal facility by its operators. To ensure the overall long-term protectiveness of the alternative, the waste disposed of off-site would be sent only to disposal facilities that are in compliance with all applicable permits.

Where sediments are isolated and not permanently removed, the need for long-term management of remaining contaminated sediments would exist. The cap would be designed to ensure that the target sediment areas are fully contained, not vulnerable to bioturbation by deep burrowing organisms, and resistant to erosion. The area proposed for capping is a low-energy marine environment, cap maintenance should pose minimal difficulty, and there is a high potential that the cap will remain effective for long-term containment of COCs. Collection of physical and chemical characterization data for the sediments and areas to be capped would help ensure that the cap design is adequate.

Following implementation, the cap would have to be routinely monitored and maintained to ensure that the contaminated sediments are effectively isolated to assure long-term effectiveness.

Reduction in Toxicity, Mobility, or Volume through Treatment: This alternative would not include any treatment as a principal element in the action; therefore it would not reduce the toxicity, mobility, or volume through treatment. Treatment of the removed sediment would be limited to removal of free liquids and possible addition of bulking or stabilization agents for land disposal. As such, this alternative provides some reduction of toxicity, and mobility, though not volume. Treatment of water prior to discharge to Narragansett Bay or POTW may be necessary to meet discharge requirements.

Short-Term Effectiveness: Implementation of this alternative would result in increased short-term impacts to the environment, including the destruction of existing biota within the capping and dredging areas and suspension of contaminated sediment that may degrade aquatic habitat or affect biota in the surrounding area. These impacts would be partially mitigated through proper RD and effective execution of that design (selection of the least disruptive capping/dredging methods possible for the site conditions and effective use of turbidity control measures).

Natural restoration of the aquatic habitat within the dredged and backfilled areas would be expected to occur within a few years. The time required for restoration of the backfilled and capped areas would be dependent on the materials used. If materials similar to the existing substrate can be used, the habitat may regenerate more quickly than in dredged areas (USEPA, 2005). In the long-term, natural rehabilitation is expected to replace whatever aquatic habitat functions and values that the area supports. Potential exposures of on-site workers to COCs during capping/dredging and handling activities would be minimized through the use of personal protective equipment (PPE) and proper engineering controls that are standard in the industry.

Implementability: Implementation of this alternative would require a significant effort, both administratively and technically. The major factor affecting ease of implementation includes securing site access and a shoreline staging area. Obtaining approval for disposal in an on-shore landfill would not be complicated. It is assumed that there would be easy access to the affected areas (to be capped or dredged) from the shore and with barge-mounted equipment because at least part of Pier 1 and the on-shore portions of the site would be available as staging areas.

Implementation of capping is complicated given the imprecision of the action and the subaqueous location in waters of depth between 15 and 25 ft. Capping under Pier 2 will be further complicated by the presence of the pier which allows only three feet of work space between the water level and the decking during high tides. Equipment must be guided remotely, and visual confirmation of completion is difficult. For capping, a minimum depth of cap throughout the capped area must be achieved and would have to be verified by single beam bathymetric surveys. Capping is a proven and reliable technology, although underwater implementation presents additional challenges. To minimize dispersion of the contaminated sediments during cap installation, placement of cap materials would need to occur by slow, uniform placement of layers to minimize resuspension. Cap materials, which may be comprised of common fill materials, are readily available for purchase. The type and size of fill materials would be selected during the RD [based on the characteristics of the native sediment and the area to be capped.

The area proposed for capping is in a low-energy marine environment, protected by the pier and pilings. Cap construction is not expected to be impacted by currents or wave action, and there is a high potential

that the cap will remain effective for long-term containment of COCs in the target areas. Capping is implementable by local marine contracting companies with trained personnel familiar with this process.

Implementation of dredging is complicated given the imprecision of dredging equipment, particularly in a deep-water port environment. Equipment must be guided remotely, and visual confirmation of completion is difficult. A significant amount of over-dredging, both vertical and horizontal, is necessary to assure the minimum target depths are achieved within the designated areas. Implementation of the sediment dewatering and water treatment operations would increase the complexity of implementing this alternative, however, it is anticipated that space would be available for these actions as well. The nature and grain-size distribution of the sediment could greatly impact the success of the dewatering process.

The State of Rhode Island generally requires dredging projects to be conducted between November 1 and January 15 to protect sensitive species. The Navy would investigate the affected areas to determine potential impacts from remedial actions during different times of the year and would coordinate with natural resource agencies to minimize disturbance to aquatic species.

Implementation of Alternative 4 would generate a significant amount of material for disposal (anticipated to be 14,016 cubic yards). It is anticipated that adequate capacity would be available in landfills licensed to accept the site sediment although out of state disposal may be required. The chemical characteristics of the sediment are not anticipated to complicate the selection of an on-shore disposal facility; however, dewatering would likely be required and a large on-shore area would be required for processing and staging removed sediment prior to disposal.

LUCs implemented at the capping area beneath Pier 2 would require future remediation of those areas if the pier is ever reconstructed or demolished and there is a potential to impact the remedy. The Navy will prevent exposure to potential asbestos in dredged shipyard sediment through development of documented precautionary measures and safe work practices. These safe work practices will be described in the LUC documentation established for the COCs that remain at the site under this alternative.

Cost: A detailed estimate of capital, O&M, and present-worth costs for Alternative 4 is provided in Appendix E and summarized below. Present-worth costs were developed for a 30-year period at a 2 percent discount rate (30-year real interest rate per OMB circular No. A-94, December 2010). The baseline assumptions for estimating the cost of this alternative are that 14,016 cubic yards of sediment would be dredged and disposed of on-shore, and an area of approximately 83,574 sq. ft. (1.9 acres) would be capped requiring 8,794 cubic yards of material. The 5-year review costs include a bathymetric survey of the capped areas.

Cost Item	Alternative 4
Capital Costs	$ 11,954,590
O&M/LTM (annual)	$ 34,355
5-Year Reviews	$ 266,825
Total Present Worth	$ 13,795,406

4.3.5 Alternative 5: Target Dredging and Backfill

Alternative 5 will achieve RAOs through removal or isolation of contaminated sediments. The removal of sediment from target areas in open water, and the isolation of sediment beneath an engineered cap at target areas beneath Pier 2, is projected to reduce SWACs for all COCs. The projected SWAC values will be confirmed after dredging using the results of the confirmation samples. In addition to removal and isolation of target areas, a monitoring program and LUCs would be established for capped areas to ensure appropriate maintenance and sustained protection. The Navy would prevent exposure to potential asbestos in shipyard sediment through development of precautionary measures and safe work practices, which would be described in the LUC documentation established for COCs remaining at the site.

If the Navy property is ever transferred out of federal control and restrictions for Coddington Cove are deemed necessary to the continued viability of the remedy at that time, the Navy will as part of the transfer process coordinate with federal and state authorities to determine what use restrictions can be imposed on the cove, which is state-owned, to prevent disturbance to areas with contaminated sediments managed under the cap. If piers are included as part of the property to be transferred, Navy will include in the deed or transfer documentation a restriction requiring that if future owners intend to make alterations to the pier (s) such as demolition, restoration or any other work that could undermine the integrity of the sediment remedy, the new owner must first obtain USEPA Region 1 concurrence, in consultation with RIDEM, and must conduct such work in a manner that does not compromise the remedy. Although the Navy may transfer the procedural LUC responsibilities to another party by contract, property transfer agreement, or through other means, the Navy will retain ultimate responsibility for remedy integrity. LUCs will be maintained until the concentrations of hazardous substances in the sediment are at such levels to allow for unlimited use and unrestricted exposure.

Figure 4-4 presents dredge areas and depths of proposed dredging under Alternative 5. Removal will also include testing and dewatering the removed materials as required for disposal, and disposing of the sediment at an approved on-shore landfill. Treatment of water removed from the sediment is likely to be necessary prior to discharge to the bay or to a POTW. Target areas to receive a 1 to 2 foot engineered barrier (cap) include G25 and G29.

The disposal location for the dredged sediment would be selected based on the chemical characteristics of the sediment determined during the SSI and the disposal facilities' requirements for accepting the sediment. The sediment would be transported by truck or rail to an on-shore landfill(s) permitted to accept the waste.

The affected areas are all within the designated port and are likely to be within areas that have been previously altered by port construction or maintenance activities. However, if wetland resource areas or special habitats are damaged either directly or inadvertently through the execution of the dredging efforts, those resource areas would be mitigated following completion of the dredging action. The SWAC for all COCs would be below PRGs, though five-year reviews and LTM would be required for cover areas under Pier 2. An analysis of this alternative with respect to the evaluation criteria is as follows:

Overall Protection of Human Health and the Environment: Alternative 5 would achieve the RAOs for the protection of human health and the environment through bulk removal and isolation of target sediment that is projected to reduce SWACs to levels below PRGs for all COCs. LUCs, long-term maintenance, monitoring, and five year reviews would be required for capped areas beneath Pier 2; additionally, potential for exposure to asbestos will be addressed through safe work practices as noted in the LUC documentation. Five year reviews, monitoring, maintenance, or LUCs would not be required for uncapped areas throughout the site with regards to the four main COCs (benzo(a)pyrene, PAHs, PCBs, and lead) since SWACs are projected to reach levels below PRGs.The long-term protection of the environment and human health due to disposal of dredged material would ultimately depend on the maintenance of the disposal facility. To help ensure the overall long-term protectiveness of the alternative, the waste disposed of off-site would be sent only to disposal facilities that are in compliance with all applicable permits.

Compliance with ARARs: Tables 4-13, 4-14, and 4-15 summarize chemical, location, and action-specific ARARs and TBCs, respectively for Alternative 5. Alternative 5, which involves dredging, permanent removal, LUC, LTM, and capping, meets the RAOs and is projected to reduce the COC concentrations adequately (on a SWAC basis) which are derived from federal and state water quality chemical-specific ARARs.

Implementation of Alternative 5 would meet all state and federal location-specific ARARs by conducting the activities in accordance with wetlands, coastal resource management, endangered species, fish and wildlife protection, and historic preservation regulations. Mitigation of special habitats such as eelgrass beds that are damaged either directly or inadvertently may be required.

Alternative 5 would be conducted in accordance with all identified state and federal action-specific ARARs. The action-specific ARARs identified for this alternative include federal and state requirements for

identification, listing, and disposal of hazardous and nonhazardous wastes, CWA requirements for discharges to surface water, and CAA requirements for emissions monitoring.

Best engineering practices would be used to minimize sediment suspension and COC migration during capping and dredging. Federal and state hazardous and toxic waste handling requirements would be followed to determine if any of the sediment is hazardous waste. It is presumed that sediments are not regulated by RCRA because none of the materials are listed or characterized as RCRA hazardous waste. The remedy will meet the TSCA standards as long as the cover remains intact and the remedy remains protective. A finding on whether the remedy is protective under TSCA will be provided in the ROD. Any sediment that is excavated from beneath the Piers will be managed considering the fact that it potentially contains asbestos, and will be tested, handled and disposed of as appropriate following applicable asbestos standards.

Long-Term Effectiveness and Permanence: The removal, disposal, and cap alternative would eliminate unacceptable risks to humans and marine biota by reducing SWACs to levels below PRGs (confirmed with confirmation sampling); additionally, potential for exposure to asbestos will be addressed through safe work practices as noted in the LUC documentation established for COCs remaining at the site. Disposal of contaminated sediment off-site would eliminate the need for long-term management of untreated sediments or residuals on-site in open water areas; and the engineered cap placed on target areas beneath Pier 2 would serve to isolate contaminated sediment from ecological receptors. For sediments disposed of off-site, the long-term protection of the environment and human health would ultimately depend on the long-term maintenance of the disposal facility by its operators. To ensure the overall long-term protectiveness of the alternative, the waste disposed of off-site would be sent only to disposal facilities that are in compliance with all applicable permits.

Reduction in Toxicity, Mobility, or Volume through Treatment: This alternative would not include any treatment as a principal element in the action; therefore it would not reduce the toxicity, mobility, or volume through treatment. Treatment of the removed sediment would be limited to removal of free liquids and possible addition of bulking or stabilization agents for the land disposal facility. As such, this alternative provides some reduction of toxicity, and mobility, though not volume. Treatment of water prior to discharge to Narragansett Bay or POTW would be necessary to meet discharge requirements.

Short-Term Effectiveness: Implementation of this alternative would result in increased short-term risks, including the destruction of existing biota within the impacted area and suspension of contaminated sediment that may degrade aquatic habitat or affect biota in the surrounding area. These impacts would be partially mitigated through proper design and implementation of the remedy (i.e. selection of the least disruptive dredging methods practical for the site and effective use of turbidity control measures). In the long-term, natural rehabilitation is expected to replace whatever aquatic habitat functions and values that

the area can support. Potential exposures of on-site workers to COCs during dredging and handling activities would be minimized through the use of PPE and proper engineering controls that are standard in the industry.

Implementability: Implementation of this alternative would require a significant effort, both administratively and technically. The major factor affecting ease of implementation includes securing site access and a shoreline staging area. Obtaining approval for disposal in an on-shore landfill would not be complicated though transportation will be a significant effort. It is assumed that there would be easy access to the affected areas (to be capped or dredged) from the shore and with barge-mounted equipment because at least part of Pier 1 and the on-shore portions of the site would be available as staging areas.

Implementation of capping under Pier 2 is expected to be complicated given the imprecision of the action and the subaqueous location in waters of depth between 15 and 25 ft. Capping under this alternative will be further complicated by the presence of the pier which allows only three feet of work space between the water level and the decking during high tides. Equipment must be guided remotely, and visual confirmation of completion is difficult. For capping, a minimum depth of cap throughout the capped area must be achieved and would have to be verified by single beam bathymetric surveys. Capping is a proven and reliable technology, although underwater implementation presents additional challenges. To minimize dispersion of the contaminated sediments during cap installation, placement of cap materials would need to occur by slow, uniform placement of layers to minimize resuspension. Cap materials, which may be comprised of common fill materials, are readily available for purchase. The type and size of fill materials would be selected during the RD [based on the characteristics of the native sediment and the area to be capped.

The area proposed for capping is in a low-energy marine environment, cap construction is not expected to be impacted by currents or wave action, and there is a high potential that the cap will remain effective for long-term containment of COCs in the target areas. Capping is implementable by local marine contracting companies with trained personnel familiar with this process.

Implementation of dredging is complicated given the imprecision of dredging equipment, particularly in a deep-water port environment. Equipment must be guided remotely, and visual confirmation of completion is difficult. A significant amount of over-dredging, both vertical and horizontal, is necessary to assure the minimum target depths are achieved within the designated areas. Implementation of the sediment dewatering and water treatment operations would increase the complexity of implementing this alternative, however, it is anticipated that space would be available for these actions as well. The nature and grain-size distribution of the sediment could greatly impact the success of the dewatering process.

The State of Rhode Island generally requires dredging projects to be conducted between November 1 and January 15 to protect sensitive species. The Navy would investigate the affected areas to determine potential impacts from remedial actions during different times of the year and would coordinate with natural resource agencies to minimize disturbance to aquatic species.

Implementation of Alternative 5 would generate a significant amount of material for disposal. It is anticipated that adequate capacity would be available in landfills licensed to accept the site sediment although out of state disposal may be required. The chemical characteristics of the sediment are not anticipated to complicate the selection of an on-shore disposal facility; however, dewatering would likely be required and a large on-shore area would be required for processing and staging removed sediment prior to disposal.

LUCs implemented at the capping area beneath Pier 2 would require future remediation of those areas if the pier is ever reconstructed or demolished and there is a potential to impact the remedy.

Cost: A detailed estimate of capital, O&M, and present-worth costs for Alternative 5 is provided in Appendix E and summarized below. The baseline assumptions for estimating the cost of this alternative are that 25,769 cubic yards of sediment would be dredged and disposed of, and an area of approximately 83,574 sq. ft. (1.9 acres) would be capped requiring 8,794 cubic yards of material.

Cost Item	Alternative 5
Capital Costs	$ 16,980,477
O&M/LTM (annual)	$25,388
5-Year Reviews	$181,025
Total Present Worth	$ 18,328,150

4.4 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

A comparative analysis is conducted to evaluate the significant differences between the site alternatives based on the threshold and balancing criteria. This analysis is provided below and is summarized on Table 4-16.

Overall Protection of Human Health and the Environment: Note that all the remedial alternatives (except the no action alternative) are developed to reduce exposure through reduction of concentrations on an area-weighted average exposure concentration. Conceptually, Alternative 5 would provide the greatest protection of human health and the environment by providing for the greatest quantity of sediment removal. However, Alternative 4 would provide similar protection, by dredging nearly the same extent in open water areas, but utilizing clean backfill after dredging to reduce projected SWACs to levels below

PRGs for all COCs. With respect to exposures, a similar outcome would be reached under both Alternatives 4 and 5, though the effort, cost, and impact of additional removal under Alternative 5 is balanced against slightly more contaminant mass behind in Alternative 4. For both Alternatives 4 and 5 a cover in place under Pier 2 would result in a need for a LUC, but neither that control nor the cover itself would restrict the use of the port, the depth of the vessels utilizing the port, or leave a risk of exposure to the human and ecological receptors present either in the long term or the short term because of the combined presence of the cap and the pier over and around the capped sediments. If the pier is altered (removed or rebuilt) the LUC would require the design for that action to take into account removal (or re-cover) of the sediments under the pier as needed.

The Implementation of Alternatives 3, 4, and 5 would destroy the existing biota over nearly the same target areas, and could result in some resuspension and migration of sediment COCs during dredging operations. Implementation of alternative 2 may also have a similar effect on biota and habitat. Such a disruption should be considered for overall protectiveness. It is expected that the use of appropriate engineering controls and mitigation of protected habitats that become altered could reduce the long-term effects of these actions. Ultimately Alternative 2 would have the lowest impact in this regard because it relies more on ICs than removal or isolation; Alternative 3 would have slightly more of an impact because of the additional amount of cover material to be placed; and Alternatives 4 and 5 would be the most disruptive due to the amount of dredging and capping required under these alternatives.

The thin layer cover used under Alternative 2 will occupy the interval considered the biotic zone, which is where most of the exposure to receptors actually takes place (acknowledging that some ecological receptors burrow deeper). After adequate cover accumulates, protection is fully ensured by the further deposition of sediment over the top of this cover material. A time frame is not defined for this achievement, and such a period could be greater than 30 years; monitoring of depositional rates, as included in the alternative, would provide more detailed information on the effectiveness of the remedy in regards to compliance with ARARs and effectiveness would be reviewed every 5 years as part of the 5 year review process under the IRP.

Off-site disposal of the sediment removed under Alternatives 4 and 5 would eliminate the need for long-term management of untreated sediments in open water areas on-site that would be required under Alternatives 2 and 3; however, under both Alternatives there would be some need for long term management of untreated sediments left beneath Pier 2. Full encapsulation of sediment as a part of Alternative 3 (and Alternatives 4 and 5 beneath Pier 2) would provide more protection than that provided under Alternative 2.

Considering the difficulties and suspension issues associated with the different alternatives, Alternatives 4 and 5 are both ranked as protective in both the short term and long term: both alternatives require

monitoring over time for a small portion of the site beneath Pier 2. Alternative 5 would remove a larger volume of sediment, but is also likely to cause greater disruption, resuspension, and potential for COC migration during dredging. Alternative 3 is ranked as slightly less protective in the short and long term, acknowledging that more sediment above PRGs remains on site, whereas Alternative 2 is ranked as least protective in the short term, though this protectiveness is expected to improve over time, as the cover is enhanced naturally by monitored deposition. However, despite the improvement, Alternative 2 would remain less protective than Alternatives 4 or 5. Alternatives 2 and 3 rely heavily upon ICs to remain protective in the long term. Additionally, there is some uncertainty as to the effectiveness of Alternative 2 due to a lack of data regarding deposition rates within the study area and it would require a monitoring aspect to ensure proper natural cover is occurring. Alternative 1 is considered not protective of human health or the environment because no actions would be taken to mitigate the identified risks.

Compliance with ARARs: Alternatives 2, 3, 4, and 5 can be performed in accordance with ARARs. However, Alternative 2 may take an extended timeframe to fully comply with chemical-specific ARARs because it relies on continued natural recovery to occur over time through sedimentation over the thin layer cover. Alternative 1 fails to meet sediment PRGs that have been derived from federal and state water quality chemical-specific ARARs. There are no location-specific or action-specific ARARs for this alternative. Dredging and covering operations under Alternatives 2-5 will require consultation with natural resource agencies to minimize disturbance to aquatic species. Coordination of operational portions of dredging, dewatering, treatment of water can be accomplished through proper planning and communication during design and construction.

Long-Term Effectiveness and Permanence: Alternatives 3, 4, and 5 would offer similar degrees of reduction of the risks to the aquatic receptors, though in different ways. Each of these alternatives reduces exposure to COCs in surface sediment by ecological receptors either through the removal of that sediment and placement of backfill, addition of an engineered cap that acts as a new surface interval, or both removal of sediment without backfill (or a combination of these actions).

There is slightly less certainty in the long-term effectiveness and permanence of Alternative 3 because it was developed to achieve projected SWACs below PRGs while relying on ICs to protect the remedy so the contaminated sediment beneath the engineered cap will not become exposed. LUCs would be effective in limiting human actions such as deep draft ship traffic, or dragging nets or traps along the bottom for fishing; but LUCs would not be able to prevent disturbance of the cap from natural phenomena such as major storm events. Alternative 3 could provide the same level of protection as Alternative 4 provided that the long-term effectiveness of the cap is maintained and managed by the LUCs, and that the cap design could effectively withstand a 100 year storm event. The area to be capped is a low-energy marine environment, and there is a high potential that a well-designed cap would remain effective permanently. Alternatives 2-5 would require 5-year reviews.

Alternatives 4 and 5 would be considered the most effective long term, although Alternative 5 slightly more so than Alternative 4. Under both alternatives SWACs are projected to be reduced to levels below PRGs, but under Alternative 4 the use of backfill after dredging requires less dredging to achieve projected SWACs; under Alternative 5 there is no backfill so additional dredging is required to reach projected SWACs below PRGs. Alternatives 4 and 5 would both require 5 year reviews because of the volume of contaminated sediment left beneath Pier 2; the remainder of the site will have achieved RAOs. The Navy will prevent exposure to potential asbestos in dredged shipyard sediment through precautionary measures and safe work practices that will be described in the LUC documentation established for the COCs that remain at the site. Under Alternatives 4 and 5 open water areas would not be addressed during 5 year reviews or require long term monitoring.

Alternative 2 would provide long-term protection of ecological receptors, provided that it is confirmed that the area remains a low-energy environment (and as long as the cover remains intact) and that deposition of sediment is occurring at a rate rapid enough to achieve a protective cap within a reasonable duration. There is some uncertainty regarding deposition rates within the study area but monitoring would be required to document deposition, in addition to COC levels in the sediment, providing a means to determine whether site conditions improve or deteriorate and whether any additional actions are required to protect human health or the environment. Additionally, implementation of LUCs would protect human health for the foreseeable future by restricting access and activity within Coddington Cove. Overall Alternative 2 is considered less effective than Alternatives 3, 4, or 5 due to the uncertainty surrounding the depositional qualities of the site.

Alternative 1 would provide no long-term effectiveness and permanence in addressing sediment contamination at the site.

Reduction in Toxicity, Mobility or Volume through Treatment: Alternatives 4 and 5 provide partial treatment of waste generated and disposed of off-site through use of bulking and dewatering agents. Thus Alternatives 4 and 5 provide some reduction of toxicity, and mobility, though not volume through this treatment. Alternatives 1, 2 and 3 do not provide any reduction in toxicity, mobility, or volume through treatment options.

Short-Term Effectiveness: The no-action alternative (Alternative 1) would offer no change in short-term risks. Implementation of Alternatives 2, 3, 4, or 5 would result in short-term human and environmental impacts from capping (Alternatives 2, 3, 4, and 5), dredging/backfilling (Alternatives 4), dredging (Alternative 5) and handling operations.

Alternative 5 provides the greatest risk to the community and environment due to the larger quantity of sediment to be dredged and handled. Proper use of PPE would minimize human risks from direct contact

with contaminated sediment. Use of appropriate engineering controls would reduce, but not eliminate, environmental impacts caused by resuspension and transport of sediment during capping or dredging and backfilling operations. Alternative 4 would have similar risks due to the similarity of the alternatives but to a lesser extent because there would be less volume dredged, handled, and disposed of. Under Alternatives 2 and 3 risk to the community or onsite workers would be minimal because contaminated sediment would remain in place (under cover or cap).

Short-term destruction of marine biota would occur under Alternatives 2, 3, 4 and 5, but natural processes would restore the natural communities that the area can support. The short-term impacts would be similar for Alternatives 2, 3, 4 and 5, though these impacts are greater for alternatives 4 and 5 due to the increased level of activity. The rate of natural habitat restoration in the backfilled, capped, and dredged areas would be the same. The rate of natural habitat restoration in the areas backfilled or capped is highly dependent on materials used. Alternative 2 exposes the community and environment to the least amount of risk since it would utilize the least amount of invasive activities to achieve the RAOs; Alternative 3 is only slightly more invasive, but achieves RAOs immediately after cap placement rather than relying on additional deposition to achieve 1 foot of cover.

Implementability: The no-action alternative is the most readily implementable in a technical sense. It would require no construction activities. Alternative 1 would not be implementable in an administrative sense because it does not meet the threshold evaluation criteria for protecting human health and the environment and meeting ARARs.

Alternatives 2 and 3 would be significantly more difficult to implement than Alternative 1, utilizing barges scows, and other equipment to broadcast cover materials over the target areas. These operations and the LTM program are readily implementable given the availability of services in the Rhode Island scientific/technical community. Placement of a thin layer cover or cap would require transport and installation of substrate material as well as development and use of a staging area, but installation of the thin layer cover would require less time and effort than Alternatives 3, 4, and 5. Installation of an engineered cap would require less time and effort than Alternatives 4 and 5.

Alternatives 4 and 5 would be more difficult to implement than Alternatives 2 and 3, because of the technical complication of dredging in open water areas. However, these alternatives would be possible because of the availability of qualified marine contractors to conduct site dredging, backfilling, and capping activities using barge-mounted or shore-based equipment. Capping and dredging/backfill or dredging operations of this type are moderately difficult to implement, due to the imprecision of the technology and the location in relatively deep waters. Some margin of error (improper horizontal extents of a cap, dredging clean sediments or not dredging contaminated sediments) will need to be addressed. Additionally, there is some uncertainty as to the effectiveness of cap material placement on the soft

sediment found beneath Pier 2; this will have to be considered during the design stage. Some restrictions on the seasonality of the dredging work may need to be adhered to. Bathymetric surveys would need to be conducted during dredging, backfilling and capping operations to ensure proper areas and depths were remedied and these services are also readily available.

Alternative 5 does not require backfill after dredging, but this alternative would require dredging to greater depths, effectively providing almost a balance of implementability between the two.

On-shore disposal for Alternatives 4 and 5 would be required and is readily implementable. It is anticipated that adequate capacity would be available in landfills permitted to accept the site sediment; although, out of state disposal may be required. The chemical characteristics of the sediment are not anticipated to complicate the selection of an on-shore disposal facility; however, additional dewatering would likely be required and a larger on-shore area would be required for processing and staging removed sediment prior to disposal.

Implementation of any of these alternatives would not prevent the implementation of any future remedial actions if required; however, the thin layer cover or cap systems proposed under Alternatives 2 and 3 may hinder future dredging operations or port maintenance, and capping beneath Pier 2 as specified under Alternatives 4 and 5 may hinder future construction or demolition of the pier.

Cost: Capital, O&M, present worth costs, and cost sensitivity analyses for the four site alternatives is summarized below.

Costs	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Capital	$ 0	$ 3,108,057	$ 4,939,678	$ 11,954,590	$ 16,980,447
Annual O&M	$ 0	$ 39,182	$ 39,182	$ 34,355	$ 25,388
5-Year Reviews	$ 0	$ 287,489	$ 439,433	$ 266,825	$ 181,025
Total 30-Year Net Present Worth	$ 0	$ 5,222,851	$ 7,708,390	$ 13,795,406	$ 18,328,150

TABLES

TABLE ES-1
SUMMARY OF REMEDIAL ALTERNATIVES
FEASIBILITY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Criteria	Alternative SD1 No Action	Alternative SD2 Enhanced Natural Recovery, LUCs, Monitoring	Alternative SD3 In-Situ Cap, LUCs, Monitoring	Alternative SD4 Dredge/Backfill, In-Situ Cap, LUCs, Monitoring	Alternative SD5 Dredge, In-Situ Cap, LUCs, Monitoring
THRESHOLD CRITERIA					
Overall Protection of Human Health and the Environment	No	Partially[1]	Yes	Yes	Yes
Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)	No	Partially[1]	Yes	Yes	Yes
BALANCING CRITERIA					
Does Alternative Reduce Residual Risk?	No	Partially[1]	Yes	Yes	Yes
Does Alternative Reduce Toxicity, Mobility, or Volume through Treatment	No	No	No	Potential treatment of sediment to be disposed	Potential treatment of sediment to be disposed
Short-Term Effectiveness: Time until Remedial Action Objectives Achieved	N/A	1 – 2 years (partial) 15 – 30 years (full)	1 – 2 Years	3 Years	3 Years
Implementability: Constructable?	No construction activities	Yes	Yes	Yes	Yes
Total Present Worth Project Costs	$ 0	$ 5,200,000	$ 7,700,000	$ 13,800,000	$ 18,300,000

1 – This alternative relies on natural depositional processes to full protect human health and the environment. There is some uncertainty surrounding the physical/geophysical characteristics at the site, so this alternative is said to only partially meet protection goals initially.

TABLE 1-1
HISTORIC SEDIMENT INVESTIGATIONS
FEASIBILITY STUDY
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

REPORT	DATE	SUMMARY
Preliminary Assessment Report, ENSR Consulting and Engineering, and Haliburton NUS Corporation	1993	Preliminary onshore investigation/inspection
Chemical Contaminants in Marine Sediments from the Former Drecktor Shipyard Site at Coddington Cove, Quinn et al, URI GSO & Texas A&M GERG	1994	Sediment samples collected for organic and inorganic chemical analysis. Biota sample collected and analyzed.
Derecktor Shipyard Marine Ecological Risk Assessment Report, SAIC and URI	1997	Sediment samples for organic and inorganic chemical analysis, elutriate analysis, toxicity studies, and benthic infaunal analysis; biota sampling and analysis conducted.
Marine Human Health Risk Assessment, Off-Shore Areas of the Former Robert E. Derecktor Shipyard, Tetra Tech, Inc.	1998	Marine ERA data used for development of the Marine HHRA
Stillwater Basin Evaluation Report, Former Robert E. Derecktor Shipyard/Coddington Cove, (draft) Tetra Tech, Inc.	1998	Performed bottom image recording, side scan sonar imaging, benthic community growth assessment, and outfall water sampling.
Marine Sediment Sampling and Analysis Report, for Former Robert E. Derecktor Shipyard, Tetra Tech, Inc.	2005	Surface and subsurface sediment sampling from 25 stations (previously sampled) throughout Coddington Cove and from reference locations.
Supplemental Sediment Investigation Report for Installation Restoration Site 19 - Former Derecktor Shipyard, Tetra Tech, Inc.	2012	Surface and subsurface sediment sampling from 119 locations within the site; sediment physical investigation including ADCP monitoring for 14 days, Pb-210 analysis, sed-flume analysis, bathymetric analysis, and grainsize analysis.

TABLE 1-2
HISTORICAL PRG EXCEEDANCES FOR SEDIMENT
FEASIBILITY STUDY
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Sample Location	Compairson Criteria - See Text	DSY-02			DSY-03		DSY-18	DSY-20		DSY-27			
Sample Number		DSY-2	DSY-SD-02-082504	DSY-SD-DUP01-	DSY-3	DSY-SD-03-082604	DSY-18	DSY-20	DSY-SD-20-082604	DSY-27-SUR	DSY-V9-MID	DSY-V9-BOT	DSY-SD-27-082604
Date Sampled		11/3/1993	8/25/2004	8/25/2004	11/3/1993	8/26/2004	6/13/1994	6/13/1994	8/26/2004	10/12/1995	1/11/1996	1/11/1996	8/26/2004
Depth Sampled (feet)		0 - 0.1	0 - 0.5	0 - 0.5	0 - 0.1	0 - 0.5	0 - 0.1	0 - 0.1	0 - 0.5	0 - 0.5	0.3 - 0.7	1.3 - 1.5	0 - 0.5
BENZO(A)PYRENE (UG/KG)	**539**	**3320**	160 J	200 J	**4710**	**1000**	**1190**	**880**	230 J	**924**	**2380**	236	530
HIGH MOLECULAR WEIGHT PAHS (UG/KG)	**13903**	**63994**	1392	1650	**72956**	9760	12860	**20406**	2048	5527	**21497**	2075	3796
TOTAL PCBs[1] (UG/KG)	**1060**	209	114	106	733	349	293	367	202	**3310**	**1380**	91	**2960**
LEAD (MG/KG)	**168**	**181**	48.2 J	50.8 J	**201**	114 J	60	77	47.9 J	151	**182**	16	138 J

Sample Location	Compairson Criteria - See Text	DSY-28						DSY-29				
Sample Number		DSY-28-SUR	DSY-28-MID	DSY-28-BOT	DSY-V4-MID	DSY-V4-BOT	DSY-SD-28-082504	DSY-29-SUR	DSY-29-SUR-D	DSY-29-MID	DSY-29-BOT	DSY-SD-29-082604
Date Sampled		10/19/1995	11/16/1995	11/16/1995	1/11/1996	1/11/1996	8/25/2004	10/19/1995	10/19/1995	11/16/1995	11/16/1995	8/26/2004
Depth Sampled (feet)		0 - 0.5	0.8 - 1.1	2.5 - 2.8	3.4 - 3.8	4.3 - 4.6	0 - 0.5	0 - 0.5	0 - 0.5	0.5 - 0.9	1.4 - 1.8	0 - 0.5
BENZO(A)PYRENE (UG/KG)	**539**	377	**698**	**4130**	0.00	6	220 J	**2380**	**3200**	**1550**	10	**1200**
HIGH MOLECULAR WEIGHT PAHS (UG/KG)	**13903**	2210	4116	**34321**	19	65	1656	**18467**	**28223**	11413	82	10970
TOTAL PCBs[1] (UG/KG)	**1060**	134	430	204	17	7	80	546	936	81	3	410
LEAD (MG/KG)	**168**	78	148	**193**	16	13	51.3 J	**186**	**173**	87	19	113 J

Sample Location	Compairson Criteria - See Text	DSY-30			DSY-SD-103		MCA-JCC-MD-01 (Reference Station)				
Sample Number		DSY-30-SUR	DSY-30-MID	DSY-30-BOT	DSY-SD-103-0006	DSY-SD-103-0612	JCC-D1-SUR	JCC-M1	JCC-D1-MID	JCC-D1-BOT	DSY-SD-CC01-082604
Date Sampled		10/12/1995	11/16/1995	11/16/1995	8/25/2004	8/25/2004	8/29/1994	8/29/1994	6/1/1995	6/1/1995	8/26/2004
Depth Sampled (feet)		0 - 0.5	0.6 - 0.9	2.2 - 2.6	0 - 0.5	0.5 - 1.0	0 - 0.1	0 - 0.1	0.3 - 0.4	1.5 - 1.6	0 - 0.5
BENZO(A)PYRENE (UG/KG)	**539**	**812**	138	2	360	**1400**	10	10	**3000**	1	270 J
HIGH MOLECULAR WEIGHT PAHS (UG/KG)	**13903**	5594	847	9	4223	**23070**	117	117	**24703**	8	2461
TOTAL PCBs[1] (UG/KG)	**1060**	315	13	5	764	749	15	11	20	4	6
LEAD (MG/KG)	**168**	80	35	22	71.6 J	168 J	23	23	25	17	9.6 J

Data is shown only for sample stations that had exceedance of at least one PRG in historical or 2004 data. Refer to Appendix C for complete data.

Refer to Appendix D for details of PRG selection.

1. TOTAL PCBs = Sum of PCB Congeners X 2 (ug/kg)

2. Shading in Recommended PRG column indicates that RPRG was exceeded in at least one historical sample.

YELLOW SHADING 1-2 X RPRG;ORANGE SHADING 2-5 X RPRG;
RED SHADING 5-10 X RPRG; PURPLE SHADING >10 X RPRG;GREY SHADING <1 X RPRG;
U-NOT DETECTED;J-QUANT. APPROX;R-REJECTED; NA-NOT ANALYZED

TABLE 1-3
SUMMARY OF THE FINDINGS OF THE ECOLOGICAL RISK ASSESSMENT
FEASIBILITY STUDY
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

STATION	LINES OF EVIDENCE										OVERALL RISK PROBABILITY RANKING[10]
	EXPOSURE					EFFECTS					
	Sediment Hazard Quotients [1]	Elutriate HQs[2]	SEM and AVS[3]	Tissue Conc. Ratio[4]	Rank[9]	Tissue Residue Effects[5]	Laboratory Toxicity[6]	Field Effects[7]	Avian Predators[8]	Rank[9]	
DSY-24				++	I	+		-	+	L	**Intermediate**
DSY-25	+	+	-	+++	I	++	+	++	+	I	**Intermediate**
DSY-26	+		-	+++	I	+	++	++	+	I	**Intermediate**
DSY-27	+++	+	+	+++	H	+++	-	++	+	H	**HIGH**
DSY-28	+		+	++	L	+	++	+	++	I	**Intermediate**
DSY-29	+++	+	+	++	H	+++	++	+++	++	H	**HIGH**
DSY-30	+		+		L		-	+		B	Low
DSY-31	+++	+	-	+	I	+	+	+	+	L	**Intermediate**
DSY-32	+	+	-	+	L	+	+	++	+	L	Low
DSY-33	-	+	+	+	L	++	+	++	+	I	**Intermediate**
DSY-34	+		-	+	L	+	-	-	+	L	Low
DSY-35	-		+	+	L	++	-	-	+	L	Low
DSY-36	+	+	-	++	L	+	-	+	++	L	Low
DSY-37	+	+	+	+	L	+	+	-	+	L	Low
DSY-38	+	+	-	+	L	++	+	+	+	L	Low
DSY-39	+	+	-	+	L	++	+	+	+	L	Low
DSY-40	+	+	-	+	L	+	-	+++	+	I	**Intermediate**
DSY-41	-	+	-	+	L	+	+	+++	+	I	**Intermediate**
JPC-1	-	+	-		B	+++	-	-	+	I	Low
JPC-2	-		+		B		-	-	+	B	Baseline
CHC-1						+++		-		I	**Intermediate**

TABLE 1-3
SUMMARY OF THE FINDINGS OF THE ECOLOGICAL RISK ASSESSMENT
FEASIBILITY STUDY
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Notes:

1 Sediment Hazard Quotient Risk Ranking: see ERA Table 6.6-1.

2 Elutriate Hazard Quotient Risk Ranking: see ERA Table 6.6-1.

3 SEM and AVS Risk Ranking: see ERA Table 6.6-1.

4 Tissue Concentration Ratios Risk Ranking: see ERA Table 6.6-1.

5 Tissue-based Risk Ranking: Based on Site vs. Reference Tissue Concentration Ratio (ERA Table 6.6-1), Tissue Screening Concentration (ERA Table 6.6-2) and Critical Body Residues (ERA Table 6.6-2).

6 Laboratory Toxicity Risk Ranking: see ERA Table 6.6-2.

7 Field Effects Ranking: Based on results of Condition Index, Benthic Community Structure. Hematopoietic neoplasia, cytochrome P450, and fecal pollution indicators; see ERA Table 6.6-2.

8 Avian Predator effects ranking based on Toxicity Reference Value Hazard Quotients; see ERA Table 6.6-2.

9 Overall Exposure/Effects (E/E) Ranking: B = Baseline Risk; L = Low Risk Probability; I = Intermediate Risk Probability; H = High Risk Probability
B = Low (+) E/E ranking observed for only one indicator or baseline E/E ranking observed for all indicators;
L = Intermediate (++) E/E ranking observed for only one indicator or low (+) E/E ranking observed for two or more indicators;
I = High (+++) E/E ranking observed for only one indicator or intermediate (++) E/E ranking observed for two or more indicators;
H = Intermediate (++) or greater E/E ranking observed for two indicators <u>including</u> high (+++) E/E ranking observed for one indicator.

10 Overall Risk Ranking (See also ERA Section 6.6): Baseline = No greater than Baseline (B) ranking for E/E WoE summaries;
Low = No greater than Low (S) ranking for E/E WoE summaries; Intermediate = No greater than intermediate (I) ranking for E/E WoE summaries, <u>or</u>
High (H) ranking for one WoE and no greater than Low (L) ranking for the other WoE summary;
High = High (H) ranking for one WoE summary and Intermediate (I) or greater ranking for the other WoE summary.

Source: SAIC and URI, May 1997: Ecological Risk Assessment - Derecktor Shipyard/Coddington Cove.

TABLE 1-4
SUMMARY OF MARINE HUMAN HEALTH RISK ASSESSMENT RESULTS
FEASIBILITY STUDY
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Exposure Scenario	Child Resident+		Adult Resident+		Subsistence Fisherman*		Trespasser Child	Trespasser Adult
	RME	CTE	RME	CTE	RME	CTE	RME	RME
CANCER RISKS								
Ingestion of Hard Shell Clams	5.1E-06	3.4E-06	**1.6E-05**	**1.1E-05**	**2.0E-04**	**1.4E-04**	NA	NA
Ingestion of Blue Mussels	1.0E-05	4.2E-06	**2.8E-05**	**1.3E-05**	**3.3E-04**	**1.6E-04**	NA	NA
Ingestion of Lobster	**1.4E-05**	**1.1E-05**	**4.4E-05**	**3.4E-05**	**5.7E-04**	**4.4E-04**	NA	NA
Sediment Ingestion and Dermal Contact	NA	NA	NA	NA	NA	NA	9.9E-07	5.4E-07
NON-CANCER RISKS								
Ingestion of Hard Shell Clams	2.2E-01	1.4E-01	1.4E-01	8.9E-02	**1.9E+00**	**1.2E+00**	NA	NA
Ingestion of Blue Mussels	4.0E-01	1.9E-01	2.6E-01	1.3E-01	**3.3E+00**	**1.6E+00**	NA	NA
Ingestion of Lobster	4.6E-01	3.4E-01	3.0E-01	2.2E-01	**3.9E+00**	**2.9E+00**	NA	NA
Sediment Ingestion and Dermal Contact	NA	NA	NA	NA	NA	NA	6.0E-02	6.6E-03

Notes:
Shading indicates risks greater than CERCLA/EPA risk thresholds (cancer risk > 1.00E-04 or non-cancer hazard index > 1.0)
Bold type indicates risks greater than RIDEM cancer risk threshold (cancer risk > 1.00E-05)
RME = Reasonable Maximum Exposure
CTE = Central Tendency Exposure
+ Resident scenario assumes recreational fisherman living at or near the site consumes 3 meals per year taken from the study area.
* Subsistence fisherman exposure scenario assumes 36 meals per year taken from the study area.

TABLE 1-5
PRG EXCEEDANCES FOR SSI SEDIMENT SAMPLES
FEASIBILITY STUDY
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT RHODE ISLAND

LOCATION ID		DSY-SD-AA05			DSY-SD-AA09			DSY-SD-AA17		
SAMPLE ID	Screening Value - See Text	DSY-SD-AA05-0012	DSY-SD-AA05-1224	DSY-SD-AA05-2448	DSY-SD-AA09-0012	DSY-SD-AA09-1224	DSY-SD-AA09-2448	DSY-SD-AA17-0012	DSY-SD-AA17-1224	DSY-SD-AA17-2448
SAMPLE DATE		10/12/11	10/12/11	10/12/11	10/13/11	10/13/11	10/13/11	10/13/11	10/13/11	10/13/11
TOP DEPTH		0 FT	1 FT	2 FT	0 FT	1 FT	2 FT	0 FT	1 FT	2 FT
BOTTOM DEPTH		1 FT	2 FT	4 FT	1 FT	2 FT	4 FT	1 FT	2 FT	4 FT
BENZO(A)PYRENE	539	170	310	1600	120 J	180	580	120	160	820
HIGH MOLECULAR WEIGHT PAHS	13903	1340 J	4210 J	31600 J	540 J	1860 J	9690 J	560 J	2120 J	12100 J
TOTAL AROCLOR	1060	25.7 UJ	22.4 UJ	170 J	27.7 UJ	23.6 U	1300	570 J	22.6 U	24.6 U
LEAD	168	55.7	55.2	111	66.3 J	96	111	76.8	74.8	138

LOCATION ID		DSY-SD-AA26			DSY-SD-AA30		DSY-SD-AB11		
SAMPLE ID	Screening Value - See Text	DSY-SD-AA26-0012	DSY-SD-AA26-1224	DSY-SD-AA26-2448	DSY-SD-AA30-0012	DSY-SD-AA30-1224	DSY-SD-AB11-0012	DSY-SD-AB11-1224	DSY-SD-AB11-2448
SAMPLE DATE		10/13/11	10/13/11	10/13/11	10/13/11	10/13/11	09/29/11	09/29/11	09/29/11
TOP DEPTH		0 FT	1 FT	2 FT	0 FT	1 FT	0 FT	1 FT	2 FT
BOTTOM DEPTH		1 FT	2 FT	4 FT	1 FT	2 FT	1 FT	2 FT	4 FT
BENZO(A)PYRENE	539	170	420	200	290	200	160	260	1300 J
HIGH MOLECULAR WEIGHT PAHS	13903	2820 J	9740 J	3390 J	5220 J	3390 J	2960 J	5120 J	41000 J
TOTAL AROCLOR	1060	97 J	1280	1270	1880 J	160 J	18.4 U	21.6 U	13.3 U
LEAD	168	44.9	180	148	59.8	48.9	58.3 J	88.4 J	139 J

YELLOW SHADING 1-2 X RPRG;ORANGE SHADING 2-5 X RPRG;
RED SHADING 5-10 X RPRG; PURPLE SHADING >10 X RPRG;GREY SHADING <1 X RPRG;
U-NOT DETECTED;J-QUANT. APPROX;R-REJECTED; NA-NOT ANALYZED

TABLE 1-5
PRG EXCEEDANCES FOR SSI SEDIMENT SAMPLES
FEASIBILITY STUDY
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT RHODE ISLAND

LOCATION ID		DSY-SD-AB15			DSY-SD-AC26			DSY-SD-AC28		
SAMPLE ID	Screening Value - See Text	DSY-SD-AB15-0012	DSY-SD-AB15-1224	DSY-SD-AB15-2448	DSY-SD-AC26-0012	DSY-SD-AC26-1224	DSY-SD-AC26-2448-AVG	DSY-SD-AC28-0012-AVG	DSY-SD-AC28-1224	DSY-SD-AC28-2448
SAMPLE DATE		09/29/11	09/29/11	09/29/11	09/28/11	09/28/11	09/28/11	09/28/11	09/28/11	09/28/11
TOP DEPTH		0 FT	1 FT	2 FT	0 FT	1 FT	2 FT	0 FT	1 FT	2 FT
BOTTOM DEPTH		1 FT	2 FT	4 FT	1 FT	2 FT	4 FT	1 FT	2 FT	4 FT
BENZO(A)PYRENE	539	220	200 J	450	180	370	52 J	230 J	310	1600 J
HIGH MOLECULAR WEIGHT PAHS	13903	3960 J	2810 J	8970 J	1740 J	4730 J	317 J	2790 J	8600 J	23200 J
TOTAL AROCLOR	1060	19.6 UJ	20.6 UJ	97	170	1100 J	122 J	65.4 J	460 J	810 J
LEAD	168	166 J	89.8 J	281 J	114	473	90.9	75.3	103	276

LOCATION ID		DSY-SD-AC30			DSY-SD-AD05			DSY-SD-AD09		
SAMPLE ID	Screening Value - See Text	DSY-SD-AC30-0012	DSY-SD-AC30-1224	DSY-SD-AC30-2448	DSY-SD-AD05-0012	DSY-SD-AD05-1224	DSY-SD-AD05-2448	DSY-SD-AD09-0012	DSY-SD-AD09-1224	DSY-SD-AD09-2448
SAMPLE DATE		09/28/11	09/28/11	09/28/11	09/29/11	09/29/11	09/29/11	09/29/11	09/29/11	09/29/11
TOP DEPTH		0 FT	1 FT	2 FT	0 FT	1 FT	2 FT	0 FT	1 FT	2 FT
BOTTOM DEPTH		1 FT	2 FT	4 FT	1 FT	2 FT	4 FT	1 FT	2 FT	4 FT
BENZO(A)PYRENE	539	80 J	520	470	88	160	400	56	110	140
HIGH MOLECULAR WEIGHT PAHS	13903	80 J	7910 J	7480 J	418 J	2020 J	7750 J	296 J	690 J	2050 J
TOTAL AROCLOR	1060	24.6 U	170	2600	23.6 U	20.4 U	340	20.6 U	20.6 U	310
LEAD	168	63.4 J	104 J	788 J	43.7 J	60.5 J	252 J	35.7 J	60 J	437 J

YELLOW SHADING 1-2 X RPRG;ORANGE SHADING 2-5 X RPRG;
RED SHADING 5-10 X RPRG; PURPLE SHADING >10 X RPRG;GREY SHADING <1 X RPRG;
U-NOT DETECTED;J-QUANT. APPROX;R-REJECTED; NA-NOT ANALYZED

TABLE 1-5
PRG EXCEEDANCES FOR SSI SEDIMENT SAMPLES
FEASIBILITY STUDY
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT RHODE ISLAND

LOCATION ID		DSY-SD-AD13			DSY-SD-AD17			DSY-SD-AD21		
SAMPLE ID	Screening Value - See Text	DSY-SD-AD13-0012	DSY-SD-AD13-1224	DSY-SD-AD13-2448-AVG	DSY-SD-AD17-0012	DSY-SD-AD17-1224	DSY-SD-AD17-2448	DSY-SD-AD21-0012	DSY-SD-AD21-1224	DSY-SD-AD21-2448
SAMPLE DATE		09/29/11	09/29/11	09/29/11	09/29/11	09/29/11	09/29/11	09/29/11	09/29/11	09/29/11
TOP DEPTH		0 FT	1 FT	2 FT	0 FT	1 FT	2 FT	0 FT	1 FT	2 FT
BOTTOM DEPTH		1 FT	2 FT	4 FT	1 FT	2 FT	4 FT	1 FT	2 FT	4 FT
BENZO(A)PYRENE	539	1300	6.4 J	14.5 U	98	220	14 J	250	100	22 J
HIGH MOLECULAR WEIGHT PAHS	13903	17300	6.4 J	320 UJ	408 J	3570 J	14 J	2310 J	680 J	22 J
TOTAL AROCLOR	1060	120	13.4 UJ	13.3 U	83 J	430 J	120	110 J	49 J	12.3 UJ
LEAD	168	109 J	8.2 J	8.75 J	59.7 J	190 J	66 J	200 J	36.6 J	10.3 J

LOCATION ID		DSY-SD-AE24			DSY-SD-AE26			DSY-SD-AG30		
SAMPLE ID	Screening Value - See Text	DSY-SD-AE24-0012	DSY-SD-AE24-1224	DSY-SD-AE24-2448	DSY-SD-AE26-0012	DSY-SD-AE26-1224	DSY-SD-AE26-2448	DSY-SD-AG30-0012	DSY-SD-AG30-1224	DSY-SD-AG30-2436
SAMPLE DATE		09/26/11	09/26/11	09/26/11	09/28/11	09/28/11	09/28/11	09/28/11	09/28/11	09/28/11
TOP DEPTH		0 FT	1 FT	2 FT	0 FT	1 FT	2 FT	0 FT	1 FT	2 FT
BOTTOM DEPTH		1 FT	2 FT	4 FT	1 FT	2 FT	4 FT	1 FT	2 FT	3 FT
BENZO(A)PYRENE	539	270 J	190	16 J	100	240	730 J	35	27	12 U
HIGH MOLECULAR WEIGHT PAHS	13903	1360 J	1660 J	16 J	430 J	2130 J	8020 J	315 J	27 J	262 UJ
TOTAL AROCLOR	1060	290 J	160 J	11.3 UJ	25.6 U	21.6 U	1390 J	10.3 U	9.06 U	8.97 U
LEAD	168	1020	198	4.8	48.4	68.2	296	8.7	191	22.1

YELLOW SHADING 1-2 X RPRG;ORANGE SHADING 2-5 X RPRG;
RED SHADING 5-10 X RPRG; PURPLE SHADING >10 X RPRG;GREY SHADING <1 X RPRG;
U-NOT DETECTED;J-QUANT. APPROX;R-REJECTED; NA-NOT ANALYZED

TABLE 1-5
PRG EXCEEDANCES FOR SSI SEDIMENT SAMPLES
FEASIBILITY STUDY
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT RHODE ISLAND

LOCATION ID		DSY-SD-AT30			DSY-SD-BB26			DSY-SD-BC28		
SAMPLE ID	Screening Value - See Text	DSY-SD-AT30-0012	DSY-SD-AT30-1224-AVG	DSY-SD-AT30-2448	DSY-SD-BB26-0012	DSY-SD-BB26-1224	DSY-SD-BB26-2448	DSY-SD-BC28-0012	DSY-SD-BC28-1224	DSY-SD-BC28-2448
SAMPLE DATE		09/23/11	09/23/11	09/23/11	09/21/11	09/21/11	09/21/11	09/21/11	09/21/11	09/21/11
TOP DEPTH		0 FT	1 FT	2 FT	0 FT	1 FT	2 FT	0 FT	1 FT	2 FT
BOTTOM DEPTH		1 FT	2 FT	4 FT	1 FT	2 FT	4 FT	1 FT	2 FT	4 FT
BENZO(A)PYRENE	539	890	11.5 U	12 U	930 J	940 J	300	790 J	340	13 U
HIGH MOLECULAR WEIGHT PAHS	13903	12300	262 U	271 U	16400 J	10900 J	4030 J	9660 J	4240 J	289 UJ
TOTAL AROCLOR	1060	10.3 UJ	10.3 UJ	10.2 UJ	16.4 UJ	13.3 UJ	13.3 UJ	13.3 UJ	12.4 UJ	10.3 UJ
LEAD	168	35	2.9	4.6	143	149	75.3	67.5	44.3	1.8

LOCATION ID		DSY-SD-BC30			DSY-SD-BD26			DSY-SD-BE28		
SAMPLE ID	Screening Value - See Text	DSY-SD-BC30-0012	DSY-SD-BC30-1224	DSY-SD-BC30-2448	DSY-SD-BD26-0012-AVG	DSY-SD-BD26-1224	DSY-SD-BD26-2448	DSY-SD-BE28-0012	DSY-SD-BE28-1224	DSY-SD-BE28-2448
SAMPLE DATE		09/21/11	09/21/11	09/21/11	09/21/11	09/21/11	09/21/11	09/22/11	09/22/11	09/22/11
TOP DEPTH		0 FT	1 FT	2 FT	0 FT	1 FT	2 FT	0 FT	1 FT	2 FT
BOTTOM DEPTH		1 FT	2 FT	4 FT	1 FT	2 FT	4 FT	1 FT	2 FT	4 FT
BENZO(A)PYRENE	539	1200 J	2100 J	690 J	1260 J	1100 J	120	610	940 J	5.2 J
HIGH MOLECULAR WEIGHT PAHS	13903	14100 J	19700 J	8760 J	16600 J	13300 J	1530 J	7640 J	11600 J	5.2 J
TOTAL AROCLOR	1060	19.4 UJ	14.4 UJ	11.4 UJ	18.4 UJ	14.3 UJ	11.3 UJ	22.4 UJ	12.3 UJ	10.3 UJ
LEAD	168	94.6	62.6	25.4	134	50.9	11.2	80.4 J	50.6 J	2 J

YELLOW SHADING 1-2 X RPRG;ORANGE SHADING 2-5 X RPRG;
RED SHADING 5-10 X RPRG; PURPLE SHADING >10 X RPRG;GREY SHADING <1 X RPRG;
U-NOT DETECTED;J-QUANT. APPROX;R-REJECTED; NA-NOT ANALYZED

TABLE 1-5
PRG EXCEEDANCES FOR SSI SEDIMENT SAMPLES
FEASIBILITY STUDY
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT RHODE ISLAND

LOCATION ID		DSY-SD-BE30			DSY-SD-BG28			DSY-SD-BI26		
SAMPLE ID	Screening Value - See Text	DSY-SD-BE30-0012	DSY-SD-BE30-1224	DSY-SD-BE30-2448	DSY-SD-BG28-0012	DSY-SD-BG28-1224	DSY-SD-BG28-2448	DSY-SD-BI26-0012	DSY-SD-BI26-1224-AVG	DSY-SD-BI26-2448
SAMPLE DATE		09/21/11	09/21/11	09/21/11	09/21/11	09/21/11	09/21/11	09/21/11	09/21/11	09/21/11
TOP DEPTH		0 FT	1 FT	2 FT	0 FT	1 FT	2 FT	0 FT	1 FT	2 FT
BOTTOM DEPTH		1 FT	2 FT	4 FT	1 FT	2 FT	4 FT	1 FT	2 FT	4 FT
BENZO(A)PYRENE	539	9000	1600	250	810 J	42	58	580	465	10 U
HIGH MOLECULAR WEIGHT PAHS	13903	117000 J	20600 J	3620 J	9760 J	352 J	765 J	6450 J	5210 J	235 UJ
TOTAL AROCLOR	1060	14.4 UJ	11.3 UJ	11.3 UJ	12.3 U	11.3 UJ	9.97 U	13.4 UJ	10.8 UJ	9.46 UJ
LEAD	168	173 J	61.7 J	9.5 J	28.8 J	7.3 J	4.3 J	39.7 J	30.6 J	4.6 J

LOCATION ID		DSY-SD-C21			DSY-SD-C25			DSY-SD-C29		
SAMPLE ID	Screening Value - See Text	DSY-SD-C21-0012	DSY-SD-C21-1224	DSY-SD-C21-2448	DSY-SD-C25-0012	DSY-SD-C25-1224-AVG	DSY-SD-C25-2448	DSY-SD-C29-0012	DSY-SD-C29-1224	DSY-SD-C29-2448
SAMPLE DATE		10/07/11	10/07/11	10/07/11	10/07/11	10/07/11	10/07/11	10/07/11	10/07/11	10/07/11
TOP DEPTH		0 FT	1 FT	2 FT	0 FT	1 FT	2 FT	0 FT	1 FT	2 FT
BOTTOM DEPTH		1 FT	2 FT	4 FT	1 FT	2 FT	4 FT	1 FT	2 FT	4 FT
BENZO(A)PYRENE	539	160	170	11 U	840	97.5 J	11 U	620 J	550	84 J
HIGH MOLECULAR WEIGHT PAHS	13903	1670 J	1810 J	244 UJ	9250 J	909 J	253 UJ	6430 J	5330 J	414 J
TOTAL AROCLOR	1060	190 J	360	10.1 U	140 J	192 J	10.3 U	470 J	550 J	59 J
LEAD	168	320 J	88.4 J	12 J	198 J	68.4 J	3.6 J	209 J	759 J	11.7 J

YELLOW SHADING 1-2 X RPRG;ORANGE SHADING 2-5 X RPRG;
RED SHADING 5-10 X RPRG; PURPLE SHADING >10 X RPRG;GREY SHADING <1 X RPRG;
U-NOT DETECTED;J-QUANT. APPROX;R-REJECTED; NA-NOT ANALYZED

TABLE 1-5
PRG EXCEEDANCES FOR SSI SEDIMENT SAMPLES
FEASIBILITY STUDY
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT RHODE ISLAND

LOCATION ID		DSY-SD-G01			DSY-SD-G25			DSY-SD-G29	DSY-SD-J24	
SAMPLE ID	Screening Value - See Text	DSY-SD-G01-0012	DSY-SD-G01-1224	DSY-SD-G01-2448	DSY-SD-G25-0012	DSY-SD-G25-1224	DSY-SD-G25-2448	DSY-SD-G29-0018	DSY-SD-J24-0012	DSY-SD-J24-1224
SAMPLE DATE		10/12/11	10/12/11	10/12/11	10/12/11	10/12/11	10/12/11	10/13/11	10/04/11	10/04/11
TOP DEPTH		0 FT	1 FT	2 FT	0 FT	1 FT	2 FT	0 FT	0 FT	1 FT
BOTTOM DEPTH		1 FT	2 FT	4 FT	1 FT	2 FT	4 FT	1.5 FT	1 FT	2 FT
BENZO(A)PYRENE	539	210	200	400	1200	2200	2100	1600 J	100	57
HIGH MOLECULAR WEIGHT PAHS	13903	4280 J	5570 J	11800 J	15000 J	26800 J	26400 J	17300 J	1680 J	857 J
TOTAL AROCLOR	1060	22.6 U	23.6 U	24.6 U	22.6 UJ	170 J	190 J	480 J	1200	400 J
LEAD	168	368 J	47.7 J	74.5 J	49.7 J	199 J	212 J	98.2	1100 J	610 J

LOCATION ID		DSY-SD-J26			DSY-SD-J28			DSY-SD-J30		
SAMPLE ID	Screening Value - See Text	DSY-SD-J26-0012	DSY-SD-J26-1224	DSY-SD-J26-2448-AVG	DSY-SD-J28-0012	DSY-SD-J28-1224	DSY-SD-J28-2448	DSY-SD-J30-0012	DSY-SD-J30-1224	DSY-SD-J30-2448
SAMPLE DATE		10/04/11	10/04/11	10/04/11	10/04/11	10/04/11	10/04/11	10/04/11	10/04/11	10/04/11
TOP DEPTH		0 FT	1 FT	2 FT	0 FT	1 FT	2 FT	0 FT	1 FT	2 FT
BOTTOM DEPTH		1 FT	2 FT	4 FT	1 FT	2 FT	4 FT	1 FT	2 FT	4 FT
BENZO(A)PYRENE	539	230	1000 J	162 J	350 J	400 J	170 J	8800 J	580 J	240 J
HIGH MOLECULAR WEIGHT PAHS	13903	3320 J	13000 J	2250 J	6270 J	8700 J	1770 J	186000 J	12400 J	4250 J
TOTAL AROCLOR	1060	180 J	160 J	690 J	180 J	380 J	400 J	24.6 UJ	130 J	160
LEAD	168	57.9 J	54.9 J	44 J	52.2 J	315 J	51.9 J	58.6 J	81 J	94.1 J

YELLOW SHADING 1-2 X RPRG;ORANGE SHADING 2-5 X RPRG;
RED SHADING 5-10 X RPRG; PURPLE SHADING >10 X RPRG;GREY SHADING <1 X RPRG;
U-NOT DETECTED;J-QUANT. APPROX;R-REJECTED; NA-NOT ANALYZED

TABLE 1-5
PRG EXCEEDANCES FOR SSI SEDIMENT SAMPLES
FEASIBILITY STUDY
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT RHODE ISLAND

LOCATION ID		DSY-SD-K05			DSY-SD-K13			DSY-SD-L24		
SAMPLE ID	Screening Value - See Text	DSY-SD-K05-0012	DSY-SD-K05-1224	DSY-SD-K05-2448	DSY-SD-K13-0012	DSY-SD-K13-1224	DSY-SD-K13-2448	DSY-SD-L24-0012	DSY-SD-L24-1224	DSY-SD-L24-2448
SAMPLE DATE		10/03/11	10/03/11	10/03/11	10/03/11	10/03/11	10/03/11	10/04/11	10/04/11	10/04/11
TOP DEPTH		0 FT	1 FT	2 FT	0 FT	1 FT	2 FT	0 FT	1 FT	2 FT
BOTTOM DEPTH		1 FT	2 FT	4 FT	1 FT	2 FT	4 FT	1 FT	2 FT	4 FT
BENZO(A)PYRENE	539	97 J	12 UJ	13 UJ	160 J	37 J	13 UJ	580 J	20 UJ	41
HIGH MOLECULAR WEIGHT PAHS	13903	507 J	280 UJ	289 UJ	2940 J	337 J	289 UJ	580 J	5300 J	4580 J
TOTAL AROCLOR	1060	240	11.3 U	9.8 UJ	17000	66 J	9.29 UJ	1710 J	2760	11.3 U
LEAD	168	1410	5.3	4.4	598	168	5.2	884 J	543 J	20.8 J

LOCATION ID		DSY-SD-L26			DSY-SD-L28			DSY-SD-L30		
SAMPLE ID	Screening Value - See Text	DSY-SD-L26-0012	DSY-SD-L26-1224	DSY-SD-L26-2448	DSY-SD-L28-0012	DSY-SD-L28-1224-AVG	DSY-SD-L28-2448	DSY-SD-L30-0012	DSY-SD-L30-1224	DSY-SD-L30-2448
SAMPLE DATE		10/04/11	10/04/11	10/04/11	10/04/11	10/04/11	10/04/11	10/04/11	10/04/11	10/04/11
TOP DEPTH		0 FT	1 FT	2 FT	0 FT	1 FT	2 FT	0 FT	1 FT	2 FT
BOTTOM DEPTH		1 FT	2 FT	4 FT	1 FT	2 FT	4 FT	1 FT	2 FT	4 FT
BENZO(A)PYRENE	539	670 J	13 J	57	420	73.5	18 J	930 J	140 J	12 U
HIGH MOLECULAR WEIGHT PAHS	13903	8580 J	13 J	217 J	5640 J	458 J	18 J	11500 J	1120 J	271 UJ
TOTAL AROCLOR	1060	1800 J	10.3 U	46	3600	115	32	270	220	10.3 U
LEAD	168	324 J	4.3 J	9.2 J	878 J	85.5 J	10.3 J	65.2 J	9.5 J	5.7 J

YELLOW SHADING 1-2 X RPRG;ORANGE SHADING 2-5 X RPRG;
RED SHADING 5-10 X RPRG; PURPLE SHADING >10 X RPRG;GREY SHADING <1 X RPRG;
U-NOT DETECTED;J-QUANT. APPROX;R-REJECTED; NA-NOT ANALYZED

TABLE 1-5
PRG EXCEEDANCES FOR SSI SEDIMENT SAMPLES
FEASIBILITY STUDY
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT RHODE ISLAND

LOCATION ID		DSY-SD-N24			DSY-SD-N28			DSY-SD-N30		
SAMPLE ID	Screening Value - See Text	DSY-SD-N24-0012	DSY-SD-N24-1224	DSY-SD-N24-2448-AVG	DSY-SD-N28-0012	DSY-SD-N28-1224	DSY-SD-N28-2448	DSY-SD-N30-0012	DSY-SD-N30-1224	DSY-SD-N30-2448
SAMPLE DATE		10/05/11	10/05/11	10/05/11	10/05/11	10/05/11	10/05/11	10/05/11	10/05/11	10/05/11
TOP DEPTH		0 FT	1 FT	2 FT	0 FT	1 FT	2 FT	0 FT	1 FT	2 FT
BOTTOM DEPTH		1 FT	2 FT	4 FT	1 FT	2 FT	4 FT	1 FT	2 FT	4 FT
BENZO(A)PYRENE	539	290 J	500	29.5 J	68 J	710 J	64 J	310 J	580 J	140 J
HIGH MOLECULAR WEIGHT PAHS	13903	2310 J	6880 J	124 J	748 J	7790 J	484 J	3070 J	5910 J	1820 J
TOTAL AROCLOR	1060	192 J	990	130 J	100	960	770 J	74 J	86 J	76
LEAD	168	53.2 J	66.6 J	842 J	70.6 J	246 J	390 J	51.1 J	213 J	38.5 J

LOCATION ID		DSY-SD-Q29			DSY-SD-T25			DSY-SD-W17		
SAMPLE ID	Screening Value - See Text	DSY-SD-Q29-0012	DSY-SD-Q29-1224	DSY-SD-Q29-2448	DSY-SD-T25-0012	DSY-SD-T25-1224	DSY-SD-T25-2448	DSY-SD-W17-0012	DSY-SD-W17-1224	DSY-SD-W17-2448
SAMPLE DATE		10/06/11	10/06/11	10/06/11	10/05/11	10/05/11	10/05/11	09/30/11	09/30/11	09/30/11
TOP DEPTH		0 FT	1 FT	2 FT	0 FT	1 FT	2 FT	0 FT	1 FT	2 FT
BOTTOM DEPTH		1 FT	2 FT	4 FT	1 FT	2 FT	4 FT	1 FT	2 FT	4 FT
BENZO(A)PYRENE	539	190	560	120	250	490	68	240 J	150	5.2 J
HIGH MOLECULAR WEIGHT PAHS	13903	1090 J	7860 J	810 J	2070 J	3830 J	338 J	2690 J	1690 J	5.2 J
TOTAL AROCLOR	1060	21.6 U	260	98	1500	92	110	21.6 UJ	900	13.3 UJ
LEAD	168	56.5	63.3	22.5	64.2	236	36.3	118 J	210 J	6.6 J

YELLOW SHADING 1-2 X RPRG;ORANGE SHADING 2-5 X RPRG;
RED SHADING 5-10 X RPRG; PURPLE SHADING >10 X RPRG;GREY SHADING <1 X RPRG;
U-NOT DETECTED;J-QUANT. APPROX;R-REJECTED; NA-NOT ANALYZED

TABLE 1-5
PRG EXCEEDANCES FOR SSI SEDIMENT SAMPLES
FEASIBILITY STUDY
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT RHODE ISLAND

LOCATION ID		DSY-SD-W24			DSY-SD-W28			DSY-SD-Y25		
SAMPLE ID	Screening Value - See Text	DSY-SD-W24-0012-AVG	DSY-SD-W24-1224	DSY-SD-W24-2448	DSY-SD-W28-0012	DSY-SD-W28-1224	DSY-SD-W28-2448	DSY-SD-Y25-0012	DSY-SD-Y25-1224	DSY-SD-Y25-2448-AVG
SAMPLE DATE		10/06/11	10/06/11	10/06/11	10/06/11	10/06/11	10/06/11	10/03/11	10/03/11	10/03/11
TOP DEPTH		0 FT	1 FT	2 FT	0 FT	1 FT	2 FT	0 FT	1 FT	2 FT
BOTTOM DEPTH		1 FT	2 FT	4 FT	1 FT	2 FT	4 FT	1 FT	2 FT	4 FT
BENZO(A)PYRENE	539	355	150	13 J	230	930 J	11 J	520	1600 J	126
HIGH MOLECULAR WEIGHT PAHS	13903	4900 J	1870 J	13 J	1150 J	10300 J	11 J	10200 J	31100 J	2110 J
TOTAL AROCLOR	1060	2050	1130	11.3 UJ	280	1400	11.3 U	190 J	1000 J	100 J
LEAD	168	904 J	577	5	66.2 J	94.8 J	28 J	165	918	48.8

LOCATION ID		DSY-SD-Y26			DSY-SD-Y28			DSY-SD-Y30	
SAMPLE ID	Screening Value - See Text	DSY-SD-Y26-0012	DSY-SD-Y26-1224	DSY-SD-Y26-2448	DSY-SD-Y28-0012	DSY-SD-Y28-1224	DSY-SD-Y28-2448	DSY-SD-Y30-0012	DSY-SD-Y30-1224
SAMPLE DATE		10/03/11	10/03/11	10/03/11	10/03/11	10/03/11	10/03/11	10/03/11	10/03/11
TOP DEPTH		0 FT	1 FT	2 FT	0 FT	1 FT	2 FT	0 FT	1 FT
BOTTOM DEPTH		1 FT	2 FT	4 FT	1 FT	2 FT	4 FT	1 FT	2 FT
BENZO(A)PYRENE	539	900 J	1200 J	370	220	2300 J	230	1100 J	650 J
HIGH MOLECULAR WEIGHT PAHS	13903	10800 J	17200 J	5500 J	1840 J	39000 J	3850 J	18900 J	15000 J
TOTAL AROCLOR	1060	200 J	1000 J	800	190 J	680 J	260 J	530	12.3 UJ
LEAD	168	69.5	160	125	69.4	199	52.4	256	41

YELLOW SHADING 1-2 X RPRG;ORANGE SHADING 2-5 X RPRG;
RED SHADING 5-10 X RPRG; PURPLE SHADING >10 X RPRG;GREY SHADING <1 X RPRG;
U-NOT DETECTED;J-QUANT. APPROX;R-REJECTED; NA-NOT ANALYZED

TABLE 1-6
TISSUE SCREENING CONCENTRATION BENCHMARKS FOR EVALUATION OF COC IMPACTS ON TARGET SPECIES
FEASIBILITY STUDY
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT RHODE ISLAND

Chemical Class	Analyte	Tissue Screening[1] Concentration (µg/g wet)
Metals	arsenic	1.6
	cadmium	0.042
	chromium	0.18
	copper	0.17
	lead	0.064
	mercury	0.12
	nickel	0.33
	silver	0.37
	zinc	2.8
PAHs	acenaphthene	126
	acenaphthylene	4.5
	anthracene	18
	benzo(a)anthracene	173
	benzo(a)pyrene	416
	benzo(b)fluoranthene	419
	benzo(g,h,i)perylene	1,009
	benzo(k)fluoranthene	416
	chrysene	173
	dibenzo(a,h)anthracene	167
	fluoranthene	18
	fluorene	11
	indeno(1,2,3-cd)pyrene	1,009
	naphthalene	6.5
	phenanthrene	12
	pyrene	42
PCBs	Sum PCB Congeners X 2	0.44
Pesticides	aldrin	0.71
	hexachlorobenzene	32
	mirex	0.018
	o,p'-DDE	0.054
	p,p'-DDE	0.054
TBT	tributyltin	4.10E-03

[1] Shepard, 1995

Note: Table adapted from ERA Table 6.2-2 (SAIC, 1997)

TABLE 2-1
SUMMARY OF CHEMICAL-SPECIFIC ARARs AND TBCs
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND
PAGE 1 OF 2

Requirement	Citation	Status	Synopsis of Requirement	Consideration
Federal				
EPA Human Health Assessment Cancer Slope Factors (CSFs)	None	To Be Considered	These are guidance values used to evaluate the potential carcinogenic hazard caused by exposure to contaminants.	Used to compute the individual incremental cancer risk resulting from exposure to carcinogenic contaminants in site media.
Reference Doses (RfDs)	None	To Be Considered	Guidance values used to evaluate potential non-carcinogenic hazards caused by exposure to contaminants.	RfDs will be used to characterize non-carcinogenic risks associated with residual COC concentrations and develop site-specific risk-based PRGs.
Guidelines for Carcinogen Risk Assessment	EPA/630/P-03/001F (March 2005)	To Be Considered	Guidance for assessing cancer risk.	Used to calculate potential carcinogenic risks caused by exposure to contaminants.
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F (March 2005)	To Be Considered	Guidance of assessing cancer risks to children.	Used to calculate potential carcinogenic risks to children caused by exposure to contaminants.
National Oceanographic and Atmospheric Administration (NOAA) Incidence of Adverse Biological Effects within Ranges of Chemical Concentration in Marine and Estuarine Sediments, Long, *et al.*, 1995	None	To Be Considered	Guidance on concentration ranges of contaminants in sediment that correspond to the likelihood of adverse effects to organisms.	Guidance used to establish sediment cleanup standards.

TABLE 2-1
SUMMARY OF CHEMICAL-SPECIFIC ARARs AND TBCs
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND
PAGE 2 OF 2

Requirement	Citation	Status	Synopsis of Requirement	Consideration
State				
There are no state Chemical – Specific ARARs for Sediment				

TABLE 2-2
SUMMARY OF LOCATION-SPECIFIC ARARs AND TBCs
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Consideration
Federal				
Fish and Wildlife Coordination Act	16 United States Code (USC) 661 et seq	Applicable	Requires Federal agencies involved in actions that will result in the control or structural modification of any stream or body of water for any purpose to take action to protect fish and wildlife resources that may be affected by the action. The Navy must coordinate with appropriate federal and state resource agencies to ascertain the means and measures necessary to mitigate, prevent, and compensate for project related losses of fish and wildlife resources and to enhance the resources.	Actions taken may impact wetlands and aquatic resources protected under this act. Alternatives will need to consider the protection measures provided by the act. If there is no alternative to damage to such resource areas, federal and state fish and wildlife officials would be consulted on how to minimize impacts of any remedial activities on any fish, wildlife and endangered species.
Endangered Species Act (ESA)	16 USC § 1531 *et seq*., 50 CFR Parts 200 and 402	Applicable	Regulates activities affecting federally-listed endangered or threatened species, or adversely modifying or destroying their critical habitat. The Atlantic Sturgeon has been listed as an Endangered Species in the region including Narragansett Bay.	The Navy will consult with the appropriate federal resource agencies to ensure that the dredging, dewatering, and cap installation and maintenance components will be conducted to minimize disturbance to aquatic habitats in Narragansett Bay that may be used by the federally endangered Atlantic Sturgeon.
Rivers and Harbors Act	33 CFR 322	Relevant and Appropriate	Sets forth criteria for obstructions and alterations of navigable waters.	Remedial actions that require work to occur within waterways will be performed in compliance with the substantive requirements of the statute.

TABLE 2-2
SUMMARY OF LOCATION-SPECIFIC ARARs AND TBCs
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Consideration
Federal (continued)				
Clean Water Act - Section 404 (b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material	40 CFR 230 and 33 CFR 322 and 323	Applicable	Under this requirement, no activity that adversely affects a wetland shall be permitted if a practicable alternative with lesser effects is available. If activity takes place, impacts must be minimized to the maximum extent. Controls discharges of dredged or fill material to protect aquatic ecosystems. Filling or discharge of dredged material will only occur where there is no other practicable alternative and any adverse impacts to aquatic ecosystems will be mitigated. Under these standards the Navy must solicit public comment through the Proposed Plan on its finding that one of the alternatives is the Least Environmentally Damaging Practicable Alternative.	Dredging operations including sediment dewatering would be conducted in a manner that will minimize impacts to navigable waters. If shoreland staging, processing, and stockpile areas are within protected resource areas, these standards will be met. Water will be treated prior to discharge within the dredge area to meet applicable standards. There is no practicable alternative to the discharge of treated water to navigable waters. The dredging and dewatering components would meet the substantive environmental requirements of these standards. Resource agencies will be consulted to determine if mitigation would be required for altering aquatic habitat. Any eelgrass (classified as vegetated shallows) impacted during remedial actions may require mitigation. If fill/dredged material is discharged, the Navy will identify a remedy that is the Least Environmentally Damaging Practicable Alternative on the aquatic ecosystem.
Coastal Zone Management Act	16 USC § 1451 *et. seq*.	Applicable	Requires that any actions must be conducted in a manner consistent with NOAA-approved state coastal management programs.	The site is located next to a coastal zone management area; therefore, applicable coastal zone management requirements need to be addressed**.**

TABLE 2-2
SUMMARY OF LOCATION-SPECIFIC ARARs AND TBCs
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Consideration
Federal (continued)				
Floodplain Management and Protection of Wetlands	44 CFR Part 9	Relevant and Appropriate	Implements Executive Order 11990 (Protection of Wetlands) and Executive Order 11988 (Floodplain Management). Prohibits activities that adversely affect a federally-regulated wetland and floodplain unless there is no practicable alternative and the proposed action includes all practicable measures to minimize harm to wetlands and floodplain that may result from such use.	Remedial alternatives conducted within the 100-year coastal storm floodplain or within federal jurisdictional wetlands and aquatic habitats will be implemented in compliance with these standards. During the remedial design stage, the effects of remedial actions on federal jurisdictional wetlands and floodplain will be evaluated. All practicable means will be used to minimize harm to the wetlands and floodplain. Wetlands and floodplain disturbed by remediation will be mitigated in accordance with requirements. The Navy will solicit public comment as part of the proposed plan on the measures taken through the remedial action to protect floodplain and wetland/aquatic habitat resources.
State				
Coastal Resources Management	Rhode Island General Laws (RIGL) 46-23-1 *et seq*	Applicable	Sets standards for management and protection of coastal resources. Jurisdiction includes areas within 200 feet of coastal features, within 50 feet of wetlands under the jurisdiction of the CRMC, and floodplains.	The entire site is located next to a coastal resource management area; therefore, applicable coastal resource management requirements will be considered during evaluation of alternatives**.**

TABLE 2-3
SUMMARY OF ACTION-SPECIFIC ARARs AND TBCs
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Consideration
Federal				
Toxic Substances Control Act (TSCA) – Polychlorinated Biphenyl (PCB) Remediation Waste	40 Code of Federal Regulations (CFR) 761.61(c)	Applicable	Risk-based standards for the sampling, cleanup, or disposal of PCB remediation waste. Written approval for the proposed risk-based clean-up will be obtained from the Director, Office of Site Remediation and Restoration, EPA Region I.	Standards apply to all alternatives that address PCBs, including cleanup levels, sampling, cleanup, disposal, or capping/cover. The Navy will solicit public comment in the Proposed Plan about the finding that the proposed remedy for PCB contamination at the Site will not pose an unreasonable risk of injury to health or the environment. An EPA finding that the remedy meets these standards will be included in the Record of Decision.
CWA, Section 402, National Pollution Discharge Elimination System (NPDES)	33 USC 1342; 40 CFR 122 through 125	Applicable	These standards govern point source discharges of pollutants to surface water. Substantive requirements under NPDES are written such that state and federal NRWQC are met. Permits are required for offsite discharges. RI Standards apply to POTWs and includes storm water requirements for construction projects that disturb over one acre.	Standards for discharging of dewatering liquid or other water to surface waters at the site. If over 1 acre of soil is disturbed, then the storm water regulations for small construction activities will be met.
Clean Water Act; General Pretreatment Regulations for Existing and New Sources of Pollution	33 USC 1251 et seq., 40 CFR. Part 403	Applicable	Standards for direct discharge of wastewater into a Publicly Owned Treatment Works (POTW).	These standards will apply if water from the remedial action such as from dewatering is discharged to a POTW.

TABLE 2-3
SUMMARY OF ACTION-SPECIFIC ARARs AND TBCs
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Consideration
Federal (continued)				
Contaminated Sediment Remediation Guidance for Hazardous Waste Sites	OSWER 9355.0-85, (December 2005)	To Be Considered	This document provides technical and policy guidance for making remedy decisions for contaminated sediment sites. Issues addressed include: Chapter 4, Monitored Natural Recovery; Chapter 5, In-situ Capping; Chapter 6, Dredging and Excavation; Chapter 7, Remedy Selection; and Chapter 8, Long-term Monitoring	Sediment alternatives will be developed using methods described in this document.
Clean Water Act, National Recommended Water Quality Criteria (NRWQC)	33 USC §1251 *et seq.*; 40 CFR 122.44	Applicable	Federal NRWQC are health-based and ecologically based criteria developed for carcinogenic and non-carcinogenic compounds.	These are standards for water quality monitoring that would be conducted to ensure that these criteria are not exceeded during dredging activities.
Coast Guard Anchorage Ground and Regulated Navigation Area Rules	33 CFR Part 165	To Be Considered (Applicable once a Rule for the LUC area is promulgated)	The Coast Guard may promulgate site-specific rules to establish federal anchorage areas and regulated navigation areas (RNAs). Once promulgated such a rule is also the basis for the National Oceanic and Atmospheric Administration (NOAA) to revise navigation charts to show the restricted area.	If, in the future, the Navy transfers the Site to a non-federal owner, it will explore the option of coordinating with the Coast Guard to retain the existing Restricted Area for the purpose of managing any required LUCs. An RNA or Restricted Area creates federally enforceable restrictions to protect the area from disturbance and to delineate the area of the LUCs on federal navigation charts.
Corps of Engineers, Danger Zone and Restricted Areas: Narragansett Bay, East Passage, Coddington Cove, Naval Station Newport, Naval Restricted Area, Newport, Rhode Island	33 CFR §334.81	Applicable	All persons, swimmers, vessels and other craft, except those vessels authorized by the Navy or Coast Guard and local or state law enforcement vessels, are prohibited from entering the restricted area without specific permission from the Command Officer.	Enforceable basis for preventing unauthorized vessels and fisherman from entering the area where sediment caps/covers are installed or where there is a risk from consumption of contaminated seafood.

TABLE 2-3
SUMMARY OF ACTION-SPECIFIC ARARs AND TBCs
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Consideration
Federal (continued)				
Clean Air Act (CAA), National Emission Standards for Hazardous Air Pollutants (NESHAPS); National Emission Standards for Asbestos	42 U.S.C. §§7411, 7412; 40 C.F.R. Part 61, Subpart M	Applicable	Establish standards for demolition of facilities containing asbestos, managing existing asbestos, and for disposal of asbestos contaminated waste.	Any maintenance or demolition of the piers where asbestos is present must be conducted in accordance with these standards.
Clean Air Act (CAA), National Emission Standards for Hazardous Air Pollutants (NESHAPS), Standards for Inactive waste disposal sites for asbestos mills and manufacturing and fabricating operations	42 U.S.C. §§7411, 7412; 40 C.F.R. §61.151	Relevant and Appropriate	NESHAPS standards for preventing air releases from inactive asbestos disposal sites, including cover standards, dust suppression, and land use controls.	For areas of sediments under the piers where asbestos is present, that will be capped/covered substantive requirements of these standards and land use controls will be established to address health and safety requirements to maintain the cover and to address any potential asbestos exposure if the cover is disturbed.
Framework for Investigating Asbestos-Contaminated Superfund Sites	OSWER Directive #9200.0-68 (Sept. 2008)	To Be Considered	Guidance on investigating and characterizing the potential human exposure from asbestos contamination at Superfund sites.	Guidance will be used to establish procedures for sampling for asbestos either for delineating the area of contamination or if areas of covered sediment are disturbed in the future.

TABLE 2-3
SUMMARY OF ACTION-SPECIFIC ARARs AND TBCs
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Consideration
State				
Standards for Identification and Listing of Hazardous Waste Rules and Regulations for Hazardous Waste Management	Code of Rhode Island Rules (CRIR), 12-030-003, Rule 5.8	Applicable	Defines the listed and characteristic hazardous wastes.	These regulations would apply when determining whether or not a solid waste is hazardous, either by being listed or by exhibiting a hazardous characteristic.
Standards for Generators of Hazardous Waste Rules and Regulations for Hazardous Waste Management	CRIR 12-030-003, Rule 5.2, 5.3, and 5.4	Applicable	Establishes manifesting and pre-transport requirements for hazardous waste.	These regulations would apply to all wastes generated during remedial actions that are determined to be hazardous.

TABLE 2-3
SUMMARY OF ACTION-SPECIFIC ARARs AND TBCs
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Consideration
State (continued)				
Clean Air Act - Fugitive Dust Control	CRIR 12-31-05	Applicable	Requires that reasonable precaution be taken to prevent particulate matter from becoming airborne.	These regulations apply to all remedial actions that involve dredging of contaminated media and solids handling. Such activities would be conducted in a manner to prevent material from becoming airborne, either through engineering or other controls.
Clean Air Act - Emissions Detrimental to Persons or Property	CRIR 12-31-07	Applicable	Prohibits emissions of contaminants which may be injurious to humans, plant or animal life or cause damage to property or which reasonably interferes with the enjoyment of life and property.	Monitoring of air emissions during remedial activities will be used to assess compliance with these standards if threshold levels are reached.
Clean Air Act - Air Toxics	CRIR 12-31-22	Applicable	Prohibits the emission of specified contaminants at rates which would result in ground level concentrations greater than acceptable ambient levels or acceptable ambient levels as set in the regulations.	Emissions of air toxics during remedial actions such dredging would be controlled.
Rules and Regulations for Dredging and the Management of Dredged Material	DEM-OWR-DR-02-03, Sections 5, 6, 7, 8, 9, and 11	Applicable	Standards to ensure that dredging in the marine environment and management of the associated dredged material is conducted in a manner which is protective of groundwater and surface water quality so as to ensure the continued viability and integrity of drinking water and fish and wildlife resources. Establish standards and criteria governing the dewatering of dredged material for upland use or disposal.	Remedial alternatives that involve dredging operations, including dewatering, will be conducted in accordance with the substantive requirements of these standards.

TABLE 2-3
SUMMARY OF ACTION-SPECIFIC ARARs AND TBCs
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Consideration
State (continued)				
Water Quality Regulations Water Quality Regulations,	CRIR 12-190-001	Applicable	Establishes water use classification and water quality criteria for waters of the state.	Surface water concentrations will be compared against these criteria to ensure that these criteria are not exceeded during dredging activities. Dredging will be conducted in a manner as to minimize degradation of water quality. Any drainage from the temporary sediment storage area and any dewatering discharge would be treated as required to meet this requirement and discharged into Narragansett Bay.
Water Pollution Control – Pollutant Discharge Elimination System (PDES)	Regulations of Rhode Island Pollutant Discharge Elimination System	Applicable	Contains applicable effluent monitoring requirements, and standards and special conditions for discharges. These regulations also include storm water standards applicable if shoreland staging, processing and stockpiling areas disturb more than one acre.	Discharge of water to surface water or a POTW from remedial activities, such as dewatering of sediment will meet these standards. If over 1 acre of soil is disturbed, then the storm water regulations for small construction activities will be met.
Pretreatment Regulations	RIGL 46-12, 42-17.1, 42-45	Applicable	Rhode Island standards for discharge to POTWs.	These standards will apply if water from the remedial action such as from dewatering is discharged to a POTW.
Rhode Island Soil Erosion and Sediment Control (SESC) Manual	None	To Be Considered	RIGL Erosion and Sediment Control Act places enforcement of soil erosion and sediment control at the local level. The SESC Manual is the primary guidance document.	An erosion and sediment control plan will be prepared according to the SESC Manual for all activities with land disturbance, including stockpiling sediment, backfill, and cover/cap material.
Identification and Management of Aquatic Invasive Species	None	To Be Considered	Guidance on addressing aquatic invasive species in Rhode Island.	Remedial work in the Bay will be conducted in a manner to prevent the establishment or spread of aquatic invasive species.

TABLE 3-1
PRELIMINARY SCREENING OF SEDIMENT TECHNOLOGIES AND PROCESS OPTIONS
FEASIBILITY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND
PAGE 1 OF 4

General Response Action	Technology	Process Option	Description	Screening Comments
No Action	None	Not Applicable	No activities would be conducted at the site to address sediment contamination.	Retain. No action is retained for comparison with other technologies.
Administrative Action	Institutional Controls	Use Restrictions/ Lobstering and Shellfishing Bans	This process relies implementation of administrative controls to include traffic restriction (prohibition of certain size vessels), and prevention of future construction without proper controls or removal of sediment.	Retain. For protection of human health. Any remedial alternative that leaves contaminated media on site will require institutional controls.
	Access Restrictions	Posting/Fencing	Physical controls might include barricades, signage, etc., or a combination of these items. Enforcement of these rules must also be applied by the Navy.	Retain. Technologies that include containment or leaving COCs on site are retained as viable options and any remedial alternative that leaves contaminated media on site will require access restrictions.
	Monitoring	Inspections, Surveys and Sample Collection	Monitoring is typically utilized to assure other controls that are in place are maintaining an adequate condition. Monitoring can include property use inspections, engineering evaluations, and measurement of COCs in media at and surrounding a site, etc.	Retain. Monitoring is required for any situation where waste is left in place. Any remedy that does not include complete removal would need to be augmented with some form of monitoring.
Containment	Capping	Constructing an Engineered Cap System Over In-Place Sediments	Onsite containment refers to the installation of natural or geosynthetic materials, or a combination of both, over impacted sediment as a cap or cover. The sediment cap effectively prevents the potential for human and ecological receptors contacting contaminated sediment.	Retain. Covering or capping contaminated sediment in place is retained as an appropriate technology for addressing the contaminated sediments. This technology can also be combined with monitored natural recovery to develop an enhanced natural recovery approach.

TABLE 3-1
PRELIMINARY SCREENING OF SEDIMENT TECHNOLOGIES AND PROCESS OPTIONS
FEASIBILITY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

General Response Action	Technology	Process Option	Description	Screening Comments
Containment (cont.)	Capping (cont.)	Contaminant Consolidation and Cap or Cover	Consolidation and onsite containment is essentially the same technology as onsite containment with the exception that sediments from several impacted areas of the site are relocated to another contaminated sediment area of the site to reduce the footprint of the containment system.	Eliminate. This technology is eliminated from consideration because consolidation within the existing site would not reduce the volume of contaminated sediment, and may continue to pose risk to human health and ecological receptors.
Enhanced Natural Recovery	Thin Layer Cover	Thin Layer Cover (Enhanced Natural Recovery)	Thin Layer Cover consists of placement of a 6 inch layer of natural material in an effort to speed the natural recovery process in depositional environments. Over time deposition of sediment from the water column can create a naturally occurring cover that is capable of eliminating risk to humans and ecological receptors. The thin layer of natural material would effectively act to speed this process.	Retain. There are areas of the site that could potentially benefit enhancing the natural recovery process to reduce risk (although there is some uncertainty regarding deposition rates within Coddington Cove).
Removal	Dredging	Mechanical Dredging	Sediment dredging involves the physical removal of sediment from a designated area. Dredging with excavation equipment involves the use of clam shells or excavators mounted on a barge, placed on shorelines or overhead cable system. Mechanical dredging is an imprecise process that results in re-suspension of sediments. The effectiveness of the technology is dependent on several factors beyond the technology itself, including the equipment operator, weather, and unpredictable site conditions (e.g., buried debris). Dredging is typically combined with disposal of the dredged sediments.	Retain. Mechanical dredging is retained for larger grain sediment mixed with debris as a viable technology to be coupled with offsite disposal.

TABLE 3-1
PRELIMINARY SCREENING OF SEDIMENT TECHNOLOGIES AND PROCESS OPTIONS
FEASIBILITY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

General Response Action	Technology	Process Option	Description	Screening Comments
Removal (cont.)	Dredging (cont.)	Hydraulic Dredging	Sediment dredging involves the physical removal of sediment from a designated area. Dredging with hydraulic pumps requires vacuum equipment and the introduction of fluids based on the distance sediments are going to be transferred. Like dredging with excavation equipment, the use of hydraulic pumps will re-suspend the sediments; however, the use of hydraulic pumps can dramatically reduce re-suspension compared to other forms of dredging. The effectiveness of the technology is dependent on many factors beyond the technology itself, including the equipment operator, weather, and unpredictable site conditions (i.e., buried debris). Dredging is typically combined with disposal of the dredged sediments.	Retain. Hydraulic dredging is retained as a viable technology for fine grain sediments to be coupled with off-site disposal.
Disposal	Landfilling Offsite	Off-Site Disposal (Hazardous, Non-Hazardous, or Toxic Substance Control Act (TSCA) Regulated Waste Landfills)	Landfilling is an option that is combined with most excavation and removal options. Landfilling of sediments requires preparation of the material before disposal. Sediments must be dewatered, stabilized, and characterized prior to transporting to the appropriate disposal facility or treatment/disposal facility. Landfill disposal may require staging of the excavated material during characterization to identify the appropriate type of waste disposal facility.	Retain. Off-site disposal is a viable option. This technology is the only technology that removes all future liabilities and land use control requirements for sediment.
	Confined Aquatic Disposal	Use of CAD cells in the Providence River	A type of sub-aqueous capping in which dredged sediment is placed within a natural or excavated depression at an underwater location, often situated away from the dredged area, and clean materials are placed on top to seal the CAD and prevent dispersion of the underlying contaminated material.	Retain for further evaluation. As of 2008, there is availability of sufficient storage capacity within a group of existing CAD cells located in the Providence River, although significant complications exist; see text.

TABLE 3-1
PRELIMINARY SCREENING OF SEDIMENT TECHNOLOGIES AND PROCESS OPTIONS
FEASIBILITY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

General Response Action	Technology	Process Option	Description	Screening Comments
Treatment	Ex-Situ, On-Site (in combination with disposal)	Physical/Chemical Treatment	Solidification/stabilization is a technique that mixes reactive materials with contaminated solids, semi-solids, and sludge to immobilize the COCs by forming a chemically-stable matrix of limited permeability. This process can be used for reducing free liquids before disposal at landfills.	Retained. Used for reducing free liquids prior to landfill disposal and potentially for treatment of inorganics.
	Ex-Situ, Off-Site (in combination with disposal)	Physical/Chemical /Thermal/Biological Treatment	Solidification/stabilization is a technique that mixes reactive materials with contaminated solids, semi-solids, and sludge to immobilize the COCs by forming a chemically-stable matrix of limited permeability. This process could be implemented on contaminated sediment off-site in an effort to reduce chemical concentrations below standards needed for disposal at landfills.	Retain. Low concentrations of COCs detected in sediment during investigations indicate that there is low probability that treatment will be necessary to meet disposal requirements. Water generated during dewatering may have to be treated on site or at a POTW prior to disposal.
	In-Situ	Physical/Chemical /Thermal/Biological Treatment	This process would solidify or stabilize COCs within the site sediment by introducing reactive chemicals to the sediment while it is in place. This process would require contamination of a similar make-up throughout the entire site, as well as contamination that can be treated using these techniques.	Eliminate. There is a low probability of effectiveness and implementability at the site due to site specific physical characteristics, and COC make-up.

TABLE 3-2
SUMMARY OF OTHER SITES WHERE DREDGING BENEATH PIERS HAS BEEN PROPOSED
FEASIBILITY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT RHODE ISLAND

ALAMEDA POINT – Former Naval Air Station Alameda, Alameda CA
▪ Dredging was not conducted under the pier. Spacing between pilings would not allow equipment to access sediment. ▪ Dredging was conducted under the wharf road, where a "white-water raft" was outfitted with pumps and hoses, and floated beneath the wharf. ▪ Divers were utilized to maneuver the hydraulic vacuum hose in the sediment (overhead clearance was not sufficient for operation of barge mounted hydraulic dredge, such as hanging ladder). ▪ Significant problems with debris beneath the wharf initially led to multiple work stoppages. ▪ Eventually, the use of divers and the resulting slow production led to a high cost of operation. ▪ Total of 2,745 cubic yards of material were dredged from beneath the wharf at a cost of ≈ $4.5M
SAN DIEGO BAY – Shipyard Sediment Site, San Diego, CA
▪ A tentative Cleanup and Abatement Order (CAO) was signed by the San Diego Water Board on Sep 15, 2010 requiring that 15.2 acres of sediment be dredged. However, of the 15.2 acres, it identified 2.3 acres that were "inaccessible or under-pier areas" that would be remediated "by one or more methods other than dredging, most likely by sand cover".
TODD SHIPYARD – Harbor Island, WA
▪ Dredging under pier proposed in 1996 ROD but after consideration it was recognized that under-pier dredging would be extremely difficult and possibly ineffective, so it was decided that the final remedy for under-pier portion would be determined in remedial design. ▪ Remedial Design abandoned under-pier dredging and implemented a cap on under-pier areas in 2007.
LOCKHEED SHIPYARD – Harbor Island, WA
▪ Dredging under pier was proposed in 1996 ROD. During design difficulties became apparent, and it was decided that the pier should be removed and enough of the sediment be exposed for dredging and capping. ▪ Wooden pier at this site was easier and cheaper to remove that the concrete pier at Derecktor Shipyard.

TABLE 4-1
ASSESSMENT OF CHEMICAL-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 1: NO ACTION
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal				
EPA Human Health Assessment Cancer Slope Factors (CSFs)	None	To Be Considered	These are guidance values used to evaluate the potential carcinogenic hazard caused by exposure to contaminants.	Used to compute the individual incremental cancer risk resulting from exposure to carcinogenic contaminants in site media. There are no actions for this alternative, so unacceptable risk remains.
Guidance for Carcinogen Risk Assessment	EPA/630/P-03/001F (March 2005)	To Be Considered	Guidance values used to evaluate the potential carcinogenic hazard caused by exposure to contaminants.	Used to calculate potential carcinogenic risks caused by exposure to contaminants. There are no actions for this alternative, so unacceptable risk remains.
Reference Doses (RfDs)	None	To Be Considered	Guidance values used to evaluate potential non-carcinogenic hazards caused by exposure to contaminants.	RfDs will be used to characterize non-carcinogenic risks associated with residual COC concentrations and develop site-specific risk-based PRGs. There are no actions for this alternative, so unacceptable risk remains.
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F (March 2005)	To Be Considered	Guidance values used to evaluate the potential carcinogenic hazard to children caused by exposure to contaminants	Used to calculate potential carcinogenic risks to children caused by exposure to contaminants. There are no actions for this alternative, so unacceptable risk remains.
National Oceanographic and Atmospheric Administration (NOAA) Incidence of Adverse Biological Effects within Ranges of Chemical Concentration in Marine and Estuarine Sediments, Long, *et al.*, 1995	None	To Be Considered	Guidance on concentration ranges of contaminants in sediment that correspond to the likelihood of adverse effects to organisms.	Used to establish sediment cleanup standards. There are no actions for this alternative, so likelihood of adverse effects to organisms remains.

TABLE 4-1
ASSESSMENT OF CHEMICAL-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 1: NO ACTION
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND
PAGE 2 OF 2

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
State				
There are no state Chemical-Specific ARARs for Sediment.				

TABLE 4-2
ASSESSMENT OF LOCATION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 1: NO ACTION
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal				
There are no federal location-specific ARARs.				
State				
There are no state location-specific ARARs.				

TABLE 4-3
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 1: NO ACTION
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal				
There are no federal action-specific ARARs.				
State				
There are no state action-specific ARARs.				

TABLE 4-4
ASSESSMENT OF CHEMICAL-SPECIFIC ARARs AND TBCs-
SEDIMENT ALTERNATIVE 2: ENHANCED NATURAL RECOVERY THROUGH THIN LAYER COVER, LUCS, AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal				
EPA Human Health Assessment Cancer Slope Factors (CSFs)	None	To Be Considered	These are guidance values used to evaluate the potential carcinogenic hazard caused by exposure to contaminants.	Used to compute the individual incremental cancer risk resulting from exposure to carcinogenic contaminants in site media. Reduction of contaminant concentrations through enhanced natural recovery (ENR), a cover layer over contaminated sediment, and LUCs will prevent exposure to target area sediments, in order to meet RAOs.
Guidance for Carcinogen Risk Assessment	EPA/630/P-03/001F (March 2005)	To Be Considered	Guidance for assessing cancer risk.	Used to calculate potential carcinogenic risks caused by exposure to contaminants. Reduction of contaminant concentrations through ENR, a cover layer over contaminated sediment, and LUCs will prevent exposure to target area sediments, in order to meet RAOs.
Reference Doses (RfDs)	None	To Be Considered	Guidance values used to evaluate potential non-carcinogenic hazards caused by exposure to contaminants.	RfDs will be used to characterize non-carcinogenic risks associated with residual COC concentrations and develop site-specific risk-based PRGs. Reduction of contaminant concentrations through ENR, a cover layer over contaminated sediment, and LUCs will prevent exposure to target area sediments, in order to meet RAOs.
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F (March 2005)	To Be Considered	Guidance of assessing cancer risks to children.	Used to calculate potential carcinogenic risks to children caused by exposure to contaminants. Reduction of contaminant concentrations through ENR, a cover layer over contaminated sediment, and LUCs will prevent exposure to target area sediments, in order to meet RAOs.

TABLE 4-4
ASSESSMENT OF CHEMICAL-SPECIFIC ARARs AND TBCs-
SEDIMENT ALTERNATIVE 2: ENHANCED NATURAL RECOVERY THROUGH THIN LAYER COVER, LUCS, AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal (continued)				
National Oceanographic and Atmospheric Administration (NOAA) Incidence of Adverse Biological Effects within Ranges of Chemical Concentration in Marine and Estuarine Sediments, Long, *et al.*, 1995	None	To Be Considered	Guidance on concentration ranges of contaminants in sediment that correspond to the likelihood of adverse effects to organisms.	Used to establish sediment cleanup standards. Subaqueous cover layer and ENR will prevent exposure to target area sediments, in order to meet RAOs.
State				
There are no state Chemical-Specific ARARs for Sediment.				

TABLE 4-5
ASSESSMENT OF LOCATION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 2: ENHANCED NATURAL RECOVERY THROUGH THIN LAYER COVER, LUCS, AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal				
Clean Water Act - Section 404 (b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material	40 Code of Federal Regulations (CFR) 230 and 33 CFR 322 and 323	Applicable	Under this requirement, no activity that adversely affects a wetland shall be permitted if a practicable alternative with lesser effects is available. If activity takes place, impacts must be minimized to the maximum extent. Controls discharges of dredged or fill material to protect aquatic ecosystems. Filling or discharge of dredged material will only occur where there is no other practicable alternative and any adverse impacts to aquatic ecosystems will be mitigated. Under these standards the Navy must solicit public comment through the Proposed Plan on its finding that one of the alternatives is the Least Environmentally Damaging Practicable Alternative.	Installation of the thin layer cover would be performed in compliance with the substantive requirements of the statute. Resource agencies will be consulted to determine if mitigation would be required for altering aquatic habitat, including any eelgrass (classified as vegetated shallows), if impacted by the remedial activities. The Navy will identify a remedy that is the Least Environmentally Damaging Practicable Alternative on the aquatic ecosystem.
Rivers and Harbors Act	33 Code of Federal Regulations (CFR) Part 322	Relevant and Appropriate	Sets forth criteria for obstructions and alterations of navigable waters.	Installation of access restriction markers and monitoring activities will be performed in compliance with the substantive requirements of the statute.

TABLE 4-5
ASSESSMENT OF LOCATION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 2: ENHANCED NATURAL RECOVERY THROUGH THIN LAYER COVER, LUCS, AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal (continued)				
Fish and Wildlife Coordination Act	16 United States Code (USC) 661 *et. seq.*	Applicable	Requires Federal agencies involved in actions that will result in the control or structural modification of any stream or body of water for any purpose to take action to protect fish and wildlife resources that may be affected by the action. The Navy must coordinate with appropriate federal and state resource agencies to ascertain the means and measures necessary to mitigate, prevent, and compensate for project related losses of fish and wildlife resources and to enhance the resources.	Installation of thin layer cover may impact the waters of the United States by adding to the bottom substrate. Federal and state fish and wildlife officials would be consulted on how to minimize impacts of any remedial activities on any fish, wildlife and endangered species.
Endangered Species Act (ESA)	16 USC § 1531 *et seq*., 50 CFR Parts 200 and 402	Applicable	Regulates activities affecting federally-listed endangered or threatened species, or adversely modifying or destroying their critical habitat. The Atlantic Sturgeon has been listed as an Endangered Species in the region including Narragansett Bay.	The Navy will consult with the appropriate federal resource agencies to ensure that the thin layer cover installation and maintenance components will be conducted to minimize disturbance to aquatic habitats in Narragansett Bay that may be used by the federally endangered Atlantic Sturgeon.

TABLE 4-5
ASSESSMENT OF LOCATION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 2: ENHANCED NATURAL RECOVERY THROUGH THIN LAYER COVER, LUCS, AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal (continued)				
Floodplain Management and Protection of Wetlands	44 CFR Part 9	Relevant and Appropriate	Implements Executive Order 11990 (Protection of Wetlands) and Executive Order 11988 (Floodplain Management). Prohibits activities that adversely affect a federally-regulated wetland and floodplain unless there is no practicable alternative and the proposed action includes all practicable measures to minimize harm to wetlands and floodplain that may result from such use.	Remedial activities conducted within the 100-year coastal storm floodplain, such as cover material stockpiling or within federal jurisdictional wetlands and aquatic habitats will be implemented in compliance with these standards. During the remedial design stage, the effects of remedial actions on federal jurisdictional wetlands and floodplain will be evaluated. All practicable means will be used to minimize harm to the wetlands and floodplain. Wetlands and floodplain disturbed by thin layer cover installation will be mitigated in accordance with requirements. The Navy will solicit public comment as part of the proposed plan on the measures taken through the remedial action to protect floodplain and wetland/aquatic habitat resources.
Coastal Zone Management Act	16 USC § 1451 *et. seq*.	Applicable	Requires that any actions must be conducted in a manner consistent with NOAA-approved state coastal management programs.	The site is located next to a coastal zone management area; therefore, applicable coastal zone management requirements need to be addressed**.**
State				
Coastal Resources Management	Rhode Island General Laws (RIGL) 46-23-1 *et seq.*	Applicable	Sets standards for management and protection of coastal resources. Jurisdiction includes areas within 200 feet of coastal features, within 50 feet of wetlands under the jurisdiction of the CRMC, and floodplains.	The entire site is located next to a coastal resource management area; therefore, activities conducted under this alternative would be conducted in compliance with applicable coastal resource management requirements**.**

TABLE 4-6
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 2: ENHANCED NATURAL RECOVERY THROUGH THIN LAYER COVER, LUCS, AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal				
Toxic Substances Control Act - PCB Remediation Waste	40 Code of Federal Regulations (CFR) 761.61(c)	Applicable	Risk-based standards for the sampling, cleanup, or disposal of PCB remediation waste. Written approval for the proposed risk-based clean-up will be obtained from the Director, Office of Site Remediation and Restoration, EPA Region I.	Standards apply to cleanup levels and installation of thin layer cover materials. The Navy will solicit public comment in the Proposed Plan about the finding that the proposed remedy for PCB contamination at the Site will not pose an unreasonable risk of injury to health or the environment. An EPA finding that the remedy meets these standards will be included in the Record of Decision. The cover layer over contaminated sediment and LUCs will reduce, and in time, prevent exposure to PCBs exceeding cleanup levels.
Contaminated Sediment Remediation Guidance for Hazardous Waste Sites	OSWER 9355.0-85, (December 2005)	To Be Considered	This document provides technical and policy guidance for making remedy decisions for contaminated sediment sites. Issues addressed include: Chapter 4, Monitored Natural Recovery; Chapter 5, In-situ Capping; Chapter 6, Dredging and Excavation; Chapter 7, Remedy Selection; and Chapter 8, Long-term Monitoring	The approach for installation of thin layer cover materials will be developed using methods described in this document.

TABLE 4-6
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 2: ENHANCED NATURAL RECOVERY THROUGH THIN LAYER COVER, LUCS, AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal (continued)				
Coast Guard Anchorage Ground and Regulated Navigation Area Rules	33 CFR Part 165	To Be Considered (Applicable once a Rule for the LUC area is promulgated)	The Coast Guard may promulgate site-specific rules to establish federal anchorage areas and regulated navigation areas (RNAs). Once promulgated such a rule is also the basis for the National Oceanic and Atmospheric Administration (NOAA) to revise navigation charts to show the restricted area.	If, in the future, the Navy transfers the Site to a non-federal owner, it will explore the option of coordinating with the Coast Guard retaining the existing Restricted Area for the purpose of retaining the LUCs. The Restricted Area is a federally enforceable restriction to protect the LUC area from disturbance and to delineate the area of the LUCs on federal navigation charts.
Corps of Engineers, Danger Zone and Restricted Areas: Narragansett Bay, East Passage, Coddington Cove, Naval Station Newport, Naval Restricted Area, Newport, Rhode Island	33 CFR §334.81	Applicable	All persons, swimmers, vessels and other craft, except those vessels authorized by the Navy or Coast Guard and local or state law enforcement vessels, are prohibited from entering the restricted area without specific permission from the Command Officer.	Enforceable basis for preventing unauthorized vessels and fisherman from entering the area where sediment caps/covers are installed or where there is a risk from consumption of contaminated seafood.
Clean Air Act (CAA), National Emission Standards for Hazardous Air Pollutants (NESHAPS); National Emission Standards for Asbestos	42 U.S.C. §§7411, 7412; 40 C.F.R. Part 61, Subpart M	Applicable	Establish standards for demolition of facilities containing asbestos, managing existing asbestos, and for disposal of asbestos contaminated waste.	Any future maintenance or demolition of the piers where asbestos is present, must be conducted in accordance with these standards.

TABLE 4-6
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 2: ENHANCED NATURAL RECOVERY THROUGH THIN LAYER COVER, LUCS, AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal (continued)				
Clean Air Act (CAA), National Emission Standards for Hazardous Air Pollutants (NESHAPS), Standards for Inactive waste disposal sites for asbestos mills and manufacturing and fabricating operations	42 U.S.C. §§7411, 7412; 40 C.F.R. §61.151	Relevant and Appropriate	NESHAPS standards for preventing air releases from inactive asbestos disposal sites, including cover standards, dust suppression, and land use controls.	For areas of sediments under the piers where asbestos is present, that will be capped/covered substantive requirements of these standards and land use controls will be established to address health and safety requirements to maintain the cover and to address any potential asbestos exposure if the cover is disturbed.
Framework for Investigating Asbestos-Contaminated Superfund Sites	OSWER Directive #9200.0-68 (Sept. 2008)	To Be Considered	Guidance on investigating and characterizing the potential human exposure from asbestos contamination at Superfund sites.	Guidance will be used to establish procedures for sampling for asbestos if areas of potential sediment contamination are disturbed in the future.
CWA, Section 402, National Pollution Discharge Elimination System (NPDES)	33 USC 1342; 40 CFR 122 through 125	Applicable	These standards govern point source discharges of pollutants to surface water. Substantive requirements under NPDES are written such that state and federal NRWQC are met. Permits are required for offsite discharges. RI Standards apply to POTWs and includes storm water requirements for construction projects that disturb over one acre.	Standards for discharging of dewatering liquid or other water to surface waters at the site. If over 1 acre of soil is disturbed, then the storm water regulations for small construction activities will be met.
Clean Water Act, National Recommended Water Quality Criteria (NRWQC)	33 USC § 1251 *et seq.*; 40 CFR 122.44	Applicable	Federal NRWQC are health-based and ecologically based criteria developed for carcinogenic and non-carcinogenic compounds.	These are standards for water quality monitoring that would be conducted to ensure that these criteria are not exceeded during thin layer cover placement activities.

TABLE 4-6
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 2: ENHANCED NATURAL RECOVERY THROUGH THIN LAYER COVER, LUCS, AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
State				
Standards for Identification and Listing of Hazardous Waste	Rules and Regulations for Hazardous Waste Management, Code of Rhode Island Rules (CRIR), 12-030-003, Rule 5.8	Applicable	Defines the listed and characteristic hazardous wastes.	These regulations would apply when determining whether or not a solid waste is hazardous, either by being listed or by exhibiting a hazardous characteristic.
Standards for Generators of Hazardous Waste	Rules and Regulations for Hazardous Waste Management, CRIR 12-030-003, Rule 5.2, 5.3, and 5.4	Applicable	Establishes manifesting and pre-transport requirements for hazardous waste.	These regulations would apply to all wastes generated during monitoring that are determined to be hazardous.
Water Pollution Control – Pollutant Discharge Elimination System (PDES)	Regulations of Rhode Island Pollutant Discharge Elimination System	Applicable	Contains applicable effluent monitoring requirements, and standards and special conditions for discharges. These regulations also include storm water standards applicable if shoreland staging, processing and stockpiling areas disturb more than one acre.	If over 1 acre of soil is disturbed, then the storm water regulations for small construction activities will be met.
Water Quality Regulations	Water Quality Regulations, CRIR 12-190-001	Applicable	Establishes water use classification and water quality criteria for waters of the state.	Installation of thin layer cover materials will be conducted in a manner as to minimize degradation of water quality.
Clean Air Act - Fugitive Dust Control	CRIR 12-31-05	Applicable	Requires that reasonable precautions be taken to prevent particulate matter from becoming airborne.	Controls would be used during storage and handling of cover material to prevent material from becoming airborne.

TABLE 4-6
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 2: ENHANCED NATURAL RECOVERY THROUGH THIN LAYER COVER, LUCS, AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
State (continued)				
Rhode Island Soil Erosion and Sediment Control (SESC) Manual	None	Applicable	RIGL Erosion and Sediment Control Act places enforcement of soil erosion and sediment control at the local level. The SESC Manual is the primary guidance document.	An erosion and sediment control plan will be prepared according to the SESC Manual for all activities with coastal land disturbance, including stockpiling dredged material and backfill.
Identification and Management of Aquatic Invasive Species	None	To Be Considered	Guidance on addressing aquatic invasive species in Rhode Island.	Remedial work in the Bay will be conducted in a manner to prevent the establishment or spread of aquatic invasive species.

TABLE 4-7
ASSESSMENT OF CHEMICAL-SPECIFIC ARARs AND TBCs-
SEDIMENT ALTERNATIVE 3: IN SITU CAP (ENGINEERED BARRIER), LUCS, AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal				
EPA Human Health Assessment Cancer Slope Factors (CSFs)	None	To Be Considered	These are guidance values used to evaluate the potential carcinogenic hazard caused by exposure to contaminants.	Used to compute the individual incremental cancer risk resulting from exposure to carcinogenic contaminants in site media. Reduction of contaminant concentrations through a cap over contaminated sediment, and LUCs will prevent exposure to target area sediments, in order to meet RAOs.
Guidance for Carcinogen Risk Assessment	EPA/630/P-03/001F (March 2005)	To Be Considered	Guidance for assessing cancer risk.	Used to calculate potential carcinogenic risks caused by exposure to contaminants. Reduction of contaminant concentrations through a cap over contaminated sediment and LUCs will prevent exposure to target area sediments, in order to meet RAOs.
Reference Doses (RfDs)	None	To Be Considered	Guidance values used to evaluate potential non-carcinogenic hazards caused by exposure to contaminants.	RfDs will be used to characterize non-carcinogenic risks associated with residual COC concentrations and develop site-specific risk-based PRGs. Reduction of contaminant concentrations through a cap over contaminated sediment and LUCs will prevent exposure to target area sediments, in order to meet RAOs.
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F (March 2005)	To Be Considered	Guidance of assessing cancer risks to children.	Used to calculate potential carcinogenic risks to children caused by exposure to contaminants. Reduction of contaminant concentrations through a cap over contaminated sediment and LUCs will prevent exposure to target area sediments, in order to meet RAOs.

TABLE 4-7
ASSESSMENT OF CHEMICAL-SPECIFIC ARARs AND TBCs-
SEDIMENT ALTERNATIVE 3: IN SITU CAP (ENGINEERED BARRIER), LUCS, AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal (continued)				
National Oceanographic and Atmospheric Administration (NOAA) Incidence of Adverse Biological Effects within Ranges of Chemical Concentration in Marine and Estuarine Sediments, Long, *et al.*, 1995	None	To Be Considered	Guidance on concentration ranges of contaminants in sediment that correspond to the likelihood of adverse effects to organisms.	Used to establish sediment cleanup standards. Subaqueous cap will prevent exposure to target area sediments, in order to meet RAOs.
State				
There are no state Chemical-Specific ARARs for Sediment.				

TABLE 4-8
ASSESSMENT OF LOCATION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 3: IN-SITU CAP (ENGINEERED BARRIER), LUCS, AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal				
Clean Water Act - Section 404 (b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material	40 Code of Federal Regulations (CFR) 230 and 33 CFR 322 and 323	Applicable	Under this requirement, no activity that adversely affects a wetland shall be permitted if a practicable alternative with lesser effects is available. If activity takes place, impacts must be minimized to the maximum extent. Controls discharges of dredged or fill material to protect aquatic ecosystems. Filling or discharge of dredged material will only occur where there is no other practicable alternative and any adverse impacts to aquatic ecosystems will be mitigated. Under these standards the Navy must solicit public comment through the Proposed Plan on its finding that one of the alternatives is the Least Environmentally Damaging Practicable Alternative.	Installation subaqueous cap would be performed in compliance with the substantive requirements of the statute. Resource agencies will be consulted to determine if mitigation would be required for altering aquatic habitat, including the eelgrass (classified as vegetated shallows), if impacted by the remedial activities. The Navy will identify a remedy that is the Least Environmentally Damaging Practicable Alternative on the aquatic ecosystem.
Rivers and Harbors Act	33 Code of Federal Regulations (CFR) Part 322	Relevant and Appropriate	Sets forth criteria for obstructions and alterations of navigable waters.	Installation of access restriction markers and monitoring activities will be performed in compliance with the substantive requirements of the statute.

TABLE 4-8
ASSESSMENT OF LOCATION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 3: IN-SITU CAP (ENGINEERED BARRIER), LUCS, AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal (continued)				
Fish and Wildlife Coordination Act	16 United States Code (USC) 661 *et. seq.*	Applicable	Requires Federal agencies involved in actions that will result in the control or structural modification of any stream or body of water for any purpose to take action to protect fish and wildlife resources that may be affected by the action. The Navy must coordinate with appropriate federal and state resource agencies to ascertain the means and measures necessary to mitigate, prevent, and compensate for project related losses of fish and wildlife resources and to enhance the resources.	Installation of subaqueous cover may impact the waters of the United States by adding to the bottom substrate. Federal and state fish and wildlife officials would be consulted on how to minimize impacts of any remedial activities on any fish, wildlife and endangered species.
Endangered Species Act (ESA)	16 USC § 1531 *et seq*., 50 CFR Parts 200 and 402	Applicable	Regulates activities affecting federally-listed endangered or threatened species, or adversely modifying or destroying their critical habitat. The Atlantic Sturgeon has been listed as an Endangered Species in the region including Narragansett Bay.	The Navy will consult with the appropriate federal resource agencies to ensure that the cover installation and maintenance components will be conducted to minimize disturbance to aquatic habitats in Narragansett Bay that may be used by the federally endangered Atlantic Sturgeon.

TABLE 4-8
ASSESSMENT OF LOCATION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 3: IN-SITU CAP (ENGINEERED BARRIER), LUCS, AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal (continued)				
Floodplain Management and Protection of Wetlands	44 CFR Part 9	Relevant and Appropriate	Implements Executive Order 11990 (Protection of Wetlands) and Executive Order 11988 (Floodplain Management). Prohibits activities that adversely affect a federally-regulated wetland and floodplain unless there is no practicable alternative and the proposed action includes all practicable measures to minimize harm to wetlands and floodplain that may result from such use.	Remedial activities conducted within the 100-year coastal storm floodplain, such as cap material stockpiling or within federal jurisdictional wetlands and aquatic habitats will be implemented in compliance with these standards. During the remedial design stage, the effects of construction activities on federal jurisdictional wetlands and floodplain will be evaluated. All practicable means will be used to minimize harm to the wetlands and floodplain. Wetlands and floodplain disturbed by remediation will be mitigated in accordance with requirements. The Navy will solicit public comment as part of the proposed plan on the measures taken through the remedial action to protect floodplain and wetland/aquatic habitat resources.
Coastal Zone Management Act	16 USC §1451 *et. seq*.	Applicable	Requires that any actions must be conducted in a manner consistent with NOAA-approved state coastal management programs.	The site is located next to a coastal zone management area; therefore, applicable coastal zone management requirements need to be addressed**.**
State				
Coastal Resources Management	Rhode Island General Laws (RIGL) 46-23-1 *et seq.*	Applicable	Sets standards for management and protection of coastal resources. Jurisdiction includes areas within 200 feet of coastal features, within 50 feet of wetlands under the jurisdiction of the CRMC, and floodplains.	The entire site is located next to a coastal resource management area, therefore, activities conducted under this alternative would be conducted in compliance with applicable coastal resource management requirements**.**

TABLE 4-9
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 3: IN-SITU CAP (ENGINEERED BARRIER), LUCS, AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal				
Toxic Substances Control Act - PCB Remediation Waste	40 Code of Federal Regulations (CFR) 761.61(c)	Applicable	Risk-based standards for the sampling, cleanup, or disposal of PCB remediation waste. Written approval for the proposed risk-based clean-up will be obtained from the Director, Office of Site Remediation and Restoration, EPA Region I.	Standards apply to cleanup levels and capping/cover. The Navy will solicit public comment in the Proposed Plan about the finding that the proposed remedy for PCB contamination at the Site will not pose an unreasonable risk of injury to health or the environment. An EPA finding that the remedy meets these standards will be included in the Record of Decision. The in situ cap, LUCs, and monitoring over contaminated sediment and LUCs will prevent exposure to PCBs exceeding cleanup levels.
Contaminated Sediment Remediation Guidance for Hazardous Waste Sites	OSWER 9355.0-85, (December 2005)	To Be Considered	This document provides technical and policy guidance for making remedy decisions for contaminated sediment sites. Issues addressed include: Chapter 4, Monitored Natural Recovery; Chapter 5, In-situ Capping; Chapter 6, Dredging and Excavation; Chapter 7, Remedy Selection; and Chapter 8, Long-term Monitoring	The cap will be developed using methods described in this document.
Corps of Engineers, Danger Zone and Restricted Areas: Narragansett Bay, East Passage, Coddington Cove, Naval Station Newport, Naval Restricted Area, Newport, Rhode Island	33 CFR §334.81	Applicable	All persons, swimmers, vessels and other craft, except those vessels authorized by the Navy or Coast Guard and local or state law enforcement vessels, are prohibited from entering the restricted area without specific permission from the Command Officer.	Enforceable basis for preventing unauthorized vessels and fisherman from entering the area where sediment caps/covers are installed or where there is a risk from consumption of contaminated seafood.

TABLE 4-9
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 3: IN-SITU CAP (ENGINEERED BARRIER), LUCS, AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal (continued)				
Clean Air Act (CAA), National Emission Standards for Hazardous Air Pollutants (NESHAPS); National Emission Standards for Asbestos	42 U.S.C. §§7411, 7412; 40 C.F.R. Part 61, Subpart M	Applicable	Establish standards for demolition of facilities containing asbestos, managing existing asbestos, and for disposal of asbestos contaminated waste.	Any future maintenance or demolition of the piers where asbestos is present, must be conducted in accordance with these standards.
Clean Air Act (CAA), National Emission Standards for Hazardous Air Pollutants (NESHAPS), Standards for Inactive waste disposal sites for asbestos mills and manufacturing and fabricating operations	42 U.S.C. §§7411, 7412; 40 C.F.R. §61.151	Relevant and Appropriate	NESHAPS standards for preventing air releases from inactive asbestos disposal sites, including cover standards, dust suppression, and land use controls.	For areas of sediments under the piers where asbestos is present, that will be capped/covered substantive requirements of these standards and land use controls will be established to address health and safety requirements to maintain the cover and to address any potential asbestos exposure if the cover is disturbed.
Framework for Investigating Asbestos-Contaminated Superfund Sites	OSWER Directive #9200.0-68 (Sept. 2008)	To Be Considered	Guidance on investigating and characterizing the potential human exposure from asbestos contamination at Superfund sites.	Guidance will be used to establish procedures for sampling for asbestos if areas of potential sediment contamination are disturbed in the future.

TABLE 4-9
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 3: IN-SITU CAP (ENGINEERED BARRIER), LUCS, AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal (continued)				
Coast Guard Anchorage Ground and Regulated Navigation Area Rules	33 CFR Part 165	To Be Considered (Applicable once a Rule for the LUC area is promulgated)	The Coast Guard may promulgate site-specific rules to establish federal anchorage areas and regulated navigation areas (RNAs). Once promulgated such a rule is also the basis for the National Oceanic and Atmospheric Administration (NOAA) to revise navigation charts to show the restricted area.	If, in the future, the Navy transfers the Site to a non-federal owner, it will explore the option of coordinating with the Coast Guard retaining the existing Restricted Area for the purpose of retaining the LUCs. The Restricted Area is a federally enforceable restriction to protect the LUC area from disturbance and to delineate the area of the LUCs on federal navigation charts.
CWA, Section 402, National Pollution Discharge Elimination System (NPDES)	33 USC 1342; 40 CFR 122 through 125	Applicable	These standards govern point source discharges of pollutants to surface water. Substantive requirements under NPDES are written such that state and federal NRWQC are met. Permits are required for offsite discharges. RI Standards apply to POTWs and includes storm water requirements for construction projects that disturb over one acre.	Standards for discharging of dewatering liquid or other water to surface waters at the site. If over 1 acre of soil is disturbed, then the storm water regulations for small construction activities will be met.
Clean Water Act, National Recommended Water Quality Criteria (NRWQC)	33 USC § 1251 *et seq.*; 40 CFR 122.44	Applicable	Federal NRWQC are health-based and ecologically based criteria developed for carcinogenic and non-carcinogenic compounds.	These are standards for water quality monitoring that would be conducted to ensure that these criteria are not exceeded during cap placement activities.

TABLE 4-9
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 3: IN-SITU CAP (ENGINEERED BARRIER), LUCS, AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
State				
Standards for Identification and Listing of Hazardous Waste	Rules and Regulations for Hazardous Waste Management, Code of Rhode Island Rules (CRIR), 12-030-003, Rule 5.8	Applicable	Defines the listed and characteristic hazardous wastes.	These regulations would apply when determining whether or not a solid waste is hazardous, either by being listed or by exhibiting a hazardous characteristic.
Standards for Generators of Hazardous Waste	Rules and Regulations for Hazardous Waste Management, CRIR 12-030-003, Rule 5.2, 5.3, and 5.4	Applicable	Establishes manifesting and pre-transport requirements for hazardous waste.	These regulations would apply to all wastes generated during monitoring that are determined to be hazardous.
Water Pollution Control – Pollutant Discharge Elimination System (PDES)	Regulations of Rhode Island Pollutant Discharge Elimination System	Applicable	Contains applicable effluent monitoring requirements, and standards and special conditions for discharges. These regulations also include storm water standards applicable if shoreland staging, processing and stockpiling areas disturb more than one acre.	If over 1 acre of soil is disturbed, then the storm water regulations for small construction activities will be met.
Water Quality Regulations	Water Quality Regulations, CRIR 12-190-001	Applicable	Establishes water use classification and water quality criteria for waters of the state.	Installation of cap materials will be conducted in a manner as to minimize degradation of water quality.

TABLE 4-9
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 3: IN-SITU CAP (ENGINEERED BARRIER), LUCS, AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
State (continued)				
Clean Air Act - Fugitive Dust Control	CRIR 12-31-05	Applicable	Requires that reasonable precautions be taken to prevent particulate matter from becoming airborne.	Controls would be used during storage and handling of cap material to prevent material from becoming airborne.
Rhode Island Soil Erosion and Sediment Control (SESC) Manual	None	Applicable	RIGL Erosion and Sediment Control Act places enforcement of soil erosion and sediment control at the local level. The SESC Manual is the primary guidance document.	An erosion and sediment control plan will be prepared according to the SESC Manual for all activities with land disturbance, including stockpiling of cap material.
Identification and Management of Aquatic Invasive Species	None	To Be Considered	Guidance on addressing aquatic invasive species in Rhode Island.	Remedial work in the Bay will be conducted in a manner to prevent the establishment or spread of aquatic invasive species.

TABLE 4-10
ASSESSMENT OF CHEMICAL-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 4: COMBINATION DREDGE / BACKFILL (OPEN WATER), COVER / LUCS (UNDER PIER 2) AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal				
EPA Human Health Assessment Cancer Slope Factors (CSFs)	None	To Be Considered	These are guidance values used to evaluate the potential carcinogenic hazard caused by exposure to contaminants.	Used to compute the individual incremental cancer risk resulting from exposure to carcinogenic contaminants in site media. Removal of contaminated sediment by dredging, cover, and LUCs will prevent exposure to target area sediments, in order to meet RAOs.
Guidance for Carcinogen Risk Assessment	EPA/630/P-03/001F (March 2005)	To Be Considered	Guidance for assessing cancer risk.	Used to calculate potential carcinogenic risks caused by exposure to contaminants. Removal of contaminated sediment by dredging, cover, and LUCs will prevent exposure to target area sediments, in order to meet RAOs.
Reference Doses (RfDs)	None	To Be Considered	Guidance values used to evaluate potential non-carcinogenic hazards caused by exposure to contaminants.	RfDs will be used to characterize non-carcinogenic risks associated with residual COC concentrations and develop site-specific risk-based PRGs. Removal of contaminated sediment by dredging, cover, and LUCs will prevent exposure to target area sediments, in order to meet RAOs.
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F (March 2005)	To Be Considered	Guidance of assessing cancer risks to children.	Used to calculate potential carcinogenic risks to children caused by exposure to contaminants. Removal of contaminated sediment by dredging, cover, and LUCs will prevent exposure to target area sediments, in order to meet RAOs.
National Oceanographic and Atmospheric Administration (NOAA) Incidence of Adverse Biological Effects within Ranges of Chemical Concentration in Marine and Estuarine Sediments, Long, *et al.*, 1995	None	To Be Considered	Guidance on concentration ranges of contaminants in sediment that correspond to the likelihood of adverse effects to organisms.	Used to establish sediment cleanup standards. Removal of contaminated sediment and cover will prevent exposure to target area sediments, in order to meet RAOs.

TABLE 4-10
ASSESSMENT OF CHEMICAL-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 4: COMBINATION DREDGE / BACKFILL (OPEN WATER), COVER / LUCS (UNDER PIER 2) AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND
PAGE 2 OF 2

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
State				
There are no state Chemical-Specific ARARs for Sediment.				

TABLE 4-11
ASSESSMENT OF LOCATION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 4: COMBINATION DREDGE / BACKFILL (OPEN WATER), COVER / LUCS (UNDER PIER 2) AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal				
Clean Water Act -Section 404 (b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material	40 Code of Federal Regulations (CFR) 230 and 33 CFR 322 and 323	Applicable	Under this requirement, no activity that adversely affects a wetland shall be permitted if a practicable alternative with lesser effects is available. If activity takes place, impacts must be minimized to the maximum extent. Controls discharges of dredged or fill material to protect aquatic ecosystems. Filling or discharge of dredged material will only occur where there is no other practicable alternative and any adverse impacts to aquatic ecosystems will be mitigated. Under these standards the Navy must solicit public comment through the Proposed Plan on its finding that one of the alternatives is the Least Environmentally Damaging Practicable Alternative.	Dredging/backfill operations, including sediment dewatering and cover installation would be conducted in a manner that will minimize discharges to navigable waters. If shoreland staging, processing, and stockpile areas are within protected resource areas, these standards will be met. Resource agencies will be consulted to determine if mitigation would be required for altering aquatic habitat. Any eelgrass (classified as vegetated shallows) removed during dredging (if any is encountered) would require mitigation. The dredging, dewatering, and cover installation components would meet the substantive environmental requirements of these standards. For backfill and cover, the Navy will identify a remedy that is the Least Environmentally Damaging Practicable Alternative on the aquatic ecosystem.
Rivers and Harbors Act	33 Code of Federal Regulations (CFR) Part 322	Relevant and Appropriate	Sets forth criteria for obstructions and alterations of navigable waters.	Installation of access restriction markers and monitoring activities will be performed in compliance with the substantive requirements of the statute.

TABLE 4-11
ASSESSMENT OF LOCATION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 4: COMBINATION DREDGE / BACKFILL (OPEN WATER), COVER / LUCS (UNDER PIER 2) AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal (continued)				
Fish and Wildlife Coordination Act	16 United States Code (USC) 661 *et. seq.*	Applicable	Requires Federal agencies involved in actions that will result in the control or structural modification of any stream or body of water for any purpose to take action to protect fish and wildlife resources that may be affected by the action. The Navy must coordinate with appropriate federal and state resource agencies to ascertain the means and measures necessary to mitigate, prevent, and compensate for project related losses of fish and wildlife resources and to enhance the resources.	Dredging and cover installation will impact the waters of the United States. Federal and state fish and wildlife officials would be consulted on how to minimize impacts of any remedial activities on any fish, wildlife and endangered species.
Endangered Species Act (ESA)	16 USC § 1531 *et seq.*, 50 CFR Parts 200 and 402	Applicable	Regulates activities affecting federally-listed endangered or threatened species, or adversely modifying or destroying their critical habitat. The Atlantic Sturgeon has been listed as an Endangered Species in the region including Narragansett Bay.	The Navy will consult with the appropriate federal resource agencies to ensure that the dredging and cover installation and maintenance will be conducted to minimize disturbance to aquatic habitats in Narragansett Bay that may be used by the federally endangered Atlantic Sturgeon.

TABLE 4-11
ASSESSMENT OF LOCATION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 4: COMBINATION DREDGE / BACKFILL (OPEN WATER), COVER / LUCS (UNDER PIER 2) AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal (continued)				
Floodplain Management and Protection of Wetlands	44 CFR Part 9	Relevant and Appropriate	Implements Executive Order 11990 (Protection of Wetlands) and Executive Order 11988 (Floodplain Management). Prohibits activities that adversely affect a federally-regulated wetland and floodplain unless there is no practicable alternative and the proposed action includes all practicable measures to minimize harm to wetlands and floodplain that may result from such use.	Remedial activities conducted within the 100-year coastal storm floodplain, such as dredged material stockpiling or within federal jurisdictional wetlands and aquatic habitats will be implemented in compliance with these standards. During the remedial design stage, the effects of remedial actions on federal jurisdictional wetlands and floodplain will be evaluated. All practicable means will be used to minimize harm to the wetlands and floodplain. Wetlands and floodplain disturbed by remediation will be mitigated in accordance with requirements. The Navy will solicit public comment as part of the proposed plan on the measures taken through the remedial action to protect floodplain and wetland/aquatic habitat resources.
Coastal Zone Management Act	16 USC §1451 *et. seq*.	Applicable	Requires that any actions must be conducted in a manner consistent with NOAA-approved state coastal management programs.	The site is located next to a coastal zone management area; therefore, applicable coastal zone management requirements need to be addressed**.**
State				
Coastal Resources Management	Rhode Island General Laws (RIGL) 46-23-1 *et seq.*	Applicable	Sets standards for management and protection of coastal resources. Jurisdiction includes areas within 200 feet of coastal features, within 50 feet of wetlands under the jurisdiction of the CRMC, and floodplains.	The entire site is located next to a coastal resource management area. Therefore, activities conducted under this alternative would be conducted in compliance with applicable coastal resource management requirements**.**

TABLE 4-12
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 4: COMBINATION DREDGE / BACKFILL (OPEN WATER), COVER / LUCS (UNDER PIER 2) AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal				
Toxic Substances Control Act - PCB Remediation Waste	40 Code of Federal Regulations (CFR) 761.61(c)	Applicable	Risk-based standards for the sampling, cleanup, or disposal of PCB remediation waste. Written approval for the proposed risk-based clean-up will be obtained from the Director, Office of Site Remediation and Restoration, EPA Region I.	Standards apply to cleanup levels, sampling, cleanup, and disposal. The Navy will solicit public comment in the Proposed Plan about the finding that the proposed remedy for PCB contamination at the Site will not pose an unreasonable risk of injury to health or the environment. An EPA finding that the remedy meets these standards will be included in the Record of Decision. The dredging, backfill, LUCs, and monitoring over contaminated sediment and LUCs will prevent exposure to PCBs exceeding cleanup levels.
CWA, Section 402, National Pollution Discharge Elimination System (NPDES)	33 USC § 1342; 40 CFR 122 through 125	Applicable	These standards govern point source discharges of pollutants to surface water. Substantive requirements under NPDES are written such that state and federal NRWQC are met. Permits are required for offsite discharges. RI Standards apply to POTWs and includes storm water requirements for construction projects that disturb over one acre.	Standards for discharging of dewatering liquid to surface waters at the site will be met by treatment of water from dewatering sediment prior to discharge. If over 1 acre of soil is disturbed, then the storm water regulations for small construction activities will be met.
Clean Water Act; General Pretreatment Regulations for Existing and New Sources of Pollution	33 USC 1251 et seq., 40 CFR. Part 403	Applicable	Standards for direct discharge of wastewater into a Publicly Owned Treatment Works (POTW).	These standards will apply if water from the remedial action such as from dewatering is discharged to a POTW.
Contaminated Sediment Remediation Guidance for Hazardous Waste Sites	OSWER 9355.0-85, (December 2005)	To Be Considered	This document provides technical and policy guidance for making remedy decisions for contaminated sediment sites. Issues addressed include: Chapter 4, Monitored Natural Recovery; Chapter 5, In-situ Capping; Chapter 6, Dredging and Excavation; Chapter 7, Remedy Selection; and Chapter 8, Long-term Monitoring	The dredging/backfill operations and the cover placement will be developed using methods described in this document.

TABLE 4-12
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 4: COMBINATION DREDGE / BACKFILL (OPEN WATER), COVER / LUCS (UNDER PIER 2) AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal (continued)				
Clean Water Act, National Recommended Water Quality Criteria (NRWQC)	33 USC § 1251 *et seq.*; 40 CFR 122.44	Applicable	Federal NRWQC are health-based and ecologically based criteria developed for carcinogenic and non-carcinogenic compounds.	These are standards for water quality monitoring that would be conducted to ensure that these criteria are not exceeded during dredge/backfill and cover installation activities.
Coast Guard Anchorage Ground and Regulated Navigation Area Rules	33 CFR Part 165	To Be Considered for the area under a permanent structure. (Applicable once a Rule for the LUC area is promulgated)	The Coast Guard may promulgate site-specific rules to establish federal anchorage areas and regulated navigation areas (RNAs). Once promulgated such a rule is also the basis for the National Oceanic and Atmospheric Administration (NOAA) to revise navigation charts to show the restricted area.	Under this alternative, the LUC is necessary only for the area under the existing Pier 2, which is a shoreline structure. Because the LUC is not for a navigable waterway, it would not be necessary to apply to this rule unless the pier was demolished and the water became navigable. Therefore, if, in the future, the Navy demolishes Pier 2, excesses the property to a private owner, and leaves the sediment in place underneath with the cover intact, it will then explore the option of coordinating with the Coast Guard retaining the existing Restricted Area for the purpose of implementing LUCs. The Restricted Area is a federally enforceable restriction to protect the LUC area from disturbance and to delineate the area of the LUCs on federal navigation charts.
Corps of Engineers, Danger Zone and Restricted Areas: Narragansett Bay, East Passage, Coddington Cove, Naval Station Newport, Naval Restricted Area, Newport, Rhode Island	33 CFR §334.81	Applicable	All persons, swimmers, vessels and other craft, except those vessels authorized by the Navy or Coast Guard and local or state law enforcement vessels, are prohibited from entering the restricted area without specific permission from the Command Officer.	Enforceable basis for preventing unauthorized vessels and fisherman from entering the area where sediment caps/covers are installed or where there is a risk from consumption of contaminated seafood.

TABLE 4-12
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 4: COMBINATION DREDGE / BACKFILL (OPEN WATER), COVER / LUCS (UNDER PIER 2) AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal (continued)				
Clean Air Act (CAA), National Emission Standards for Hazardous Air Pollutants (NESHAPS); National Emission Standards for Asbestos	42 U.S.C. §§7411, 7412; 40 C.F.R. Part 61, Subpart M	Applicable	Establish standards for demolition of facilities containing asbestos, managing existing asbestos, and for disposal of asbestos contaminated waste.	Any future maintenance or demolition of the piers where asbestos is present, must be conducted in accordance with these standards.
Clean Air Act (CAA), National Emission Standards for Hazardous Air Pollutants (NESHAPS), Standards for Inactive waste disposal sites for asbestos mills and manufacturing and fabricating operations	42 U.S.C. §§7411, 7412; 40 C.F.R. §61.151	Relevant and Appropriate	NESHAPS standards for preventing air releases from inactive asbestos disposal sites, including cover standards, dust suppression, and land use controls.	For areas of sediments under the piers where asbestos is present, that will be capped/covered substantive requirements of these standards and land use controls will be established to address health and safety requirements to maintain the cover and to address any potential asbestos exposure if the cover is disturbed.
Framework for Investigating Asbestos-Contaminated Superfund Sites	OSWER Directive #9200.0-68 (Sept. 2008)	To Be Considered	Guidance on investigating and characterizing the potential human exposure from asbestos contamination at Superfund sites.	Guidance will be used to establish procedures for sampling for asbestos if areas of potential sediment contamination are disturbed in the future.
State				
Standards for Identification and Listing of Hazardous Waste	Rules and Regulations for Hazardous Waste Management, Code of Rhode Island Rules (CRIR), 12-030-003, Rule 5.8	Applicable	Defines the listed and characteristic hazardous wastes.	These regulations would apply when determining whether or not a solid waste is hazardous, either by being listed or by exhibiting a hazardous characteristic.

TABLE 4-12
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 4: COMBINATION DREDGE / BACKFILL (OPEN WATER), COVER / LUCS (UNDER PIER 2) AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
State (continued)				
Standards for Generators of Hazardous Waste	Rules and Regulations for Hazardous Waste Management, CRIR 12-030-003, Rule 5.2, 5.3, and 5.4	Applicable	Establishes manifesting and pre-transport requirements for hazardous waste.	These regulations would apply to all waste generated during dredging and other remedial activities that are determined to be hazardous.
Rules and Regulations for Dredging and the Management of Dredged Material	DEM-OWR-DR-02-03, Sections 5, 6, 7, 8, 9, and 11	Applicable	Standards to ensure that dredging in the marine environment and management of the associated dredged material is conducted in a manner which is protective of groundwater and surface water quality so as to ensure the continued viability and integrity of drinking water and fish and wildlife resources. Establish standards and criteria governing the dewatering of dredged material for upland use or disposal.	Dredging/backfill operations, including dewatering, will be conducted in accordance with the substantive requirements of these standards.
Clean Air Act - Fugitive Dust Control	CRIR 12-31-05	Applicable	Requires that reasonable precautions be taken to prevent particulate matter from becoming airborne.	Controls would be used during storage and handling of sediment, backfill, and cover material to prevent material from becoming airborne.
Clean Air Act - Emissions Detrimental to Persons or Property	CRIR 12-31-07	Applicable	Prohibits emissions of contaminants which may be injurious to humans, plant or animal life or cause damage to property or which reasonably interferes with the enjoyment of life and property.	Monitoring of air emissions during dredging and dewatering will be used to assess compliance with these standards if threshold levels are reached.
Clean Air Act – Air Toxics	CRIR 12-31-22	Applicable	Prohibits the emission of specified contaminants at rates which would result in ground level concentrations greater than acceptable ambient levels or acceptable ambient levels as set in the regulations.	Emissions of hydrogen sulfide during dredging, dewatering, and stockpiling would be controlled.

TABLE 4-12
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 4: COMBINATION DREDGE / BACKFILL (OPEN WATER), COVER / LUCS (UNDER PIER 2) AND MONITORING
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
State (continued)				
Water Quality Regulations	Water Quality Regulations, CRIR 12-190-001	Applicable	Establishes water use classification and water quality criteria for waters of the state.	Dredging will be conducted in a manner as to minimize degradation of water quality. Any drainage from the temporary sediment storage area and any dewatering discharge would be treated as required to meet this requirement and discharged into Narragansett Bay.
Water Pollution Control – Pollutant Discharge Elimination System (PDES)	Regulations of Rhode Island Pollutant Discharge Elimination System	Applicable	Contains applicable effluent monitoring requirements, and standards and special conditions for discharges. These regulations also include storm water standards applicable if shoreland staging, processing and stockpiling areas disturb more than one acre.	Discharge of water to surface water from remedial activities, such as dewatering of sediment will meet these standards. If over 1 acre of soil is disturbed, then the storm water regulations for small construction activities will be met.
Pretreatment Regulations	RIGL 46-12, 42-17.1, 42-45	Applicable	Rhode Island standards for discharge to POTWs.	These standards will apply if water from the remedial action such as from dewatering is discharged to a POTW.
Rhode Island Soil Erosion and Sediment Control (SESC) Manual	None	Applicable	RIGL Erosion and Sediment Control Act places enforcement of soil erosion and sediment control at the local level. The SESC Manual is the primary guidance document.	An erosion and sediment control plan will be prepared according to the SESC Manual for all activities with land disturbance, including stockpiling dredged material, backfill, and cover material.
Identification and Management of Aquatic Invasive Species	None	To Be Considered	Guidance on addressing aquatic invasive species in Rhode Island.	Remedial work in the Bay will be conducted in a manner to prevent the establishment or spread of aquatic invasive species.

TABLE 4-13
ASSESSMENT OF CHEMICAL-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 5: DREDGE (OPEN WATER), CAP AND MONITORING (BENEATH PIER 2)
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal				
EPA Human Health Assessment Cancer Slope Factors (CSFs)	None	To Be Considered	These are guidance values used to evaluate the potential carcinogenic hazard caused by exposure to contaminants.	Used to compute the individual incremental cancer risk resulting from exposure to carcinogenic contaminants in site media. Removal of contaminated sediment by dredging and capping under Pier 2 will prevent exposure to target area sediments, in order to meet RAOs.
Guidance for Carcinogen Risk Assessment	EPA/630/P-03/001F (March 2005)	To Be Considered	Guidance for assessing cancer risk.	Used to calculate potential carcinogenic risks caused by exposure to contaminants. Removal of contaminated sediment by dredging and capping under Pier 2 will prevent exposure to target area sediments, in order to meet RAOs.
Reference Doses (RfDs)	None	To Be Considered	Guidance values used to evaluate potential non-carcinogenic hazards caused by exposure to contaminants.	RfDs will be used to characterize non-carcinogenic risks associated with residual COC concentrations and develop site-specific risk-based PRGs. Removal of contaminated sediment by dredging and capping under Pier 2 will prevent exposure to target area sediments, in order to meet RAOs.
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F (March 2005)	To Be Considered	Guidance of assessing cancer risks to children.	Used to calculate potential carcinogenic risks to children caused by exposure to contaminants. Removal of contaminated sediment by dredging and capping under Pier 2 will prevent exposure to target area sediments, in order to meet RAOs.

TABLE 4-13
ASSESSMENT OF CHEMICAL-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 5: DREDGE (OPEN WATER), CAP AND MONITORING (BENEATH PIER 2)
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND
PAGE 2 OF 2

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal (continued)				
National Oceanographic and Atmospheric Administration (NOAA) Incidence of Adverse Biological Effects within Ranges of Chemical Concentration in Marine and Estuarine Sediments, Long, *et al.*, 1995	None	To Be Considered	Guidance on concentration ranges of contaminants in sediment that correspond to the likelihood of adverse effects to organisms.	Used to establish sediment cleanup standards. Removal of contaminated sediment by dredging and capping under Pier 2 will prevent exposure to target area sediments, in order to meet RAOs.
State				
There are no state Chemical-Specific ARARs for Sediment.				

TABLE 4-14
ASSESSMENT OF LOCATION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 5: DREDGE (OPEN WATER), CAP AND MONITORING (BENEATH PIER 2)
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal				
Clean Water Act -Section 404 (b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material	40 Code of Federal Regulations (CFR) 230 and 33 CFR 322 and 323	Applicable	Under this requirement, no activity that adversely affects a wetland shall be permitted if a practicable alternative with lesser effects is available. If activity takes place, impacts must be minimized to the maximum extent. Controls discharges of dredged or fill material to protect aquatic ecosystems. Filling or discharge of dredged material will only occur where there is no other practicable alternative and any adverse impacts to aquatic ecosystems will be mitigated. Under these standards the Navy must solicit public comment through the Proposed Plan on its finding that one of the alternatives is the Least Environmentally Damaging Practicable Alternative.	Dredging open water areas and capping under Pier 2operations including sediment dewatering would be conducted in a manner that will minimize discharges to navigable waters. If shoreland staging, processing, and stockpile areas are within protected resource areas, these standards will be met. Resource agencies will be consulted to determine if mitigation would be required for altering aquatic habitat. The eelgrass (classified as vegetated shallows) if encountered during dredging, would require mitigation. The dredging and dewatering components would meet the substantive environmental requirements of these standards. For backfill, the Navy will identify a remedy that is the Least Environmentally Damaging Practicable Alternative on the aquatic ecosystem.
Rivers and Harbors Act	33 Code of Federal Regulations (CFR) Part 322	Relevant and Appropriate	Sets forth criteria for obstructions and alterations of navigable waters.	Installation of access restriction markers during dredging activities will be performed in compliance with the substantive requirements of the statute.

TABLE 4-14
ASSESSMENT OF LOCATION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 5: DREDGE (OPEN WATER), CAP AND MONITORING (BENEATH PIER 2)
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal (continued)				
Fish and Wildlife Coordination Act	16 United States Code (USC) 661 *et. seq.*	Applicable	Requires Federal agencies involved in actions that will result in the control or structural modification of any stream or body of water for any purpose to take action to protect fish and wildlife resources that may be affected by the action. The Navy must coordinate with appropriate federal and state resource agencies to ascertain the means and measures necessary to mitigate, prevent, and compensate for project related losses of fish and wildlife resources and to enhance the resources.	Dredging open water areas and capping under Pier 2 will impact the waters of the United States. Federal and state fish and wildlife officials would be consulted on how to minimize impacts of any remedial activities on any fish, wildlife and endangered species.
Endangered Species Act (ESA)	16 USC § 1531 *et seq.*, 50 CFR Parts 200 and 402	Applicable	Regulates activities affecting federally-listed endangered or threatened species, or adversely modifying or destroying their critical habitat. The Atlantic Sturgeon has been listed as an Endangered Species in the region including Narragansett Bay.	The Navy will consult with the appropriate federal resource agencies to ensure that dredging open water areas and capping under Pier 2 will be conducted to minimize disturbance to aquatic habitats in Narragansett Bay that may be used by the federally endangered Atlantic Sturgeon.

TABLE 4-14
ASSESSMENT OF LOCATION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 5: DREDGE (OPEN WATER), CAP AND MONITORING (BENEATH PIER 2)
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal (continued)				
Floodplain Management and Protection of Wetlands	44 CFR Part 9	Relevant and Appropriate	Implements Executive Order 11990 (Protection of Wetlands) and Executive Order 11988 (Floodplain Management). Prohibits activities that adversely affect a federally-regulated wetland and floodplain unless there is no practicable alternative and the proposed action includes all practicable measures to minimize harm to wetlands and floodplain that may result from such use.	Remedial activities conducted within the 100-year coastal storm floodplain, such as dredged material stockpiling or within federal jurisdictional wetlands and aquatic habitats will be implemented in compliance with these standards. During the remedial design stage, the effects of remedial actions on federal jurisdictional wetlands and floodplain will be evaluated. All practicable means will be used to minimize harm to the wetlands and floodplain. Wetlands and floodplain disturbed by remediation will be mitigated in accordance with requirements. The Navy will solicit public comment as part of the proposed plan on the measures taken through the remedial action to protect floodplain and wetland/aquatic habitat resources.
Coastal Zone Management Act	16 USC §1451 *et. seq*.	Applicable	Requires that any actions must be conducted in a manner consistent with NOAA-approved state coastal management programs.	The site is located next to a coastal zone management area; therefore, applicable coastal zone management requirements need to be addressed**.**
State				
Coastal Resources Management	Rhode Island General Laws (RIGL) 46-23-1 *et seq.*	Applicable	Sets standards for management and protection of coastal resources. Jurisdiction includes areas within 200 feet of coastal features, within 50 feet of wetlands under the jurisdiction of the CRMC, and floodplains.	The entire site is located next to a coastal resource management area, therefore, activities conducted under this alternative would be conducted in compliance with applicable coastal resource management requirements**.**

TABLE 4-15
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 5: DREDGE (OPEN WATER), CAP AND MONITORING (BENEATH PIER 2)
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal				
Toxic Substances Control Act - PCB Remediation Waste	40 Code of Federal Regulations (CFR) 761.61(c)	Applicable	Risk-based standards for the sampling, cleanup, or disposal of PCB remediation waste. Written approval for the proposed risk-based clean-up will be obtained from the Director, Office of Site Remediation and Restoration, EPA Region I.	Standards apply to cleanup levels, sampling, cleanup, and disposal. The Navy will solicit public comment in the Proposed Plan about the finding that the proposed remedy for PCB contamination at the Site will not pose an unreasonable risk of injury to health or the environment. An EPA finding that the remedy meets these standards will be included in the Record of Decision. The dredging, LUCs, and monitoring sediment containing PCBs will address the standards.
CWA, Section 402, National Pollution Discharge Elimination System (NPDES)	33 USC § 1342; 40 CFR 122 through 125	Applicable	These standards govern point source discharges of pollutants to surface water. Substantive requirements under NPDES are written such that state and federal NRWQC are met. Permits are required for offsite discharges. RI Standards apply to POTWs and includes storm water requirements for construction projects that disturb over one acre.	Standards for discharging of dewatering liquid to surface waters at the site will be met by treatment of water from dewatering sediment prior to discharge. If over 1 acre of soil is disturbed, then the storm water regulations for small construction activities will be met.
Clean Water Act; General Pretreatment Regulations for Existing and New Sources of Pollution	33 USC 1251 et seq., 40 CFR. Part 403	Applicable	Standards for direct discharge of wastewater into a Publicly Owned Treatment Works (POTW).	These standards will apply if water from the remedial action such as from dewatering is discharged to a POTW.
Contaminated Sediment Remediation Guidance for Hazardous Waste Sites	OSWER 9355.0-85, (December 2005)	To Be Considered	This document provides technical and policy guidance for making remedy decisions for contaminated sediment sites. Issues addressed include: Chapter 4, Monitored Natural Recovery; Chapter 5, In-situ Capping; Chapter 6, Dredging and Excavation; Chapter 7, Remedy Selection; and Chapter 8, Long-term Monitoring.	The dredging open water areas and capping under Pier 2 operations will be developed using methods described in this document.

TABLE 4-15
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 5: DREDGE (OPEN WATER), CAP AND MONITORING (BENEATH PIER 2)
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal (continued)				
Clean Water Act, National Recommended Water Quality Criteria (NRWQC)	33 USC § 1251 *et seq.*; 40 CFR 122.44	Applicable	Federal NRWQC are health-based and ecologically based criteria developed for carcinogenic and non-carcinogenic compounds.	These are standards for water quality monitoring that would be conducted to ensure that these criteria are not exceeded during dredging, capping, and dewatering activities.
Coast Guard Anchorage Ground and Regulated Navigation Area Rules	33 CFR Part 165	To Be Considered for the area under a permanent structure. (Applicable once a Rule for the LUC area is promulgated)	The Coast Guard may promulgate site-specific rules to establish federal anchorage areas and regulated navigation areas (RNAs). Once promulgated such a rule is also the basis for the National Oceanic and Atmospheric Administration (NOAA) to revise navigation charts to show the restricted area.	Under this alternative, the LUC is necessary for the area under the existing Pier 2, which is a shoreline structure. Because the LUC is not for a navigable waterway, it would not be necessary to apply to this rule unless the pier was demolished and the water became navigable. Therefore, if, in the future, the Navy demolishes Pier 2, excesses the property to a private owner, and leaves the sediment in place underneath with the cover intact, it will then explore the option of coordinating with the Coast Guard retaining the existing Restricted Area for the purpose of implementing LUCs. The Restricted Area is a federally enforceable restriction to protect the LUC area from disturbance and to delineate the area of the LUCs on federal navigation charts.
Corps of Engineers, Danger Zone and Restricted Areas: Narragansett Bay, East Passage, Coddington Cove, Naval Station Newport, Naval Restricted Area, Newport, Rhode Island	33 CFR §334.81	Applicable	All persons, swimmers, vessels and other craft, except those vessels authorized by the Navy or Coast Guard and local or state law enforcement vessels, are prohibited from entering the restricted area without specific permission from the Command Officer.	Enforceable basis for preventing unauthorized vessels and fisherman from entering the area where sediment caps/covers are installed or where there is a risk from consumption of contaminated seafood.

TABLE 4-15
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 5: DREDGE (OPEN WATER), CAP AND MONITORING (BENEATH PIER 2)
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
Federal (continued)				
Clean Air Act (CAA), National Emission Standards for Hazardous Air Pollutants (NESHAPS); National Emission Standards for Asbestos	42 U.S.C. §§7411, 7412; 40 C.F.R. Part 61, Subpart M	Applicable	Establish standards for demolition of facilities containing asbestos, managing existing asbestos, and for disposal of asbestos contaminated waste.	Any future maintenance or demolition of the piers where asbestos is present, must be conducted in accordance with these standards.
Clean Air Act (CAA), National Emission Standards for Hazardous Air Pollutants (NESHAPS), Standards for Inactive waste disposal sites for asbestos mills and manufacturing and fabricating operations	42 U.S.C. §§7411, 7412; 40 C.F.R. §61.151	Relevant and Appropriate	NESHAPS standards for preventing air releases from inactive asbestos disposal sites, including cover standards, dust suppression, and land use controls.	For areas of sediments under the piers where asbestos is present, that will be capped/covered substantive requirements of these standards and land use controls will be established to address health and safety requirements to maintain the cover and to address any potential asbestos exposure if the cover is disturbed.
Framework for Investigating Asbestos-Contaminated Superfund Sites	OSWER Directive #9200.0-68 (Sept. 2008)	To Be Considered	Guidance on investigating and characterizing the potential human exposure from asbestos contamination at Superfund sites.	Guidance will be used to establish procedures for sampling for asbestos if areas of potential sediment contamination are disturbed in the future.
State				
Standards for Identification and Listing of Hazardous Waste	Rules and Regulations for Hazardous Waste Management, Code of Rhode Island Rules (CRIR), 12-030-003, Rule 5.8	Applicable	Defines the listed and characteristic hazardous wastes.	These regulations would apply when determining whether or not a solid waste is hazardous, either by being listed or by exhibiting a hazardous characteristic.

TABLE 4-15
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 5: DREDGE (OPEN WATER), CAP AND MONITORING (BENEATH PIER 2)
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
State (continued)				
Standards for Generators of Hazardous Waste	Rules and Regulations for Hazardous Waste Management, CRIR 12-030-003, Rule 5.2, 5.3, and 5.4	Applicable	Establishes manifesting and pre-transport requirements for hazardous waste.	These regulations would apply to all wastes generated during dredging that is determined to be hazardous.
Rules and Regulations for Dredging and the Management of Dredged Material	DEM-OWR-DR-02-03, Sections 5, 6, 7, 8, 9, and 11	Applicable	Standards to ensure that dredging in the marine environment and management of the associated dredged material is conducted in a manner which is protective of groundwater and surface water quality so as to ensure the continued viability and integrity of drinking water and fish and wildlife resources. Establish standards and criteria governing the dewatering of dredged material for upland use or disposal.	Dredging and capping under Pier 2 operations, including dewatering, will be conducted in accordance with the substantive requirements of these standards.
Clean Air Act - Fugitive Dust Control	CRIR 12-31-05	Applicable	Requires that reasonable precautions be taken to prevent particulate matter from becoming airborne.	Controls would be used during storage and handling of sediment and capping material to prevent material from becoming airborne.
Clean Air Act - Emissions Detrimental to Persons or Property	CRIR 12-31-07	Applicable	Prohibits emissions of contaminants which may be injurious to humans, plant or animal life or cause damage to property or which reasonably interferes with the enjoyment of life and property.	Monitoring of air emissions during dredging and dewatering will be used to assess compliance with these standards if threshold levels are reached.
Clean Air Act - Air Toxics	CRIR 12-31-22	Applicable	Prohibits the emission of specified contaminants at rates which would result in ground level concentrations greater than acceptable ambient levels or acceptable ambient levels as set in the regulations.	Emissions of hydrogen sulfide during dredging, dewatering, and stockpiling would be controlled.

TABLE 4-15
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs –
SEDIMENT ALTERNATIVE 5: DREDGE (OPEN WATER), CAP AND MONITORING (BENEATH PIER 2)
FEASIBILTY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Requirement	Citation	Status	Synopsis of Requirement	Action to Be Taken to Attain ARAR
State (continued)				
Water Quality Regulations	Water Quality Regulations, CRIR 12-190-001	Applicable	Establishes water use classification and water quality criteria for waters of the state.	Dredging will be conducted in a manner as to minimize degradation of water quality. Any drainage from the temporary sediment storage area and any dewatering discharge would be treated as required to meet this requirement and discharged into Narragansett Bay.
Water Pollution Control – Pollutant Discharge Elimination System (PDES)	Regulations of Rhode Island Pollutant Discharge Elimination System	Applicable	Contains applicable effluent monitoring requirements, and standards and special conditions for discharges. These regulations also include storm water standards applicable if shoreland staging, processing and stockpiling areas disturb more than one acre.	Discharge of water to surface water from remedial activities, such as dewatering of sediment will meet these standards. If over 1 acre of soil is disturbed, then the storm water regulations for small construction activities will be met.
Pretreatment Regulations	RIGL 46-12, 42-17.1, 42-45	Applicable	Rhode Island standards for discharge to POTWs.	These standards will apply if water from the remedial action such as from dewatering is discharged to a POTW.
Rhode Island Soil Erosion and Sediment Control (SESC) Manual	None	Applicable	RIGL Erosion and Sediment Control Act places enforcement of soil erosion and sediment control at the local level. The SESC Manual is the primary guidance document.	An erosion and sediment control plan will be prepared according to the SESC Manual for all activities with land disturbance, including stockpiling dredged material or capping material.
Identification and Management of Aquatic Invasive Species	None	To Be Considered	Guidance on addressing aquatic invasive species in Rhode Island.	Remedial work in the Bay will be conducted in a manner to prevent the establishment or spread of aquatic invasive species.

TABLE 4-16
SUMMARY OF DETAILED ANALYSES OF SEDIMENT REMEDIAL ALTERNATIVES
FEASIBILITY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Criteria	Alternative SD1 No Action	Alternative SD2 Enhanced Natural Recovery, LUCs, LTM	Alternative SD3 In-Situ Cap, LUCs, LTM	Alternative SD4* Dredge/Backfill, In-Situ Cap , LUCs, LTM (Sub-Pier)	Alternative SD5* Dredge, In-Situ CapLUCs, LTM (Sub-Pier)
THRESHOLD CRITERIA					
Overall Protection of Human Health and the Environment					
Does Alternative Protect Current and Future Users?	No	Partially	Yes	Yes	Yes
Are Environmental Risks Reduced by Alternative?	No	Partially	Yes	Yes	Yes
Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)					
Compliance with Chemical-Specific ARARs	No	Partially	Yes	Yes	Yes
Compliance with Location-Specific ARARs	Not applicable	Partially	Yes	Yes	Yes
Compliance with Action-Specific ARARs	Not applicable	Partially	Yes	Yes	Yes
Compliance with Other Criteria	Not applicable	Partially	Yes	Yes	Yes
BALANCING CRITERIA					
Long-Term Effectiveness and Permanence					
Does Alternative Reduce Residual Risk?	No	Partially	Yes	Yes	Yes
Does Alternative Provide Adequate Remedial Controls?	No	Yes	Yes	Yes	Yes
Need a 5-Year Review?	No	Yes	Yes	Yes	Yes
Need for Long-Term Management?	No	Yes	Yes	Yes	Yes
Reduction of Toxicity, Mobility, or Volume through Treatment					
Treatment Process Used	No Treatment	No Treatment	No Treatment	Potential Treatment of sediment to be disposed	Potential Treatment of sediment to be disposed
Sediment Treated	Not applicable	Not applicable	Not applicable	Potential	Potential
Reduction in Toxicity, Mobility, or Volume	No	No	No	Potential	Potential
Type and Quantity of Residuals Remaining after Treatment	No Treatment	No Treatment	No Treatment	TBD	TBD

TABLE 4-16
SUMMARY OF DETAILED ANALYSES OF SEDIMENT REMEDIAL ALTERNATIVES
FEASIBILITY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Criteria	Alternative SD1 No Action	Alternative SD2 Enhanced Natural Recovery, LUCs, LTM	Alternative SD3 In-Situ Cap, LUCs, LTM	Alternative SD4* Dredge/Backfill, In-Situ Cap , LUCs, LTM (Sub-Pier)	Alternative SD5* Dredge, In-Situ CapLUCs, LTM (Sub-Pier)
Short-Term Effectiveness					
Risks to the Community during Remedial Action	None	Minor:Truck Traffic (least amount)	Minor:Truck Traffic	Moderate:Truck Traffic	Moderate Truck Traffic
Risk to Workers during Remedial Action	No Construction	Unlikely	Unlikely	Moderate risk through handling of waste. Any risks would be controlled through the proper use of PPE	Moderate risk through handling waste. Any risks would be controlled through the proper use of PPE
Environmental Impacts	No Activities	Temporary impacts to benthic community	Temprorary impacts to benthic community	Temporary impacts to benthic community	Temporary impacts to benthic community
Time until Remedial Action Objectives Achieved	N/A	Estimated 12 to 24 months	Estimated 12 to 24 months	Estimated 18 to 36 months	Estimated 18 to 36 months
Implementability					
Constructable	No construction activities	Yes	Yes	Yes	Yes
Reliability of Technology	No technology implemented	Moderately Reliable	Reliable	Reliable assuming SWACs can be reached using backfill	Reliable assuming SWACs can be reached without use of backfill
Ease of Undertaking Additional Remedial Action, if Necessary	Easily implementable	High - Moderate	Moderate	High-Moderate	High-Moderate
Ability to Monitor Effectiveness of Remedy	Not applicable	Yes	Yes	Yes	Yes
Ability to Coordinate with Other Agencies	Easy	Yes	Yes	Yes	Yes
Availability of Off-Site Disposal Services	None required	None required	None Required	Yes	Yes
Availability of Equipment and Specialists	None required	Yes	Yes	Yes	Yes
Availability of Prospective Technologies	None required	Yes	Yes	Yes	Yes

TABLE 4-16
SUMMARY OF DETAILED ANALYSES OF SEDIMENT REMEDIAL ALTERNATIVES
FEASIBILITY STUDY
SITE 19 – DERECKTOR SHIPYARD MARINE SEDIMENT
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

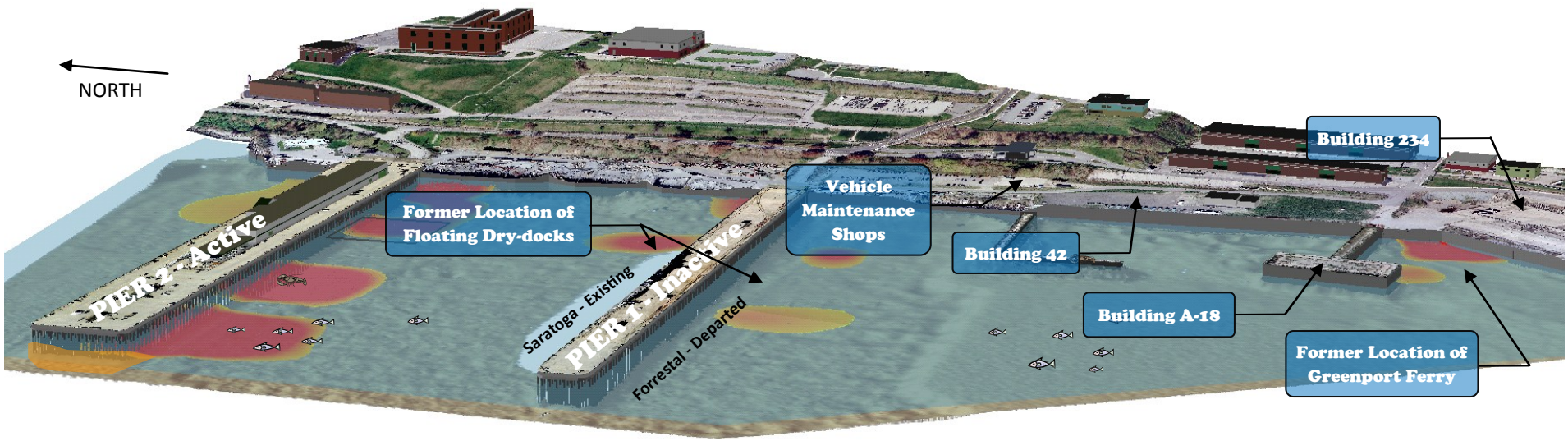
Criteria	Alternative SD1 No Action	Alternative SD2 Enhanced Natural Recovery, LUCs, LTM	Alternative SD3 In-Situ Cap, LUCs, LTM	Alternative SD4* Dredge/Backfill, In-Situ Cap , LUCs, LTM (Sub-Pier)	Alternative SD5* Dredge, In-Situ CapLUCs, LTM (Sub-Pier)
Cost					
Capital Costs	$ 0	$ 3,108,057	$ 4,939,678	$ 11,954,590	$ 16,980,477
Total Annual Operations and Maintenance (O&M)	$ 0	$ 39,182	$ 39,182	$ 34,355	$ 25,388
5-Year Review Costs	$ 0	$ 287,489	$ 439,433	$ 266,825	$ 181,025
Total Present Worth Project Costs	$ 0	$ 5,222,851	$ 7,708,390	$ 13,795,406	$ 18,328,150

* LEDPA – Least Environmentally Damaging Practicable Alternative could be identified as Alternative 4 or 5.

FIGURES

NAVAL STATION NEWPORT

SITE 19, FORMER DERECKTOR SHIPYARD



-Not to scale
-Not to be used for design
-Contaminant concentrations represented here have been manipulated for presentation. Refer to SSI Report, Figures 4-1A through 4-3G for accurate representations.

High
Low

Sum of the quotients calculated for all COCs: Surface Concentration : PRG

Media	Risk	COC	PRG
Bedded Sediment	Risk to ecological receptors (benthic community)	HMW PAHs	13,903 µg/kg
Bedded Sediment / Suspended Sediment	Risk to human receptors (ingestion of shellfish)	Benzo(a)pyrene	539µg/kg
		Lead	168 mg/kg
Suspended Sediment	Risk to ecological receptors (pelagic community)	PCBs	1060 µg/kg

TETRA TECH

NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

LOCATION OF SITE FEATURES

SITE 19—DERECKTOR SHIPYARD, MARINE SEDIMENT FEASIBILITY STUDY

File	No Scale (perspective view)
Figure Number ES-1	Date: 2/14/2013

I:\02747\FS.DF.1\DER_SITE_LOCUS.MXD NEC 02/04/13

TETRA TECH

NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

SITE LOCATION MAP, NAVAL STATION NEWPORT

SITE 19 - DERECKTOR SHIPYARD, MARINE SEDIMENT FEASIBILITY STUDY

SCALE	PER SCALE BAR
FILE	I:\...\DER_SITE_LOCUS.MXD
REV	0
DATE	02/04/13
FIGURE NUMBER	1-1

I:\02747\FS.DF.1\DER_SITE_LOCATION_MAP.MXD NEC 02/04/13

TETRA TECH

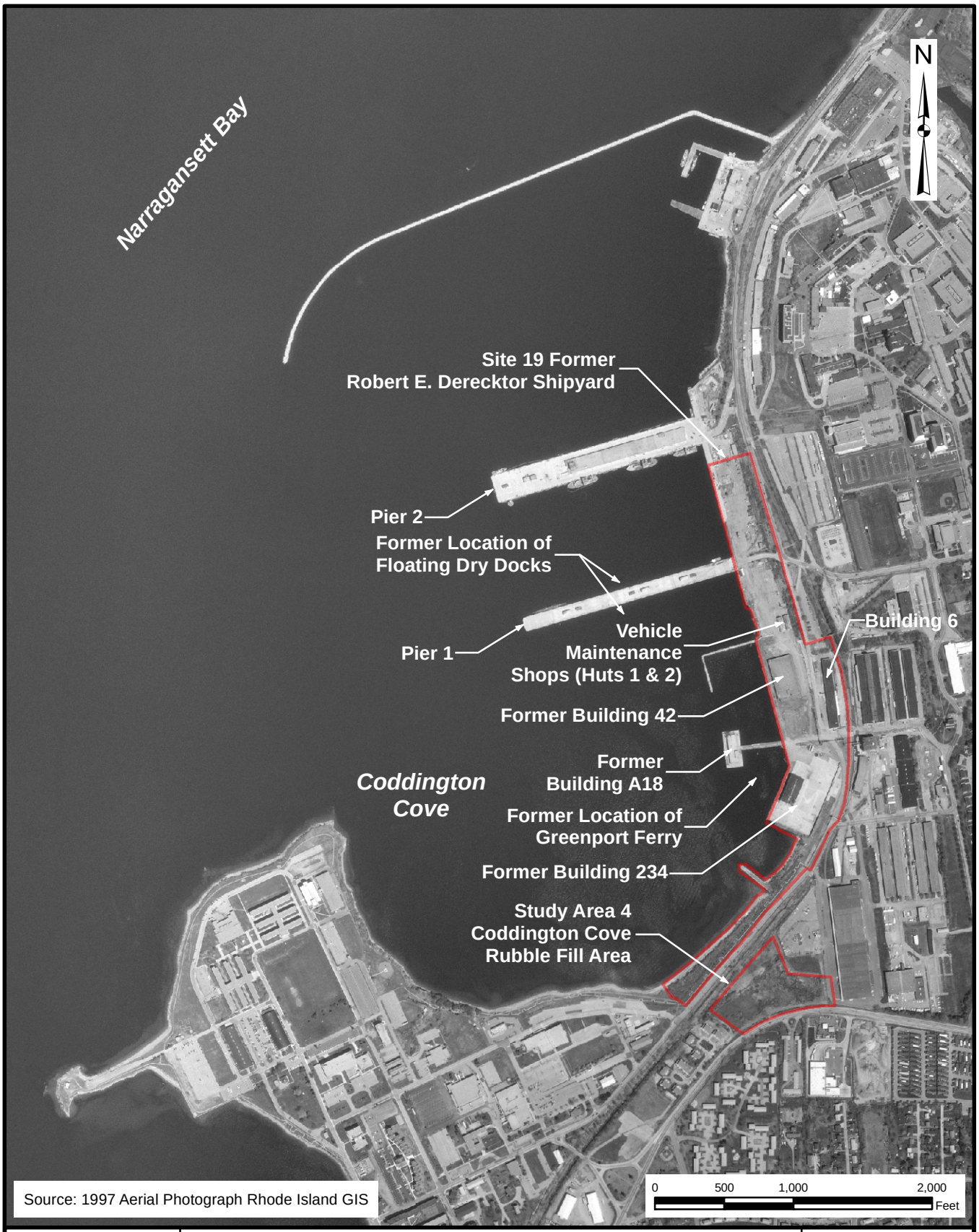
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

SITE LOCUS

SITE 19 - DERECKTOR SHIPYARD, MARINE SEDIMENT
FEASIBILITY STUDY

SCALE	PER SCALE BAR
FILE	I:\...\DER_SITE_LOCATION_MAP.MXD
REV	0
DATE	02/04/13
FIGURE NUMBER	1-2

I:\02747\FS.DF.1\DER_HISTORIC_SITE_FEATURES.MXD NEC 02/04/13



Source: 1997 Aerial Photograph Rhode Island GIS

TETRA TECH

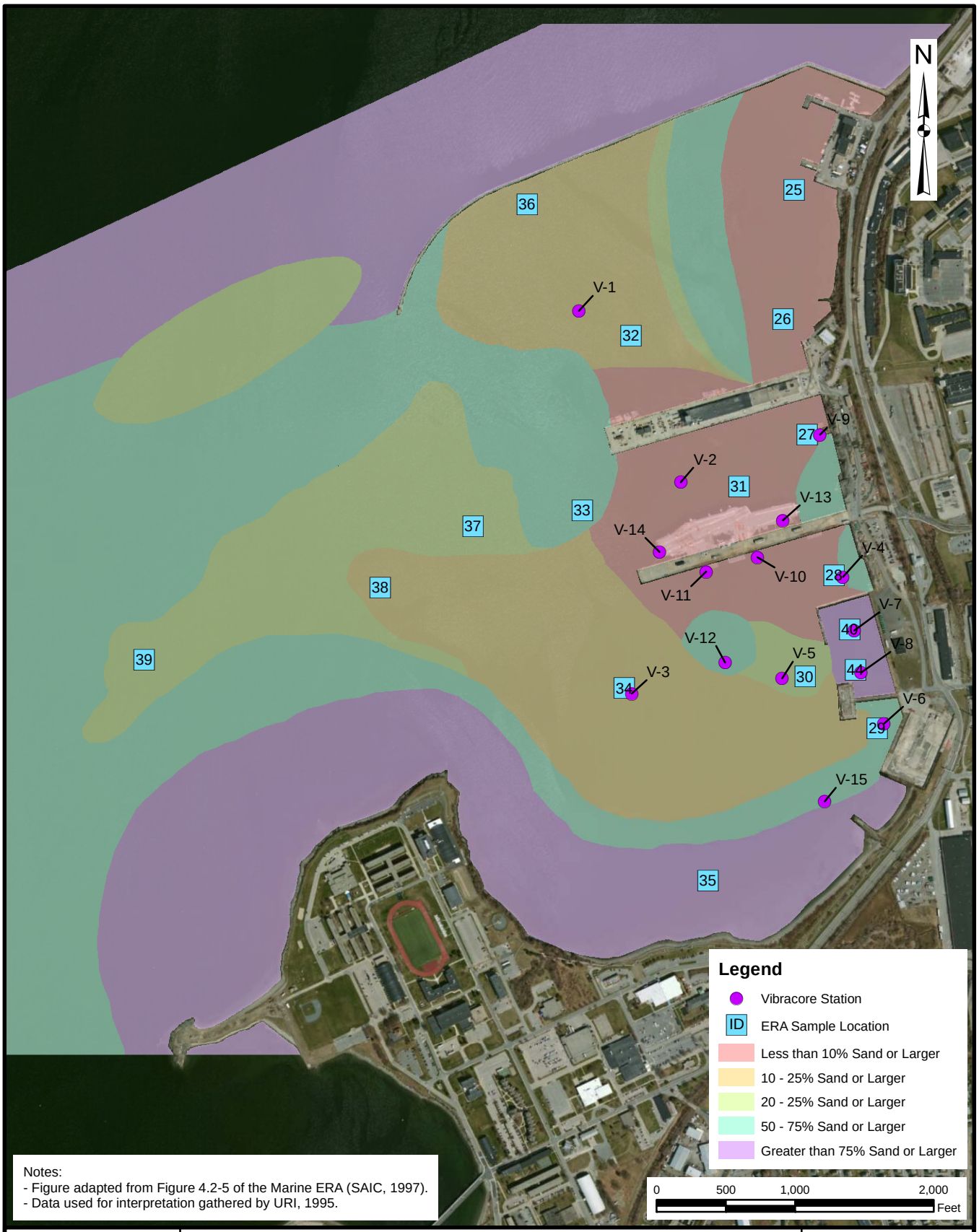
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

HISTORIC SITE FEATURES

SITE 19 - DERECKTOR SHIPYARD, MARINE SEDIMENT
FEASIBILITY STUDY

SCALE	PER SCALE BAR
FILE	I:\...\DER_HISTORIC_SITE_FEATURES.MXD
REV	0
DATE	02/04/13
FIGURE NUMBER	1-3

I:\02747\FS.DF.1\DER_GRAINSIZE_CHARACTERISTICS.MXD NEC 01/22/14



Notes:
- Figure adapted from Figure 4.2-5 of the Marine ERA (SAIC, 1997).
- Data used for interpretation gathered by URI, 1995.

TETRA TECH

NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

GRAIN SIZE CHARACTERISTICS OF SURFACE SEDIMENTS 1996 (0-15 CM)

SITE 19 - DERECKTOR SHIPYARD, MARINE SEDIMENT FEASIBILITY STUDY

SCALE	
PER SCALE BAR	
FILE	
I:\...\DER_GRAINSIZE_CHARACTERISTICS.MXD	
REV	DATE
0	01/22/14
FIGURE NUMBER	
1-4	

I:\02747\FS.DF.1\DER_BATHYMETRIC_SURVEY.MXD MJH/DWM/NEC 01/25/13

TETRA TECH

NAVAL STATION NEWPORT
NEWPORT RHODE ISLAND

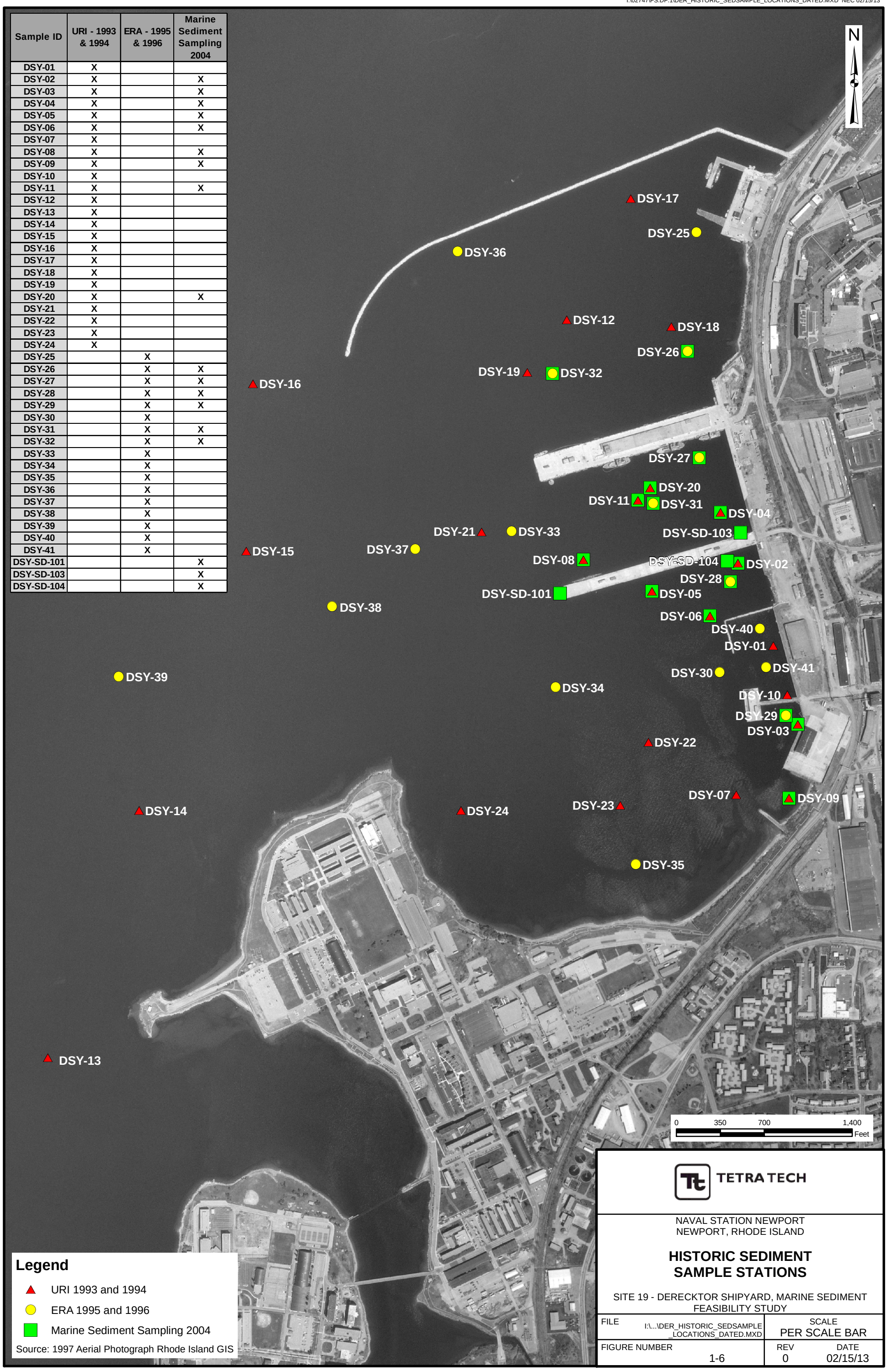
BATHYMETRIC SURVEY RESULTS

SITE 19 - DERECKTOR SHIPYARD, MARINE SEDIMENT
FEASIBILITY STUDY

FILE	SCALE	
I:\...\DER_BATHYMETRIC_SURVEY.MXD	PER SCALE BAR	
FIGURE NUMBER	REV	DATE
1-5	0	01/25/13

I:\02747\FS.DF.1\DER_HISTORIC_SEDSAMPLE_LOCATIONS_DATED.MXD NEC 02/15/13

Sample ID	URI - 1993 & 1994	ERA - 1995 & 1996	Marine Sediment Sampling 2004
DSY-01	X		
DSY-02	X		X
DSY-03	X		X
DSY-04	X		X
DSY-05	X		X
DSY-06	X		X
DSY-07	X		
DSY-08	X		X
DSY-09	X		X
DSY-10	X		
DSY-11	X		X
DSY-12	X		
DSY-13	X		
DSY-14	X		
DSY-15	X		
DSY-16	X		
DSY-17	X		
DSY-18	X		
DSY-19	X		
DSY-20	X		X
DSY-21	X		
DSY-22	X		
DSY-23	X		
DSY-24	X		
DSY-25		X	
DSY-26		X	X
DSY-27		X	X
DSY-28		X	X
DSY-29		X	X
DSY-30		X	
DSY-31		X	X
DSY-32		X	X
DSY-33		X	
DSY-34		X	
DSY-35		X	
DSY-36		X	
DSY-37		X	
DSY-38		X	
DSY-39		X	
DSY-40		X	
DSY-41		X	
DSY-SD-101			X
DSY-SD-103			X
DSY-SD-104			X



TETRA TECH

NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

HISTORIC SEDIMENT SAMPLE STATIONS

SITE 19 - DERECKTOR SHIPYARD, MARINE SEDIMENT FEASIBILITY STUDY

FILE	SCALE
I:\...\DER_HISTORIC_SEDSAMPLE_LOCATIONS_DATED.MXD	PER SCALE BAR

FIGURE NUMBER	REV	DATE
1-6	0	02/15/13

I:\02747\FS.DF.1\DER_HISTORICBIOTA_SAMPLESTATIONS.MXD NEC 01/25/13

Sample Station ID	Deep Sediment	Surface Sediment	Sediment Elutriate	Finfish	Lobster	Hard Clams	Blue Mussels	Deployed Mussels
24							X	
25		X			X		X	
26		X		X			X	X
27	X	X	X		X		X	
28	X	X		X	X			X
29	X	X	X	X	X		X	X
30	X	X						
31		X	X			X		X
32		X	X			X		
33		X	X		X	X		X
34								
35								
36	X	X	X	X	X	X	X	
37		X	X			X		
38		X	X		X	X		X
39		X	X		X			X
40		X	X				X	X
41		X				X		

TETRA TECH

NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

HISTORIC BIOTA SAMPLE STATIONS (ERA)

SITE 19 - DERECKTOR SHIPYARD, MARINE SEDIMENT
FEASIBILITY STUDY

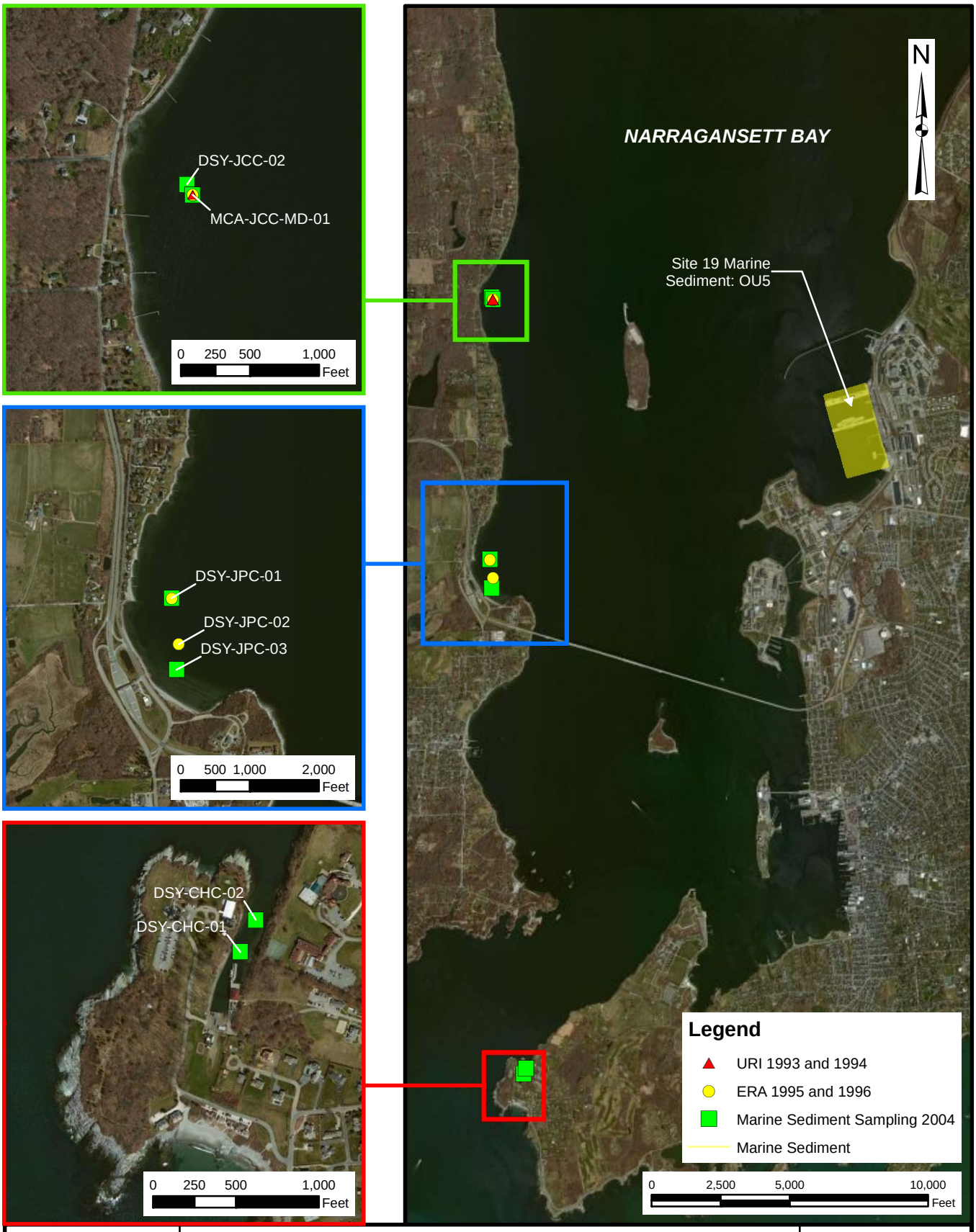
SCALE
PER SCALE BAR

FILE
I:\...\DER_HISTORICBIOTA
_SAMPLESTATIONS.MXD

REV	DATE
0	01/25/13

FIGURE NUMBER
1-7

I:\02747\FS.DF.1\DER_REFERENCE_SEDIMENT_SAMPLESTATIONS_8X11.MXD NEC 02/04/13



TETRA TECH

NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

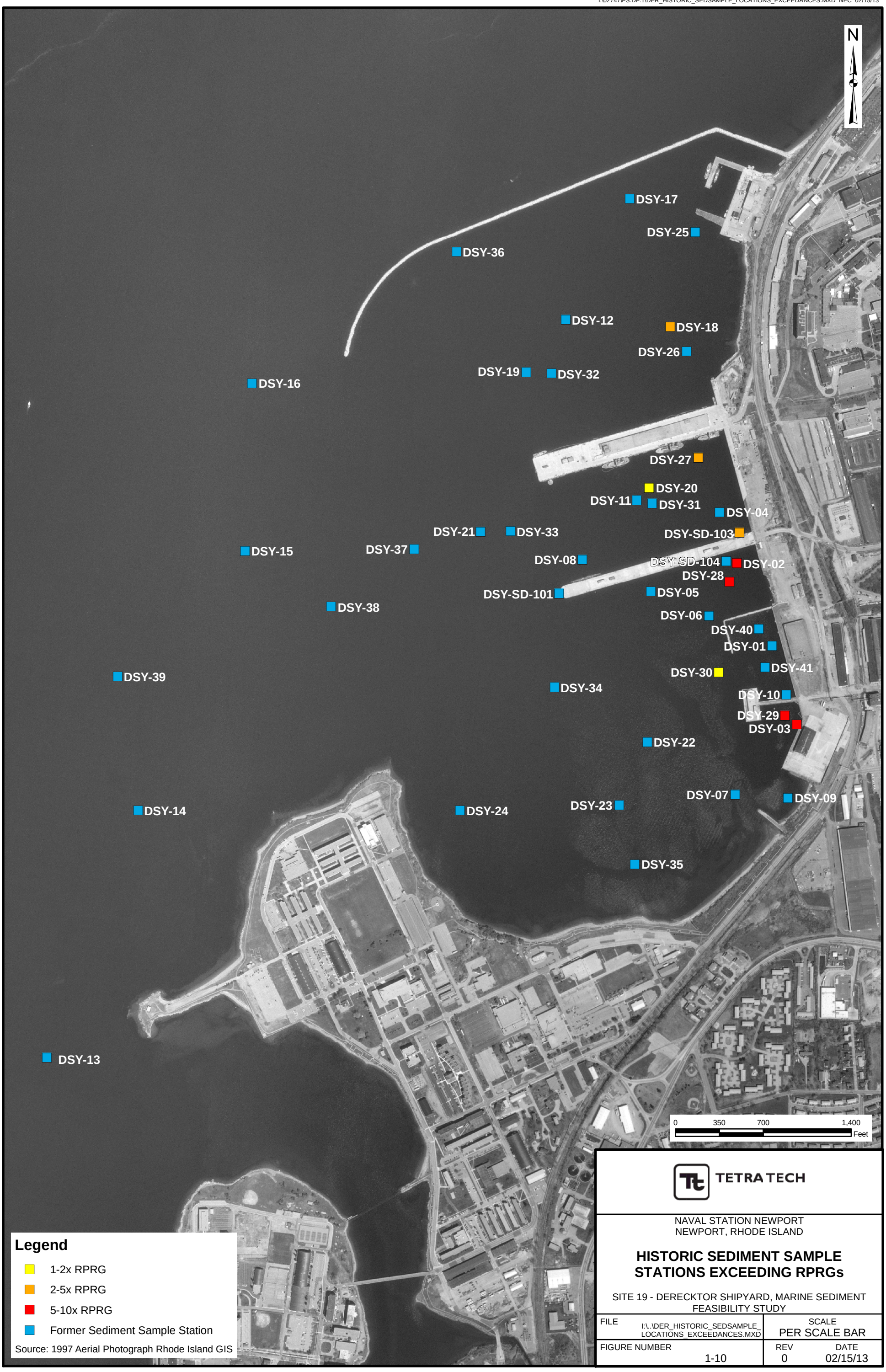
REFERENCE SEDIMENT SAMPLE LOCATIONS

SITE 19 - DERECKTOR SHIPYARD, MARINE SEDIMENT
FEASIBILITY STUDY

SCALE	
PER SCALE BAR	
FILE I:\..\DER_REFERENCE_SEDIMENT _SAMPLESTATIONS_8X11.MXD	
REV	DATE
0	02/04/13
FIGURE NUMBER	
1-8	

I:\02747\FS.DF.1\DER_GRID.MXD DWM/NEC 01/25/13

I:\02747\FS.DF.1\DER_HISTORIC_SEDSAMPLE_LOCATIONS_EXCEEDANCES.MXD NEC 02/15/13



TETRA TECH

NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

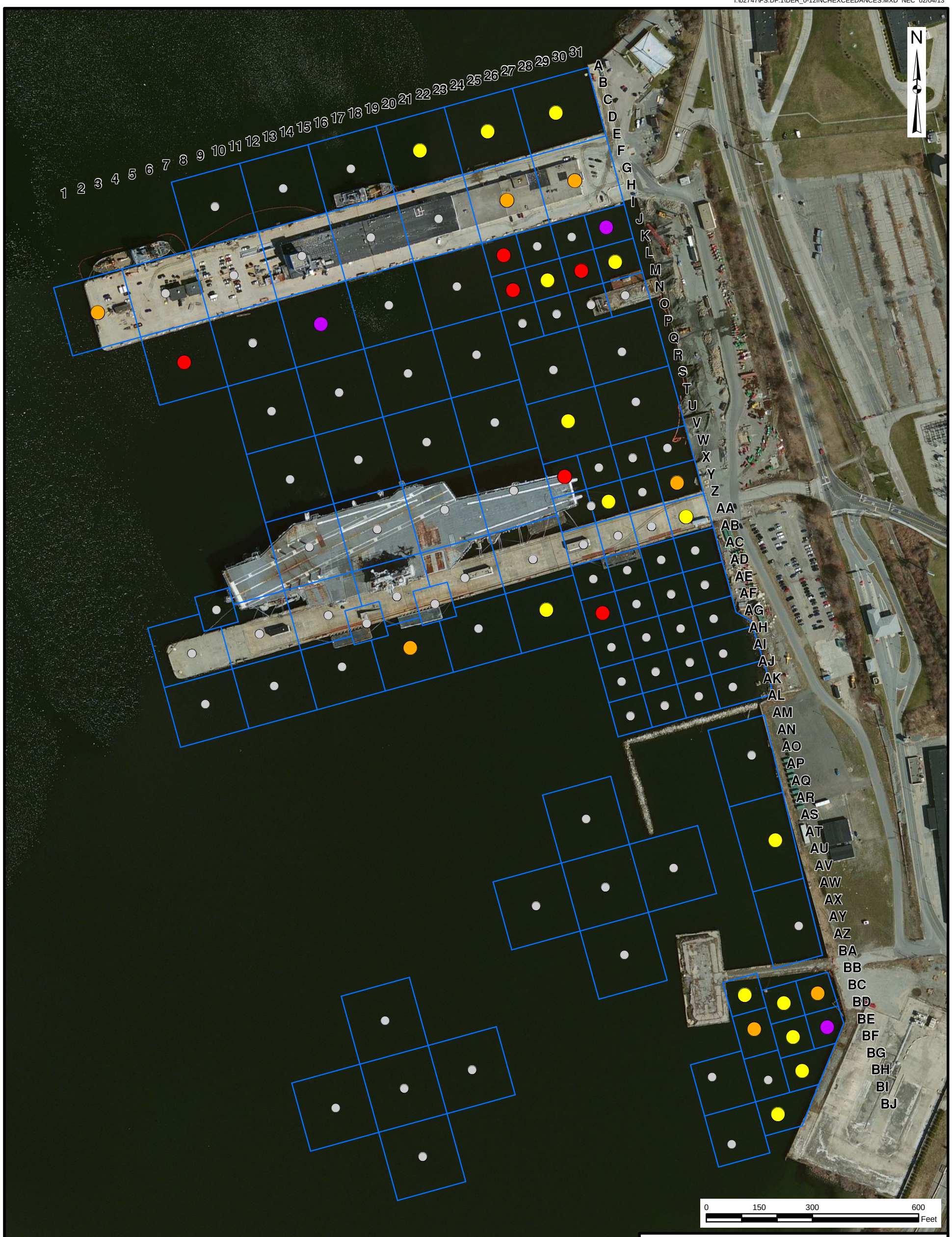
HISTORIC SEDIMENT SAMPLE STATIONS EXCEEDING RPRGs

SITE 19 - DERECKTOR SHIPYARD, MARINE SEDIMENT FEASIBILITY STUDY

FILE	SCALE
I:\..\DER_HISTORIC_SEDSAMPLE_LOCATIONS_EXCEEDANCES.MXD	PER SCALE BAR

FIGURE NUMBER	REV	DATE
1-10	0	02/15/13

I:\02747\FS.DF.1\DER_0-12INCHEXCEEDANCES.MXD NEC 02/04/13



Legend

- 1 to 2x PRG
- 2 to 5x PRG
- 5 to 10x PRG
- > 10x PRG
- Sample Location
- Sampling Grid

TETRA TECH

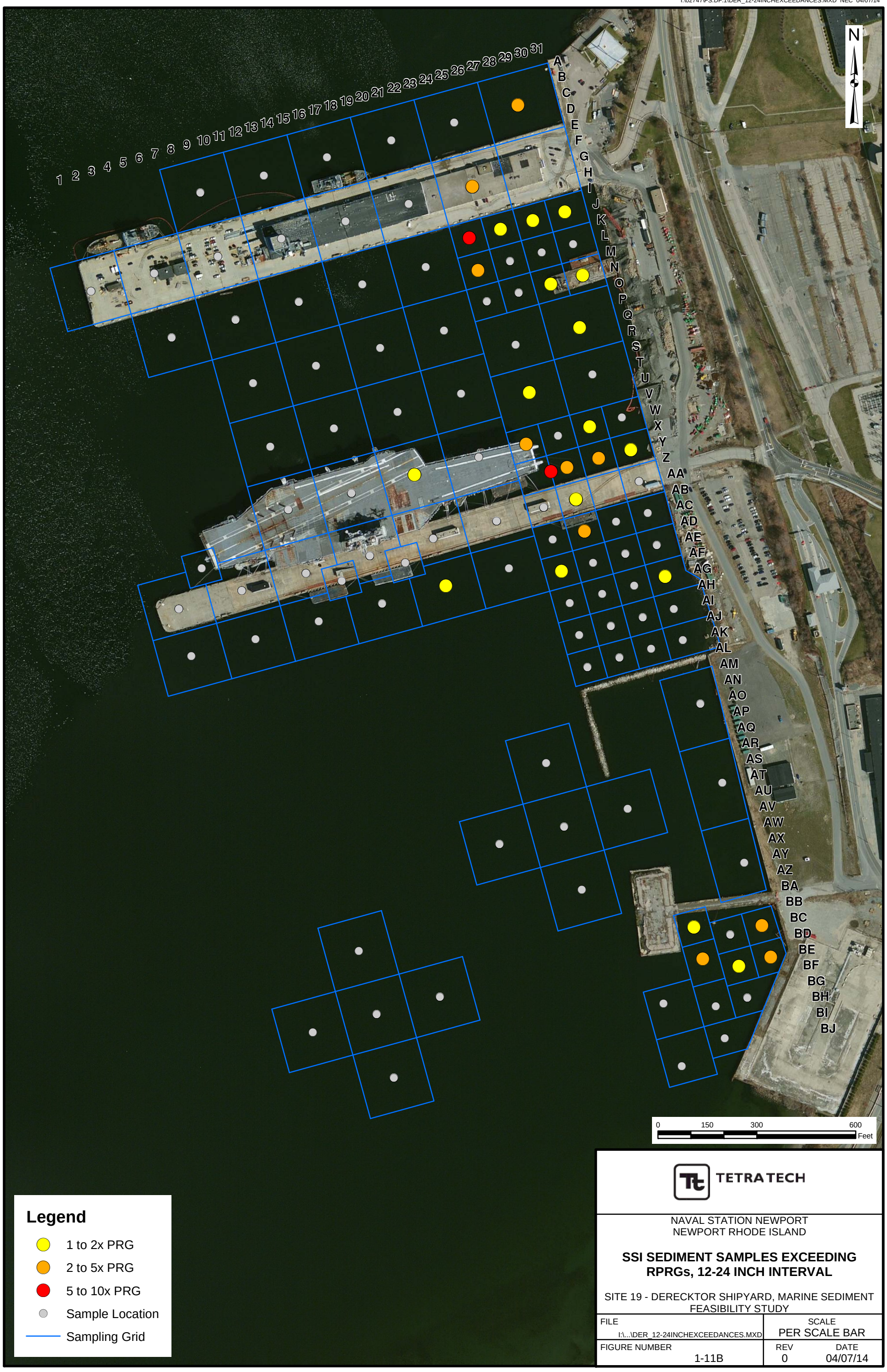
NAVAL STATION NEWPORT
NEWPORT RHODE ISLAND

SSI SEDIMENT SAMPLES EXCEEDING RPRGs, 0-12 INCH INTERVAL

SITE 19 - DERECKTOR SHIPYARD, MARINE SEDIMENT FEASIBILITY STUDY

FILE	SCALE	
I:\...\DER_0-12INCHEXCEEDANCES.MXD	PER SCALE BAR	
FIGURE NUMBER	REV	DATE
1-11A	0	02/04/13

I:\02747\FS.DF.1\DER_12-24INCHEXCEEDANCES.MXD NEC 04/07/14



TETRA TECH

NAVAL STATION NEWPORT
NEWPORT RHODE ISLAND

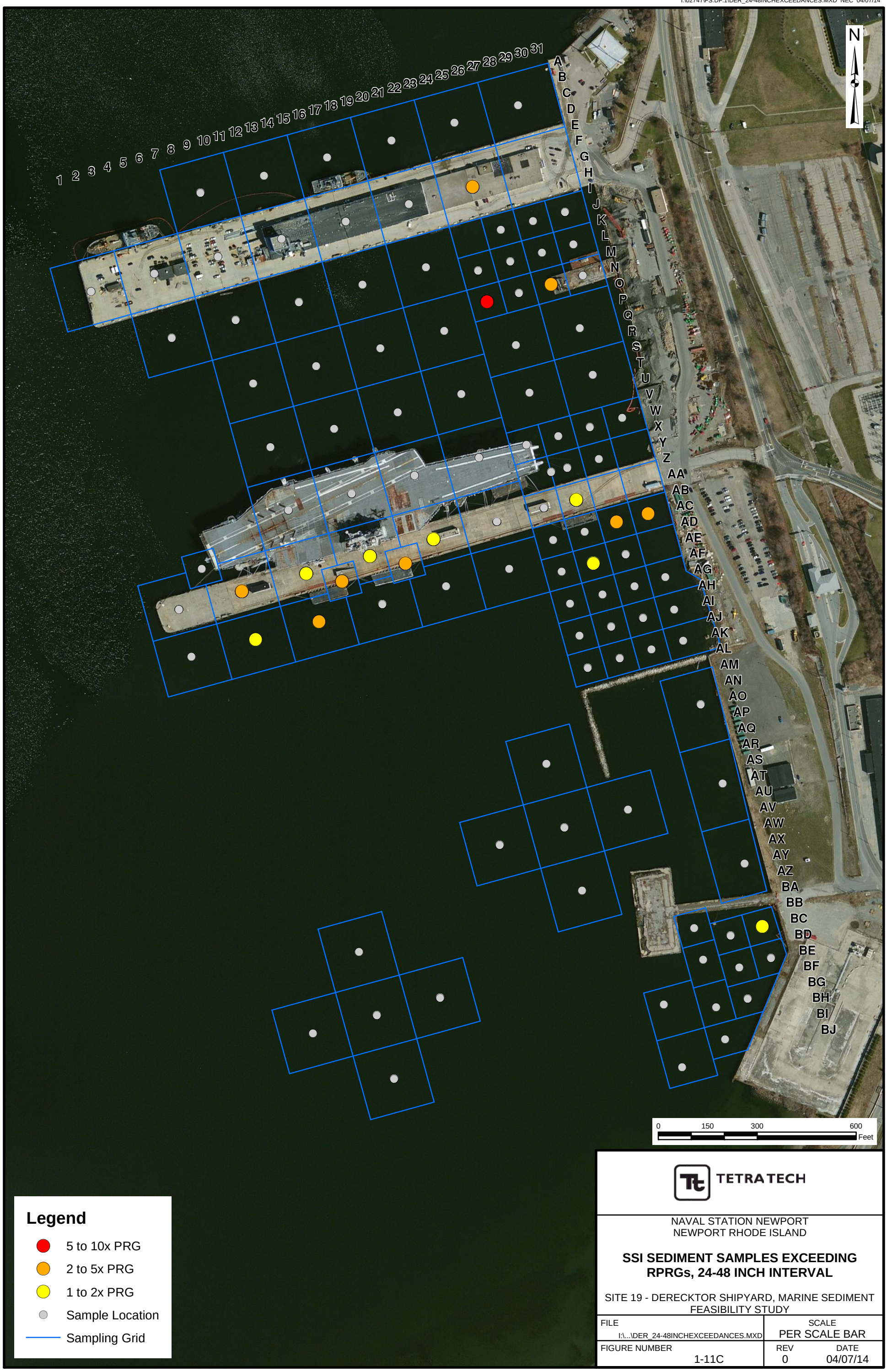
SSI SEDIMENT SAMPLES EXCEEDING RPRGs, 12-24 INCH INTERVAL

SITE 19 - DERECKTOR SHIPYARD, MARINE SEDIMENT FEASIBILITY STUDY

FILE	SCALE
I:\...\DER_12-24INCHEXCEEDANCES.MXD	PER SCALE BAR

FIGURE NUMBER	REV	DATE
1-11B	0	04/07/14

I:\02747\FS.DF.1\DER_24-48INCHEXCEEDANCES.MXD NEC 04/07/14



TETRA TECH

NAVAL STATION NEWPORT
NEWPORT RHODE ISLAND

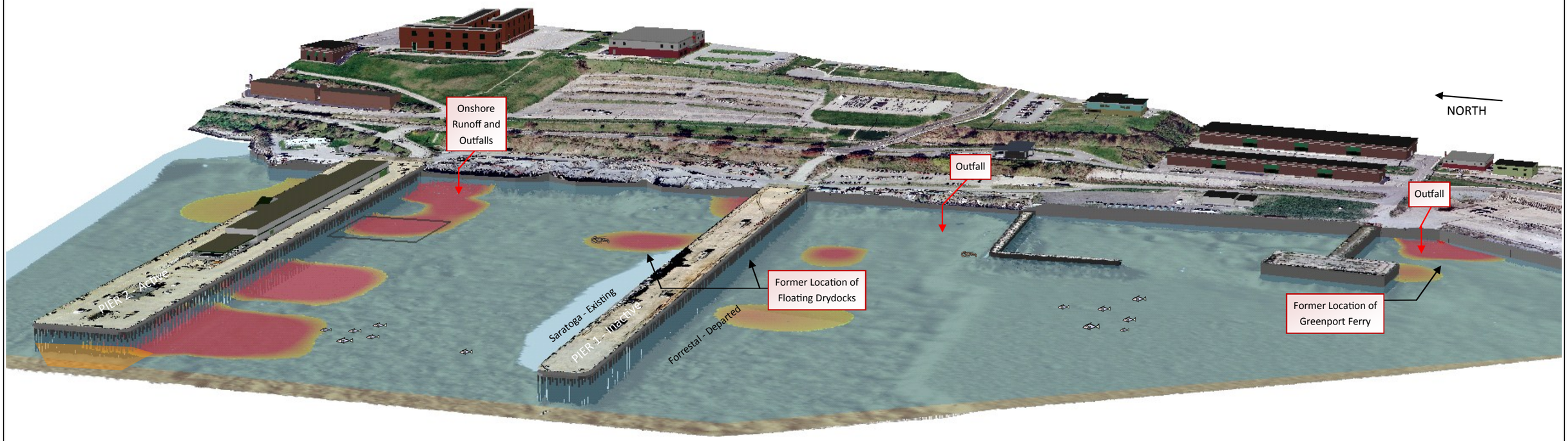
SSI SEDIMENT SAMPLES EXCEEDING RPRGs, 24-48 INCH INTERVAL

SITE 19 - DERECKTOR SHIPYARD, MARINE SEDIMENT FEASIBILITY STUDY

FILE	SCALE	
I:\...\DER_24-48INCHEXCEEDANCES.MXD	PER SCALE BAR	
FIGURE NUMBER	REV	DATE
1-11C	0	04/07/14

NAVAL STATION NEWPORT

SITE 19, FORMER DERECKTOR SHIPYARD



Not to scale
Not to be used for design

TETRA TECH

NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

CONCEPTUAL SITE MODEL

SITE 19—DERECKTOR SHIPYARD, MARINE SEDIMENT FEASIBILITY STUDY

File	No Scale (perspective view)
Figure Number 1-12	Date: 1/24/2013

Key:

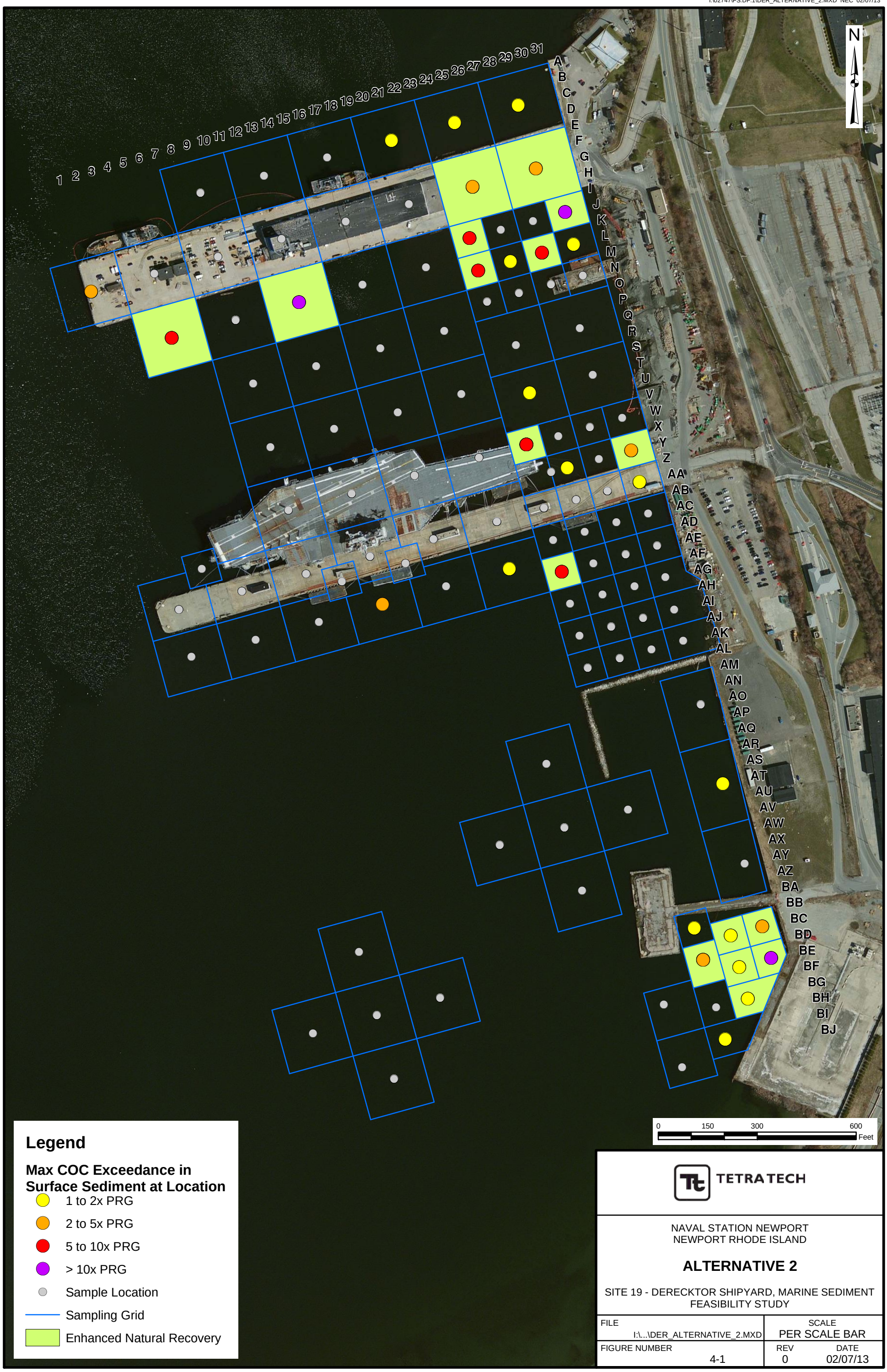
High / Low — Sum of the quotients calculated for all COCs: Surface Concentration : PRG

Media of Concern

Former Contaminant Sources

Media	Risk	COC	PRG
Bedded Sediment	Risk to ecological receptors (benthic community)	HMW PAHs	13,903 µg/kg
Bedded Sediment / Suspended Sediment	Risk to human receptors (ingestion of shellfish)	Benzo(a)pyrene	539µg/kg
		Lead	168 mg/kg
Suspended Sediment	Risk to ecological receptors (pelagic community)	PCBs	1060 µg/kg

I:\02747\FS.DF.1\DER_ALTERNATIVE_2.MXD NEC 02/07/13



TETRA TECH

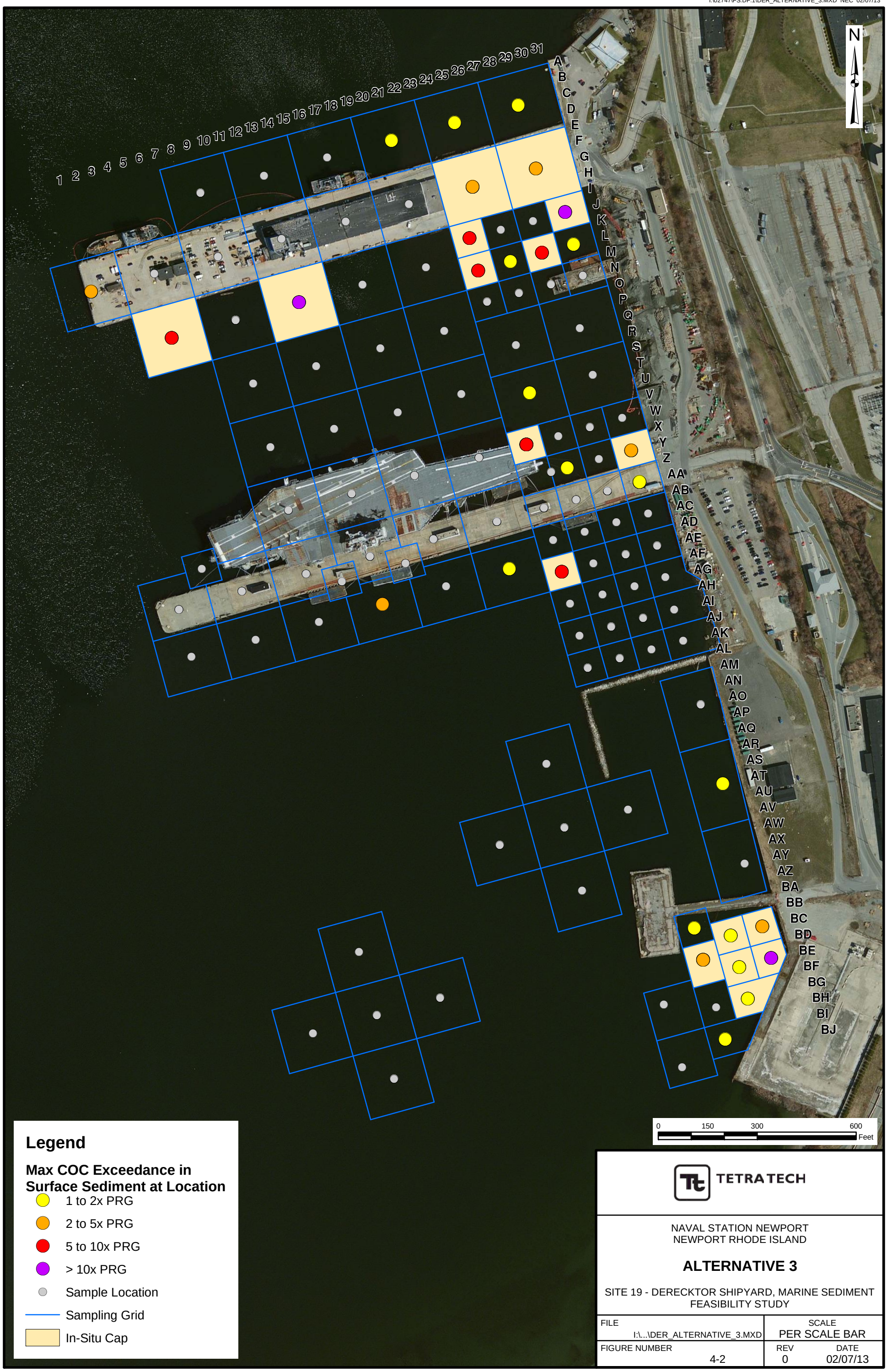
NAVAL STATION NEWPORT
NEWPORT RHODE ISLAND

ALTERNATIVE 2

SITE 19 - DERECKTOR SHIPYARD, MARINE SEDIMENT FEASIBILITY STUDY

FILE	SCALE
I:\...\DER_ALTERNATIVE_2.MXD	PER SCALE BAR
FIGURE NUMBER 4-1	REV 0 / DATE 02/07/13

I:\02747\FS.DF.1\DER_ALTERNATIVE_3.MXD NEC 02/07/13



TETRA TECH

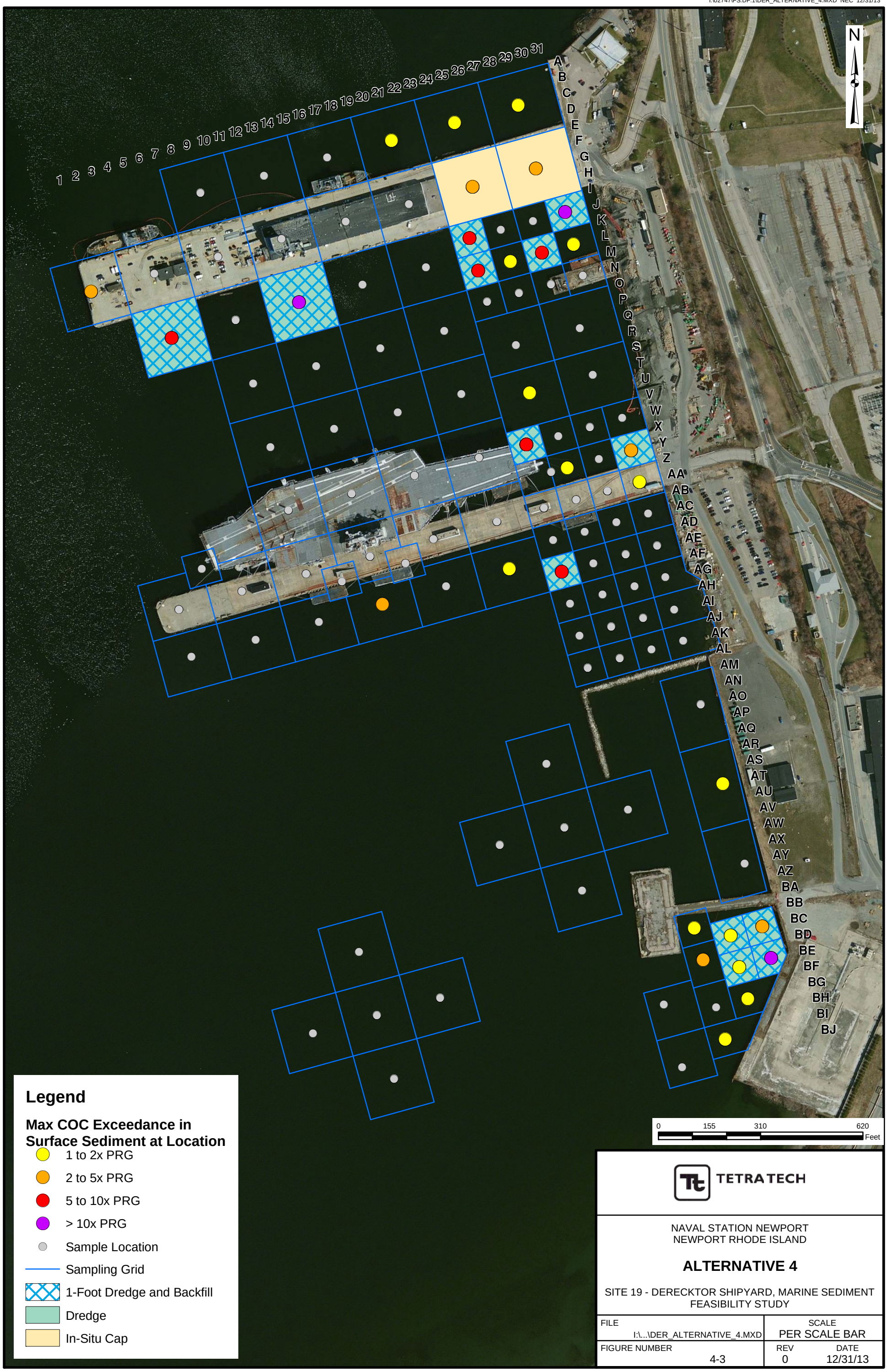
NAVAL STATION NEWPORT
NEWPORT RHODE ISLAND

ALTERNATIVE 3

SITE 19 - DERECKTOR SHIPYARD, MARINE SEDIMENT FEASIBILITY STUDY

FILE	SCALE	
I:\...\DER_ALTERNATIVE_3.MXD	PER SCALE BAR	
FIGURE NUMBER	REV	DATE
4-2	0	02/07/13

I:\02747\FS.DF.1\DER_ALTERNATIVE_4.MXD NEC 12/31/13



TETRA TECH

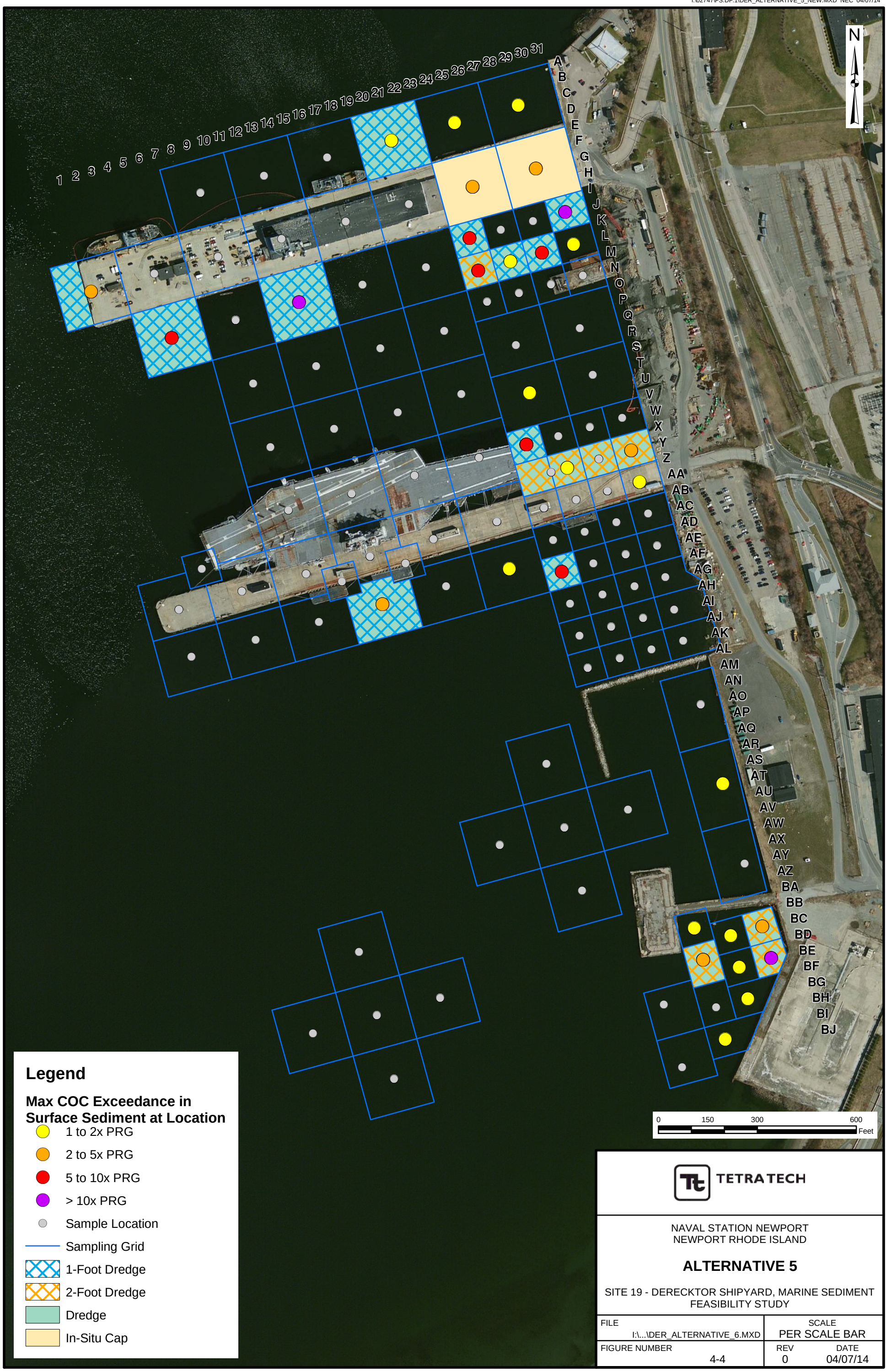
NAVAL STATION NEWPORT
NEWPORT RHODE ISLAND

ALTERNATIVE 4

SITE 19 - DERECKTOR SHIPYARD, MARINE SEDIMENT FEASIBILITY STUDY

FILE	SCALE	
I:\...\DER_ALTERNATIVE_4.MXD	PER SCALE BAR	
FIGURE NUMBER	REV	DATE
4-3	0	12/31/13

I:\02747\FS.DF.1\DER_ALTERNATIVE_5_NEW.MXD NEC 04/07/14



REFERENCES

REFERENCES

Bales, Roger C., James J. Morgan, 1984. Surface Chemical and Physical Behavior of Chrysotile Asbestos in Natural Waters and Water Treatment. California Institute of Technology, Pasadena CA. (unpublished)

Bridges, T.S, Ells, S., Hayes, D., Mount, D., Nadeau, S.C. Palermo, M.R., Patmont, C., and Schroeder, P. 2008. The Four Rs of Environmental Dredging: Resuspension, Release, Residual, and Risk. ERDC/EL TR-80-4. Washington, DC.

Brown & Root Environmental, 1997. *Site Assessment Screening Evaluation (SASE) Report for* the Former Robert E. Derecktor Shipyard (Draft Final), NETC Newport, Rhode Island.

Brown & Root Environmental, June 1998. Marine Human Health Risk Assessment Off-Shore Areas of the Former Robert E. Derecktor Shipyard (Draft Final), NETC Newport, Rhode Island.

EEI, 1983. Initial Assessment Study, Naval Education and Training Center, Newport, Rhode Island. Envirodyne Engineers, Inc. St. Louis, MO. March.

Foster Wheeler Environmental Corporation, March 2001. Draft Remedial Action Report for Various Removal Actions at Derecktor Shipyard, NETC Newport, RI.

Goulet, Dan – RIDEM Coastal Resources Management Council, Personal Communication, January 29 and February 21, 2007.

Kaplan, David E., undated. Unregulated Disposal of Asbestos Contaminated Shower Water Effluent: A Question of Public Health Risk. http://www.mesothelioma.us/pages/additional-information/articles-for-patients/ . Accessed 10/31/13.

National Research Council (NRC), 2007. Sediment Dredging at Superfund Megasites – Assessing the Effectiveness. National Academic Press. Washington, DC.

NAVSTA, 2002. "Memorandum of Understanding Between the Commanding Officer, Naval Station Newport, Pertinent Federal and State Agencies and The Rhode Island Lobsterman's Association and Ocean State Fisherman's Association", 33 C.F.R. 334.4, May 21.

Patmont, C. 2006. Contaminated Sediment Dredging Residuals: Recent Monitoring Data and Management Implications. Presentation at the Second Meeting on Sediment Dredging at Superfund Megasites, June 7, 2006, Irvine, CA.

Quinn, J.G., King, I.W., Cairns, R.W., and Gangemi, P.F., 1994, "Chemical Contaminants in Marine Sediments from The Former Derecktor Shipyard at Coddington Cove, Newport, Rhode Island."

RIGIS, 1997. Rhode Island Geographic Information System, Groundwater Classification Maps.

SAIC, URI, and Geochemical and Environmental Research Group, Texas A&M University, College Station, Texas. May 1997, "Final Derecktor Shipyard Marine Ecological Risk".

SAIC, 1998. Preliminary Remediation Goals (PRGs) for Derecktor Shipyard/Coddington Cove, Prepared under contract to Tetra Tech NUS Corp. August.

Sea Vision Marine Services LLC, 2006. "Hydrographic Survey Pier 1 Naval Station Newport, RI" for Global – A 1st Flagship Company Naval Inactive Ships Maintenance Office. May.

Tetra Tech NUS, Inc., 1999. Feasibility Study for the Former Robert E. Derecktor Shipyard. Prepared under CLEAN Contract Task Order No. 302, Northern Division of Naval Facilities Engineering Command. July.

Tetra Tech, 2005. Marine Sediment Sampling and Analysis Report for Former Robert E. Derecktor Shipyard. NAVSTA Newport, Newport Rhode Island.

Tetra Tech, 2011. Final Sampling and Analysis Plan for Former Derecktor Shipyard Marine Sediment, Data Gaps Investigation. NAVSTA Newport, Newport Rhode Island..

Tetra Tech, 2012a. Final Supplemental Sediment Investigation Report for Installation Restoration Site 19, Former Derecktor Shipyard. Naval Station Newport. Naval Facilities Engineering Command Mid-Atlantic.

Tetra Tech, 2012b. Study Area Screening Evaluation Addendum for Site 19 – On Shore Derecktor Shipyard. NAVSTA Newport, Newport Rhode Island. Naval Facilities Engineering Mid-Atlantic.

University of Rhode Island Graduate School of Oceanography, and SAIC, 1995. Work/Quality Assurance Project Plan for Narragansett Bay Eco-Risk and Monitoring for Navy Sites. July 28.

USEPA (United States Environmental Protection Agency), 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final, EPA/540/G-89/004, October.

USEPA, 2005. Contaminated Sediment Remediation Guidance for Hazardous Waste Sites, EPA-540-R-05-12, October.

U.S. Food and Drug Administration (USFDA) 1993, Guidance Document of Arsenic in Shellfish, U.S. Food and Drug Administration, January.

Wood, Kimberley, 1998. Deep Draft Berthing Facility Site Plan, Prepared for Naval Sea Systems Command. NFESC East Coast Detachment.

APPENDIX A

PRELIMINARY REMEDIATION GOALS (PRGS) FOR DERECKTOR SHIPYARD/CODDINGTON COVE (FINAL, SAIC, NOVEMBER 1998)

Final

Preliminary Remediation Goals (PRGs) for Derecktor Shipyard/Coddington Cove

November 1998

Prepared by:

Science Applications International Corporation
165 Dean Knauss Drive
Narragansett, RI 02882

Under contract to:

Tetra Tech NUS
55 Jonspin Rd.
Wilmington, MA 01887

for

United States Navy - Northern Division
10 Industrial Highway
Lester, PA 19113-2090

Table of Contents

List of Figures iii

List of Tables v

List of Appendices vii

List of Acroynms and Units ix

2. PRG Derivation 2
    2.1. PRG Development Approach 3
    2.2. Aquatic PRG Derivation 6
    2.3. Avian Predator PRG Derivation 12
    2.4. Human Health PRG Derivation 14
    2.5. PRG Derivation Summary 18

3. PRG Implementation 18
    3.1. Translation of TEV Values into PRGs 19
        3.1.1. Aquatic PRGs-Calculation Method 19
        3.1.2. Avian Predator/Human Health PRGs- Calculation Method 20
    3.2. Approach for Spatial Implementation of PRGs 21
    3.3. Assessment of PRGs for Risk Reduction 23
        3.3.1. Aquatic Exposure Pathways 23
        3.3.2. Avian Predator Exposure Pathway 29
        3.3.3. Human Health Exposure Pathway 30

4. Conclusions/Recommendations 32

List of Figures

Figure 2.2-1 Water quality screening value selection process and associated data qualifiers.

Figure 3.2-1 Thiessen Polygons for PRG Implementation for the Derecktor Shipyard/Coddington Cove study area.

Figure 3.2-2. Aquatic risk probability for the Derecktor Shipyard/Coddington Cove study area.

Figure 3.3-1. Summary of CoCs exceeding PRGs for protection of aquatic biota by location for sediments in the Derecktor Shipyard/Coddington Cove study area: Bedded Sediment Exposure Pathway for HWM PAH.

Figure 3.3-2. Summary of CoCs exceeding PRGs for protection of aquatic biota by location for sediments in the Derecktor Shipyard/Coddington Cove study area: Bedded Sediment Exposure Pathway for Total PCBs.

Figure 3.3-3. Summary of CoCs exceeding aquatic PRGs by location for sediments in the Derecktor Shipyard/Coddington Cove study area: Recommended PRG Implementation for the Bedded Sediment Exposure Pathway.

Figure 3.3-4. Summary of CoCs exceeding PRGs for protection of aquatic biota by location for sediments in the Derecktor Shipyard/Coddington Cove study area: Resuspended Sediment Exposure Pathway for Copper.

Figure 3.3-5. Summary of CoCs exceeding PRGs for protection of aquatic biota by location for sediments in the Derecktor Shipyard/Coddington Cove study area: Resuspended Sediment Exposure Pathway for Lead.

Figure 3.3-6. Summary of CoCs exceeding PRGs for protection of aquatic biota by location for sediments in the Derecktor Shipyard/Coddington Cove study area: Resuspended Sediment Exposure Pathway for Total PCBs.

Figure 3.3-7. Summary of CoCs exceeding aquatic PRGs by location for sediments in the Derecktor Shipyard/Coddington Cove study area: Recommended PRG Implementation for the Resuspended Sediment Exposure Pathway.

Figure 3.3-8 Inferred zones of potential sediment resuspension in the Derecktor Shipyard/Coddington Cove study area.

List of Figures (continued)

Figure 3.3-9. Summary of CoCs exceeding PRGs for protection of avian predators by location for sediments in the Derecktor Shipyard/Coddington Cove study area: Exposure Pathway for Copper.

Figure 3.3-10. Summary of CoCs exceeding PRGs for protection of avian predators by location for sediments in the Derecktor Shipyard/Coddington Cove study area: Exposure Pathway for Zinc.

Figure 3.3-11. Summary of CoCs exceeding PRGs for protection of avian predators by location for sediments in the Derecktor Shipyard/Coddington Cove study area: Exposure Pathway for Total PCBs.

Figure 3.3-12. Summary of CoCs exceeding PRGs for protection of human health by location for sediments in the Derecktor Shipyard/Coddington Cove study area: Exposure Pathway for Benzo(a)pyrene.

Figure 3.3-13. Summary of CoCs exceeding human health PRGs by location for sediments in the Derecktor Shipyard/Coddington Cove study area: Recommended PRG Implementation for the Human Health Exposure Pathway.

Figure 3.3-14. Summary of PRG exceedences by pathway for Derecktor Shipyard/Coddington Cove study area.

List of Tables

Table 1. Potential Remedial Action Objectives for Derecktor Shipyard/Coddington Cove study area.

Table 2. Chemical-specific ARARs for the Derecktor Shipyard/Coddington Cove study area.

Table 3. Procedure for Preliminary Remediation Goals development for aquatic, avian predator and human health exposure pathways in the Derecktor Shipyard/Coddington Cove study area.

Table 4. Water Quality Criteria for target analytes selected for aquatic PRG development and derived Water Quality Screening Values.

Table 5. Distribution of toxic and non-toxic aquatic Hazard Quotients and derivation of No Observable Effect Quotients for the aquatic receptors exposed to CoC via bedded and resuspended sediment aquatic exposure pathways for the Derecktor Shipyard aquatic exposure pathway.

Table 6. Derivation of Aquatic Reference Screening Values based on concentrations for selected contaminants in porewater and elutriates from Narragansett Bay reference locations.

Table 7. Derivation of Threshold Effects Values for bedded (PW) and resuspended (ELU) aquatic exposure pathway in the Derecktor Shipyard/Coddington Cove study area.

Table 8. Avian Predator Reference Screening Values for selected CoCs in tissues of prey from Narragansett Bay reference locations.

Table 9. Derivation of Threshold Effects Values for the avian predator exposure pathway in the Derecktor Shipyard/Coddington Cove study area.

Table 10. Summary of Exposure Parameter Values used in estimating exposures via shellfish consumption by subsistence fishermen in the Derecktor Shipyard/Coddington Cove study area.

Table 11. Toxicity values for Chemicals of Concern in shellfish tissue for the Derecktor Shipyard/Coddington Cove study area.

Table 12. Summary of risk-based concentration thresholds for CoCs in shellfish tissue for the Derecktor Shipyard/Coddington Cove study area.

List of Tables (continued)

Table 13. Derivation of Human Health Reference Screening Values based on concentrations of selected contaminants in tissues of shellfish harvested from lower Narragansett Bay for consumption by subsistence fishermen.

Table 14. Derivation of Threshold Effects Values for the human health exposure pathway in the Derecktor Shipyard/Coddington Cove study area.

Table 15. Summary of maximum TEV-HQs and identification of Limiting CoCs by sampling location for aquatic, avian predator and human health exposure pathways for the Derecktor Shipyard/Coddington Cove study area.

Table 16. Summary of Preliminary Remediation Goals for aquatic, avian predator, human health, and combined exposure pathways for the Derecktor Shipyard study area expressed as sediment concentration-based values.

List of Appendices

Table A-1. Summary of Kow and Koc values used in calculations of organic contaminant concentrations in porewaters by equilibrium partitioning.

Table A-2.1. Concentrations of chemical contaminants in surface sediment collected in the Derecktor Shipyard/Coddington Cove study area.

Table A-2.2. Geotechnical characteristics of reference sediments in Narragansett Bay, Rhode Island.

Table A-2.3. Lipid and solids content data for species collected for the Derecktor Shipyard ERA.

Table A-2.4. Concentration of selected contaminants in tissues of prey in the Derecktor Shipyard/Coddington Cove study area available for consumption by avian predators and subsistence fishermen.

Table A-3.1. Equilibrium-partitioning calculated concentrations of organic contaminants in sediment porewaters from the Derecktor Shipyard/Coddington Cove study area.

Table A-3.2. Hazard Quotients calculated for organic contaminants in sediment porewaters from the Derecktor Shipyard/Coddington Cove study area.

Table A-3.3. Porewater Hazard Quotients based on data from the Derecktor Shipyard Marine ERA for stations exhibiting no toxicity to amphipods (*Ampelisca abdita*).

Table A-4.1. Elutriate concentrations for sediments collected from the Derecktor Shipyard study area.

Table A-4.2. Elutriate Hazard Quotients for sediment collected from the Derecktor Shipyard study area.

Table A-4.3. Elutriate Hazard Quotients based on data from the Derecktor Shipyard Marine ERA for stations exhibiting toxicity to sea urchin (*Arbacia punctulata*) normal larval fertilization.

Table A-4.4. Elutriate Hazard Quotients based for Derecktor Shipyard Marine ERA for stations exhibiting toxicity to sea urchin (*Arbacia punctulata*) normal larval development.

List of Appendices (continued)

Table A-5. Comparing aquatic Threshold Effects Value Hazard Quotients for CoCs in porewaters and elutriates for identification of Limiting CoCs for the Derecktor Shipyard/Coddington Cove study area.

Table A-6. Avian predator Threshold Effects Value Hazard Quotients for CoCs in tissue of prey species consumed by avian aquatic predators in the Derecktor Shipyard/Coddington Cove study area.

Table A-7. Human Health Threshold Effects Value Hazard Quotients based on concentrations of selected contaminants in tissues of shellfish harvested from lower Narragansett Bay for consumption by recreational fishermen.

Table A-8. Derivation of aquatic PRGs for CoCs in porewaters and elutriates obtained from sediments collected in the Derecktor Shipyard/Coddington Cove study area.

Table A-9. Comparison of sediment concentrations between URI and ERA investigations of the Derecktor Shipyard/Coddington Cove study area.

Table A-10. PRG Hazard Quotients for CoCs in the aquatic exposure pathways for the Derecktor Shipyard/Coddington Cove study area.

Table A-11. PRG Hazard Quotients for CoCs in avian predator exposure pathway for the Derecktor Shipyard/Coddington Cove study area.

Table A-12. PRG Hazard Quotients for CoCs in the human health exposure pathway for the Derecktor Shipyard/Coddington Cove study area.

Table A-13. Summary of maximum PRG-HQs and identification of Limiting CoCs by sampling location for aquatic, avian, and human health exposure pathways for the Derecktor Shipyard study area.

List of Acroynms and Units

ACL/MCL	Alternate Concentration Levels/Maximum Contaminant Concentration Levels
ADI	Average Daily Intake
AE	Average Exposure
AET	Apparent Effects Threshold
ARAR	Applicable or Relevant and Appropriate Requirements
AT	Averaging Time
AVS	Acid Volatile Sulfide
AWQC	Ambient Water Quality Criteria
BAF	Bioaccumulation Factor
BPJ	Best Professional Judgment
BSAF	Biota-Sediment Accumulation Factor
BW	Body Weight
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CF	Conversion Factor
CFR	Code of Federal Regulations
CoC	Constituent (Chemical) of Concern
CV	Coefficient of Variation
CWA	Clean Water Act
DEP	Depurated Sample
DQ	Data Qualifier
DoD	Department of Defense
DW	Dry-Wet Ratio
ED	Exposure Duration
EF	Exposure Frequency
ELU	Elutriate
EMAP	Environmental Monitoring and Assessment Program
EPA (USEPA)	Environmental Protection Agency
EqP	Equilibrium Partitioning
ER-L	Effects Range Low
ER-M	Effects Range Medium
ERA	Ecological Risk Assessment
FA	Freshwater Acute
FC	Freshwater Chronic
FCR	Food Consumption Rate
FFA	Federal Facility Agreement
FI	Factor Ingested
FS	Feasibility Study
HHRA	Human Health Risk Assessment

List of Acroynms and Units (continued)

HI	Hazard Index
HQ	Hazard Quotient
HMW	High Molecular Weight
IF	Intake Factor
IR	Installation Restoration
L-CoC	Limiting Chemical of Concern
LADI	Lifetime Average Daily Intake
LOAEL	Lowest Observed Adverse Effect Levels
LMW	Low Molecular Weight
NA	Not Available
NCP	National Contingency Plan
ND	Non-Depurated Sample
NETC	Naval Education and Training Center
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No Observed Adverse Effect Level
NOEC	No Observable Effect Concentration
NOEQ	No Observable Effect Quotient
OSWER	Office of Solid Waste Enforcement Regulations
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PRG	Preliminary Remediation Goal
PW	Porewater
RAF	Relative Absorption Factor
RAO	Remedial Action Objectives
RBC	Risk Based Concentration
RBV	Risk-Based Value
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
RIDEM	Rhode Island Department of Environmental Management
RIDOH	Rhode Island Department of Health
RME	Reasonable Maximum Exposure
RPD	Relative Percent Difference
RPRG	Recommended Preliminary Remediation Goal
RSV	Reference Screening Value
SA	Saltwater Acute
SAIC	Science Applications International Corporation
SC	Saltwater Chronic
SD	Standard Deviation
SDWA	Safe Drinking Water Act
SEM	Simultaneously Extractable Metals

List of Acroynms and Units (continued)

SF	Slope Factor
SQC	Sediment Quality Criteria
SQRT	Square Root
STDEV	Standard Deviation
TBC	To Be Considered
TCLP	Toxic Concentration Leachate Procedure
TEV	Threshold Effects Value
TOC	Total Organic Carbon
TRV	Toxic Reference Value
TSCA	Toxic Substance Control Act
UCL	Upper Confidence Limit
URI	University of Rhode Island
WQC	Water Quality Criteria
WQSV	Water Quality Screening Value
μg/L	micro grams per liter
μg/g dw sediment	micro grams per gram of dry weight sediment
ng/g dw sediment	nano grams per gram of dry weight sediment
mg/L	milligrams per liter
kg/L	kilogram grams per liter

1. Background and Objectives

The purpose of this document is to present a plan for the development of Preliminary Remediation Goals (PRGs) for the offshore area of the Derecktor Shipyard/ Coddington Cove Superfund Site. The general framework for this activity was based upon the "Risk Assessment Guidance for Superfund: Volume 1 - Human Health Evaluation manual (Part B, Development of Risk-based Preliminary Remediation Goals, USEPA, 1991a).

The Derecktor Shipyard/Coddington Cove site is located at the Naval Education and Training Center (NETC), Newport, RI, located in the lower East Passage of Narragansett Bay. As a Department of Defense (DoD) facility, investigation and cleanup are conducted as part of the Navy's IR (Installation Restoration) Program, although requirements are also to be consistent with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), pursuant to the Federal Facility Agreement (FFA) agreement of March 1992 between the Navy, USEPA and RIDEM.

As part of the IR Program, numerous investigations have been conducted to determine the type and extent of constituents of concern (CoCs) in soil, groundwater, and offshore sediment and shellfish, including associated risks to the environment and human health. Results of these investigations revealed elevated ecological and human health risks for offshore (e.g. sediment and shellfish tissue) media.

Based on the results of these investigations, the Navy will prepare a Feasibility Study (FS) for Derecktor Shipyard describing options for remedial actions. The remedy options will be evaluated with regard to effectiveness for meeting objectives for mitigation of existing and potential threats to public health and the environment. These Remedial Action Objectives (RAOs) are based on knowledge of the types of CoCs, the environmental media (e.g., soil, water, sediment) in which they are found or could be found in the future and the projected use of the site (Table 1).

Although it is recognized that the remedy will provide a mechanism to meet the RAOs, the spatial extent of the remedy will have to be sufficient to ensure that residual CoCs do not remain at levels higher than Federal and State Applicable or Relevant and Appropriate Requirements (ARARs) or To-Be-Considered (TBC) standards. The applicable chemical-specific ARARs/TBCs are likely to be focused on sediment as the media of concern.

Among the chemical-specific ARARs described in Table 2 are the Federal ARARs/TBCs derived from promulgated USEPA Water Quality Criteria and proposed USEPA Sediment Quality Criteria, which are intended to be protective of 95% of all aquatic species. The threshold chemical concentrations that comply with the ARAR or TBC criteria are called the PRGs for the site. The CoCs and associated concentrations to be used as PRGs are supposed to be risk-based, i.e., reflective of the results of the risk assessment with respect to the selection of those CoCs that "limit" remediation

(USEPA, 1991a). Here, "limiting" CoCs (L-CoCs) are those analytes that are responsible for much of the baseline risk (because of high concentrations and/or strong correlations with high toxicity), such that by cleaning up these CoCs to their PRG concentrations, other co-located CoCs will be cleaned up to levels much lower than their corresponding goals.

In this report, PRGs are developed to permit remedial alternatives evaluation in accordance with the requirements of the National Contigency Plan (NCP) and CERCLA guidance. Two threshold criteria (overall protection of human health and the environment, and compliance with ARARs) and one of five "balancing" criteria (reduction of toxicity) that are used to evaluate the RAOs are directly applicable to PRG selection. The other balancing criteria (long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability and cost) are evaluated in the FS that also directly affect the acceptability of various remedial alternatives. Hence, the PRGs developed in this report do not represent absolute levels which must be removed from the site, rather the application of the seven criteria with Trustee involvement will be necessary to select the Final Remediation Goals for the site.

Based on this information, the objectives of this investigation are as follows:

- Derive PRGs;
- Implement PRGs to determine potential spatial extent of remedial action;
- Assess PRG-based results against human health/ecological risk findings and ARAR compliance.

Derivation and implementation of PRGs are discussed in Sections 2.0 and 3.0, respectively. In Section 4.0, the effectiveness of selected PRGs are discussed relative to risk reduction achieved versus type and concentration of CoCs constituting the PRGs.

2. PRG DERIVATION

The objective of the overall PRG development process is to select the L-CoCs for the site and identify their respective concentrations that, when implemented as cleanup criteria, will focus remedial action in those areas where risk is higher than acceptable levels. Risk at the site is determined by aquatic, avian predator, and human health concerns, hence the derivation of PRGs to protect each of these principal exposure pathways is required. The general approach for PRG derivation is presented in Section 2.1; pathway-specific procedures and results are presented in Section 2.2, Section 2.3 and Section to 2.4 for aquatic, avian predator, and human health, respectively.

In the PRG development process, it is assumed that the final PRGs developed for various CoCs can be used as a basis for intercomparison of relative risks contributed by the CoCs, both within and between exposure pathways. Implementing aquatic PRGs for a few CoCs exhibiting the maximum observed exceedences of PRG concentrations would be assumed to be protective of all co-located CoCs contributing risk in the aquatic exposure pathway. The ability to draw such conclusions is critical to the derivation of "Limiting" PRGs as described throughout Section 2.0.

As indicated earlier, a second critical assumption in PRG development involves the degree to which the remediation of the chemical causing the highest risk will lead to reduction of risks caused by other CoCs. For the Derecktor Shipyard/Coddington Cove study area, all the various CoCs tend to be found in each environmental sample, such that it can be reasonably expected that a similar condition of co-located CoCs will exist for unsampled areas. In addition, any CoC found to be "limiting" at a given location and exposure pathway is included in the final list of CoCs selected for the pathway. Thus, when remedial technologies are applied, the implementation of the most conservative (i.e., limiting) PRG can be expected to lead to risk reduction for all CoCs at those locations.

It is important to note that the limiting PRG approach will be effective only when various chemical contaminants and exposure pathways remain co-located at the sampling location. "Dis-location" of CoCs from one another might arise from application of treatment technologies that preferentially remove one CoC class over another. Dis-location of pathways may occur if different remedial solutions for a given location are selected (e.g., monitoring to protect human health vs. capping to protect the marine ecosystem) to protect various classes of receptors (e.g., marine organisms, birds, humans). If either of these practices are instituted, then the available data must be re-evaluated for each CoC class and exposure pathway to ensure all receptors are adequately protected.

2.1. PRG Development Approach

It is the objective of PRG development to determine sediment-based concentrations which represent thresholds below which adverse effects on aquatic biota are not expected to be ecologically significant. Since sediments are the primary reservoir of shipyard-related chemical contamination, the primary exposure mechanism of concern to be addressed by PRGs are the CoC exposures which occur via sediment which may directly expose aquatic biota, or accumulate in tissues of prey organisms for terrestrial, avian, and human receptors. The exposure pathways being addressed by PRGs can vary greatly; in this document, the process is used to address bedded (i.e., in-place) and, resuspended sediment effects on aquatic biota, shellfish predation by avian predators and shellfish harvesting by subsistent fishermen in the Derecktor Shipyard Coddington Cove study area.

The PRG process has been designed to address and integrate these various exposure pathways using a consistent and systemic approach. For the present report, PRGs for the four distinct exposure pathways are evaluated using standardized procedures; development of risk-based PRGs involves refinement of the CoC list and calculation of protective concentrations (derivation), followed by an analysis of site-specificity and practicality for supporting risk reduction (implementation). The general procedures outlined below in 5 steps (1-5) and in Table 3 are discussed in detail in later sections will be followed to derive candidate PRGs for the site. Steps 6 and 7 involve PRG implementation and assessment and are discussed in Section 3.

1. *Identify primary exposure pathways and select/derive benchmarks to express risks of CoC exposure to target receptors.* For the aquatic exposure pathways identified in the Marine ERA, the media of concern for PRG derivation is the concentration of CoCs in the water of bedded and resuspended sediments, while prey tissue residues are the focus of avian exposures. The principal pathway of concern for human health exposure was determined in the HHRA to be shellfish ingestion by subsistence fishermen. For aquatic pathways Water Quality Criteria and/or water-based screening values derived from sediment benchmarks are used. For avian predators and human health, the exposure pathway of concern are CoCs contained in biota; tissue residue benchmarks are based on safe levels of shellfish ingestion and require consideration of site-specific factors discussed in Step 2, below.

2. *Calculate site-specific no effect threshold concentrations for each CoC-receptor pair.* For each CoC, site-specific factors may exist that modify the degree of chemical exposure/bioavailability to target receptors. For the aquatic pathway, site-specific factors include the bound form of the CoC in the environment (e.g., some CoCs present as paint chips, scrap metal, sand blast material, etc.) which could result in CoC bioavailability being less than predicted directly by bulk sediment concentrations. Here, aquatic toxicity tests are used to discern possible site-specific modification in CoC bioavailability. Similarly, avian and human receptors may have varying CoC exposure depending on the age and weight of receptors and factors related to their feeding/harvesting habits.

   Using the site-specific information discussed above, the second step in the PRG development process is to calculate no effect threshold concentrations (NOEC) for each CoC and exposure pathway. The NOEC represents the highest chemical concentration for which effects are unlikely to occur. For example, if an effect was observed at 2, 3, and 4 ppm but not at 0.5 and 1 ppm, the 1 ppm concentration would be selected at the NOEC. Full details of the NOEC derivation are discussed on a pathway-specific basis in Section 2.

3. *Retain CoCs substantially contributing to risk.* An objective of PRG derivation is to identify and retain CoCs for which PRG implementation will lead to effective risk reduction at the site while eliminating other CoCs that would not. For this

step, it was assumed that if a CoC was a substantial risk contributor, the highest concentration associated with toxic samples must be greater than the NOEC. All CoCs satisfying this requirement were retained for further consideration as PRGs.

4. *Evaluate the feasibility of the CoC and pathway-specific NOEC as a long-term remediation goal.* Because of the general exchange of water and sediment in the region of the study area, it must be assumed that it would not technically feasible in the long term to remediate to CoC concentrations that are lower than those generally found in the region. For this step, regional CoC concentrations were summarized and the greater of the NOEC and reference-based concentration was determined. The resulting value was adopted as the Threshold Effects Value (TEV) for each exposure pathway.

5. *Assess CoC exceedences of TEVs to identify "limiting," pathway-specific CoCs for PRG selection.* The CoCs and associated concentrations to be used as PRGs are supposed to be risk-based, i.e., reflective of the results of the risk assessment with respect to the selection of those CoCs that "limit" remediation (USEPA, 1991a). Here, L-CoCs are those analytes that are responsible for much of the baseline risk (because of high concentrations and/or strong correlations with high toxicity) such that by cleaning up these CoCs to their PRG concentrations other co-located CoCs will be reduced to levels much lower than their corresponding effects-based concentrations.

   The approach for selection of L-CoCs for aquatic, avian and human health exposure pathways involved the straightforward application of pathway-specific TEV values to derive Hazard Quotients (HQs). These HQ values were inter-compared for each station and CoC to identify the L-CoC, e.g., that CoC-exposure pathway pair that represents the maximum TEV-HQ observed for the station. This procedure greatly reduces the reliance on assumption of CoC co-location across the site because the broad spatial distribution of sampling locations minimizes the potential that a novel CoC (unique in distribution, concentration or speciation) would be missed and thus fail to be included as a L-CoC.

6. *Calculate PRGs from TEVs.* Based on the selection of L-CoC and the media-specific concentrations that will achieve optimal risk reduction (TEVs), the TEV values are recalculated as necessary into appropriate (sediment-based) concentration (PRG) units to be implemented during site remediation. The calculated values are also discussed relative to traditional benchmarks so as to compare the relative degree of protection afforded to exposure pathways by site-specific and generic approaches.

7. *Evaluate the practicality of the PRGs for effective risk reduction.* In this spatial analysis, a candidate PRG that, upon implementation as part of a remedial

action, would result in risk reduction in the most affected areas should be favored over other candidate PRGs that do not. Note that this step, unlike the previous steps, is a qualitative, risk-based interpretation based on best professional judgment. In this analysis, the location of PRG exceedences (e.g., PRG-HQ > 1) for each of the L-CoCs is reviewed with respect to the spatial distribution and likelihood of observed risks at the site as concluded from the results of the ecological risk assessment (ERA) or human health risk assessment (HHRA). The extent of concurrence between the degree of apparent risk reduction and remediated area is discussed and presented as Recommended PRGs (RPRGs) so as to provide input into risk management decisions regarding the setting of Final Remediation Goals (established as part of the final Record of Decision for the site). As such, this focused discussion is intended to be primarily supportive of the FS analysis of the five balancing criteria (see Section 1) in which extent of risk reduction is assessed against monetary and engineering implications of remedial alternatives.

In summary, steps 1-5 above involve the identification of L-CoCs and matrix-specific (water, sediment, shellfish tissue) concentrations below which no adverse effects are expected. These steps are discussed in detail for aquatic, avian, and human health exposure pathways in Section 2.2 to Section 2.4, respectively; a summary of L-CoC selections is provided in Section 2.5. Separate from the above, steps 6-7 involve PRG implementation and assessment on a pathway-specific basis and are discussed in detail in Section 3.

2.2. Aquatic PRG Derivation

As identified in Section 1, five steps are required for aquatic PRG derivation. Each of these steps is fully addressed in the following sections.

1. Pathway Identification/Benchmark selection. The Marine ERA identified sediments as the principal exposure pathway of concern for aquatic receptors. Sediment Quality Criteria (SQC) for sediments and Water Quality Criteria (WQC) for surface waters are logical choices as ARARs for the Derecktor Shipyard/Coddington Cove study area. Although the direct applicability of SQC has been limited by the number of available criteria to date (presently five non-ionic organic compounds including three PAHs (acenaphthene (USEPA, 1993a), fluoranthene (USEPA, 1993b), phenanthrene (USEPA, 1993c) included as CoCs in the Marine ERA), the SQC derivation process has demonstrated the applicability of WQC to porewater concentrations for prediction of sediment toxicity when partitioning characteristics of the CoC between water and the organic carbon fraction of the sediment (K_{oc}) is taken into account using the equilibrium partitioning (EqP) model of Di Toro *et al.* (1991) as follows:

$$1) \qquad C_p = C_s/(f_{oc} * K_{oc});$$

In the above equation, organic chemical porewater concentrations (C_p, µg/L) are calculated from the corresponding sediment concentration (C_s; µg/kg), based on the fraction of organic carbon (Foc) in the site sediment; [foc = %TOC/100 (Total Organic Carbon)] and the organic carbon/water partitioning coefficient (Koc) for the CoC. Values for K_{oc} (Table 5) were determined from the relationship developed by the EPA (Karickhoff, 1989):

$$2) \quad \log_{10}K_{oc} = 0.00028 + 0.983*\log_{10}K_{ow};$$

where K_{ow} = the octanol/water partition coefficient.

By adopting the EqP approach for the development of aquatic PRGs for the present investigation, the chemical concentration in porewater in relation to WQC is used as the primary measure of potential adverse effects (i.e., risk) to aquatic biota. The EqP model also allows incorporation of station-specific conditions (principally TOC content of sediment measured at the location) that control sediment-porewater partitioning and hence chemical bioavailability in bedded sediments. In contrast to the bedded sediment exposure pathway, direct measurements of CoCs in elutriates for the resuspended pathway obviates the need for partitioning calculations for this medium.

As discussed in Section 1, determination of organic and metal CoCs responsible for the majority of the risk is assessed through normalizing concentrations to benchmarks so as to adjust for differences in the inherent toxicity of the chemical. For this investigation, Water Quality Screening Values (WQSV) adopted primarily from EPA Water Quality Criteria - Saltwater Chronic (WQC-SC) values (or estimated equivalents, discussed below) were used as the benchmarks.

Water-based CoC criteria are proposed for calculation following the decision tree presented in Figure 2.2-1. This approach allows for calculation of "WQC-SC equivalent" benchmarks, and assigns a data qualifier (DQ) to identify the benchmark source for derivation of the HQ. In Table 4, the DQ "A" is applied to benchmarks derived directly from existing WQC-SC values. For CoCs possessing WQC-saltwater acute values (WQC-SA), an 8:1 acute:chronic ratio is applied to derive the equivalent WQC-SC value (DQ = "B"). The conversion factor was derived from the mean overall acute:chronic ratio for paired chemical data contained in the EPA AQUIRE database (Shepard, 1998). Freshwater chronic data (WQC-FC) are used directly as screening values, with assigned data qualifier "C". As with WQC-SA values, freshwater acute (FA) values were converted to chronic values using an 8:1 acute:chronic ratio, and assigned DQ = "D".

Some sediment-based correlative benchmarks are required to complete the assessment of site-related CoCs where water quality benchmarks are lacking (Table 4). In these cases, NOAA Effects Range-Low (ER-L) (Long et al., 1995) concentrations were selected and translated into porewater equivalent concentrations using the EqP model. In this process, it is assumed that the resultant value provides a level of

protection equivalent to other water quality based benchmarks. This assumption is not unreasonable given that the WQC values are designed to be protective of 95% of all species, while NOAA ER-L values represent concentrations below which 90% of all sediment samples had no measurable adverse effect. Hence, sediment benchmark values (NOAA ER-L) were transformed into water-equivalent benchmarks using the EqP model by assuming 1% sediment TOC concentration (DQ = E). Finally, compounds for which no benchmark screening values were available are designated "NA" in Table 4.

Research by the USEPA into the development of SQC for divalent metals (Cu, Cd, Pb, Ni, and Zn) in sediment has shown that sediment toxicity can be predicted when the quantity of Simultaneously Extractable Metal (SEM) present in excess of the Acid Volatile Sulfide (AVS) concentration in sediment is measured (Berry *et al.*, 1996). The expression of SEM relative to AVS has been historically expressed as the SEM/AVS ratio, although the difference of SEM and AVS (SEM-AVS) is now preferred, as the metric is less sensitive to conditions where AVS is near detection limits (e.g., resulting in very high SEM/AVS ratios). The use of SEM-AVS is based on the fact that AVS will bind divalent metals in direct proportion to their respective molar concentrations (Hansen *et al.*, 1996). In the EPA National Sediment Quality Inventory (USEPA, 1996a) the SEM-AVS value of 5 µmol/g dry wt is recommended as a screening value for identification of bedded sediments of concern with regard to potential divalent metal effects on aquatic biota in bedded sediments.

The above application of SEM:AVS data to bedded sediments can be modified to be relevant to sediments recently deposited as a result of resuspension. By assuming that all AVS is oxidized during resuspension (AVS = 0) and that the SEM concentration of settled particulates is the same as that of bedded sediment (conservatively assuming no losses in the water column), the potential effect of metals in sediments subject to resuspension can be assessed by direct comparison of SEM metal concentration against the SEM benchmark (5 µMol/g). It is noted that this evaluation was also performed in the ERA (Table 6.1-1). The SEM-AVS method is not directly amenable to PRG development since it does not directly identify CoC-specific PRGs. However, the data are useful for evaluation of the overall need for metals-based site-specific PRGs.

The WQSV presented in Table 4 represent thresholds for adverse effects to aquatic biota as derived from available water quality criteria and modified sediment benchmarks. Porewater and elutriate concentrations (reported in Tables A-3.1 and A-4.1, respectively) are divided by the WQSV to obtain Porewater Hazard Quotients (PW-HQs; Table A-3.2) and Elutriate Hazard Quotients (ELU-HQs; Table A-4.2). These quotients are used to determine no effect concentrations as discussed in the following section.

2. *Calculate site-specific no effect threshold concentrations for each CoC-receptor pair.* A common element of correlative benchmark development is the process

of establishing statistical confidence limits for sediment concentrations with varying likelihood of biological effects. For example, the NOAA ER-L benchmark (Long and Morgan, 1990; Long *et al.*, 1995) was developed by matching of chemical concentrations with incidence of benthic effects (e.g., toxicity, reduced benthic composition, biomarker response) measured in field samples, and statically estimating the sediment concentration below which no adverse effect was observed 90% of the time.

As introduced in Section 1, it is expected that site-specific factors exist which control the bioavailability of CoCs in the marine sediments of the shipyard/cove study area and thus modify the degree of chemical impacts on target receptors. For the present investigation, the primary indicator of site-specific CoC bioavailability in bedded sediment are toxicity results from the amphipod (*Ampelisca abdita*) 10-day bulk sediment test, while for resuspended sediments, results of the sea urchin (*Arbacia punctulata*) fertilization and larval development elutriate tests are used. An amphipod and sea urchin biotoxicity test was conducted at each location where a bulk sediment or elutriate chemistry sample was collected, respectively.

Adapting the general approach presented for ER-L derivation (discussed above), PW-HQ data were paired with co-located amphipod toxicity results, while elutriate hazard quotient (ELU-HQ) data were paired with co-located sea urchin toxicity results. The paired data sets were subsequently segregated in non-toxic and toxic samples defined for each as follows: amphipod survival $\geq$ 80% = non-toxic; sea urchin successful fertilization $\geq$ 70% = non-toxic, and sea urchin larval development $IC_{10} \geq 50\%$ = non toxic. The PW-HQ or ELU-HQ database test endpoint are reported in (Tables A-3.3A, A-3.3B, A-4.3, and A-4.4).

The HQ databases include statistical summaries of the mean, maximum, and upper 95% of CoC-specific HQs. The non-toxic data sets available for derivation of no effect thresholds include 15 co-located stations for the bedded sediment pathway and 9-11 stations for the resuspended sediment pathway.

For each CoC, the highest concentration for which adverse effects are unlikely, called the No Observable Effect Quotient (NOEQ), was estimated as the upper 95% confidence limit (UCL) of the non-toxic PW-HQ or ELU-HQ data set (e.g., expected risk threshold at maximum CoC bioavailability). The 95% UCL approached was adopted as a method comparable to the USEPA WQC level of protection for chronic effects as calculated from single species/single toxicant bioassay results. For NOEQ values < 1, an NOEQ = 1 was adopted for the CoC assuming that it is unlikely that site specific factors could increase CoC bioavailability to levels above that occurring in water-only tests.

NOEQ results for the bedded and resuspended sediment exposure pathways are provided in Tables 5A and 5B, respectively. The listed CoCs include metals, PAHs, Total PCBs, and pesticides as well as aggregate values for Low Molecular Weight

(LMW) PAHs, High Molecular Weight (HMW) PAHs and Total PAHs, and a sediment-based measure of divalent metal bioavailability (SEM-AVS). The aggregate CoC classes were included to address the potential additive effects of PAH and metal mixtures.

For most CoCs, the NOEQ was less than 1, indicating good agreement between measured toxicity and the literature-based WQC data; indicating that toxicity was not observed where criteria values predict that toxicity should not occur. In such cases where the *CoC-specific* NOEQ was less than 1, a NOEQ value of 1 was retained. For some CoCs, the NOEQ did exceed unity somewhat; this is attributed to the fact site-specific conditions have slightly reduced CoC bioavailability relative to conditions under which the WQC are derived (i.e., single-species, water-only laboratory bioassays). Here, the NOEQ was selected as the greater of the upper 95% HQ and the default HQ (e.g., HQ=1).

3. Retain CoCs substantially contributing to risk. Also listed in Table 5 are the maximum PW-HQ values for sediment samples found to be toxic to amphipods and maximum ELU-HQ values for elutriate samples found to be toxic to sea urchin larval development. No toxicity to sea urchin fertilization exposed to elutriates was observed in the ERA investigation. Those CoCs which were found to exceed the NOEQ benchmark (Max. HQ > NOEQ) for a given test endpoint were retained for further PRG derivation. For bedded sediment, the CoCs included HMW PAHs and Total PCBs. For resuspended sediments, CoCs included arsenic, copper, lead, HMW PAHs, Total PAHs, Total PCBs, and the pesticide o,p'-DDE. In assessing the potential for metals effects in resuspended sediment only four stations (DSY-27, 28, 29, 30) marginally exceeded the benchmark (e.g. SEM concentration >5 μmole/g), and only one station by more than a factor of two (DSY-27 12.1 μmole/g). Given that the SEM value the sum of five metals (Cu, Cd, Pb, Ni, Zn), and that AVS was extremely high in this sediment (176 μmole/g) it is unlikely that the combined effect of metals (let alone individual metals) are responsible for adverse effects at this or any other sample location.

The Aquatic NOEQ value used for further PRG development was taken as the minimum of the test-specific endpoints. Given the comparability of the NOEQ data among test endpoints and the observation that the calculated NOEQs are generally less than three (LMW and Total PAH for resuspended sediment was ~7.3), it is apparent that the site-specific CoC bioavailability is similar to that found for laboratory bioassay experiments. This good agreement is attributed to the fact that the test species employed in the Marine ERA are sensitive to site CoCs and serve as adequate surrogates for the most sensitive species in the shipyard/cove study area.

4. Evaluate the feasibility of the CoC and pathway-specific NOEC as a long-term remediation goal. Table 6 presents a summary of aquatic Reference Screening Values (RSVs) for the candidate CoCs identified in Steps 1-3, above. The database was assembled from measured or predicted porewater and elutriate concentrations at

reference locations used for the Allen Harbor (SAIC, 1996), McAllister Point (SAIC and URI, 1997a), and Derecktor Shipyard (SAIC and URI, 1997b) Marine ERAs (Table 6).

Prior to the use of these data, a limited assessment of these reference locations in lower Narragansett Bay to reference stations selected for the Derecktor Shipyard/Coddington Cove study area was conducted to demonstrate comparability of habitat and hence suitability as sites for background data. Data presented in Table A-2.2 show that the sand (66-88%), silt (12-33%), and TOC (1.1-1.7%) content for Derecktor Shipyard/Coddington Cove reference locations were within the range observed for Narragansett Bay stations as a whole; these similar geotechnical characteristics imply comparability of habitats. Hence it was assumed that the reference database can serve as suitable indicator of background CoC concentrations for derivation of aquatic PRGs.

In the development of the reference databases for the aquatic exposure pathways, the porewater reference data were screened for statistical outliers (defined as values greater than + 2 S.D. of the mean) to ensure that the RSV was not inappropriately elevated by atypical CoC distribution. The mean and 95% UCL of porewater concentrations after outlier removal were recalculated to obtain the RSV for the bedded sediment exposure pathway. In the case of the resuspended sediment scenario, only a single reference location (JPC-1) was measured for elutriate concentrations, hence the value obtained were used without modification.

Data for determination of aquatic TEVs are presented in Table 7. The Aquatic NOEQ values (from Step 3) were converted into the NOEC (e.g., water concentration units) to permit comparison against porewater and elutriate RSVs derived as described in Step 4. Subsequently the Aquatic TEV (AQ-TEV) was taken as the greater of the Aquatic NOEC and Aquatic RSV concentrations. The comparison of the two values show that the NOEC concentration exceeds the background concentration in most cases, suggesting that it would be feasible to remediate to the TEV concentrations, as background concentrations (represented as the aquatic RSV) would not be expected contribute to recontamination of the site. For lead and o,p'-DDE, however, the RSV exceeds the TEV, and thus the RSV is selected as the TEV for these CoCs.

5. *Assess CoC exceedences of TEVs to identify "limiting," pathway-specific CoCs for PRG selection.* As discussed in Section 2.1 (step 5), the list of CoCs to be retained as candidate PRGs are supposed to be "limiting", such that by cleaning up these CoCs to their PRG concentrations, other co-located CoCs will be reduced to levels much lower than their corresponding effects thresholds. In this step, the L-CoCs are derived by intercomparing TEV-HQs (in turn, derived from normalization of CoC concentrations in site to respective TEVs) and selecting the CoC with the maximum risk within and among pathways on a station-by-station basis.

To further ensure that all important L-CoCs be retained for the aquatic exposure pathway, the CoC with the maximum TEV-HQ for the station-pathway was selected

whenever the station-pathway sum TEV-HQ > 1. This step was taken to further address the uncertainty in the co-location assumption by identifying any CoC which might substantially contribute to risk at the site. The process was repeated for all sampled locations to identify the collection of all possible L-CoCs. Because of the large number of stations used in this analysis (19) and the broad spatial distribution of sampling locations, the potential that a novel CoC (unique in distribution, concentration or speciation) would be missed and hence fail to be included as a L-CoC was greatly reduced.

Table A-5 presents the maximum observed TEV-HQs by exposure pathway and station. Results show that among all the possible CoC candidates for both exposure pathways, only a small number of CoCs had TEV-HQs > 1. For the bedded sediment exposure pathway, the two L-CoCs were HMW PAHs and Total PCBs. Arsenic, copper, lead, Total PCBs, and o,p'-DDE were identified as L-CoCs for the resuspended sediment exposure pathway. These CoCs are identified as Limiting CoCs in Table 7 which will be brought forward to Section 3.1 (Aquatic PRG implementation) for further development as PRGs.

It is noted that the application of a toxicity screen for the identification of L-CoCs did not appear to have greatly affected those CoCs which would have been selected based on direct WQSV comparisons alone. For porewater, SEM-AVS values suggest that divalent metals are not biologically available (SEM-AVS < 0, Table A-3.3A), hence analyte-specific porewater concentrations, although not measured, would be expected to be less than ambient water quality criteria. Some high molecular weight PAHs were predicted to exceed WQSVs (e.g., anthracene, benzo(a)anthracene, flourene, chrysene), but were not identified by the toxicity evaluation. In this case, however, these PAHs were addressed by adopting a HMW PAH aggregate PRG. Thus, while not specifically selecting these CoCs, the potential cumulative risks responsible from these PAHs were accounted for. Finally, pesticides were not identified in the toxicity screen, nor were any of these CoCs above WQSV values. Hence, it can be concluded that the toxicity screen did not exclude any key CoCs which might have been selected by the application of WQSV alone.

2.3. Avian Predator PRG Derivation

1. Pathway Identification/Benchmark derivation. Findings of the Marine ERA indicate that avian aquatic predators are at potential risk because of CoCs contained in the tissue of prey that they consume. Initial selection of CoCs and benchmarks for avian predator PRG derivation were based on the Derecktor Shipyard Marine ERA results comparing prey species tissue residue concentrations to Toxicity Reference Value (TRV) benchmarks for any CoC and predator-prey combination in the shipyard/cove study area (ERA Table 6.3-2). These TRVs already incorporate site-specific factors as described in Step 2, below. The resulting HQ values (TRV-HQs), derived as the prey species concentration (mg/kg dry weight) divided by the TRV

(mg/kg dry weight), are reported in Appendix A-2-4 of the Final Marine ERA (SAIC and URI, 1997b).

2. *Calculate site-specific no effect threshold concentrations for each CoC-receptor pair.* Site-specific factors controlling CoC bioavailability to local birds selected for the ERA (great blue heron and herring gull) include the species, age and weight, and factors related to their feeding habits and migratory range in the New England region. The following description of methods and results for deriving TRVs for great blue heron follows is the same as used in the Marine ERA (Section 6.3).

A literature survey was conducted to identify studies where No Observed Adverse Effect Levels (NOAELs) and/or Lowest Observed Adverse Effect Levels (LOAELs) were determined for avian test species. The resulting data set included NOAEL/LOAELs for both domestic and wild birds; where possible, aquatic bird test data was selected in preference over data for other bird species. Subsequently, the equivalent NOAEL for the receptor of concern (wildlife NOAEL) was obtained by scaling the laboratory data (test NOAEL) on the basis of differences in body size according to the following equation:

NOAEL-wildlife = test NOAEL x $[\text{test bw/wildlife bw}]^{1/3}$ (Opresko *et al.*, 1994)

where: wildlife bw = body weight of wildlife species in kg
test bw = body weight of laboratory species in kg
test NOAEL = experimental dose in mg CoC/kg RoC/day

The TRV is defined as the concentration in food (in mg CoC/kg dry weight of food) which would result in a dose equivalent to the NOAEL (assuming no exposure through other environmental media), after Opresko *et al.*, 1996. The TRV was calculated from the food factor *f*, which is the amount of food consumed per unit body weight per day:

TRV = wildlife NOAEL/f (Opresko *et al.*, 1994)

Food factors for aquatic predators were derived from the Food Consumption Rate (FCR, in kg prey dry weight/day) and the receptor body weight (bw in kg):

f = FCR/bw (Opresko *et al.*, 1994).

For the Derecktor Shipyard ERA, the FCR for great blue heron were estimated from the allometric regression model of Kushlan (1978, as cited in USEPA, 1993).

3. *Retain CoCs substantially contributing to risk.* Using the above model and results for great blue heron, all CoCs with TRV-HQs > 1 were retained for further PRG derivation (ERA Table A-2-4.6). CoCs meeting the TRV-HQ >1 criteria include eight metals (arsenic, cadmium, chromium, copper, lead, mercury, silver, and zinc) as well as

Total PCBs. Note that in the ERA, maximum TRV-HQs for the PAHs and pesticides were found to be uniformly less than unity and thus were eliminated from further development as PRGs for the avian exposure pathway.

4. *Evaluate the feasibility of the CoC and pathway-specific no effect threshold concentration as a long-term remediation goal.* As done for the aquatic RSV derivation, a reference database consisting of prey species tissue concentrations was developed for CoCs identified in Step 3, above, to derive Avian Reference Screening Values (AV-RSVs), being the mean + upper 95% confidence band statistics of reference tissue data after outlier removals. These results are reported in Table 8.

The resulting avian predator RSVs are compared against TRVs in Table 9 to evaluate the feasibility of implementation. The TRV values for cadmium, copper, lead, and mercury were higher than avian predator RSV concentrations, while the reverse was true for arsenic, chromium, silver, zinc, and Total PCBs. The avian TEV was taken as the greater of the TRV and avian RSV concentration to ensure that PRGs are not set to concentrations below regional background values.

5. *Assess CoC exceedences of TEVs to identify "limiting," pathway-specific CoCs for PRG selection.* Following the aquatic pathway procedure, the list of L-CoCs to be retained as candidate PRGs was derived by intercomparing avian TEV-HQs and selecting the CoC with the maximum risk for each station.

Results of this comparison are presented in Table A-6. Analytes identified as L-CoCs include copper, lead, silver, zinc and Total PCBs. These CoCs are identified in Table 9 and will be brought forward to Section 3.2 (Avian Predator PRG implementation) where a spatial implementation analysis will be used to determine the L-CoCs needed for protection of the avian predator exposure pathway.

2.4. Human Health PRG Derivation

Chemical-specific PRGs are concentration goals for individual CoCs for specific medium and land use combinations at CERCLA sites. Two general sources of chemical-specific PRGs for human health are concentrations based on ARARs and concentrations based on risk assessment. ARARs include concentration limits set by other environmental regulations (e.g., non-zero maximum contaminant level goals (MCLGs) set under the Safe Drinking Water Act (SDWA)). The second source for PRGs, and the focus of this section, is risk assessment or risk-based calculations that set concentration limits using carcinogenic and/or noncarcinogenic toxicity values under site-specific exposure conditions.

1. *Pathway Identification/Benchmark selection.* Findings of the HHRA indicate that consumption of shellfish containing elevated CoCs by subsistence fishermen is the primary pathway of concern for the Derecktor Shipyard/Coddington Cove study area.

Hence, the list of benchmarks for human health PRG development focus only on CoCs in shellfish tissue caught in the vicinity of Derecktor Shipyard/Coddington Cove. Four indigenous species were used in the Derecktor Shipyard HHRA (BRE, 1998) to characterize edible shellfish. This included hard shell clams (*Mercenaria mercenaria* and *Pitar morrhuana*), blue mussels (*Mytilus edulis*), and lobster (*Homarus americanus*). The CoCs determined to exceed the carcinogenic effects threshold representing a 1×10^{-6} probability of risk included arsenic, benzo(a)anthracene, benzo(a)pyrene, dibenz(a,h)anthracene, indeno(1.2.3-cd)pyrene, and Total PCBs. The HHRA also found arsenic concentrations in shellfish to exceed the non-carcinogenic effects threshold (e.g., HQ≥1). Based on these findings, this exposure pathway was evaluated for PRG development. The site-specific benchmarks for shellfish tissue residues, called Risk Based Values (RBVs), are derived as described in Step 2, below.

2. *Calculate site-specific no effect threshold concentrations for each CoC-receptor pair.* Threshold chemical intake rates assumed to be protective of potential adverse effects from carcinogenic and non-carcinogenic CoCs were used to determine no effect threshold concentrations in shellfish tissue, or RBC. The majority of exposure parameters needed for RBC derivation were obtained from USEPA Standard Default Exposure Factors (USEPA, 1993e), reported in Table 10. These same exposure parameters and values were used in the HHRA. The main site-specific parameter was the annual shellfish consumption rate for New Englanders published by Rupp *et al.* (1980). The survey showed the 95th percentile of total shellfish consumption for adults in the range of 18 to 65 years of age was 15.6 g/day (Rupp *et al.*, 1980). As had been done in the HHRA, it was conservatively assumed that all shellfish consumption by subsistence fishermen will occur in Derecktor Shipyard/Coddington Cove.

The CoC-specific RBC is typically taken as the concentration in shellfish which is unlikely to cause adverse health effects, even in sensitive populations (USEPA, 1991a). For non-carcinogenic CoCs, the RBC representing a baseline (HQ=1) hazard to humans from ingestion of CoCs is following USEPA guidance (USEPA, 1989a) as follows:

$$C,\ non\text{-}carcinogen\ (mg/kg\ wet\ tissue) = \frac{HI \times RfD \times BW \times AT}{IF \times CF \times FI \times EF \times ED \times RAF}$$

Where:

HI	=	Total Hazard Index; ratio of average daily intake level to acceptable daily intake level (unitless)
ADI	=	Average Daily Intake (mg/kg-day)
RfD	=	Reference dose (acceptable daily intake level; mg CoC/kg-day; see Table 11)
C	=	Concentration in shellfish tissue (mg/kg)
CF	=	Conversion factor (1 kg/10^3 g)
IF	=	Intake factor[1] (i.e., shellfish consumption rate, g/day)

FI	=	Fraction ingested (i.e., fraction of shellfish ingested)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
RAF	=	Relative absorption factor (unitless; analyte-specific; see Table 10)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

Assuming the reasonable maximum exposure scenario is the reduced form of the equation using the site-specific exposure parameters from Table 10 is as follows:

$$C,\ non\text{-}carcinogen\ (mg/kg\ wet\ tissue) = \frac{4679.5 \times RfD}{RAF} \quad (1)$$

For carcinogenic effects, a concentration range (i.e., the preliminary shellfish remediation goal range) is calculated which corresponds to a range between 10^{-4} and 10^{-6} incremental risk of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen from all significant exposure pathways for a given medium (USEPA, 1991a). This is based on USEPA's interpretation of the significance of the cancer risk estimate as stated in the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR Part 300).

By setting the total risk for carcinogenic effects at a target risk level of 10^{-6} (the NCP's point of departure for determination of PRGs), the risk-based shellfish concentration (C) is calculated as follows:

$$C,\ carcinogen\ (mg/kg\ wet\ tissue) = \frac{Risk \times BW \times AT}{SF \times IF \times CF \times FI \times EF \times ED \times RAF}$$

Where:

Risk	=	The unitless probability of an exposed individual developing cancer
LADI	=	Lifetime average daily intake (mg/kg-day)
SF	=	Cancer slope factor $(mg/kg\text{-}day)^{-1}$

and remaining exposure parameters are as defined above. The equation shown below reflects the use of Reasonable Maximum Exposure (RME) parameters identified in Table 10.

$$C,\ carcinogen\ (mg/kg\ wet\ tissue) = \frac{0.011}{SF \times RAF} \quad (2)$$

The above equation is used to calculate CoC-specific threshold tissue residue concentrations below which adverse effects on subsistent shellfish consumers are not expected to occur. The CoC-specific parameters include RAF and SF values identified in Table 10 and Table 11, respectively.

Table 12 presents the calculated CoC-specific non-carcinogenic (Equation 1) and carcinogenic (Equation 2) RBC values assuming the RME exposure scenario. The overall Risk Based Values (RBVs) were taken as the minimum of RBC concentrations for each analyte. For comparison, the RBC concentration at 1×10^{-4} is also presented. As the RBV values will be compared against dry weight-based reference shellfish concentrations for the study area (Table A-2.4) and RBCs are calculated as wet (e.g. live) weight concentrations, % solids content (g dry/g live wt) statistics were developed for tissue samples to permit conversion of the RBV data to dry weight units. Data reported in Table A-2.3 indicates good agreement in solids content for various species allowing use of the average of 14% solids content (i.e., 86% water content) for conversion of wet weight values into dry weight concentrations. Thus, the RBVs for CoCs represent the dry weight shellfish tissue concentrations that are protective of subsistent fishermen consuming locally caught shellfish.

3. *Retain CoCs substantially contributing to risk.* All CoCs found in environmental samples above the RBV (as calculated in Step 2) are retained for further PRG derivation. In effect, the HHRA has already performed this calculation and identified these CoCs as presenting possible cancer and non-cancer risks although here threshold effect concentrations are also presented. A more detailed evaluation of the exposure assumptions (e.g., 10^{-6} vs. 10^{-5} cancer risk assumption) and exposure parameters will be performed to assess reasonableness during PRG implementation (Section 3.3). This will afford the opportunity to correct for overly conservative assumptions in the risk assessment and incorporate the most recent literature values published since the HHRA was completed.

4. *Evaluate the feasibility of the CoC and pathway-specific no effect threshold concentration as a long-term remediation goal.* The efficacy of these human health RBVs are further evaluated by comparison against human health RSVs derived from measured CoC concentrations in mussels and clams collected from reference locations (Table 13). These values are carried forward to Table 14, where Human Health TEVs (HH-TEVs) are obtained by selecting the greater of the RBV data and the RSV data. With the exception of arsenic, the RBV was higher than the reference (RSV) concentration. Elevated arsenic concentrations in shellfish tissues was addressed in the ERA and attributed to high arsenic in crustal materials typical of the Rhode Island formation (see text in ERA Section 4.3.1.1).

5. *Assess CoC exceedences of TEVs to identify "limiting," pathway-specific CoCs for PRG selection.* Following the same procedures as employed for the aquatic and avian predator exposure pathways, the list of CoCs retained as candidate PRGs for Human Health were derived by intercomparing TEV-HQs and selecting the CoC with the maximum risk within and among pathways on a station-by-station basis (Table A-7). The results indicate that arsenic, benzo(a)pyrene and dibenz(a,h)anthracene are L-CoCs for the human health pathway (Table 14). A single occurrence of TEV exceedence by dibenz(a,h)anthracene was noted for deployed mussels at off shore station DSY-39. Given that this media would not be available to shellfishermen and

that other species collected from this location did not show similar exceedence, this analyte was not selected as a L-CoC. The above results demonstrate that relatively few CoCs account for the majority of risk in the study area, and further supports the selection of L-CoCs as PRGs for risk reduction at the site.

2.5. PRG Derivation Summary

The above PRG derivation process has identified pathway-specific L-CoCs and media-specific concentrations (TEVs) for protection of aquatic, avian, and human receptors. Table 15 presents a summary of maximum observed TEV-HQs observed by exposure pathway and station that constitute the list of L-CoCs for PRG implementation. Results show that among all the possible CoC candidates, only a small number of CoCs for the aquatic, avian predator, and human health observations, respectively, had TEV-HQs>1. For the bedded sediment aquatic exposure pathway, the two L-CoCs were HMW PAHs and Total PCBs, while arsenic, copper, lead, Total PCBs, and o,p'-DDE were identified as L-CoCs during resuspended sediment exposure. Additional L-CoCs included copper, lead, silver, zinc, and Total PCBs for the avian predator pathway, while arsenic and benzo(a)pyrene were identified for the human health pathway with the single exception of o,p-DDE (TEV-HQ = 0.8). The same list of CoCs is retained for all pathways combined.

The above results demonstrate that relatively few CoCs account for the majority of risk in the Derecktor Shipyard/Coddington Cove study area, and further supports the selection of chosen L-CoCs as PRGs for risk reduction at the site. It should be noted that the small number of identified CoCs is a reflection of the relative similarity of CoC bioavailability and related risk sources across the site. This observation provides some assurance that a novel CoC (unique in distribution, concentration or speciation) has not been missed and thus wrongly excluded as a L-CoC.

3. PRG Implementation

The second phase of PRG development involves a qualitative assessment of the practicality for spatial implementation, i.e., whether the spatial implementation of the PRG preferentially target areas of higher risk as identified in the Marine ERA (aquatic and avian) and HHRA. In this regard, candidate PRG values are "tested" through comparison against measured chemical concentrations at the site. This requires that the TEV values be translated into sediment based units (PRGs) so the available data at the site can be considered with respect to PRG compliance and risk reduction (Section 3.1). Subsequently, the relationship among the degree of risk reduction achieved in consideration of remediated area is discussed to recommend appropriate PRGs from a risk-based perspective (Section 3.2). These recommendations are used as input into the FS and resulting risk management decisions regarding the setting of Remediation Goals discussed in Section 3.3.

3.1. Translation of TEV Values into PRGs

3.1.1. Aquatic PRGs-Calculation Method.

With respect to the translation of the TEV for porewater and elutriate media back to sediment-based concentrations, the primary intention is to derive a PRG number that both protects the receptor, and when applied to measured sediment chemistry, reflects a comparable degree of risk as indicated by the matrix-specific risk indicator (i.e., the TEV-HQ). For example, a sediment porewater concentration at a given location that is two-fold above the TEV (e.g., TEV-HQ = 2) should ideally have a corresponding PRG concentration that, when implemented, will reduce the risk by a factor of two (e.g. from PRG-HQ = 2 to a PRG-HQ < 1). Inherent in this application of PRGs is the assumption that risk at a given location when expressed as a unitless quotient is the same regardless of whether the benchmark is TEV-based or PRG-based, thus:

$$\text{PRG-HQ}_{\text{Sta., CoC, Pathway}} = \text{TEV-HQ}_{\text{Sta., CoC, Pathway}} \quad (3)$$

Where the risk equivalency assumption in Equation 3, the previous statement holds true only for a given location, CoC, and exposure pathway.

The concept of cross-matrix risk equivalency is not new. This approach, for example, was used in the ERA to assess risks as a result of CoCs in tissues (from Shepard, 1998) based on WQC, wherein the tissue concentration in the biota achieved at the water-based effects threshold (e.g., WQC-chronic) is the relevant tissue-based effects threshold because CoCs must reach the site of toxic action (e.g., tissues) to exert their effect. Similarly, the degree of risk associated with porewater/elutriate concentration of causing the effect in bedded/resuspended sediment (i.e., TEV-HQ) must equal the risk associated with bulk sediment concentration (PRG-HQ) responsible for generating (via partitioning) that porewater concentration:

The relationship described in Equation 3 can be used to solve for the location-CoC-pathway as follows. Substituting for PRG-HQ:

$$\frac{[\text{Sed}]}{\text{PRG}} = \text{TEV-HQ} \quad (4)$$

Given the TEV-HQ and associated sediment concentration ([SED]), the PRG concentration can be solved:

$$\frac{[\text{Sed}]}{\text{TEV-HQ}} = \text{PRG} \quad (5)$$

The important feature of this TEV-to-PRG translation method is that the measured risk data is used to derive the PRG value, whereas traditionally the EqP models would be used to back-calculate PRGs. In some cases, the models may still be needed, for example, where characteristics of a particular media sampled at a given location (e.g., TOC content of sediment, inert CoC materials such as metal fragments) result in an estimated PRG that is outside the expected range about the value at PRG-HQ = 1. In these instances, the predicted values can be validated against model estimates in relation to the model parameter inputs for the given location and the cause for atypical (high or low) PRG values can be isolated. In the present study, the procedure described above was used to calculate station-specific PRG estimates from which the mean PRG value was taken as the site-wide PRG concentration. Results of this process are discussed in Section 3.2.

3.1.2. Avian Predator/Human Health PRGs- Calculation Method.

The translation of both Avian Predator and Human Health PRGs require the conversion of tissue-based TEVs to sediment-based concentrations. This method of translation involves the application of Bioaccumulation Factors (BAFs) for metals and Biota-Sediment Accumulation Factors (BSAFs) for organics as discussed in the marine ERA (SAIC, 1997). For metals, the sediment-based concentration (μg/g gry wt) is calculated from the tissue-based TEV concentration according to the formula:

$$BAF = \frac{tissue\ concentration}{sediment\ concentration}$$

therefore:

$$sediment\ concentration = \frac{TEV}{BAF} \quad (6)$$

BAF values for arsenic (0.875), copper (0.33), lead (5.0E-6), silver (6.0E-4), and zinc (1.05) were derived in the Marine ERA (Marine ERA Figure 6.3-3).

For organic CoCs, the corresponding sediment concentration (ng/g dry wt) can be estimated from the formula:

$$BSAF = \frac{tissue\ concentration\ /\ lipid\ concentration}{sediment\ concentration\ /\ TOC\ concentration}$$

therefore:

$$sediment\ conc = \frac{TOC\ conc\ [TEV\ /\ lipid\ conc]}{BSAF} \quad (7)$$

The site-specific BSAF values for PCBs, PAHs, and pesticides derived in the ERA were 5.00, 0.12 and 3.85 respectively (ERA Figure 6.3-2). These values were found to compare well with literature BSAF values reported by USEPA (EPA, 1998). Also assumed for the above calculation is a mean sediment TOC (2.78%; Appendix Table A-2.1), and a mean biota lipid (4.59%; Appendix Table A-2.3).

3.1.3. PRG Calculation Results

Table 16 presents a summary of calculated PRGs for each of the three exposure pathways using methods described in Section 3.1.1, above. The analyte list includes only L-CoCs, i.e., those CoCs identified in Table 15 as having the maximum TEV-HQ by station and pathway. For the aquatic PRGs, the station-specific estimates used to derive the site-wide baseline PRG (HQ=1) shown in Table 16 are reported in Table A-8. Baseline PRGs for Avian Predator and Human Health pathways were calculated directly from the TEV values presented in Table 9 and Table 14, respectively.

Also included in Table 16 are RPRG concentrations for aquatic, avian, human health and combined exposure pathways discussed in the Section 3.3-1, Section 3.3-2, Section 3.3-3, respectively based on spatial implementation considerations discussed in Section 3.2, below. Baseline PRGs for the combined exposure pathway were taken as the minimum of the pathway-specific baseline PRGs.

3.2. Approach for Spatial Implementation of PRGs

Implementation of PRGs to determine areas of potential remedial action requires that the CoC data obtained from point samples be assigned to non-sampled locations to produce a map of complete spatial coverage. Numerous methods for spatial extrapolation of point data to larger areas (such as contouring) have been developed for environments and sampling strategies in which the assumptions of continuity (e.g., constant CoC dilution with distance) and gradation (e.g., regular spacing of sampling locations) are met. In the case of the Derecktor Shipyard/Coddington Cove study area, these assumptions are not met because of heterogeneous CoC distributions and station clustering in focused areas. Thus, for this investigation, a method using Thiessen polygons was used as it does not require the presumption of continuity in the data (ESRI, 1989). An approach of this type was undertaken during the USEPA EMAP Demonstration Study for the Virginian Province (Weisberg *et al.*, 1993). Here, the Thiessen polygon technique creates irregularly shaped polygons around sampled locations with a geometry such that any location in the polygon is closer to the sampled point than to any other sampled point. Hence, the concentration of the entire polygon is assumed to be equal to the value measured at the sampled location within the polygon.

The Thiessen polygon model constructed for the Derecktor Shipyard/Coddington Cove study area is shown in Figure 3.2-1. Geographic Information Systems software

(ESRI, 1989) was used for polygon construction and subsequent generation of PRG implementation maps. The inshore boundary of the site polygons was established as the shoreline at high tide, offshore polygons are unbounded. Shading of polygons obtained from PRG implementation will be used to demonstrate the locations in which CoC concentration data exceed the PRG (lightly-shaded), hence the area of potential remedial action. However, the polygonal area does not necessarily represent the final remediation area because the final area will depend on final PRG selection and additional sampling to improve spatial resolution.

Because it is desirable to use as much of the available site-specific data as possible to reduce spatial uncertainty, the Marine ERA evaluated chemical and biological results at 19 sampling locations throughout the Derecktor Shipyard/Coddington Cove study area (Stations 25-41) were combined with data from 24 stations obtained from a previous investigation (URI, 1993), hence accounting for the number of polygons shown in Figure 3.2-1.

Although both the ERA and URI investigations used similar sampling protocols and chemical analytical procedures, one notable difference was the depth of sediment sampling in the URI investigation (0-2 cm depth) vs. the ERA investigation (0-15 cm depth). The potential effect of this sampling variation on data comparability (hence usability) was evaluated by comparison of chemical results obtained from closely located stations between the two studies. The station pairs included DSY-1/40, DSY-1/41, DSY-2/28, DSY-3/29, DSY-10/41, DSY-11/31, DSY-18/26, DSY-19/32, DSY-20/31, and DSY-21/33 (Figure 3.2-1). The Relative Percent Difference (RPD) between stations for all stations and measured CoCs was 36%, while the mean RPD among PRG analytes for all stations was 47% (Table A-9). However, those stations within a proximity of 30 m had about a two-fold reduction in RPD relative to station pairs with >30m spatial separation.

Because the observed variation among datasets is well within the range generally considered to be acceptable among field duplicates (i.e., 30-40%), it can be concluded that the two data sets are sufficiently comparable to permit the incorporation of the URI data set into the PRG assessment. The data would further suggest that chemical distributions at the site are fairly homogeneous on the scale of 25-30 m. Heterogeneity on smaller scales (e.g., < 25 m) may represent 'hot spots' that were not detected. Still, the ERA sampling density was intended to characterize chemical risks at ecologically significant spatial scales, such that hot spots, if present, are more likely of ecological significance as potential CoC sources than for the loss of habitat.

Results of the Marine ERA have been used to classify the study area polygons based on the probability of adverse ecological risk caused by site-related CoCs to aquatic/avian aquatic receptors (Figure 3.2-2). The map shows the highest probability of adverse ecological risk ("+++") is occurring at harborfront stations DSY-27 and DSY-29 while the lowest probability of risk ("+") was observed for outer cove areas. The risk assessment for human health did not provide comparable spatial resolution,

but rather concluded that adverse risk to subsistence fishermen due to consumption of CoCs in biota does exist within Coddington Cove. Because the implementation of PRGs are intended to reduce risk, the spatial distribution of risk should be considered when evaluating the results of PRG implementation, discussed in the following section.

3.3. Assessment of PRGs for Risk Reduction

The assessment of PRG suitability as cleanup goals for the site involve the separate evaluation of L-CoCs listed in Table 16 as baseline (HQ=1) concentrations to determine the relationship between the degree of PRG exceedence and risk at the site. In the following sections, RPRG concentrations for aquatic, avian, and human health exposure pathways (discussed in the Section 3.3-1, Section 3.3-2, Section 3.3-3, respectively) are proposed that (based on best professional judgment) reflect a risk-based perspective on the optimal balance between degree of risk reduction and remediated area. These recommended values are further evaluated in the FS with respect to technical and fiscal constraints of PRG implementation.

3.3.1. Aquatic Exposure Pathways.

Bedded sediments. L-CoCs for the bedded sediment exposure pathway (Table 16) include HMW PAHs and Total PCBs.

HMW PAHs. The baseline PRG for HMW PAHs (6951 ng/g dry weight) was exceeded at eight shipyard/cove stations (DSY-2, DSY-3, DSY-18, DSY-19, DSY-20, DSY-27, DSY-29, and DSY-30; Figure 3.3-1). PRG exceedences were observed primarily for the harborfront stations, particularly Stations DSY-3/29 where PRG-HQs ranged from 4.3 to 10.5 (Table A-10). Another area in the vicinity of Station DSY-20 also exceeded the PRG by approximately three-fold, although closely located stations did not show similar exceedences (PRG-HQs <1 were observed for DSY-11 and DSY-31).

Among the stations exhibiting PRG exceedences, only Station DSY-29 was at high probability of risk, the extent PRG exceedences at this station (PRG-HQ= 4.3) and proximal station DSY-3 (PRG-HQ=10.5) indicate HMW PAHs are a significant source of risk. In contrast, the extent of PRG exceedences at low risk probability station DSY-30 (PRG-HQ = 1.49) are equivalent to that found at high risk Station DSY-27 (PRG-HQ=1.47), suggesting that PRG exceedences less than two are likely to preferentially address higher risk vs. lower risk areas. Further support for a RPRG equal to 2 times the baseline PRG (13903 ng/g) is seen in the risk/PRG comparison of the Station DSY-32 area; this location was classified as low risk while nearby station DSY-19 was exceeded the PRG by less than two fold. Similarly, PRG exceedence at Station DSY-18 (PRG-HQ = 1.86) is adjacent to intermediate risk station DSY-26 with no PRG exceedence (PRG-HQ < 1) such that implementing a PRG-HQ < 2 would not reliably address intermediate risks.

Based on the above analysis of PRG exceedence vs. risk reduction potential, a RPRG equal to two times higher than the baseline PRG is selected. The RPRG value (13903 ng/g) was compared to the literature-based effects concentrations as a check on the degree of protection that would be afforded to aquatic biota. The RPRG concentration was found to be 1.4X higher than the NOAA ER-M (9600 ng/g dry weight (Long *et al.*, 1995)) but 1.2X less than the State of Washington Apparent Effects Threshold - Low (AET-L; 17,000ng/g) concentration (Barrick et al., 1988). Hence, the RPRG is within the range of values expected to protect aquatic biota from adverse exposures.

Total PCBs. In contrast to HMW PAHs, the PRG for Total PCBs (1638 ng/g dry wt) was exceeded only at Station DSY-27 (Figure 3.3-2). In contrast, the lack of PRG exceedences for this CoC at all other sampled locations suggests that risks due to PCBs are not widespread, and implementation of a lower PRG value is not needed. Still, this station was identified as high risk in the Marine ERA, and thus implementation of the RPRG at a PRG-HQ = 1 concentration is recommended to address risk at this location.

The RPRG concentration (1638 ng/g) is nine-fold higher than the NOAA ER-M (180 ng/g dry weight), but is intermediate between the AET-low (1000 ng/g dry) and AET-high (3100 ng/g dry) benchmarks and about 1.5X lower than the Sediment Effect Concentration of 2700 ng/g calculated by MacDonald (1994) based on a PCB-spiked sediment bioassay. Thus the RPRG is within the range of independent estimates of threshold effects levels for aquatic biota.

It is also of interest to note that the corresponding TEV value for Total PCBs was set equal to the WQC-SC value (0.03 µg/L) without site-specific modification (Table 7) such that there would appear to be a discrepancy between the level of protection afforded by water- vs. sediment-based benchmarks, with the latter being overly conservative. This is attributed to the fact that the sediment benchmarks are field-based and correlative in nature, i.e., reflective of effects caused by complex mixtures of CoCs, not PCBs acting alone. In this case, the sediment-based PCB benchmark is artificially lowered because the presence of other CoCs in the mixture which will cause the sample to be more toxic than would otherwise occur in the PCB-only case. In contrast, the WQC is based solely on PCB toxicity. Thus, the baseline PRG value, being set equivalent to the WQC-SC concentration, is expected to be completely protective of risks to aquatic biota from PCB exposure in sediment. It is also noted that the TEV value (i.e., 0.03 µg/L) is 300X less than the WQC-SA criteria (10 µg/L), and in contrast to the WQC-SA, the WQC-SC was selected for protection of birds not aquatic biota. Hence, the comparability of sediment benchmarks (ER-L/ER-M values aside) with the PRG calculated from WQC suggests that the RPRG should be adequately protective of aquatic receptors.

Overall Assessment. From the above comparison of PRG exceedences with observed risk at the site, PRG-HQs above two were observed for both high risk

locations determined by the Marine ERA (Figure 3.2-2). Hence, adopting a RPRG of 13903 ng/g for HMW PAHs and 1638 ng/g for PCBs would ensure risk reduction at the two high risk areas for the site. A summary of areas exceeding the RPRG threshold is shown in Figure 3.3-3. Below these PRG-HQ thresholds, there was a poor correlation between the degree of risk reduction achieved by adopting lower PRG-HQ thresholds (i.e., PRG-HQ=1 for HMW PAHs) and the potentially affected area. As a result, PRG thresholds could not be discerned which could discriminate between intermediate or lower risks. Hence, adopting PRG concentrations below the recommended values would not appear supportable from a risk reduction perspective.

Resuspended Sediments. L-CoCs for resuspended sediments include arsenic, copper, lead, Total PCBs and o,p'-DDE.

Arsenic. Although TEV-HQ exceedences for arsenic were observed at two locations (DSY-38: TEV-HQ=1.01; DSY-39:TEV-HQ = 1.88), the poor proximity between the location of exceedences and lack of associated risks indicated that arsenic was a poor candidate for PRG selection. Application of the baseline PRG (24.6 μg/g) against sediment concentrations revealed PRG-HQ (Table A-10). Hence, as shown in Table 16, the implementation of a RPRG for this analyte is not recommended.

Copper. For copper, a TEV-HQ= 1.76 at Station DSY-31 was found based on a concentration of 5.1 μg/L measured in the elutriate sample. Following the methodology for PRG translation from TEVs, the PRG-HQ=1 concentration of 74 μg/g dry wt was calculated and the spatial implementation of the sediment PRG is found in Figure 3.3-4. While several stations had sediment concentrations above the PRG, a number of these locations had non-detectable elutriate Cu concentrations (e.g.,Station DSY-27 and DSY-29), such that it is clear that the predicted exceedences are erroneous. This is consistent with the fact that copper concentrations at DSY-27 and DSY-29 are not high; measured bulk concentrations were marginally above the ER-L and SEM-AVS was < 5, indicating that metals including copper are not at concentrations high enough to contribute significantly to risk. The lack of measured copper in elutriates is also consistent with the low/non-bioavailable concentrations in sediments evaluated for the ERA. Two additional URI stations (DSY-2 and DSY-3) did have Cu concentrations in sediment higher than was observed for ERA locations, but the increase was marginal (less than two-fold) and hence aquatic biota would be presumed to be at minimal risk due to Cu in resuspended sediments. Hence, the data demonstrate that copper is not a primary contributor to risk and thus retaining a PRG for remediation of sediments subject to resuspension is not recommended (Table 16).

Lead. The PRG for lead (84 μg/g dry weight) was exceeded at five stations (DSY-2, DSY-3, DSY-27, DSY-29, and DSY-32; Figure 3.3-5; Table A-10).

In the ERA exposure response relationships between benthic community (% dominant taxa) and Pb concentration in sediments suggest possible impact above about 150 μg/g (ERA Figure 6.5-1). The ordinance analysis (ERA Figure 6.5-4D) also

suggested that Pb at DSY-29 may explain the degraded conditions at this location. Hence, implementing a PRG for Pb would appear to be warranted to achieve risk reduction at this area.

In contrast to Station DSY-29, there was no evidence of Pb effects at the other high risk station (DSY-27) or any other stations from exposure-response analyses presented in the ERA. Since there was no apparent effect of Pb at DSY-27, a PRG for Pb should not be set to concentrations below that observed at DSY-27. Given that the DSY-27 (no effect) and DSY-29 concentrations are 150 and 185 μg/g, respectively, an intermediate PRG of 166 μg/g (2X baseline PRG) would appear to be adequately conservative to protect risk to aquatic biota such as was observed at DSY-29. This recommendation is consistent with the observation that tissue residues of Pb in biota at these locations are not elevated relative to reference (see ERA Figure 4.3-8 to Figure 4.3-10) .

Total PCBs. The PRG for Total PCBs (530 ng/g dry weight) was exceeded at four stations (DSY-3, DSY-11, DSY-27 and DSY-29; Figure 3.3-6). Good agreement was found between observed risk and PRG exceedence; the highest PRG-HQ (6.25) occurred at high risk Station DSY-27. Sediment PCB concentration at DSY-27 was 3310 ng/g dry wt, which is six-fold higher than the next highest surface sediment concentration (DSY-29). Reduced condition of indigenous mussels at DSY-27 was associated with increased tissue PCB concentration (ERA Figure 6.5-5), and possible PCB effects on for amphipod survival were noted (ERA Figure 6.4-2B), hence supporting the selection of Total PCBs as a PRG to address risks at this location.

Station DSY-29 was also a high risk area with a marginal PRG exceedence (PRG-HQ = 1.03). However, unlike Station DSY-27, PCBs effects at Station DSY-29 were not indicated in exposure-response analyses for amphipod survival (ERA Figure 6.4-2) or benthic community structure (ERA Figure 6.5-3D). Thus, there is a lack of supporting data to suggest that implementation of a PRG for PCBs is needed to address risks at Station DSY-29. Instead, risks are more likely related to other CoCs, notably Pb (see discussion above).

As with lead, PCB PRG thresholds below PRG-HQ < 2 could not be discerned which could discriminate between high and low risks, and thus adopting a PRG concentration below 1060 ng/g is not recommended, whereas adopting a RPRG at 1060 ng/g would conservatively ensure risk reduction in one of the high risk areas. While the RPRG is well above the NOAA ER-M (180 ng/g dry weight), the value is comparable to the State of Washington AET-low (1000 ng/g dry) and well below the AET-high (3100 ng/g dry) benchmarks. Thus the RPRG is within the range of independent estimates of protective threshold effects levels for aquatic biota.

o,p'-DDE. A single exceedence of the PRG value for o,p'-DDE (9.06 ng/g) was observed for Station DSY-27 (PRG-HQ = 7.2, Table A-10). Although this station is one of two high risk areas identified in the Marine ERA (Figure 3.2-1), the corresponding

TEV-HQ for this station (TEV-HQ = 0.78, Table A-5) was below the presumed threshold for aquatic risks. The CoC was retained as a L-CoC only to permit a more thorough evaluation of all sediment data available, and in doing so, facilitate the detection of any locations where this CoC might be a primary risk driver to the maximum extent possible. Given that no other location contained sediment concentrations above the PRG, it is recommended that this CoC not be retained as a PRG.

Resuspension Evaluation. The ERA concluded that there exists considerable uncertainty as to whether short term risks during resuspension events would actually occur to produce exposure concentrations equivalent to 1:4 dilution used in elutriate exposures (corresponding to g/L total suspended solids concentrations). Two scenarios which have been proposed include 1) prolonged resuspension of sediments in shallow water due to severe storm events, and 2) short-term, high scouring events caused by propellor wash from large vessels during docking maneuvers. A preliminary spatial assessment of these scenarios is presented below.

Wind and wave action during storms in addition to the prevailing current are expected to have a dominant influence on patterns of sediment resuspension. These forces are expected to be particularly important for fine grained sediments which resuspend most easily and generally contain the highest bulk concentration of contaminants. Geotechnical and hydrodynamic studies of Coddington Cove conducted as part of the ERA provide insight as to the distribution of such sediments and the background currents to which they are exposed. From the analysis of cove bathymetry (ERA Figure 3.1-2), grain size distribution (ERA Figure 4.2-5) and near-bottom deposition/erosion energies (ERA Figure 4.2-17) the area of the cove most likely to contain silt/clay (< 0.8 mm diameter) sediments available for resuspension are generally restricted in water depths less than 7m (Figure 3.3-8). This zone includes bottom sediment throughout much of southern Coddington Cove, the eastern and northern portion of the cove out to 150-200 m. Resuspension of sands is also possible due to storms and/or vessel activity, however this CoC transport pathway should be considered to be of minor concern relative to fine grained sediments because of the generally lower CoC concentrations found in sandy sediments. Hence, as a rough, worst-case approximation, sediments above RPRGs within this zone could adversely effect biota depending upon the strength and duration of the resuspension event. Given the considerable uncertainties about the delineation of this zone and nature of actual resuspension conditions (location, intensity), a more detailed study of actual resuspension events are strongly recommended if concern over resuspension is the primary motivation for remedial action.

The effect of large vessel propellor turbulence as a cause of sediment resuspension (i.e., "prop scour") has been investigated by a number of authors, most recently by Maynord (1998). This USACE study was conducted to validate earlier models developed to simulate prop scour and hence predict stability of waterway channels to erosion from ship traffic. The study found good agreement between predicted and measured bottom velocity (V_b) currents for the model:

$$V_b = (C_j * V_j * D_p)/H_p \quad (8)$$

where C_j = constant for a ducted propellor, Vj = jet velocity at surface created by a docked vessel in gear at high RPM, D_p = propellor diameter, and H_p = height of propellor shaft above bottom. For Derecktor Shipyard, worst-case conditions for prop wash would appear to exist for vessel tenders that may frequently escort larger vessels into the pier. Larger vessels, such as offshore Coast Guard vessels, are presumed to only infrequently dock or may only do so with vessel tender assistance hence, as a less likely contribution to overall resuspension in the Cove. Substituting representative characteristic of vessel tenders (C_j = 0.3, D_p = 1 m) and moderately high RPM operations (Vj = 3 m sec^{-1}), and bottom currents typical for Coddington Cove (V_b = 0.1 m sec^{-1}, ERA Figure 4.2-12B), the water depth (~H_p) at which the prop wash current is no greater than the ambient current can be determined:

$$H_p = (C_j * V_j * D_p)/V_b \quad (9)$$
$$= (0.3 * 3 * 1)/0.1$$
$$= 9 \text{ m}$$

Adding 1 m for vessel draft, this result suggests that wherever the water depth in the cove is greater than 10 m, the contribution of propellor current to the bottom flow is no greater than the ambient current.

This first order approximation is translated into a prediction of bottom area potentially affected by prop wash produced by vessel tenders (Figure 3.3-8), and accordingly, potentially the resuspension of contaminated sediments above PRGs which could adversely effect biota. The map shows the 10 m bathymetry contour; bottom areas in <10 m water depth may be subject to prop wash from vessel tenders while maneuvering deeper draft vessels. It should be noted that water depth will also limit the operational area and thus the locations where prop wash scouring might occur.

The above analysis was intended to provide a conservative, yet realistic assessment of bottom areas frequently affected by prop wash. Of course, more conservative assumptions (larger vessels, higher RPM operations) would lead to potential resuspension at greater water depth. As discussed for storm resuspension, there are large uncertainties about the delineation of this zone and nature of actual resuspension conditions (location, frequency) that might occur. Finally, as noted in the ERA, it is unlikely that the intensity of resuspension would come close to the high slurry concentration represented as by 1:4 dilution used to prepare sediments for testing the toxicity of elutriates. More detailed studies of actual prop wash events are strongly recommended if concern over resuspension is used as the primary motivation for remedial action.

Overall Assessment. Based on the above information, it is recommended that sediment concentrations of 168 μg/g and 1060 ng/g respectively be adopted for lead and Total PCBs for the resuspended sediment exposure pathway since good

correspondence was observed between areas exceeding PRGs and areas of high risk. A summary of areas exceeding the RPRG threshold is shown in Figure 3.3-7. Unlike bedded sediments, however, it is difficult to independently assess the level of protection afforded by the RPRGs since benchmarks for resuspended sediments are not available. In addition, it is unclear whether the high risk areas identified in the ERA were due to exposures from bedded or resuspended sediments, or both. It is of interest to note that based on present data, areas exceeding resuspension PRGs are a subset of the total area above the bedded PRG, such that addressing bedded risks will rectify resuspension risks as presently delineated. Finally, the likelihood of resuspension does vary spatially within the cove and is dependent on the source of resuspension energy (wave action vs. ship traffic). Information on the active intensity, frequency and duration of such events will be required to effectively implement PRGs for protection of aquatic biota based solely from resuspended CoCs.

3.3.2. Avian Predator Exposure Pathway.

For the avian predator exposure pathway, five metals (arsenic, copper, lead, silver, and zinc) and Total PCBs were identified as L-CoCs and thus are included as candidate PRGs in Table 16. Sediment-based PRGs for the metals were back-calculated using the BAF-based model (Equation 5), while for Total PCBs the BSAF model was used (Equation 6).

Metals. Among the metals, sediment concentrations of arsenic did not exceed the PRG at any location (Table A-11). Copper also exceeded the PRG at two locations (Stations DSY-2 and DSY-3; Figure 3.3-9), with PRG-HQs ranging from = 1.07 to 1.43. Zinc was above the sediment PRG at 21 stations with PRG-HQs ranging from = 1.0 to 10.4 (Figure 3.3-10). Among these two CoCs, only five stations had PRG-HQs > 2 (DSY-2, DSY-3, DSY-11, DSY-27, and DSY-29). PRGs were not exceeded for the remaining metal-related L-CoCs (lead and silver).

In the Marine ERA, generally intermediate risks to avian predators were assigned to Stations DSY-28, DSY-29, and DSY-36, while slight risks were apparent elsewhere, including reference locations (SAIC, 1997; Table 6.6-3). Although there is an apparent concordance between PRG exceedence and observed risk including areas represented by Station pairs DSY-2/DSY-28 and DSY-3/DSY-29, implementation of remedial action based on this PRG does not appear warranted given the limitation of the conservative exposure assumptions in the ERA and subsequent conclusion that CoCs in Coddington Cove do not likely pose an unacceptable risk to avian receptors (ERA Section 6.3). Thus, despite the fact that PRGs were exceeded, the avian predator would have to spend its entire life feeding in the affected area for true risks to occur. This overly conservative assumption leads to the recommendation that the PRGs for risk reduction for the avian aquatic exposure pathway metals not be adopted at this time except perhaps for purposes of monitoring to ensure continued lack of significant risks via food chain transfer from prey species to aquatic predators.

Total PCBs. PRGs for Total PCBs were exceeded at 24 stations (Table A-11; Figure 3.3-11), with PRG-HQs ranging from 1.0 (Station DSY-21) to 35.7 (Station DSY-27). Among these locations, only four stations exhibited PRG-HQs > 5 (DSY-3, DSY-11, DSY-27, and DSY-29). As noted above for metals, intermediate risks were assigned to avian predators feeding at Stations DSY-28, DSY-29, and DSY-36. The agreement between PRG exceedence and observed risk included areas represented by Station pairs DSY-28 (PRG-HQ=1.45, Table A-11A and A-11B) and particularly DSY-29 (PRG-HQ=35.9), might ordinarily suggest implementation of remedial action, but because of the conservative exposure assumptions unacceptable risk to avian receptors due to PCB exposure is unlikely.

An additional consideration for the indirect effects that PCBs might have on avian predators through reduction in the supply food from PCB-sensitive species. The maximum predicted porewater concentration of PCBs was found at Station DSY-27 (0.027 µg/L) is slightly below the USEPA WQC-SC value (0.03 µg/L), but is nearly 1500-fold lower than the measured Aroclor-1254 LC_{50} for the amphipod, *Ampelisca abdita* (40 µg/L; Ho et al., 1997) used in the ERA and found to exhibit slight toxicity when exposed to sediments from this location. Hence it is unlikely that PCBs in Derecktor Shipyard/Coddington Cove would impact avian predators through reduction in their food supply. Thus, as shown in Table 16, a PRG for Total PCBs to protect the avian predator exposure pathway is not recommended for implementation.

3.3.3. Human Health Exposure Pathway.

The L-CoCs identified for protection of risks to subsistence fishermen from consumption of shellfish were arsenic and benzo(a)pyrene (Table 16). Baseline PRGs presented in Table 16 represent threshold concentrations for protection of carcinogenic effects at 1×10^{-6} risk and non-carcinogenic risks at HQ=1. However, there is a high probability that the exposure scenario is overly conservative (a subsistent fisherman is not likely to derive all seafood exclusively from Coddington Cove for 30+ years, nor could the cove support such intensive pressure from a subsistence population). Perhaps a more plausable (yet conservative) assumption is that the shellfishing population might rely on the cove for up to 10% of the amounts noted in Table 10, such that 10 times the PRG-HQ threshold is a realistic point of departure for assumption of possible adverse health effects due to shellfish consumption. With this assumption in mind, the PRGs were evaluated below at PRG-HQ = 1 and at 10 times the PRG-HQ thresholds.

Arsenic. Arsenic was identified as a L-CoC for protection of risks to human health exposure from consumption of shellfish (Table 16). While arsenic concentrations marginally exceeded the TEV (TEV-HQ < 2, Appendix Table A-7), the corresponding PRG-HQs were all less than unity (Appendix Table A-12). This discrepancy is attributed in part to uncertainty in the BAF factor for arsenic used to calculate the sediment PRG (19.7 µg/g) from the tissue-based TEV value. However, any overlooked risk because of the BAF limitation would appear to be outweighed by

the fact that the true risk to arsenic may be overestimated by an order of magnitude since the toxic fraction (i.e., the organic component) is typically about 10% of the total arsenic content (USFDA, 1993). Further, a review of the literature regarding the methodology used to derive the TRV value (extrapolated from mice), reveals that the route of exposure evaluated was arsenic in drinking water, and since arsenic was administered in soluble form, it is likely to be far more bioavailable than arsenic bound to sediment particles. Finally, arsenic risks are unlikely to be significant as all areas of the cove had sediment concentrations well below the baseline PRG.

Based on the above data, it is recommended that an arsenic value not be selected as a Final Remediation Goal, but monitoring for organic arsenic concentrations should be performed at least once to confirm that bioavailable concentrations are below toxic levels. Revision of the PRG list could occur pending outcome of the monitoring results.

Benzo(a)pyrene. Benzo(a)pyrene was also identified as a L-CoC for protection of risks from consumption of shellfish (Table 16). The sediment-based PRG concentration at PRG-HQ=1 (53.9 ng/g dry wt) was exceeded at 34 of 41 stations (Appendix Table A-12; Figure 3.3-12). The areas with highest PRG-HQs (HQs > 10) were confined to the nearshore areas including Stations DSY-2, DSY-3, DSY-18, DSY-20, DSY-27, DSY-29, and DSY-30. Much of the area exceeding the PRG-HQ=10 threshold are not fishable due to industrial/military activity in the shipyard/cove (approximately all areas between and eastward of the piers and dock areas shown in Figure 3.3-12). Perhaps the area represented by polygons around Stations DSY-18 and DSY-30 may be fishable and PRGs could be implemented in some manner to guard against adverse risk from shellfish consumption. It is recommended that the 10 X PRG concentration (535 ng/g dry weight) be adopted given the conservative nature of the subsistence fishermen scenario, but a careful cost/benefit analysis (including more detailed delineation of the affected area) should be conducted to weigh the advantages of risk reduction against the disruptive nature of remediation.

Summary. A summary of areas exceeding the RPRG for benzo(a)pyrene (539 ng/g dry weight) threshold is shown in Figure 3.3-13. Based on present data, it is unlikely that the shellfishing population is substantially at risk since fishable areas above RPRG concentrations are limited and would not be expected to support a subsistence fishing population. However, it would seem reasonable to monitor for this CoC to confirm that harvested shellfish remain below toxic levels.

4. Conclusions/Recommendations

The PRG development strategy for the Derecktor Shipyard/ Coddington Cove study area was developed in a manner consistent with site ARARs and has identified RPRGs that are consistent with the findings of the risk assessments. The magnitudes of the PRGs are generally comparable to correlative benchmarks which increases the

certainty that minimal residual risk associated with the CoCs will remain when the PRGs are implemented.

The RPRG concentrations identified in Table 16 for aquatic, avian, and human health exposure pathway are listed for consideration as Final Remediation Goals (pending further evaluation in the FS). These values may differ from concentrations assumed to represent the baseline risk condition (i.e., PRG-HQ=1) because of the need to ensure that the PRG implementation leads to effective and practical risk reduction; selecting all PRGs or remediating to baseline concentrations would affect nearly all of Coddington Cove (light and densely shaded areas of Figure 3.3-14; Table A-13), and thus does not appear to provide an optimal balance between the degree of risk reduction achieved and potential environmental impacts that would occur on adjacent areas during the remediation process. In contrast, the RPRG concentrations are based on interpretation of the data in light of observed distribution and severity of estimated risks at the site; high and some intermediate risk areas are addressed (densely shaded areas noted B or R in Figure 3.3-14), while simultaneously, a number of areas above RPRG concentrations for human health are also included (densely shaded areas noted H in Figure 3.3-14). Other considerations presented in FS report regarding cost and engineering constraints may also modify the Final Remediation Goals to be adopted by risk managers.

Depending on the nature of the remedial action, a PRG list based on a combined pathway analysis may be suitable. It is acknowledged that the spatial resolution of the analysis depends on the density of stations within the study area. Some areas which might require remedial action may presently be depicted larger than they actually are, and thus will require confirmation sampling during the pre-design investigation in order to reduce uncertainty and to better define the extent of the areas to be remediated.

5. Literature Cited

Barrick, R., S. Becker, L. Brown, H. Beller, and R. Pastorok, 1988. *Sediment quality values refinement: 1988 update and evaluation of Puget Sound AET*. Vol. 1. Prepared for the Puget Sound Estuary Program, Office of Puget Sound.

Berry, W.J., D.J. Hansen, J.D. Mahoney, D.L. Robson, D.M. Di Toro, B.P. Shipley, B. Rogers, J.M. Corbin, and W.S. Boothman, 1996. Predicting the toxicity of metal-spiked laboratory sediments using acid-volatile sulfide and interstitial water normalizations. *Environmental Toxicology and Chemistry*. 15:2067-2079.

Di Toro, D. M., C. S. Zarba, D. J. Hansen, W. J. Berry, R. C. Schwartz, C. E. Cowan, S. P. Pavlou, H. E. Allen, N. A. Thomas and P. R. Paquin, 1991. Technical basis for establishing sediment quality criteria for non-ionic organic chemicals using equilibrium partitioning. *Environmental Toxicology and Chemistry*. 10:1541-1586.

Efroymson, R.A., G.W. Suter II, B.E. Sample, and D.S. Jones, 1996. *Preliminary Remediation Goals for Ecological Endpoints*. Prepared by Environmental Restoration Risk Assessment Program, Lockheed Martin Energy Systems, Inc., Oak Ridge National Laboratory, Tennessee. Prepared for U.S. Department of Energy, Office of Environmental Management. Rept. ES/ER/TM-162/R1.

Environmental Sciences Research Institute (ESRI), 1989. Triangulated irregular networks. ARC/Info User's manual. Redlands, CA.

Ferraro, S. P., H. Lee II, R. J. Ozretich, and D. T. Specht, 1990. Predicting Bioaccumulation Potential: A Test of a Fugacity-Based Model. *Archives of Environmental Contamination and Toxicology*. 19: 386-394.

Ford, K., F. Appleluns, and R. Ober, 1992. *Development of Toxicity Reference Values for Terrestrial Wildlife*. Presented at 1992 Superfund Conference.

Hansen, D.J., W.J. Berry, J.D. Mahony, W.S. Boothman, D.M. Di Toro, D.L. Robson, G.T. Ankley, D. Ma, Q. Yan, and C.E. Pesch, 1996. Predicting the toxicity of metal contaminated field sediments using interstitial concentrations of metals and acid-volatile sulfide normalizations. Environ. Toxicol. Chem. 15(12):2080-2094.

Ho, K.T., R.A. McKinney, A. Kuhn, M.C. Pelletier, and R.M. Burgess, 1997. Identification of acute toxicants in New Bedford Harbor sediments. *Environmental Toxicology and Chemistry*. 16:551-558.

Karickhoff, S.W., L.A. Carreira, C. Melton, V.K. McDaniel, A.N. Vellino, and D.E. Nate,

1989. Computer prediction of chemical reactivity. The ultimate SAR. USEPA 600/M-89-017. U.S. Environmental Protection Agency, Athens, GA.

Karickhoff, S. W. and J. M. Long, 1995. Summary of measured, calculated and recommended log Kow values. Office of Water, U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, GA.

Long, E. R. and L. G. Morgan, 1990. The Potential for Biological Effects of Sediment-Sorbed Contaminants tested in the National Status and Trends Program. NOS OMA 52. National Oceanic and Atmospheric Administration.

Long, E. R., D. D MacDonald, S. L. Smith and F. D. Calder, 1995. Incidence of Adverse Biological Effects Within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environmental Management Vol. 19, (1), pp 81-97.

Maynord, S.T., 1998. Bottom shear stress from propellor jets. *In*: Ports '98, pp. 1074-1083.

Ott, R. Lyman, 1993. *An Introduction to Statistical Methods and Data Analysis, Fourth Edition*. Duxbury Press, Belmont, CA.

Quinn, J. G., J. W. King, R. W. Cains, P. F. Gangemi, and T. L. Wade, 1994. Chemical contaminants in marine sediments from the former Derecktor Shipyard site at Coddington Cove, Newport, RI, Phase II. Draft Final Report to the Naval Education and Training Center, Newport RI., 133 pp.

Rupp, E.M., F.L. Miller, and C.F. Baes, III. 1980. Some Results of Recent Surveys of Fish and Shellfish Consumption by Age and Region of U.S. Residents. *Health Physics*. 39:165-174.

SAIC, 1996. Allen Harbor Landfill and Calf Pasture Point Offshore Ecological Risk Assessment Report: Technical Report and Appendices A-D. SAIC Report to EA Engineering under U.S. Navy Northern Division Contract No. N624-92-D-1296, Contract Task Order 0032.

SAIC and URI, 1997a. McAllister Point Landfill Ecological Risk Assessment Report: Technical Report and Appendices A-D. SAIC and URI Report to Brown and Root Environmental under U.S. Navy Northern Division Contract No. N624-92-D-1296, Contract Task Order 197.

SAIC and URI, 1997b. Derecktor Shipyard Marine Ecological Risk Assessment Report: Technical Report and Appendices A-E. SAIC and URI Report to Brown and Root Environmental under U.S. Navy Northern Division Contract No. N624-92-D-1296, Contract Task Order 197.

Shepard, B.K., 1998. Tissue screening concentrations for use in assessing ecological risks of chemical residues in aquatic biota. Second SETAC World Congress, November 1995. p 99.

Swartz, R.C., D.W. Schults, R.J. Ozretich, J.O. Lamberson, F.A. Cole, T.H. DeWitt, M.S. Redmond, and S.P. Ferraro, 1995. ∑PAH: A model to predict the toxicity of polynuclear aromatic hydrocarbon mixtures in field-collected sediments. *Environmental Toxicology and Chemistry.* 11:1977-1987.

Tetra Tech NUS, 1998. *Human Health Risk Assessment for Off Shore Areas of the Former Robert E. Derecktor Shipyard, Naval Education and Training Center, Newport, Rhode Island, Draft.* Prepared for Northern Division Naval Facilities Engineering Command, Contract Number N62472-90-D-1298, March.

TRC Environmental Corporation, 1994. Draft Final Volume I, McAllister Point Landfill, Remedial Investigation Report, Naval Education and Training Center, Newport, RI. Prepared for Northern Division, Naval Facilities Engineering Command.

USEPA (United States Environmental Protection Agency), 1986. Guidelines for carcinogen risk assessment. *Fed. Reg.* 51: 33992–34003. September 24.

USEPA (United States Environmental Protection Agency), 1989a. *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A) (Interim Final).* Report No. USEPA/540/1-89/002. USEPA Office of Emergency and Remedial Response, Washington, DC. December.

USEPA (United States Environmental Protection Agency), 1989b. *Supplemental Risk Assessment Guidance for the Superfund Program.* Report. No. US93EPA/901/5-89-001. USEPA Region I Risk Assessment Work Group, Boston, Massachusetts.

USEPA (United States Environmental Protection Agency), 1991a. Risk Assessment Guidance for Superfund: Volume 1 - Human Health Evaluation Manual. Part B, Development of Risk-based Preliminary Remediation Goals.

USEPA (United States Environmental Protection Agency), 1991b. *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B) (Interim).* Publication 9285.7-01B. USEPA Office of Emergency and Remedial Response, Washington, DC. December

USEPA (United States Environmental Protection Agency), 1993a. Sediment Quality Criteria for the Protection of Benthic Organisms: Acenaphthene (Draft). USEPA-822-R-93-013.

USEPA (United States Environmental Protection Agency), 1993b. Sediment Quality Criteria for the Protection of Benthic Organisms: Fluoranthene (Draft). USEPA-822-R-93-012.

USEPA (United States Environmental Protection Agency), 1993c. Sediment Quality Criteria for the Protection of Benthic Organisms: Phenanthrene (Draft). USEPA-822-R-93-014.

USEPA (United States Environmental Protection Agency), 1993d. *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons*. Report. No. USEPA/600/R-93/089. USEPA Office of Research and Development, Washington, DC. July.

USEPA (United States Environmental Protection Agency), 1993e. Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure. Preliminary Review Draft May 5.

USEPA (United States Environmental Protection Agency), 1994a. Methods for Assessing the Toxicity of Sediment-associated Contaminants with Estuarine and Marine Amphipods. USEPA/600/R-94/025.

USEPA (United States Environmental Protection Agency), 1994b. *Risk Updates*, Number 2. USEPA Region I, Waste Management Division, Boston. August.

USEPA (United States Environmental Protection Agency), 1996a. The National Sediment Quality Survey: A report to Congress on the extent and severity of sediment contamination in the surface waters of the United States. Office of Science and Technology, USEPA-823-D-96-002.

USEPA (United States Environmental Protection Agency), 1996b. *PCBs: Cancer Dose-Response assessment and Application to environmental Mixtures.* Report. No. USEPA/600/P-96/001A. USEPA Office of Research and Development, Washington, DC. January.

USEPA (United States Environmental Protection Agency), 1997. IRIS (Integrated Risk Information System) online database maintained in Toxicology Data Network (TOXNET) by the National Library of Medicine, Bethesda, Maryland. USEPA Environmental Criteria and Assessment Office, Cincinnati, Ohio.

USFDA (United States Food and Drug Administration), 1993. Guidance Document for arsenic in shellfish. Center for Food Safety and Applied Nutrition, USFDA, Washington DC. 44 pp.

Weisberg, S.B., J.B. Frithsen, A.F. Holland, J.F. Paul, K.J. Scott, J.K. Summers, H.T. Wilson, R. Valente, D.G. Heimbuch, J. Gerritsen, S.C. Schimmel, and R.W.

Latimer, 1993. EMAP-Estuaries Virginian Province Demonstration Project Report. USEPA/620/R-93/006.

Wentsel, R.S., R.T. Checkai, T.W. LaPoint, M. Simini, and D. Ludwig, 1994. *Procedural Guidelines for Ecological Risk Assessments at U.S. Army Sites, Volume 1.* Edgewood Research, Development and Engineering Center, U.S. Army Chemical and Biological Defense Command, Aberdeen Proving Ground, Maryland.

Figure 2.2-1. Water quality screening value selection process and associated data qualifiers.

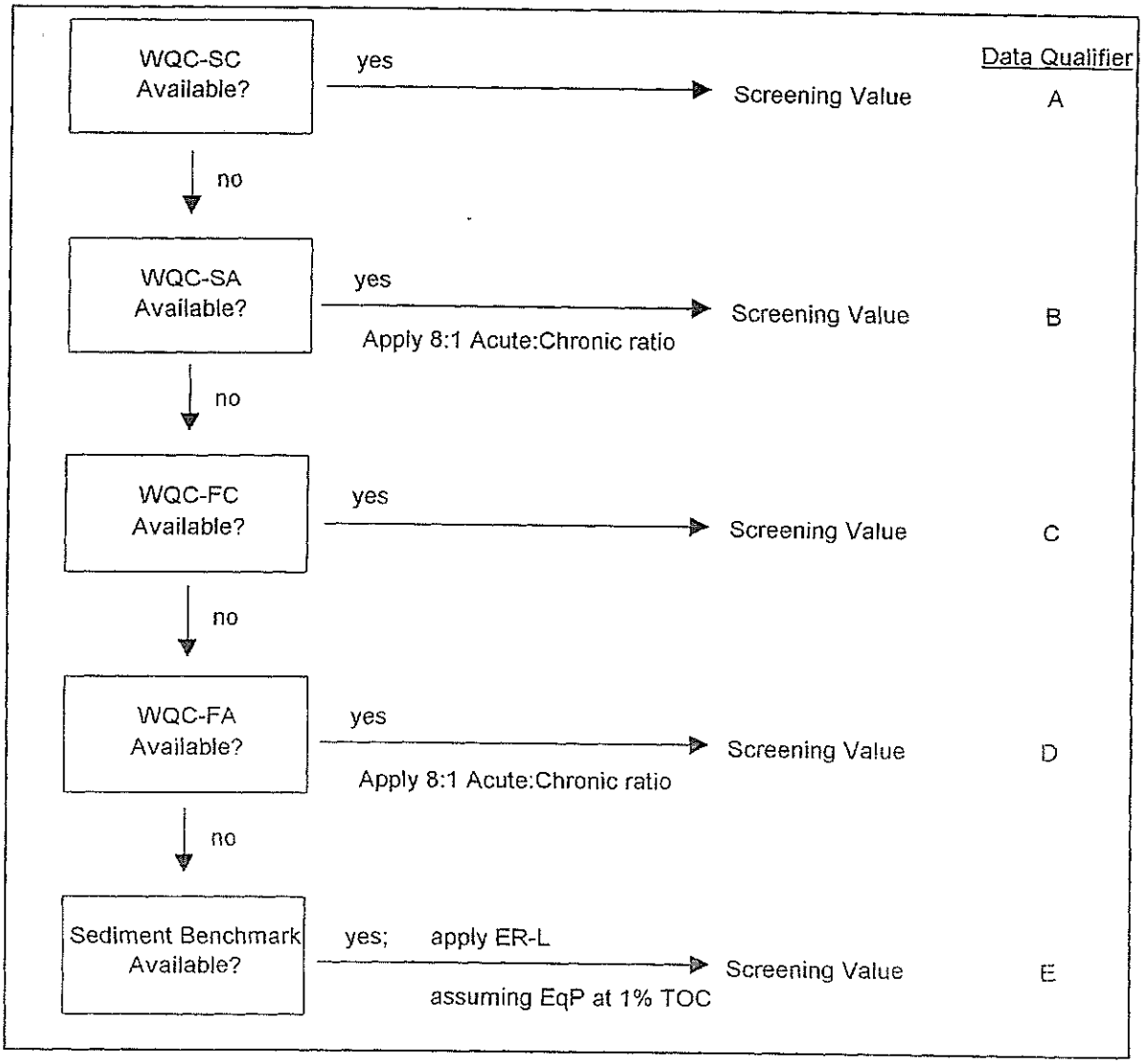


Figure 3.2-1. Thiessen polygons for PRG implementation for the Derecktor Shipyard/ Coddington Cove study area.

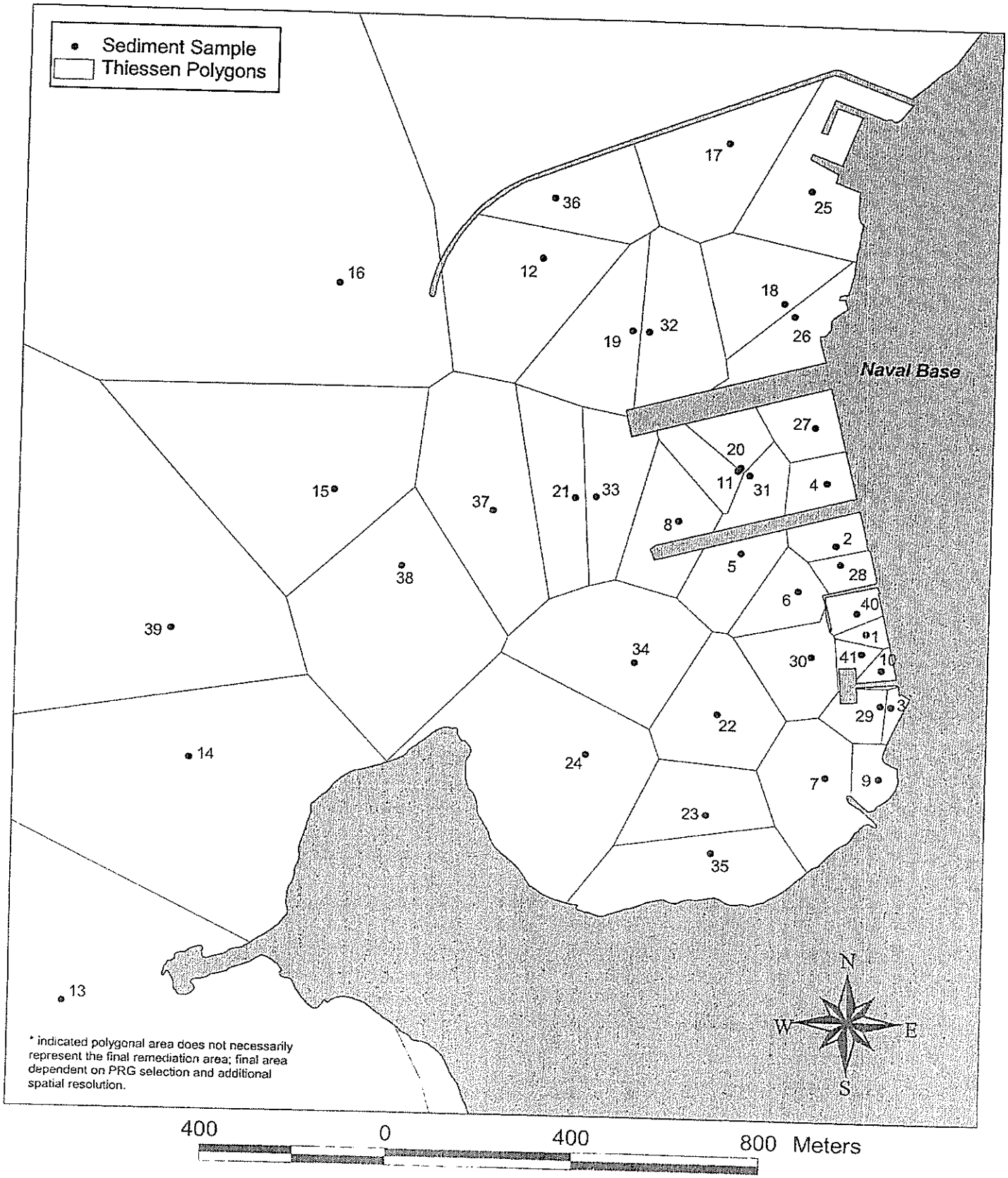


Figure 3.2-2. Risk probability for the Derecktor Shipyard/Coddington Cove study area.

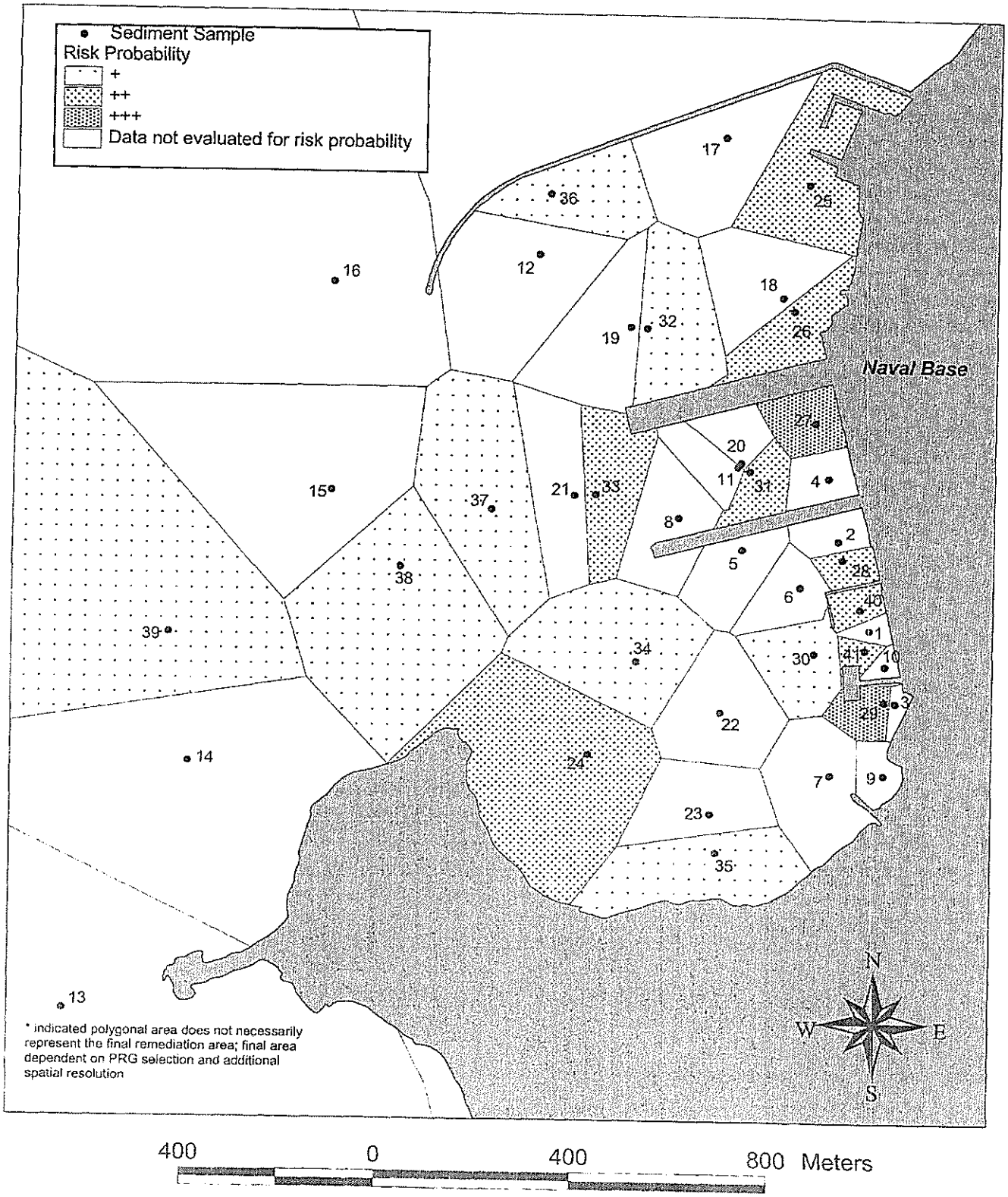


Figure 3.3-1. Summary of CoCs exceeding PRGs for protection of aquatic biota by location for sediments in the Derecktor Shipyard/Coddington Cove study area:*

Bedded Sediment Exposure Pathway for HMW PAHs

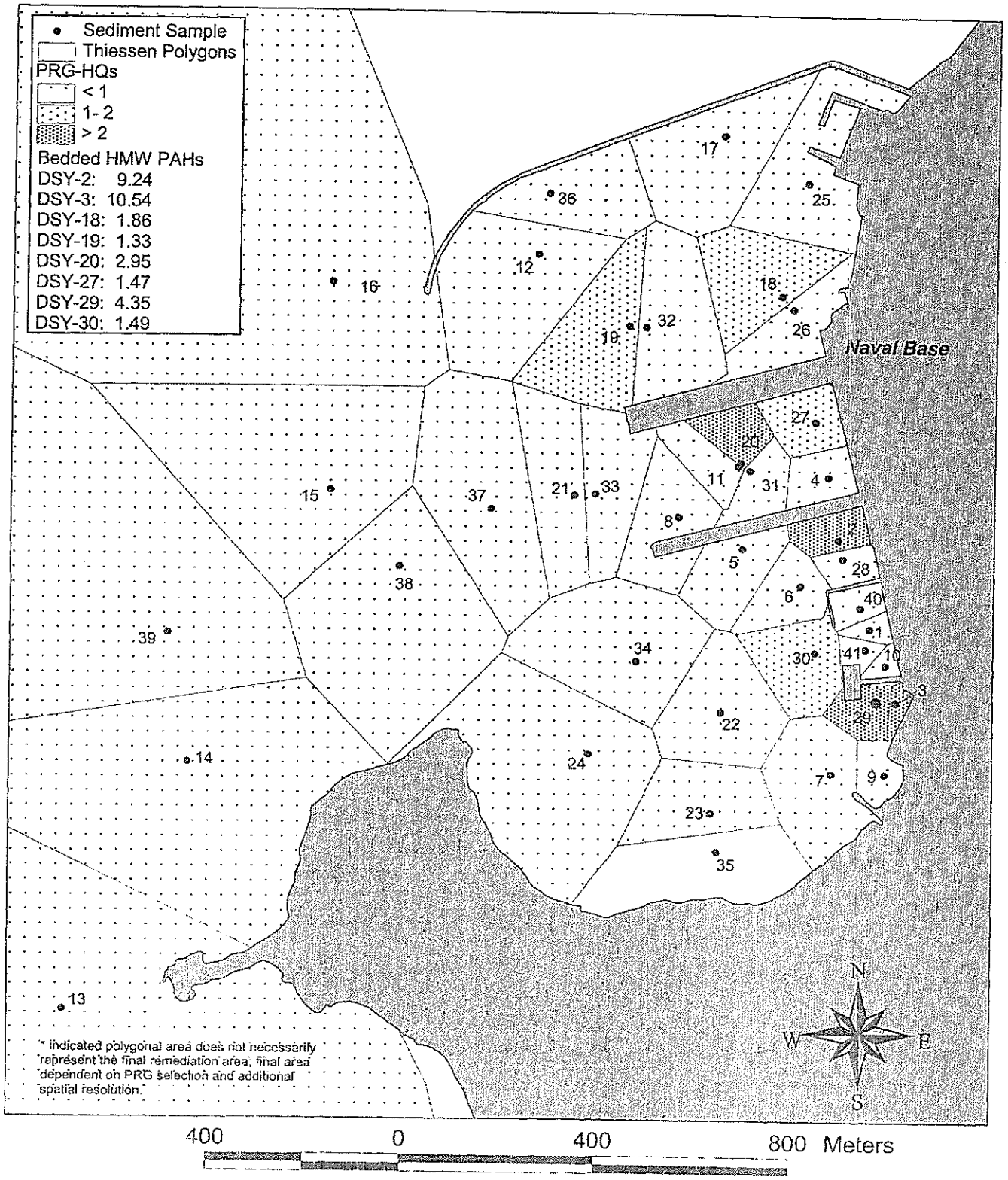


Figure 3.3-2. Summary of CoCs exceeding PRGs for protection of aquatic biota by location for sediments from the Derecktor Shipyard/Coddington Cove study area:*

Bedded Sediment Exposure Pathway for Total PCBs

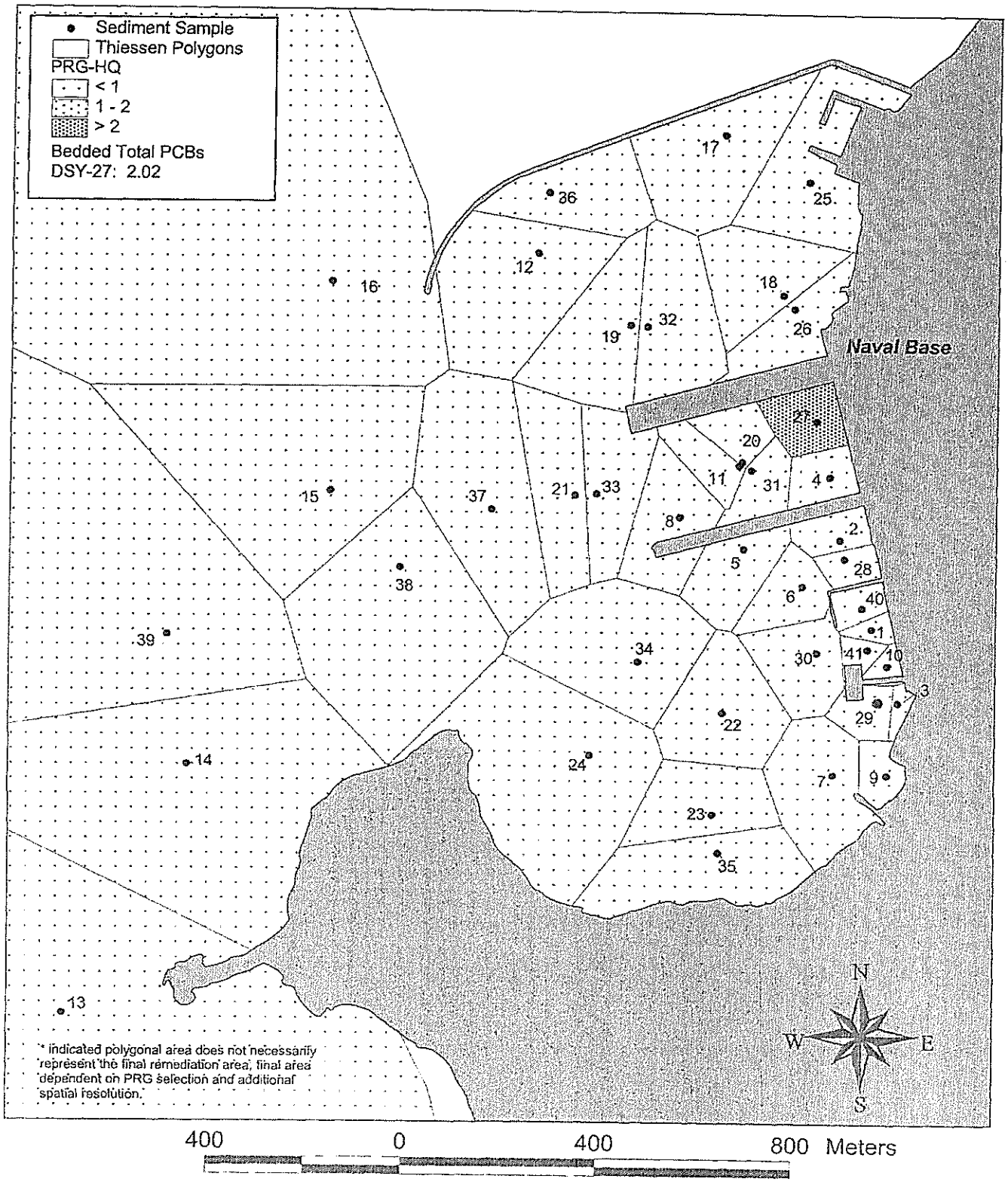


Figure 3.3-3. Summary of CoCs exceeding aquatic PRGs by location for sediments from the Derecktor Shipyard/Coddington Cove study area:*

Recommended PRG Implementation for the Bedded Sediment Exposure Pathway

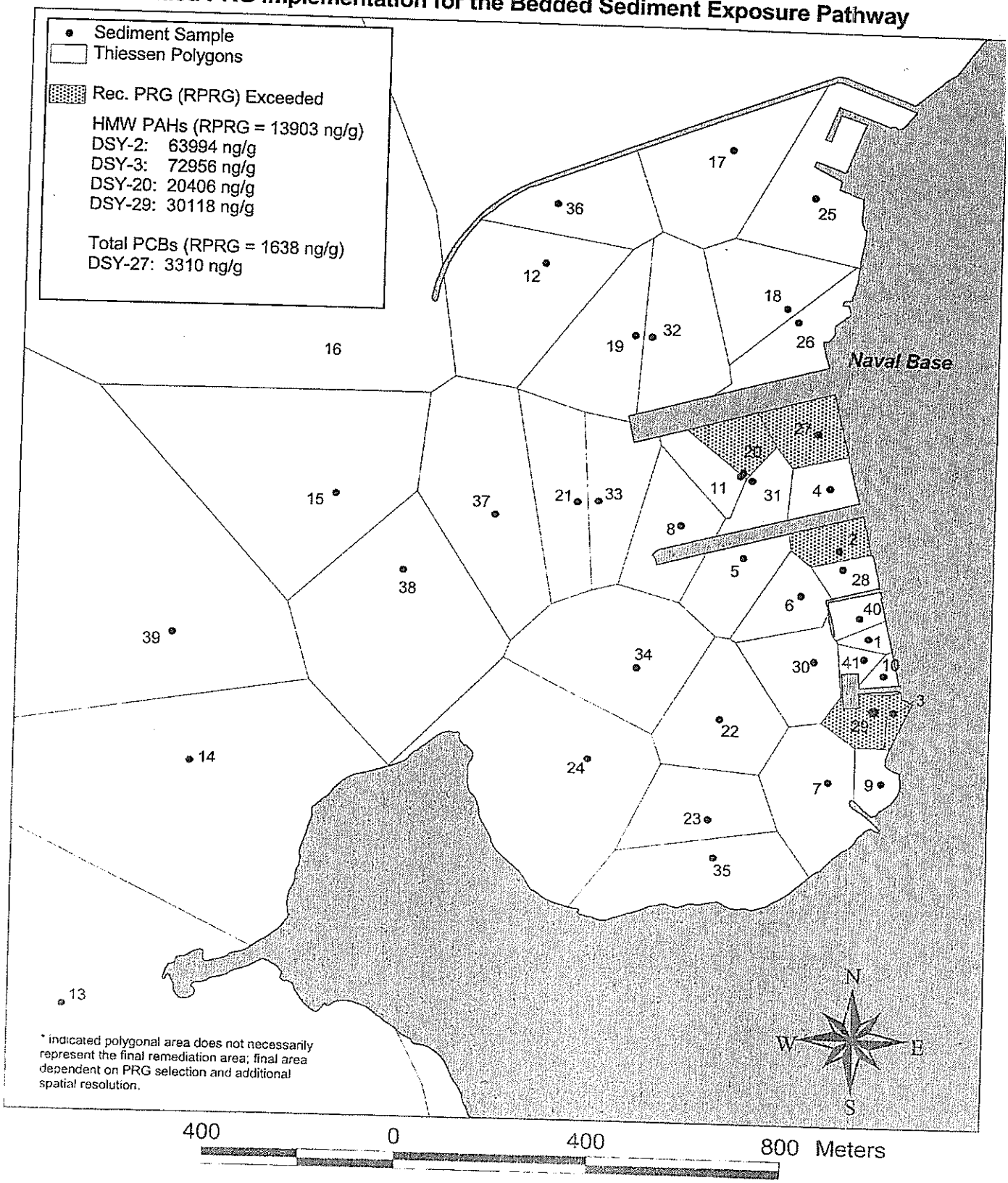


Figure 3.3-4. Summary of CoCs exceeding PRGs for protection of aquatic biota by location for sediments from the Derecktor Shipyard/Coddington Cove study area:*

Resuspended Sediment Exposure Pathway for Copper

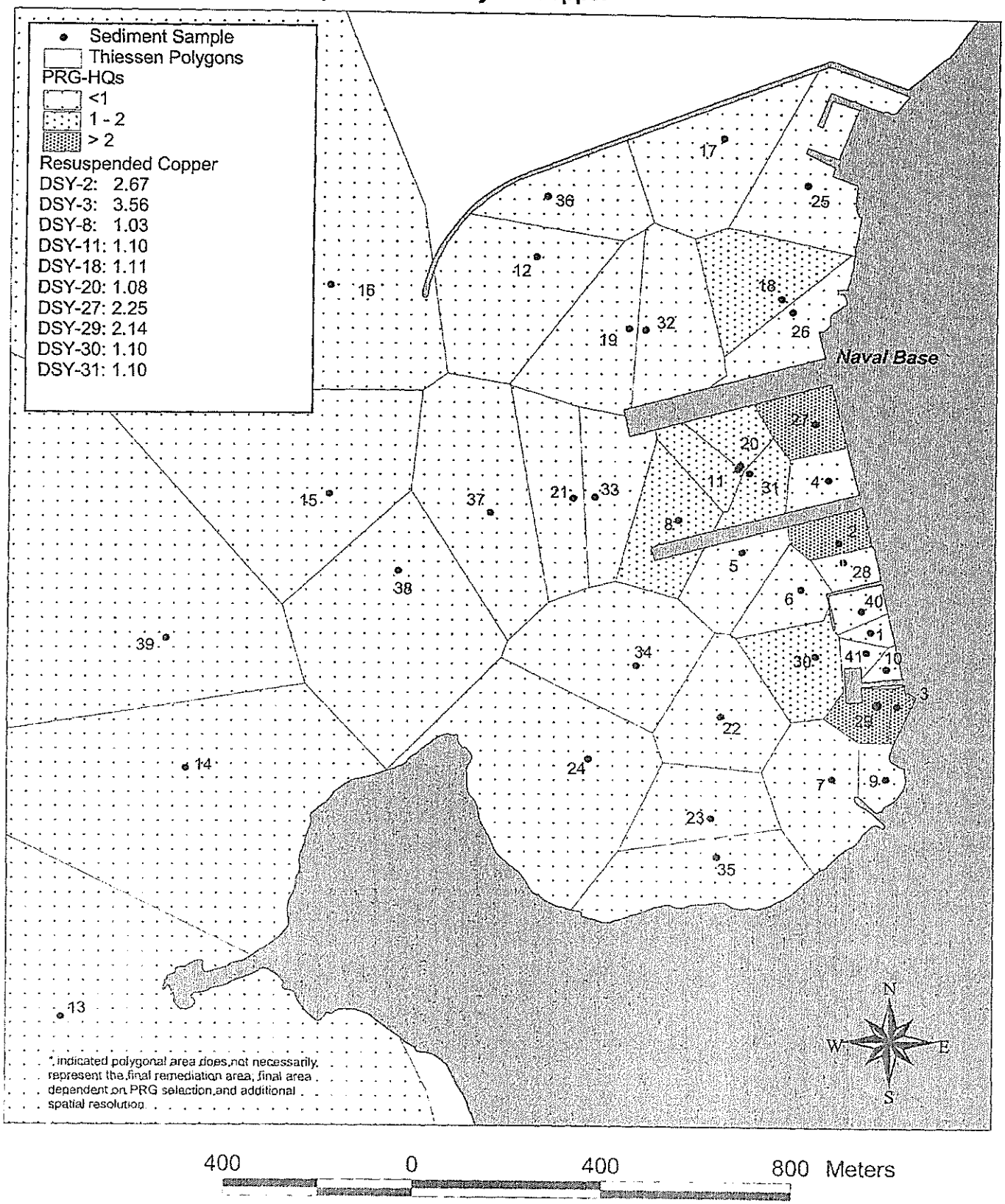


Figure 3.3-5. Summary of CoCs exceeding PRGs for protection of aquatic biota by location for sediments from the Derecktor Shipyard/Coddington Cove study area:*

Resuspended Sediment Exposure Pathway for Lead

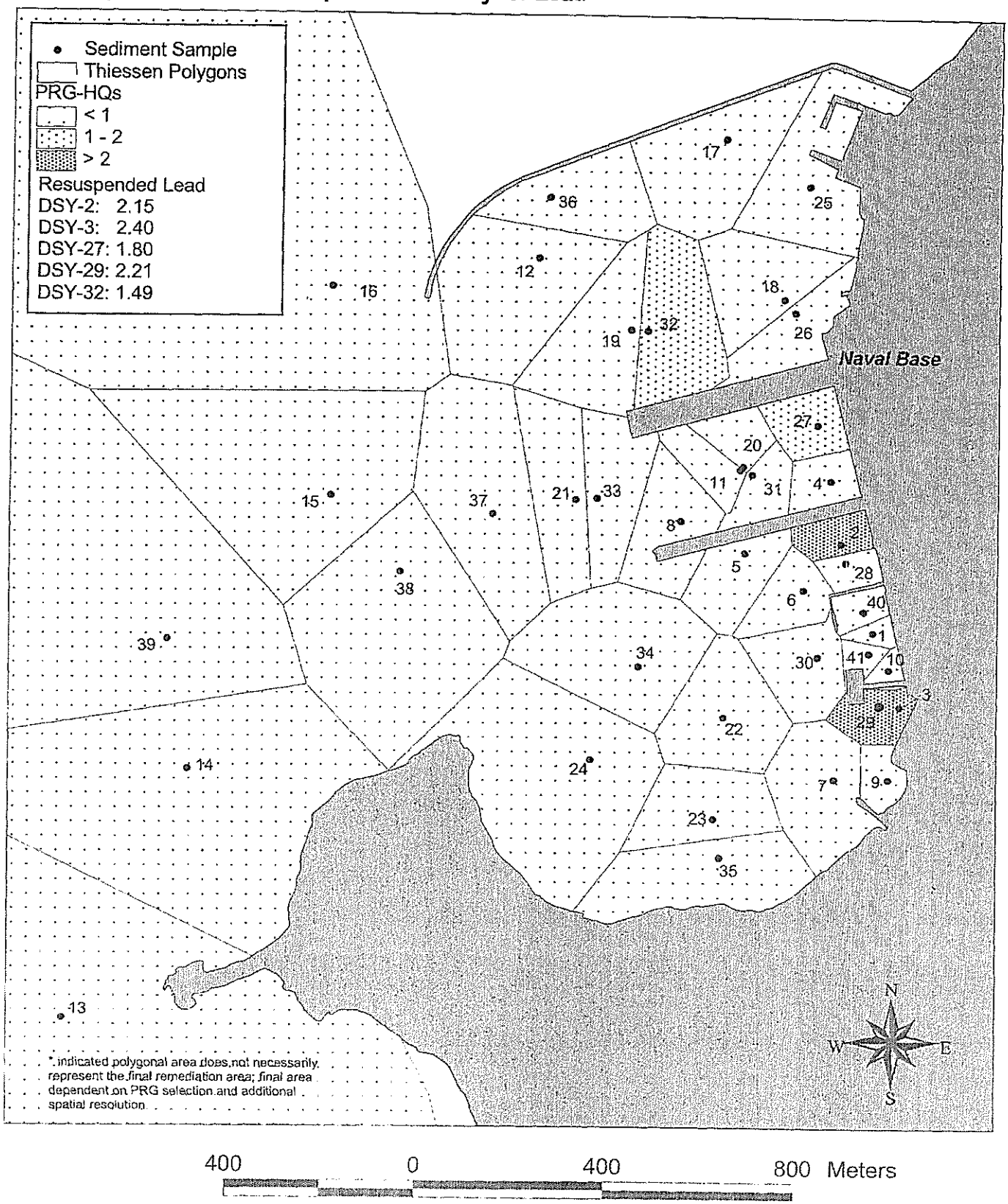
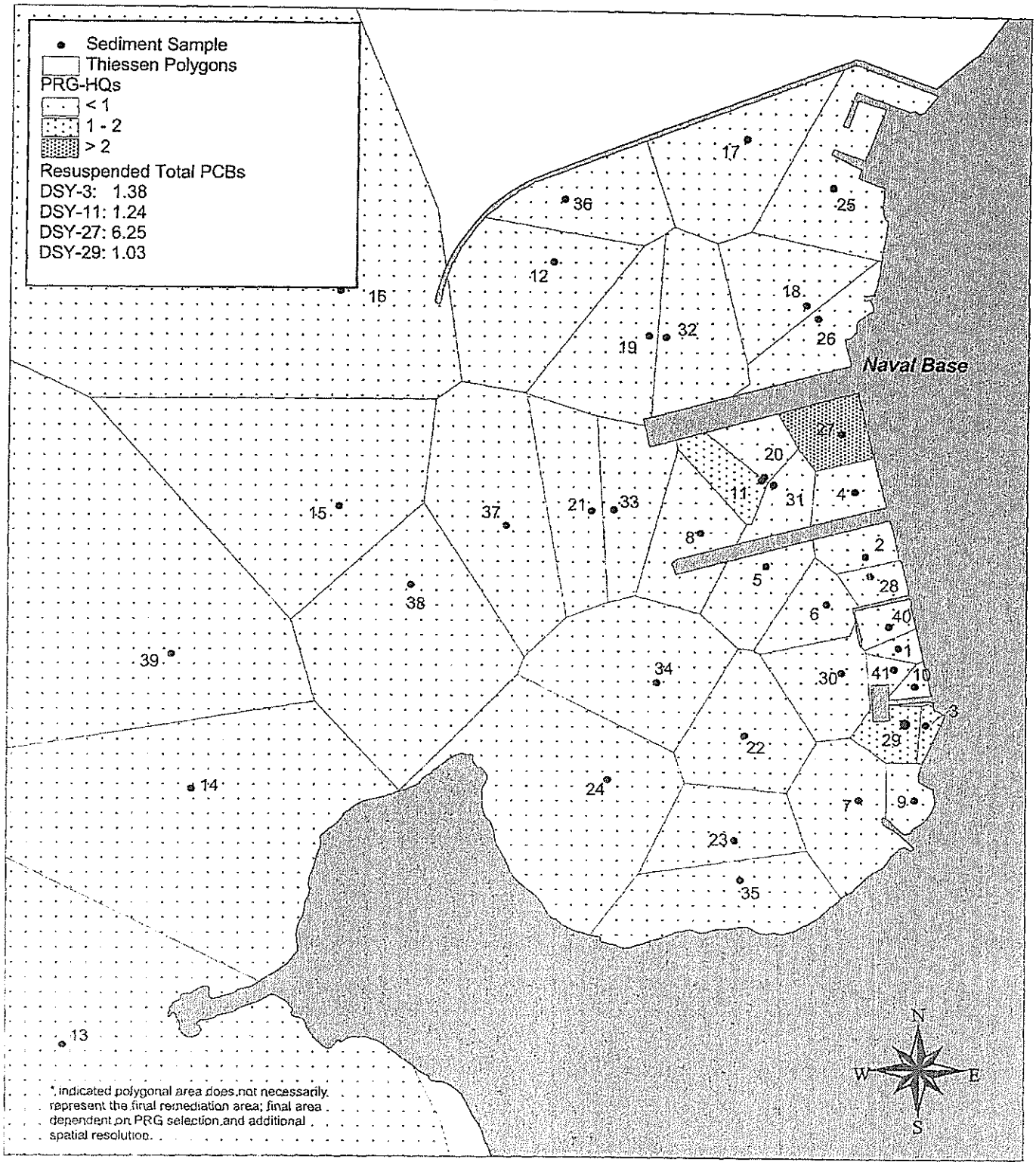


Figure 3.3-6. Summary of CoCs exceeding PRGs for protection of aquatic biota by location for sediments from the Derecktor Shipyard/Coddington Cove study area:*

Resuspended Sediment Exposure Pathway for Total PCBs



400 0 400 800 Meters

Figure 3.3-7. Summary of CoCs exceeding aquatic PRGs by location for sediments from the Derecktor Shipyard/Coddington Cove study area:*

Recommended PRG Implementation for the Resuspended Sediment Exposure Pathway

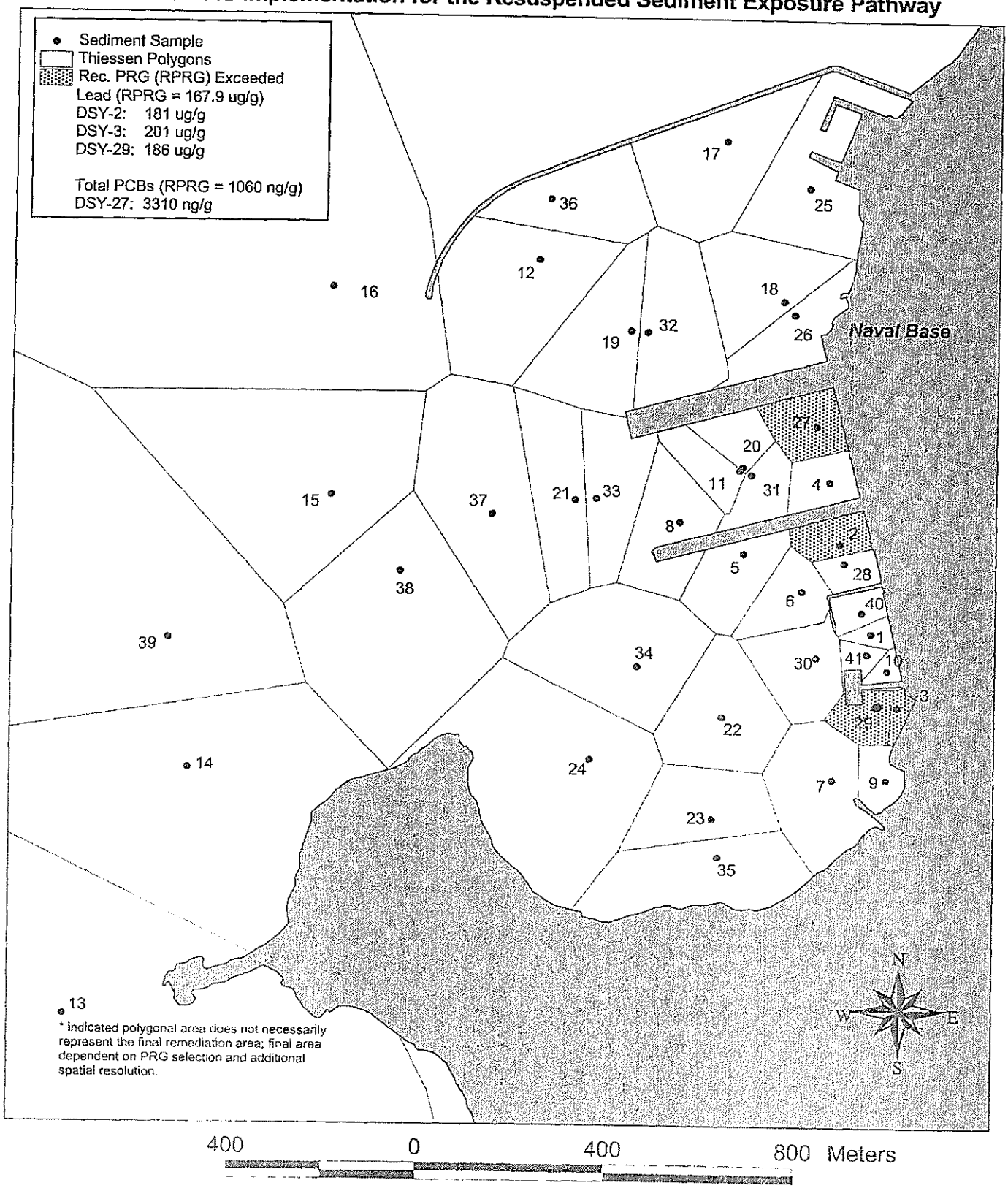


Figure 3.3-8. Bathymetry of Coddington Cove, NETC Newport, RI and the inferred zone of potential sediment resuspension.

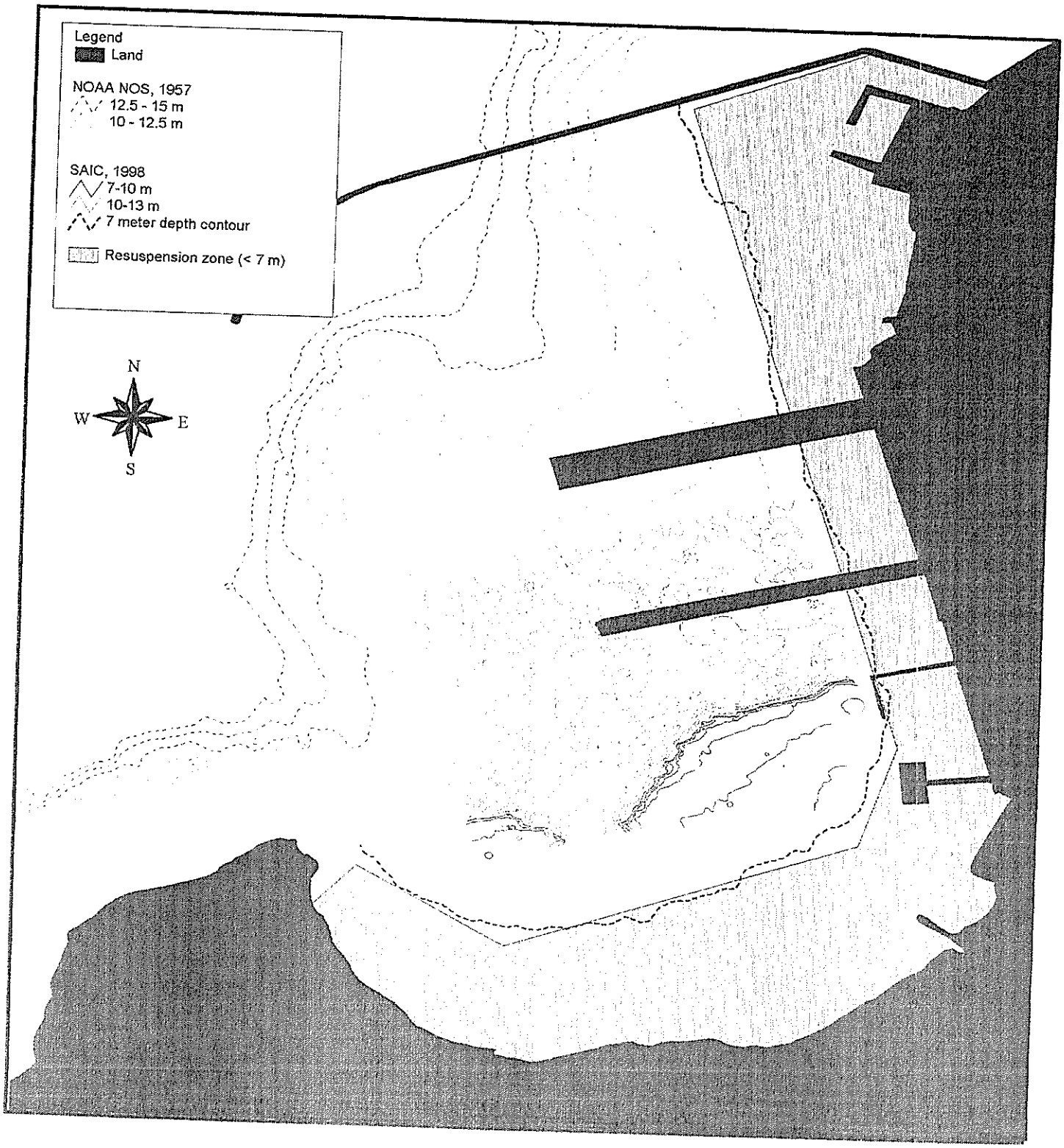


Figure 3.3-9. Summary of CoCs exceeding PRGs for protection of avian predators by location for sediments from the Derecktor Shipyard/Coddington Cove study area:*

Avian Predator Exposure Pathway for Copper

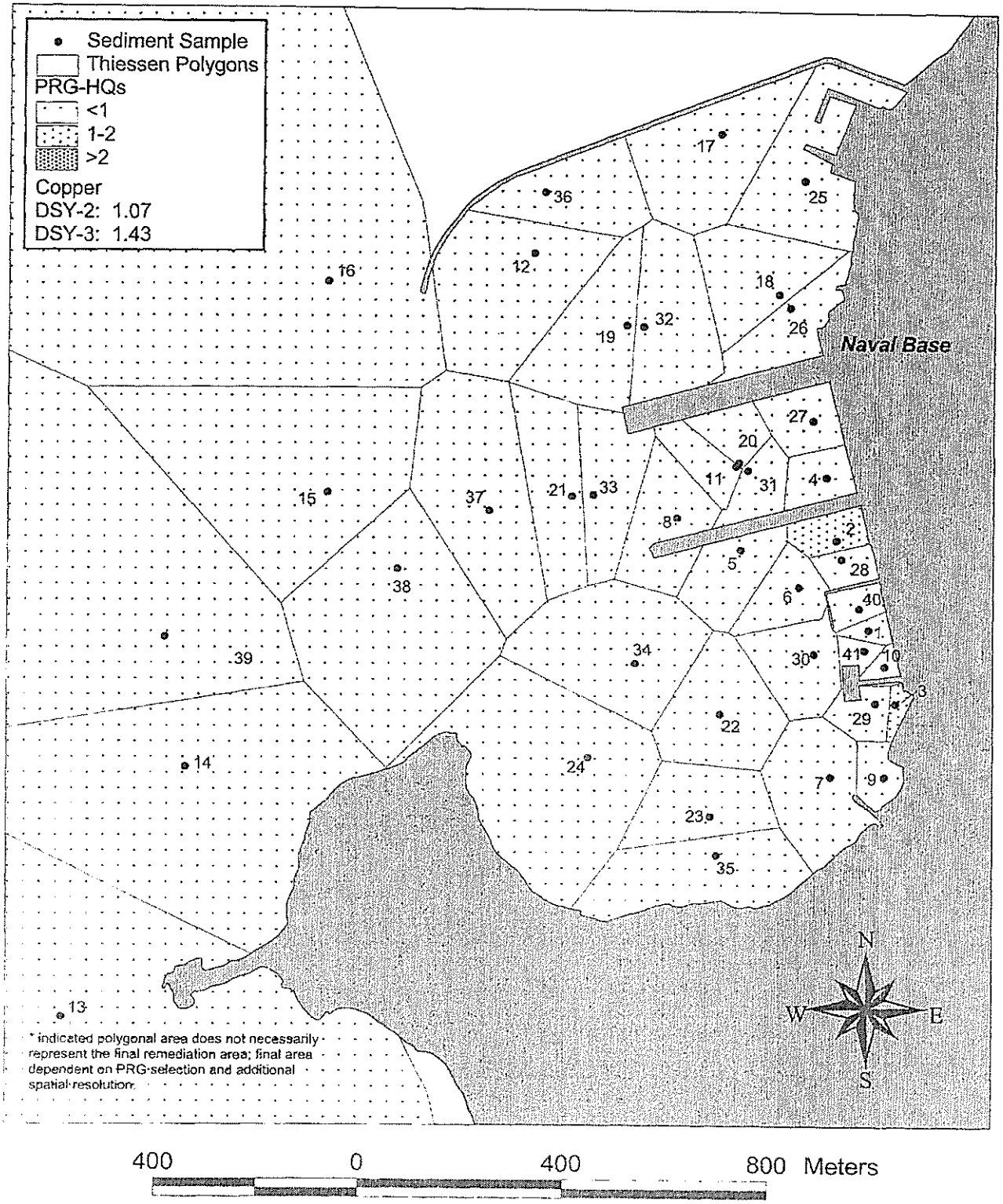


Figure 3.3-10. Summary of CoCs exceeding PRGs for protection of avian predators by location for sediments from the Derecktor Shipyard/Coddington Cove study area:*

Avian Predator Exposure Pathway for Zinc

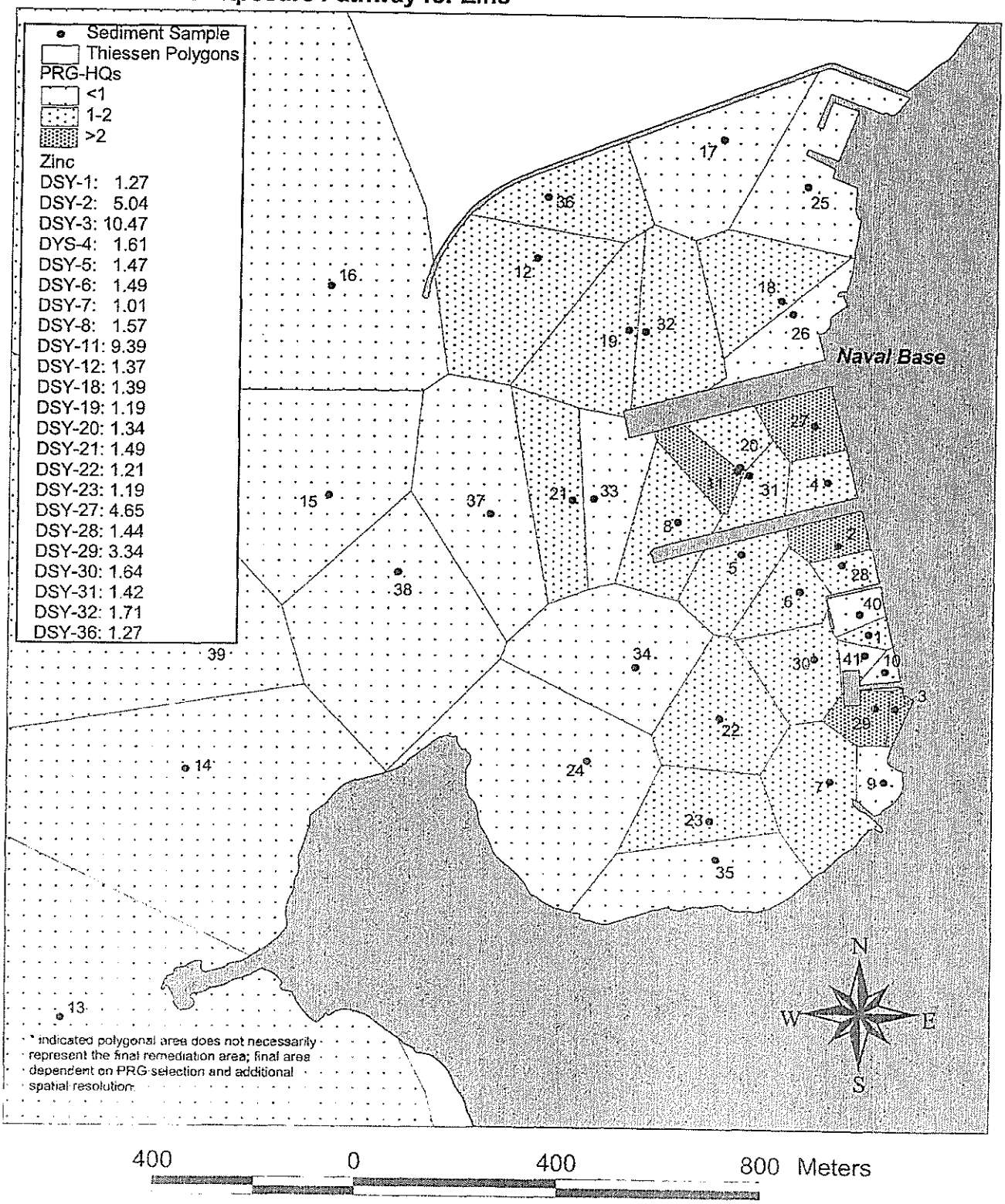


Figure 3.3-11. Summary of CoCs exceeding PRGs for protection of avian predators by location for sediments from the Derecktor Shipyard/Coddington Cove study area:*

Avian Predator Exposure Pathway for Total PCBs

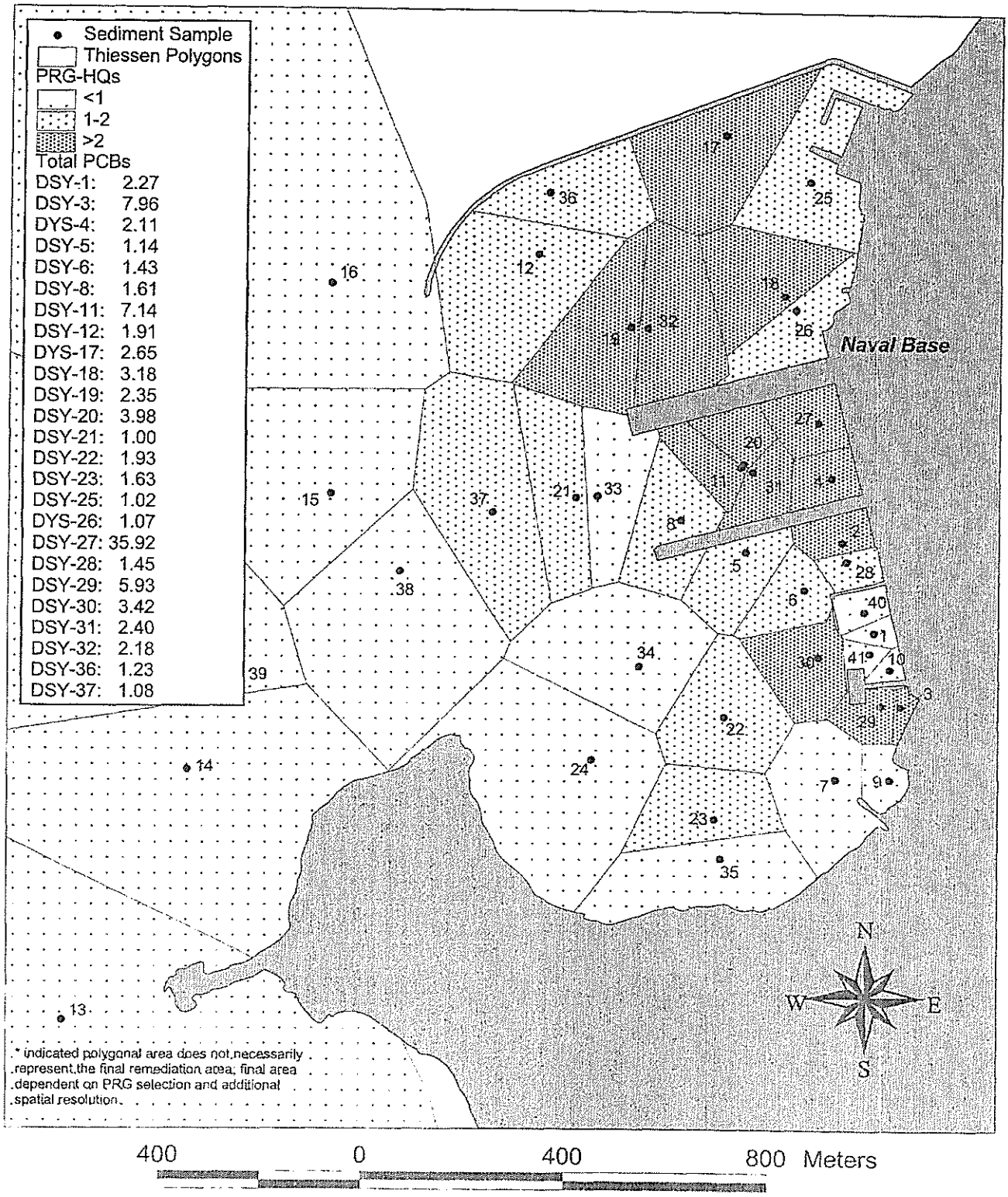


Figure 3.3-12. Summary of CoCs exceeding PRGs for protection of human health by location for sediments from the Derecktor Shipyard/Coddington Cove study area:*

Human Health Exposure Pathway for Benzo(a)pyrene

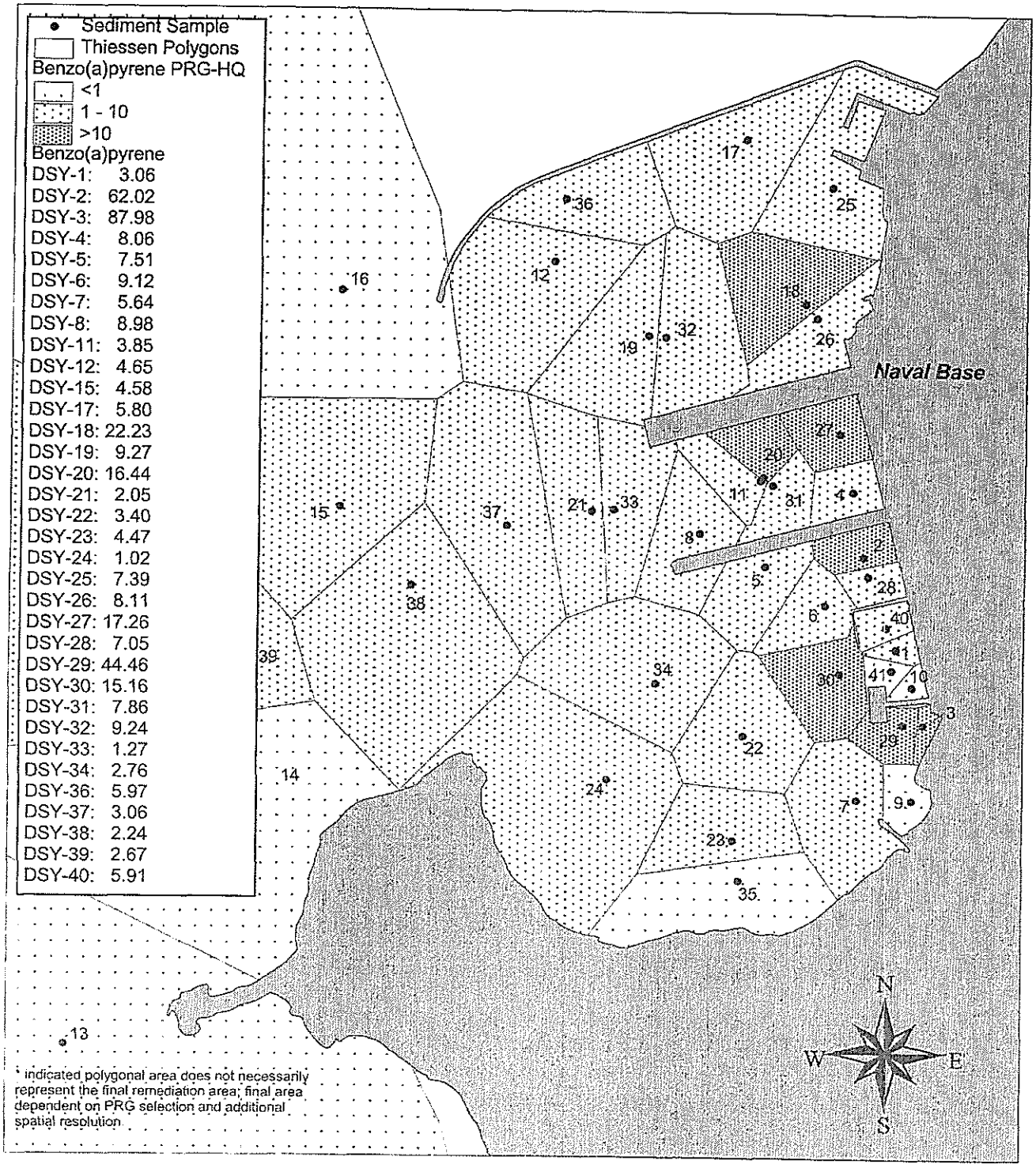


Figure 3.3-13. Summary of CoCs exceeding human health PRGs by location for sediments from the Derecktor Shipyard/Coddington Cove study area:*

Recommended PRG Implementation for the Human Health Exposure Pathway

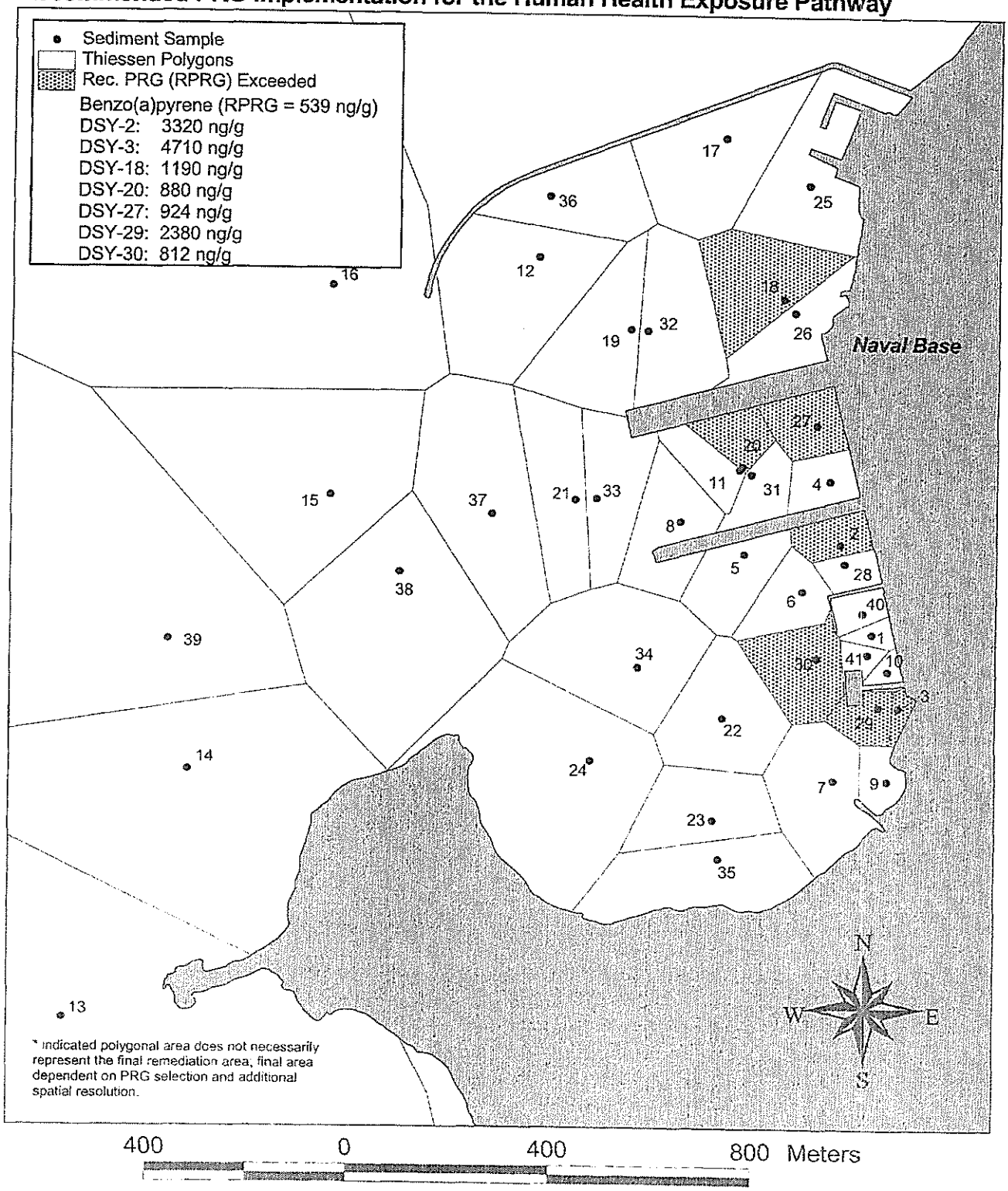


Figure 3.3-14. Summary of PRG exceedences by pathway for Derecktor Shipyard/Coddington Cove study area.

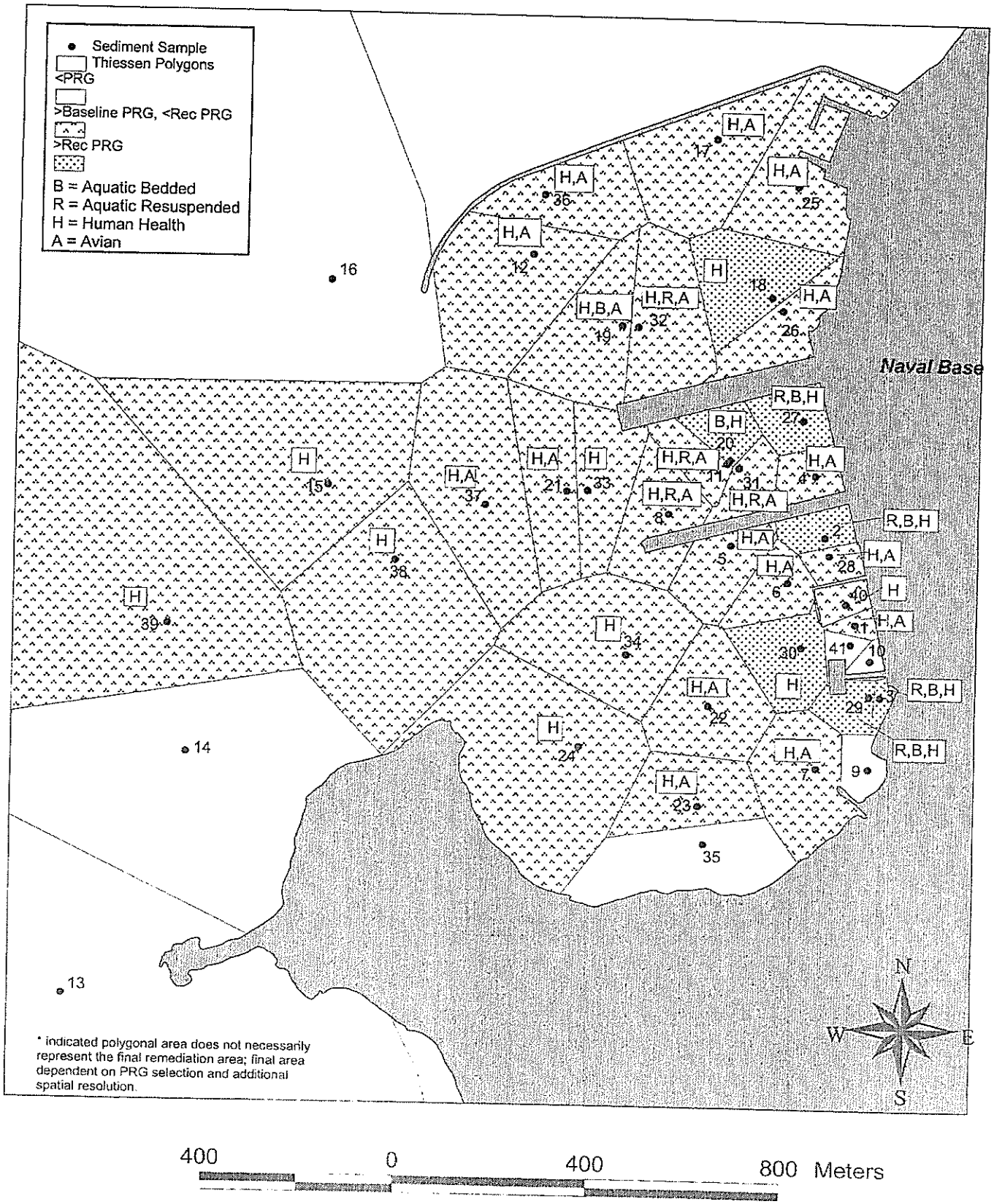


Table 1. Potential Remedial Action Objectives for the Derecktor Shipyard/ Coddington Cove study area.

Media/Receptor	Remedial Action Objectives (RAOs)
Aquatic Organisms	• Prevent exposure of aquatic organisms to bedded (in place) sediments with CoC concentrations exceeding the recommended PRGs. • Prevent exposure of aquatic organisms to sediments with CoC concentrations exceeding the recommended PRGs and that are present within areas where resuspension could occur.
Avian	• Prevent exposure of avian predators to shellfish that are impacted by sediments with CoC concentrations exceeding the selected PRGs and are within areas where shellfish predation could regularly occur.
Human Health	• Prevent human ingestion of shellfish that are impacted by sediments with CoC concentrations exceeding the selected PRGs, and are within areas where shellfishing could regularly occur.

Table 2. Chemical-specific ARARs for the Derecktor Shipyard/Coddington Cove study area.

MEDIA	REQUIREMENT	STATUS	SYNOPSIS	APPLICABILITY TO SITE CONDITIONS
Groundwater (Federal)	Federal Resource Conservation and Recovery Act (RCRA), Subpart F (40 CFR 264.94), Ground-Water Protection Standards and Alternate Concentration Levels.	To Be Considered	Allows for the development of ACL for facilities which treat, store, or dispose of hazardous wastes when the characteristics of the ground water (e.g. high salinity) limit the application of MCLs or health-based criteria. Exposure-based ACL may be developed which take into account potentially adverse effects on groundwater quality and hydraulically connected surface water quality.	Although currently undeveloped, ACL for groundwater may be relevant and appropriate to the development of site-specific PRGs.
	Federal Clean Water Act (CWA) (33 USC 1251-1376); Clean Water Act, Water Quality Criteria, Section 404 (40 CFR 230)	To Be Considered	Non-enforceable guidelines established for the protection of human health and/or aquatic organisms. These guidelines are used by states to set water quality standards for surface water.	AWQC, with modification, may be relevant and appropriate for the development of PRGs for groundwater which enters a surface water.
	Federal Safe Drinking Water Act	Relevant and Appropriate	Establishes drinking water MCLs and health-based criteria.	Appropriate for the development of PRGs for remedial actions involving the discharge of treated groundwater.
Surface Water (Federal)	Federal Clean Water Act (CWA) (33 USC 1251-1376); Clean Water Act, Water Quality Criteria, Section 404 (40 CFR 230)	Relevant and Appropriate or Applicable	Non-enforceable guidelines established for the protection of human health and/or aquatic organisms. These guidelines are used by states to set water quality standards for surface water.	AWQC are relevant and appropriate to the development of PRGs for surface water. AWQC will also be applicable to remedial alternatives which involve discharges to surface water.
Soil/Sediment (Federal)	Toxicity Characteristic (40 CFR 261-24)	To Be Determined	Establishes maximum concentrations of CoC for the TCLP test method described in 40 CFR 261, Appendix II.	Applicable where wastes produced during remedial action require handling as a hazardous waste based upon results of TCLP analysis.
	Land Disposal Restrictions (40 CFR 268)	To Be Determined	Establishes maximum concentrations of CoCs on the basis of which hazardous wastes area restricted from land disposal.	Applicable to remedial alternatives which specify the land disposal of hazardous wastes.
	Toxic Substances Control Act (TSCA) (40 CFR 761.125)	Relevant and Appropriate	Establishes PCB cleanup levels for soils and solid surfaces.	Applicable to spills of materials containing PCBs at concentrations of 50 mg/kg or greater that occurred after May 4 1987. Although landfill operations ceased in 1972, this regulation may still be relevant and appropriate for the development of the PRG
	EPA Proposed Sediment Quality Criteria (Fed. Reg. Vol. 59, No. 11, 18 January 1994)	To Be Considered	Establishes proposed levels of five priority pollutants in fresh and saltwaters for the protection of benthic organisms.	To be considered for the development of PRGs.
	EPA Interim Sediment Criteria Values for Non Polar Hydrophobic Organic Contaminants (EPA SCD#17 May 1988)	To Be Considered	Screening values for contaminants in sediments.	To be considered for the development of PRGs. EPA's proposed criteria are contained in the 1994 document (above).
	Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites (OWSER 9355, 4-02)	To Be Considered	Sets as an interim soil cleanup level for lead at 500 to 1,000 mg/kg.	To be considered for the development of PRGs.
Groundwater (State)	Rules and Regulations for Groundwater Quality Criteria (CRIR No. 12-100-006)	To Be Considered	Establishes water classifications and water quality criteria. Also establishes acute and chronic water quality criteria for the protection of aquatic life.	Class GA WQS, with modification, may be relevant and appropriate to the development of PRGs for groundwater based upon the potential discharge following treatment to fishable surface water.
	Groundwater Protection Act of 1985 (RIGL 46 13 1)	Applicable	Establishes the policy for maintaining and restoring groundwater quality and presents groundwater classifications.	Applicable to Class GB groundwater within the state of Rhode Island
Surface Water (State)	Rules and Regulations for Groundwater Quality Criteria (CRIR No. 12-100-006)	Relevant and Appropriate or Applicable	Establishes water classifications and water quality criteria. Also establishes acute and chronic water quality criteria for the protection of aquatic life	WQS are relevant and appropriate to the development of PRGs for surface water. WQS will also be applicable for remedial alternatives which involve discharges to surface water.
	Water Quality Regulations for Water Pollution Control	Applicable	Establishes water quality criteria and water classifications.	Applicable to Class SA surface water for the development of PRGs
Soils (State)	Rules and Regulations for Lead Poisoning Prevention	Applicable	RIDEM, in conjunction with RIDOH, established a permissible level of lead in soil at 500 mg/kg for surface soils and 1,000 mg/kg for subsurface soils. A "lead-free" level in soil was defined as 150 mg/kg	Applicable to the development of soil PRGs
	RI Hazardous Waste Management Act of 1987 (RIGL 23-19.1 et seq.)	Relevant and Appropriate or Applicable	Defines Type 6 - Extremely hazardous waste at including wastes which contain PCB at a concentration of 50 mg/kg or greater or showing 10 µg/100 cm² or greater as measured by a standard wipe test	Relevant and appropriate for the development of soil PRGs. Applicable for remedial actions which involve handling hazardous wastes
	Rules and Regulations for Solid Waste Management	Relevant and Appropriate or Applicable	Defines solid waste as including any soil, debris, or other material with a concentration of PCBs of 10 ppm or greater as measured by a standard wipe test	Relevant and appropriate for the development of soil PRGs. Applicable for remedial action which involve handling solid wastes.

Table 3. Procedure for Preliminary Remediation Goals (PRGs) development for aquatic, avian predator and human health exposure pathways in the Derecktor Shipyard/Coddington Cove study area.

PROCEDURE	EXPOSURE PATHWAY			
	Aquatic Bedded	Aquatic Resuspended	Avian Predator	Human Health
1 - Identify primary CoC exposure pathways and benchmarks to be used to express risks.	Exposure pathway = porewater; Benchmark = Water Quality Screening Values (WQSV); PW-HQ = Porewater (PW) concentration/WQSV.	Exposure pathway = Elutriate water; Benchmark = Water Quality Screening Values (WQSV); Elu-HQ = Elutriate (Elu) concentration/WQSV.	Exposure pathway = Fish and shellfish consumption; Benchmark = Toxicity Reference Value (TRV); TRV-HQ = Tissue concentration of prey species/TRV.	Exposure pathway = Shellfish consumed by subsistence fishermen; Benchmark = minimum Reasonable Maximum Exposure (RME) value; RME-HQ = Shellfish tissue concentration/RME.
2 - Evaluate CoC bioavailability under site-specific conditions.	Estimate 95% Upper Confidence Limit (95% UCL) of PW-HQs associated with non-toxic samples; set NOEQ = 1 where 95% UCL<1.	Estimate 95% Upper Confidence Limit (95% UCL) of Elu-HQs associated with non-toxic samples; set NOEQ = 1 where 95% UCL<1.	TRV based on avian predator exposure model for species living in the New England region.	RME based on human health exposure model for recreational shellfishing characteristics in the New England region.
3 - Retain CoCs substantially contributing to risk at the site.	Retain CoCs for which the Maximum PW-HQ associated with toxic samples > NOEQ.	Retain CoCs for which the Maximum Elu-HQ associated with toxic samples > NOEQ.	Retain CoCs with TRV-HQ>1.	Retain carcinogenic CoCs with risk > $1x10^{-6}$; Retain non-carcinogenic CoCs with HQ>1.
4 - Evaluate feasibility of pathway/CoC-specific PRG as a long-term remedial goal.	Compare Aquatic NOEC[1] and Reference Screening Value (RSV) for CoCs in porewater; select greater of two values as aquatic Threshold Effects Value (TEV).	Compare Aquatic NOEC[1] and Reference Screening Value (RSV) for CoCs in resuspended sediment; select greater of two values as aquatic Threshold Effects Value (TEV).	Compare Avian Predator TRV and Reference Screening Value (RSV) for CoCs in prey species tissues; select greater of two values as avian predator Threshold Effects Value (TEV).	Compare human health RME and Reference Screening Value (RSV) for CoCs in shellfish species tissues; select greater of two values as human health Threshold Effects Value (TEV).
5 - Rank pathway-specific TEV-HQs and select CoCs with maximum HQs by station and pathway as "limiting" CoCs.	Calculate Aquatic TEV-HQs as station-specific PW conc./TEV; identify maximum TEV-HQ by station; compile resulting list as "limiting" Aquatic CoCs for PRG development.	Calculate Aquatic TEV-HQs as station-specific Elu conc./TEV; identify maximum TEV-HQ by station; compile resulting list as "limiting" Aquatic CoCs for PRG development.	Calcluate Avian Predator TEV-HQs as station-specific prey tissue conc./TEV; identify maximum TEV-HQ by station; compile resulting list as "limiting" Avian Predator CoCs for PRG development.	Calcluate Human Health TEV-HQs as station-specific shellfish tissue conc./TEV; identify maximum TEV-HQ by station; compile resulting list as "limiting" Human Health CoCs for PRG development.
6 - Determine PRGs for "limiting" CoCs, i.e., convert TEV values in concentration-based units to be used during remediation.	For metal CoCs, use aquatic TEVs as PRGs (units = µg/L); derive organic PRGs (units = ng/g dry wt sediment) from TEV using EqP model.	For metal CoCs, use aquatic TEVs as PRGs (units = µg/L); derive organic PRGs (units = ng/g dry wt sediment) from TEV using EqP model.	Calculate PRGs (units = ng/g dry wt sediment) from avian TEVs using BAF (metals) and BSAF (organics) models.	Calculate PRGs (units = ng/g dry wt sediment) from human health TEVs using BAF (metals) and BSAF (organics) models.
7 - Evaluate practicality of pathway-specific PRGs for effective risk reduction.	Compare PRG exceedence to aquatic risk distribution.	Compare PRG exceedence to aquatic risk distribution.	Compare PRG exceedence to avian predator risk distribution.	Compare PRG exceedence to human health risk distribution.

1 - NOEC = NOEQ x WQSV

Table 4. Water Quality Criteria for target analytes selected for aquatic PRG development and derived Water Quality Screening Values.

Chemical Class	Analyte[3,4]	EPA Water Quality Criteria[1]				NOAA	WQSV[1,2]	
		WQC-FA	WQC-FC	WQC-SA	WQC-SC	ER-L	Conc.	DQ
Metals	Arsenic	360	190	69.00	36.00	8.20	36.00	A
	Cadmium	3.90	1.10	43.00	9.30	1.20	9.30	A
	Chromium	1700	210	1100	50.00	81.00	50.00	A
	Copper	18.00	12.00	2.90	2.90	34.00	2.90	A
	Lead	83.00	3.20	220	8.50	46.70	8.50	A
	Mercury	2.40	0.01	2.10	0.03	0.15	0.03	A
	Nickel	1400	160	75.00	8.30	20.90	8.30	A
	Silver	0.92	0.12	7.20	0.92	1.00	0.92	A
	Zinc	120	110	95.00	86.00	150	86.00	A
	SEM:AVS						5.00	F
PAHs	1,6,7-Trimethylnaphthalene							NA
	1-Methylnaphthalene							NA
	1-Methylphenanthrene							NA
	2,6-Dimethylnaphthalene							NA
	2-Methylnaphthalene					70.00	0.88	E
	Acenaphthene	1700	520	970	710	16.00	710	A
	Acenaphthylene					44.00	0.46	E
	Anthracene					85.30	0.29	E
	Benzo(a)anthracene					261	0.07	E
	Benzo(a)pyrene					430	0.04	E
	Benzo(b)fluoranthene							NA
	Benzo(e)pyrene							NA
	Benzo(g,h,i)perylene							NA
	Benzo(k)fluoranthene							NA
	Biphenyl							NA
	Chrysene					384	0.10	E
	Dibenz(a,h)anthracene					63.40	1.68E-03	E
	Fluoranthene	3980		40.00	16.00	600	16.00	A
	Fluorene					19.00	0.14	E
	Indeno(1,2,3-cd)pyrene							NA
	Naphthalene	2300	620	2350		160	620	B
	Perylene							NA
	Phenanthrene	30.00	6.30	7.70	4.60	240	0.81	A
	Pyrene					665	0.63	E
	LMW PAHs					552	5.26	E
	HMW PAHs					1700	0.29	E
	Total PAHs					4022	5.09	NA
PCBs	Total PCBs	2.00	0.01	10.00	0.03	22.70	0.03	A
Pesticides	Aldrin	3.00		1.30			0.16	B
	Hexachlorobenzene	6.00	3.68				3.68	C
	Mirex		1.00E-03		1.00E-03		1.00E-03	A
	o,p'-DDE			0.13	1.00E-03	2.20	1.00E-03	B
	p,p'-DDE			0.13	1.00E-03	2.20	1.00E-03	B
TBT	Tributyltin							NA

DQ - Data Qualifier (see Figure 2.2-1).
WQC-FA = Water Quality Criteria = Freshwater Acute Value
WQC-FC = Water Quality Criteria = Freshwater Chronic Value
WQC-SA = Water Quality Criteria = Saltwater Acute Value
WQC-SC = Water Quality Criteria = Saltwater Chronic Value
WQSV = Water Quality Screening Value
WQSV CODES.
NA= Benchmark not available to derive Screening Value
A- WQC-SC VALUE
B- 8.1 ACUTE/CHRONIC RATIO APPLIED TO WQ-SA VALUE (Shepard, 1995). * = Acute value based on LOAEL
C- WQC-FC VALUE
D- 8.1 ACUTE/CHRONIC RATIO APPLIED TO WQ-FA VALUE (Shepard, 1995)
E- EqP PARTITIONING OF ER-L SEDIMENT BENCHMARK INTO POREWATER AT 1% TOC
1- Units: µg/L.
2- See text and Figure 2.2-1 for WQSV derivation process.
3- LMW PAH = ten 2-ring & 3-ring PAHs, HMW-PAH = eight 4-ring and 5-ring PAHs. Total PAH = sum of LMW and HMW PAHs (NOAA, 1991)
LMW PAH, HMW PAH Kow = median of analyte specific Kows
4 - Assumed to be the same as DDT

Table 5A. Distribution of toxic and non-toxic aquatic Hazard Quotients and derivation of No Observable Effect Quotients for the aquatic receptors exposed to CoC via bedded and resuspended sediment aquatic exposure pathways for the Derecktor Shipyard/Coddington Cove study area.

BEDDED SEDIMENT		Bedded Sediment Exposure (Amphipod Survival)						
		Non-Toxic Samples			Toxic Samples			
Class	Analyte[2]	N	95% UCL PW-HQ[3]	AMP-NOEQ	N	Max. PW-HQ[3]	Max. PW-HQ > NOEQ?	AQ-BED NOEQ[4]
MET	Arsenic	0			0		NO	
MET	Cadmium	0			0		NO	
MET	Chromium	0			0		NO	
MET	Copper	0			0		NO	
MET	Lead	0			0		NO	
MET	Mercury	0			0		NO	
MET	Nickel	0			0		NO	
MET	Silver	0			0		NO	
MET	Zinc	0			0		NO	
MET	SEM:AVS	15.00	-0.67	5.00	2.00	-11.10	NO	
PAH	1,6,7-Trimethylnaphthalen	0			0		NO	
PAH	1-Methylnaphthalene	0			0		NO	
PAH	1-Methylphenanthrene	0			0		NO	
PAH	2,6-Dimethylnaphthalene	0			0		NO	
PAH	2-Methylnaphthalene	15.00	0.16	1.00	2.00	0.16	NO	
PAH	Acenaphthene	15.00	3.60E-04	1.00	2.00	1.27E-04	NO	
PAH	Acenaphthylene	15.00	0.84	1.00	2.00	0.87	NO	
PAH	Anthracene	15.00	1.38	1.38	2.00	1.21	NO	
PAH	Benzo(a)anthracene	15.00	0.73	1.00	2.00	0.83	NO	
PAH	Benzo(a)pyrene	15.00	0.45	1.00	2.00	0.58	NO	
PAH	Benzo(b)fluoranthene	0			0		NO	
PAH	Benzo(e)pyrene	0			0		NO	
PAH	Benzo(g,h,i)perylene	0			0		NO	
PAH	Benzo(k)fluoranthene	0			0		NO	
PAH	Biphenyl	0			0		NO	
PAH	Chrysene	15.00	0.59	1.00	2.00	0.64	NO	
PAH	Dibenz(a,h)anthracene	15.00	0.45	1.00	2.00	0.56	NO	
PAH	Fluoranthene	15.00	0.02	1.00	2.00	0.01	NO	
PAH	Fluorene	15.00	1.23	1.23	2.00	0.87	NO	
PAH	Indeno(1,2,3-cd)pyrene	0			0		NO	
PAH	Naphthalene	15.00	1.22E-03	1.00	2.00	9.01E-04	NO	
PAH	Perylene	0			0		NO	
PAH	Phenanthrene	15.00	0.67	1.00	2.00	0.38	NO	
PAH	Pyrene	15.00	0.64	1.00	2.00	0.79	NO	
PAH	LMW PAHs	15.00	3.38	3.38	2.00	2.58	NO	
PAH	HMW PAHs	15.00	2.87	2.87	2.00	3.41	YES	2.87
PAH	Total PAHs	15.00	6.22	6.22	2.00	5.99	NO	
PCB	Total PCBs	15.00	0.11	1.00	2.00	1.78	YES	1.00
PST	Aldrin	15.00	1.91E-05	1.00	2.00	6.72E-06	NO	
PST	Hexachlorobenzene	15.00	2.83E-06	1.00	2.00	1.46E-06	NO	
PST	Mirex	15.00	6.14E-03	1.00	2.00	0.01	NO	
PST	o,p'-DDE	15.00	0.02	1.00	2.00	0.40	NO	
PST	p,p'-DDE	15.00	0.02	1.00	2.00	0.04	NO	

PW-HQ=Porewater Hazard Quotient, ELU-HQ=Elutriate Hazard Quotient

1 - NOEQ = No Observable Effect Quotient = greater of 95% Upper Confidence Limit (UCL) HQ or 1.

2 - SEM-AVS expressed as µmol/g dry wt. sediment (benchmark from USEPA, 1996)

3- Porewater Hazard Quotients: from Table A-3.2; segregated by amphipod survival results, see Tables A-3.3A (no toxicity) and A-3.3B (toxicity).

4 - If Max PW-HQ>NOEQ, AQ BED-NOEQ = NOEQ

Table 5B. Distribution of toxic and non-toxic aquatic Hazard Quotients and derivation of No Observable Effect Quotients for the aquatic receptors exposed to CoC via bedded and resuspended sediment aquatic exposure pathways for the Derecktor Shipyard/Coddington Cove study area.

RESUSPENDED SEDIMENT		Resuspended Sediment (Sea Urchin Fertilization)							Resuspended Sediment (Sea Urchin Development)							
		Non-Toxic Samples			Toxic Samples				Non-Toxic Samples			Toxic Samples				
Class	Analyte[6]	N	95% UCL ELU-HQ[3]	NOEQ[1]	N	Max. ELU-HQ[3]	Max. ELU-HQ > NOEQ?	FERT[4A] NOEQ	N	95% UCL ELU-HQ[3]	NOEQ[1]	N	Max. ELU-HQ[3]	Max. ELU-HQ > NOEQ?	DEV[4B] NOEQ	AQ ELU[5] NOEQ
MET	Arsenic	9.00	0.84	1.00	0		NO		2.00	1.12	1.12	7.00	2.11	YES	1.12	1.12
MET	Cadmium	9.00	0.01	1.00	0		NO		2.00	0.01	1.00	7.00	0.01	NO		
MET	Chromium	9.00	8.00E-03	1.00	0		NO		2.00	8.00E-03	1.00	7.00	8.00E-03	NO		
MET	Copper	9.00	0.59	1.00	0		NO		2.00	0.43	1.00	7.00	1.76	YES	1.00	1.00
MET	Lead	9.00	1.29	1.29	0		NO		2.00	1.06	1.06	7.00	1.87	YES	1.06	1.06
MET	Mercury	9.00	4.00	4.00	0		NO		2.00	4.00	4.00	7.00	4.00	NO		
MET	Nickel	9.00	0.48	1.00	0		NO		2.00	0.48	1.00	7.00	0.48	NO		
MET	Silver	9.00	0.27	1.00	0		NO		2.00	0.27	1.00	7.00	0.27	NO		
MET	Zinc	9.00	0.05	1.00	0		NO		2.00	0.05	1.00	7.00	0.05	NO		
MET	SEM:AVS	17.00	1.06	1.06	0		NO		6.00	1.70	1.70	8.00	1.51	NO		
PAH	1,6,7-Trimethylnaphthale	0			0		NO		0			0		NO		
PAH	1-Methylnaphthalene	0			0		NO		0			0		NO		
PAH	1-Methylphenanthrene	0			0		NO		0			0		NO		
PAH	2,6-Dimethylnaphthalene	0			0		NO		0			0		NO		
PAH	2-Methylnaphthalene	9.00	7.34E-03	1.00	0		NO		2.00	6.57E-03	1.00	7.00	0.01	NO		
PAH	Acenaphthene	11.00	6.53E-06	1.00	0		NO		3.00	3.45E-06	1.00	8.00	3.90E-05	NO		
PAH	Acenaphthylene	11.00	8.44E-03	1.00	0		NO		3.00	0.01	1.00	8.00	0.03	NO		
PAH	Anthracene	10.00	0.04	1.00	0		NO		2.00	0.05	1.00	8.00	0.16	NO		
PAH	Benzo(a)anthracene	10.00	0.23	1.00	0		NO		2.00	0.19	1.00	8.00	0.71	NO		
PAH	Benzo(a)pyrene	11.00	0.29	1.00	0		NO		3.00	0.28	1.00	8.00	0.97	NO		
PAH	Benzo(b)fluoranthene	0			0		NO		0			0		NO		
PAH	Benzo(e)pyrene	0			0		NO		0			0		NO		
PAH	Benzo(g,h,i)perylene	0			0		NO		0			0		NO		
PAH	Benzo(k)fluoranthene	0			0		NO		0			0		NO		
PAH	Biphenyl	0			0		NO		0			0		NO		
PAH	Chrysene	9.00	0.08	1.00	0		NO		2.00	0.06	1.00	7.00	0.33	NO		
PAH	Dibenz(a,h)anthracene	11.00	3.69	3.69	0		NO		3.00	6.84	6.84	8.00	6.84	NO		
PAH	Fluoranthene	11.00	1.87E-03	1.00	0		NO		3.00	1.19E-03	1.00	8.00	7.36E-03	NO		
PAH	Fluorene	11.00	0.04	1.00	0		NO		3.00	0.04	1.00	8.00	0.18	NO		
PAH	Indeno(1,2,3-cd)pyrene	0			0		NO		0			0		NO		
PAH	Naphthalene	9.00	1.57E-05	1.00	0		NO		2.00	1.55E-05	1.00	7.00	2.36E-05	NO		
PAH	Perylene	0			0		NO		0			0		NO		
PAH	Phenanthrene	11.00	0.01	1.00	0		NO		3.00	0.01	1.00	8.00	0.04	NO		
PAH	Pyrene	11.00	0.19	1.00	0		NO		3.00	0.44	1.00	8.00	0.49	NO		
PAH	LMW PAHs	11.00	0.09	1.00	0		NO		3.00	0.08	1.00	8.00	0.39	NO		
PAH	HMW PAHs	11.00	4.44	4.44	0		NO		3.00	7.32	7.32	8.00	8.37	YES	7.32	7.32
PAH	Total PAHs	11.00	4.54	4.54	0		NO		3.00	7.37	7.37	8.00	8.46	YES	7.37	7.37
PCB	Total PCBs	11.00	1.43	1.43	0		NO		3.00	2.31	2.31	8.00	2.59	YES	2.31	2.31
PST	Aldrin	11.00	9.05E-03	1.00	0		NO		3.00	9.82E-03	1.00	8.00	9.82E-03	NO		
PST	Hexachlorobenzene	11.00	6.58E-05	1.00	0		NO		3.00	2.45E-04	1.00	8.00	2.45E-04	NO		
PST	Mirex	11.00	0.32	1.00	0		NO		3.00	0.60	1.00	8.00	0.71	NO		
PST	o,p'-DDE	11.00	2.48	2.48	0		NO		3.00	2.80	2.80	8.00	3.52	YES	2.80	2.80
PST	p,p'-DDE	11.00	0.48	1.00	0		NO		3.00	0.59	1.00	8.00	0.71	NO		

PW-HQ=Porewater Hazard Quotient, ELU-HQ=Elutriate Hazard Quotient

1 - NOEQ = No Observable Effect Quotient = greater of 95% Upper Confidence Limit (UCL) HQ or 1.

2 - SEM-AVS expressed relative to 5 µmol/g dry wt. sediment benchmark (from USEPA, 1996)

3- Elutriate Hazard Quotients, from Table A-4.2, segregated by sea urchin fertilization results, see Table A-4.3A (no toxicity) and Table A-4.3B (toxicity); for sea urchin larval development (elutriates), see Tables A-4.4A (no toxicity) and A-4.4B (toxicity).

4A - If Max FERT ELU-HQ > NOEQ, FERT NOEQ = NOEQ

4B - If Max DEV ELU-HQ > NOEQ, DEV NOEQ = NOEQ

5 - Aquatic NOEQ = minimum of TEST-specific NOEQs

6 - SEM concentration used; AVS assumed = 0 in resuspended sediment.

Table 6. Derivation of Aquatic Reference Screening Values based on concentrations for selected contaminants in porewater[1] and elutriates from Narragansett Bay reference locations.

POREWATERS

Class	Analyte[2,4]	Pathway	JCC-D1	JCC-D1-BOT	JCC-D1-MID	JCC-M1	JCC-S1	JPC-1	JPC-2	JSC-D1	JSC-DC1	JSC-V1	JSC-W1	PCC-D1	PCC-DC1[2]	PCC-V1	PCC-W1	n	T0.975	Mean	95% UCL	Aquatic RSV[3]
PAH	HMW PAHs	PW	0.07	8.63E-03		0.03	0.07	0.10		2.70E-03	2.44E-03	0.04	0.54	1.62E-03	2.14E-03	0.01	1.08	13.00	2.13	0.15	0.19	0.34
PCB	Total PCBs	PW		1.59E-04	2.92E-04	1.44E-04	2.07E-04	2.67E-04		3.58E-05	6.71E-05	1.06E-04		1.12E-04	7.54E-05	7.62E-05		11.00	2.13	1.40E-04	5.39E-05	1.94E-04
MET	Arsenic	ELU						18.30										1.00	2.13	18.30		
MET	Copper	ELU						1.25										1.00	2.13	1.25		
MET	Lead	ELU						13.20										1.00	2.13	13.20		
PAH	HMW PAHs	ELU						209										1.00	2.13	209		
PAH	Total PAHs	ELU						237										1.00	2.13	237		
PCB	Total PCBs	ELU						48.37										1.00	2.13	48.37		
PST	o,p'-DDE	ELU						3.59										1.00	2.13	3.59		
TOC	% TOC	ELU	1.79	1.47	3.73	4.01	6.09	3.79	3.84	3.57	1.66	3.18	0.61	3.55	2.55	1.48	0.81	15.00	2.13	2.81		

Missing PW values indicate outliers removed from the RSV calculation. Outliers are defined as values greater than the mean + 2 standard deviations of the mean for all data.

Only one sample was available for ELU data; hence no outlier analysis was performed.

1-Porewater concentration (µg/L) = sediment concentration/(foc X Koc). See Table A-1 for Koc values.

foc = %TOC/100.

Data Sources: SAIC, 1996 (JSC/PCC - Allen Harbor ERA reference locations), Appendix A-1-1 (sediment concentrations) and A-1-3 (porewater concentrations);

SAIC and URI, 1997a (JCC - McAllister Point ERA reference location), Appendix A-1-1-1 (sediment organic chemistry), A-1-2-1 (sediment metals chemistry), and A-1-2-3 (porewater metals chemistry);

SAIC and URI, 1997b (JPC/CHC - Derecktor Shipyard ERA reference locations), Appendix A-1-1 (sediment chemistry) and A-1-2 (elutriate chemistry).

2 - List includes analytes for which NOEQs were developed; see Table 5A (PW) and Table 5B (ELU).

3 - Aquatic Reference Screening Value (RSV) calculated as 95% Upper Confidence Limit based on sample size as follows:

Mean + ($t_{0.975}(df)$*(STDEV/(SQRT(n))); where STDEV=standard deviation; n=sample size;

$t_{0.975}(df)$ = sample size-dependent percentage points of the t distribution, (Ott, 1993).

4 - Koc for Aroclor 1254 assumed for Total PCBs (see Table A-1).

Table 7. Derivation of Threshold Effects Values (TEVs) for bedded (PW) and resuspended (ELU) aquatic exposure pathways in the Derecktor Shipyard/Coddington Cove study area.

Class	Analyte[1]	Exposure Pathway[1]	Aquatic NOEQ[2]	NOEC[3,5] (µg/L)	Aquatic RSV[4] (µg/L)	Aquatic TEV[5] (µg/L)	L-CoC?[6]
PAH	HMW PAHs	PW	2.87	0.82	0.34	0.82	yes
PCB	Total PCBs	PW	1.00	0.03	1.94E-04	0.03	yes
MET	Arsenic	ELU	1.12	40.40	18.30	40.40	yes
MET	Copper	ELU	1.00	2.90	1.25	2.90	yes
MET	Lead	ELU	1.06	9.00	13.20	13.20	yes
PAH	HMW PAHs	ELU	7.32	2.09	0.21	2.09	no
PAH	Total PAHs	ELU	7.37	37.51	0.24	37.51	no
PCB	Total PCBs	ELU	2.31	0.07	0.05	0.07	yes
PST	o,p'-DDE	ELU	2.80	2.80E-03	3.59E-03	3.59E-03	yes

PW=Porewater, ELU=Elutriate.

NOEQ=No Observable Effect Quotient; WQSV=Water Quality Screening Value; NOEC=No Observable Effect Concentration; RSV=Reference Screening Value; TEV=Toxicity Effect Value.

1 - List includes analytes for which Aquatic NOEQs were developed; see Table 5.

2 - Aquatic NOEQ = minimum of exposure pathway-specific NOEQs; see Table 5.

3 - NOEC = Aquatic NOEQ x WQSV (Table 4).

4 - RSV = reference data compiled by SAIC (Table 6).

5 - Aquatic TEV is the greater of the NOEC and RSV.

6- L-CoC = Limiting CoC; see Table A-5 for L-CoC derivation.

Table 8 Avian Predator Reference Screening Values for selected CoCs in tissues of prey from Narragansett Bay reference locations.

Class	Analyte[1]	C1-1/2/3-HC	C1-4-HC	CHC-1-CN	CHC-1-IBM	CHC-1-LOB	JCC-D1-LOB-HPP	JCC-D1-LOB-MUS	JCC-M1-HC	JCC-S1-HC	JPC-1-IBM	JPC-1-LOB	JPC-1-MF	JSCD1HCND	JSCW1MFMIX	PCCD1HCND	PCCW1HCND	PCCW1MFCOM	PCCW1MFMIX	PCCW1MFSTP	Mean	Avian Predator RSV[2]
Metals	Arsenic	11.30	19.30	3.48	4.68	21.68	19.77	19.82			6.77	19.43	5.92	5.91	2.88	10.44	17.66	1.25	6.83		11.07	14.96
	Cadmium	0.58	0.65	0.94	0.58	0.23	8.27	1.50E-03			0.59	0.18	1.18	0.20	0.11	0.30	0.37	0.19	0.10		0.41	0.60
	Chromium	7.57	8.73	1.22	1.84	1.43	0.11	0.11			2.44	1.68	1.08	2.65	0.69	2.82	4.06	1.36	1.76		2.05	3.08
	Copper	10.60	8.50	18.39	11.93	102	10.77	45.71			8.62	143	22.74	5.33	1.94	33.84	3.75	2.69	3.67		10.98	16.54
	Lead	0.65	0.99	0.84	0.78	0.18	0.09	0.14			3.28	0.39	0.43	0.79	0.14	0.91	0.59	0.70	0.26		0.54	0.72
	Mercury	0.08	0.13	0.17	0.18	0.23	0.11	0.56			0.17	0.30	0.11	0.01	0.07	0.10	0.01	0.10	0.01		0.12	0.16
	Silver		0.93	1.56	1.50E-04	3.84	1.25	0.84			1.50E-04	2.19	1.50E-04	1.79	0.81	4.15	1.69	0.69	0.92		0.98	1.41
	Zinc	112	97.50	21.97	91.68	119	65.15	102			92.83	106	34.06	74.10	167	89.64	86.11	160	186		100	124
PCBs	Total PCBs	53.54		1010	389	461	4210	106	91.43	37.73	565	397	1900	50.96	616	120	68.11			1191	470	766

Missing values indicate outliers removed from the RSV calculation. Outliers are defined as values greater than the mean + 2 standard deviations of the mean for all data.

Metals units=µg/g dry tissue wt.; organics units=ng/g dry tissue wt.

CN=cunner, HC=hard clams, IBM=indigenous blue mussels, LOB=lobster, LOB-HPP= lobster hepatopancreas, LOB-MUS=lobster muscle,

MF=marine fish, ND=non-depurated, DEP=depurated.

Data Sources: SAIC, 1996 (JSC/PCC - Allen Harbor ERA reference locations), Appendix A-1-2 (tissue concentrations);

SAIC and URI, 1997a (JCC - McAllister Point ERA reference location), Appendix A-1-1-2 (tissue organic chemistry) and A-1-2-2 (tissue metals chemistry),

SAIC and URI, 1997b (JPC/CHC - Derecktor Shipyard ERA reference locations), Appendix A-1-3 (tissue chemistry);

TRC, 1994 (C1 - NETC reference location).

1 - Analytes for which maximum TRV-HQs<1 were excluded from PRG development; see ERA Appendix A-2-4 (SAIC and URI 1997).

2 - Avian Predator Reference Screening Value (RSV) calculated as 95% Upper Confidence Limit based on sample size as follows:

Mean + ($t_{0.95}(df)$*(STDEV/(SQRT(n))), where STDEV=standard deviation; n=sample size;

$t_{0.95}(df)$ = sample size-dependent percentage points of the t distribution (Ott, 1993).

Table 9. Derivation of Threshold Effects Values for the avian predator exposure pathway in the Derecktor Shipyard/Coddington Cove study area.

Class	Analyte[1]	Maximum TRV-HQ[2]	Avian Predator TRV[3] (mg/kg dry tiss. wt.)	Avian Predator RSV[4] (mg/kg dry tiss. wt.)	Avian Predator TEV[5] (mg/kg dry tiss. wt.)	L-CoC?[6]
Metals	Arsenic	3.50	8.18	14.96	14.96	no
	Cadmium	1.02	1.83	0.60	1.83	no
	Chromium	1.84	1.72	3.08	3.08	no
	Copper	3.24	60.71	16.54	60.71	yes
	Lead	1.87	3.11	0.72	3.11	yes
	Mercury	1.19	0.38	0.16	0.38	no
	Silver	6.16	1.11	1.41	1.41	yes
	Zinc	5.96	28.77	124	124	yes
PCBs	Total PCBs	13.50	0.29	0.77	0.77	yes

TRV=Toxicity Reference Value.

1 - Analytes identified in Table 8.

2 - Maximum TRV-HQ=maximum Hazard Quotient observed for any prey-receptor combination in the Derecktor Shipyard/Coddington Cove study area: see Appendix A-2-4 in Final Derecktor Shipyard Marine ERA (SAIC and URI, 1997b).

3 - TRV = minimum of receptor-specific TRV; see Table 6.3-2 in Final Derecktor Shipyard Marine ERA (SAIC and URI, 1997b).

4 - Avian Predator Reference Screening Value (RSV) ; see Table 8.

5 - Avian Threshold Effects Value (TEV); selected as greater of TRV and RSV.

6- L-CoC = Limiting CoC; see Table A-6 for L-CoC derivation.

Table 10. Summary of exposure parameter values used in estimating CoC exposures via shellfish consumption by subsistence fishermen in the Derecktor Shipyard/Coddington Cove study area.

Parameter	RME Value	Rationale	Reference
Global variables			
Body Weight (kg)			
- Shellfishing	70.00	Average of adults between 18-65 years of age.	USEPA 1994
Exposure Duration (yr)			
- Shellfishing and Residential (yr)	30.00	Median and upper-bound time at one residence, adults.	USEPA 1994
Averaging Time (days)			
- Cancer risks	25550	Based on 70 year life expectancy.	USEPA 1989b
- Noncancer risks			
Shellfishing and Residential	10950	Based on exposure duration.	USEPA 1989b
Relative Absorption Factors			
- Ingestion of shellfish			USEPA 1989b
VOCs	1.00		
PAHs	1.00		
PCBs	0.30		
Pesticides	0.30	Pesticides in this study are considered high sorption (logKow=5.89-6.89).	
Inorganics	1.00		
Lead	0.30		
Consumption of Locally-Caught Shellfish Scenario			
Exposure Frequency (day/yr)	350	Assumes two weeks vacation.	USEPA 1994
Ingestion Rate (g/day)	15.60	Based on 150 g shellfish per serving and 36.5 servings of shellfish per year.	USEPA 1994; Rupp *et al*. (1980)
Fraction of Ingested Shellfish Caught Locally	1.00	Conservative assumption in absence of site-specific data.	BPJ

NOTES:
RME: Reasonable Maximum Exposure.
BPJ: Best professional judgment.

Table 11. Toxicity values for Chemicals of Concern in shellfish tissue for the Derecktor Shipyard/Coddington Cove study area.

		Cancer Slope Factor (SF)[1] (mg CoC/kg body wt-day^{-1})	Non-cancer Chronic Reference Dose (RfD)[1,3] (mg CoC/kg body wt-day^{-1})
Class	Analyte	Ingestion	Ingestion
MET	Arsenic	1.50	3.00E-04
PAH	Benzo(a)anthracene	0.73	
PAH	Benzo(a)pyrene	7.30	
PAH	Dibenz(a,h)anthracene	7.30	
PAH	Indeno(1,2,3-cd)pyrene	0.73	
PCB	Total PCBs	2.00	

Cancer Slope Factors for all carcinogenic PAHs were set equal to the most toxic PAH, Benzo(a)pyrene.

1 - Original source for SF and RfD values from IRIS database (USEPA, 1997).

2 - Value adjusted in comparison to SF for benzo(a)pyrene; as per USEPA (1993) *Provisional Guidance For Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons.*

3 - Missing values indicates this CoC is not a non-carcinogenic CoC.

Table 12. Summary of risk-based concentration thresholds for CoCs in shellfish tissue for the Derecktor Shipyard/Coddington Cove study area.

		Risk-based Concentration (mg CoC/kg wet tissue wt.)[1]			Human Health Risk-Based Value (RBV)[5]
Class	Analyte	1×10^{-6} Cancer Risk[2]	1×10^{-4} Cancer Risk[2]	HQ = 1 Non-cancer Risk[3,4]	
MET	Arsenic	7.28E-03	0.73	1.40	0.05
PAH	Benzo(a)anthracene	0.01	1.50		0.11
PAH	Benzo(a)pyrene	1.50E-03	0.15		0.01
PAH	Dibenz(a,h)anthracene	1.50E-03	0.15		0.01
PAH	Indeno(1,2,3-cd)pyrene	0.01	1.50		0.11
PCB	Total PCBs	0.18	18.20		1.30

1 - Assumes Reasonable Maximum Exposure scenario.

Benchmarks calculated for CoCs with > 1×10-6 cancer risk or HQ>1.0 non-cancer risk for HH ERA under RME exposure scenario.

2 - Derived using Equation 2 in Section 2.4.3 of text.

3 - Derived using Equation 1 in Section 2.4.3 of text.

4 - Missing values indicates this CoC is not a non-carcinogenic CoC in shellfish tissue under RME conditions based on baseline human health risk assessment results.

5 - Human Health Risk-based Value (RBV); minimum of risk-based RME values for carcinogenic and non-carcinogenic CoCs.

Units: mg CoC/kg dry wt. tissue. Value converted to dry weight units dry wt=wet wt/% solids content (Table A-2.3).

Table 13. Derivation of Human Health Reference Screening Values based on concentrations of selected contaminants in tissues of shellfish harvested from lower Narragansett Bay for consumption by subsistence fishermen.

Class	Analyte[1]	C1-1/2/3	C1-4	CHC-1-IBM	CHC-1-LOB	JCC-D1-LOB-HPP	JCC-D1-LOB-MUS	JCC-M1-HC	JCC-S1-HC	JPC-1-IBM	JPC-1-LOB	JPC-1-MM	JPC-1-PM	JSCD1HCND	PCCD1HCND	PCCW1HCND	Mean	Human Health RSV[2]
MET	Arsenic	11.30	19.30	4.68	21.68	19.77	19.82			6.77	19.43	7.73	11.04	5.91	10.44	17.66	13.50	17.27
PAH	Benzo(a)anthracene	3.57	3.18	47.31	3.36	120	0.90	3.36	0.75	15.80	3.36	10.53	26.48	1.83	1.91	1.13	8.82	16.46
PAH	Benzo(a)pyrene	1.60	2.62	31.00	3.62	51.92	4.90	4.00	1.23	7.81	3.62	4.20	8.00	1.33	1.54	1.26	5.48	9.91
PAH	Dibenz(a,h)anthracene	0.79	1.12	0.49	0.49	0.49	0.49	0.49	0.18	0.49	0.49	0.49	0.49	1.30	1.05	1.40	0.68	0.88
PAH	Indeno(1,2,3-cd)pyrene	4.07	4.96	15.51	1.54	41.42	0.10	2.00	1.65	1.54	1.54	1.54	1.54	0.53	2.10	0.99	2.83	5.06
PCB	Total PCBs	53.54		389	461	4210	106	91.43	37.73	565	397	204	267	50.96	120	68.11	216	325

Units: metals units=µg/g dry tissue weight; organics=ng/g dry tissue weight.

HC=hard clams, PM=*Pitar morrhuana*, MM=*Mercenaria mercenaria*, ND=non-depurated, LOB=lobster, MUS=lobster muscle, HPP=lobster hepatopancreas, IBM=indigenous blue mussel.

Data Sources. JSC/PCC = Allen Harbor ERA reference locations (SAIC, 1996, Appendix Tables A-1-2 (tissue data));

JCC = McAllister Point ERA reference location (SAIC and URI, 1997a, Appendix A-1-1-2 (tissue organic data) and A-1-2-2 (tissue metals data));

JPC/CHC = Derecktor Shipyard ERA reference locations (SAIC and URI, 1997b, Appendix Tables A-1-3 (tissue data)).

TRC, 1994 (C1 - NETC reference location).

1 - List includes CoCs for which RBVs were developed; see Table 12.

2 - Human Health Reference Screening Value (RSV) calculated as 95% Upper Confidence Limit based on sample size as follows:

Mean + ($t_{0.975}(df)$*(STDEV/(SQRT(n))); where STDEV=standard deviation; n =sample size;

$t_{0.975}(df)$ = sample size-dependent percentage points of the t distribution (Ott, 1993).

Table 14. Derivation of Threshold Effects Values for the human health exposure pathway in the Derecktor Shipyard/Coddington Cove study area.

Class	Analyte	Human Health RBV[1] (mg/kg dry tiss. wt)	Human Health RSV[2] (mg/kg dry tiss. wt)	Human Health TEV[3] (mg/kg dry tiss. wt)	L-CoC?[4]
Metals	Arsenic	0.05	17.27	17.27	yes
	Benzo(a)anthracene	0.11	0.02	0.11	no
	Benzo(a)pyrene	0.01	9.91E-03	0.01	yes
	Dibenz(a,h)anthracene	0.01	8.83E-04	0.01	no
	Indeno(1,2,3-cd)pyrene	0.11	5.06E-03	0.11	no
PCBs	Total PCBs	1.30	0.33	1.30	no

1 - Human Health Risk-based Value (RBV); see Table 12.
2 - Human Health Reference Screening Value (RSV), see Table 13.
3 - Human Health Threshold Effects Values (TEV) = greater of RBV and RSV.
4 - L-CoC = Limiting CoC; see Table A-7 for L-CoC derivation.

Table 15. Summary of maximum TEV-HQs and identification of Limiting CoCs by sampling location for aquatic, avian predator and human health exposure pathways for the Derecktor Shipyard/Coddington Cove study area.

Exposure Pathway	Parameter	DSY-24	DSY-25	DSY-26	DSY-27	DSY-28	DSY-29	DSY-30	DSY-31	DSY-32	DSY-33	DSY-34	DSY-35	DSY-36	DSY-37	DSY-38	DSY-39	DSY-40	DSY-41
Aquatic (A)	TEV-HQ[1,2]		0.89	1.42	1.78		2.34	1.15										1.74	
Bedded	L-CoC		HMW PAHs	HMW PAHs	Total PCBs		HMW PAHs	HMW PAHs										HMW PAHs	
Aquatic (A)	TEV-HQ[1,2]		1.12		1.00		0.83		1.76	0.71	1.20			1.00	0.98	1.01	1.88	0.74	
Resuspended	L-CoC		Total PCBs		Total PCBs		o,p'-DDE		Copper	Lead	Lead			Arsenic	Lead	Arsenic	Arsenic	Arsenic	
Avian Predator (P)	TEV-HQ[1,3]	1.87	3.89	2.87	4.89	5.05	4.16		1.33		2.44		4.65	4.08		4.34	3.24	1.19	
	L-CoC	Lead	Silver	Total PCBs	Silver	Total PCBs	Silver		Zinc		Silver		Silver	Total PCBs		Silver	Copper	Total PCBs	
Human Health (HH)	TEV-HQ[1,4]		10.72	51.30	6.84	3.17	1.65		4.21	3.99	2.08	2.10	1.51	3.02	2.17	1.93	1.08		1.62
	L-CoC		Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Arsenic		Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Arsenic		Benzo(a) pyrene
Combined	TEV-HQ[1,5]	1.87	10.72	51.30	6.84	5.05	4.16	1.15	4.21	3.99	2.44	2.10	4.65	4.08	2.17	4.34	3.24	1.74	1.62
Exposure	L-CoC	Lead	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Total PCBs	Silver	HMW PAHs	Benzo(a) pyrene	Benzo(a) pyrene	Silver	Benzo(a) pyrene	Silver	Total PCBs	Benzo(a) pyrene	Silver	Copper	HMW PAHs	Benzo(a) pyrene
Pathway	Pathway[6]	P	HH	HH	HH	P	P	A	HH	HH	P	HH	P	P	HH	P	P	A	HH

TEV-HQ=Threshold Effects Value Hazard Quotient. L-CoC=Limiting Chemical of Concern. See text, Section 1.0. TEV-HQs<1 not reported

1 - TEV-HQ = media-specific concentration/analyte-pathway-specific TEV value.

2 - Values presented are maximum of Aquatic TEV-HQs by station. Complete TEV-HQ values presented in Tables A-5

3 - Values presented are maximum of Avian Predator TEV-HQs by station. Complete TEV-HQ values presented in Table A-6

4 - Values presented are maximum of Human Health TEV-HQs by station. Complete TEV-HQ values presented in Table A-7

5 - Values presented are maximum of individual exposure pathway TEV-HQs by station.

6 - Limiting Exposure Pathway. A = Aquatic, P = Avian Predator, HH = Human Health

Table 16. Summary of Preliminary Remediation Goals (PRGs) for aquatic, avian predator, human health, and combined exposure pathways for the Derecktor Shipyard/Coddington Cove study area.

		Preliminary Remediation Goal[1]									
		Aquatic-Bedded[3A]		Aquatic-Resuspended[3B]		Avian Predator[4]		Human Health[5]		Combined Pathway	
Class	Analyte[2]	HQ=1	RPRG	HQ=1	RPRG	HQ=1	RPRG	HQ=1	RPRG	HQ=1	RPRG
MET	Arsenic			24.63	NR	17.09	NR	19.74	NR	17.09	NR
MET	Copper			73.74	NR	184	NR			73.74	NR
MET	Lead			83.94	168	622000	NR			83.94	168
MET	Silver					2342	NR			2342	NR
MET	Zinc					118	NR			118	NR
PAH	Benzo(a)pyrene							53.92	539	53.92	539
PAH	HMW PAHs	6951	13903							6951	13903
PCB	Total PCBs	1638	1638	530	1060	92.82	NR			92.82	1060
PST	o,p'-DDE			9.06	NR					9.06	NR

RPRG - Recommended Preliminary Remediation Goal
NR - Not Recommended
1 - Pathway-specific PRGs expressed in concentration units for use during remediation.
PAHs, PCBs, pesticides: units = ng/g dry weight sediment
metals: units = µg/g dry weight sediment

2 - List includes only limiting CoCs, i.e., CoCs with maximum TEV-HQs by station and pathway (Table 15).

3A - Aquatic Bedded PRG at HQ=1 calculated as the mean (TEV*[Sed])/[PW];
REC = 2 x PRG at HQ = 1; adjusted to reduce risk to CoC exposure in bedded sediment of high risk areas. See text in Section 3.3.

3B - Aquatic Resuspended sediment PRG at HQ=1 calculated as the mean (TEV*[Sed])/[Elutriate]).
REC = 2 x PRG at HQ = 1; adjusted to reduce risk to CoC exposure during sediment resuspension in high risk areas. See text in Section 3.3.

4 - Avian predator PRG (at HQ=1) for organics calculated as [$\%TOC_{avg}$ x ((Avian TEV*1000)/$\%lipid_{avg}$))/BSAF];
For Metals, PRG conc. = [Avian TEV/BAF].
REC = NR; due to low risk and lack of probable exposure. See text Section 3.3.

5 - For PCBs, PRG (ng/g dry wt. sediment) = [$\%TOC_{avg}$ x ((Human Health TEV)*(1000/$\%lipid_{avg}$))/BSAF];
For metals, PRG (µg/g dry wt. sediment) = ((Human Health TEV)/BAF).
REC=10x PRG at HQ=1; adjusted for site usage ratio to address risk above HQ=$10/1x10^{-5}$. See text Section 3.3.

Data Sources:
- see Table 7 for Aquatic TEV concentrations (µg/L);
- see Table 9 for Avian Predator TEV concentrations (mg/kg dry weight);
- see Table 14 for Human Health TEV concentrations (mg/kg wet tissue weight);
- see Table 15 for maximum of pathway-specific TEV-HQ values;
- see Table A8 for calculation of mean aquatic bedded and resuspended pathway PRGs from station-specific PRGs;
- site average %lipid = 4.59, see Table A-2.3 for derivation;
- site average %TOC = 2.78, see Table A-2.1A for derivation;
- site average BAF for arsenic = 0.875, see Derecktor Shipyard ERA Figure 6.3-3;
- site average BAF for copper = 0.33, see Derecktor Shipyard ERA Figure 6.3-3;
- site average BAF for lead = 5.0E-6, see Derecktor Shipyard ERA Figure 6.3-3;
- site average BAF for silver = 0.0006, see Derecktor Shipyard ERA Figure 6.3-3;
- site average BAF for zinc = 1.05, see Derecktor Shipyard ERA Figure 6.3-3;
- site average BSAF for pesticides = 3.85, see Derecktor Shipyard ERA Figure 6.3-2;
- site average BSAF for PCBs = 5.00, see Derecktor Shipyard ERA Figure 6.3-2;
- site average BSAF for PAHs = 0.12, see Derecktor Shipyard ERA Figure 6.3-2.

Table A-1. Summary of Kow and Koc values used in calculations of organic contaminant concentrations in porewaters by equilibrium partitioning.

Class	Analyte	CAS No.	Full Analyte Name	$Log_{10}K_{ow}$	Source[1]	$Log_{10}K_{oc}$[2]	K_{oc}
MET	As		Arsenic	NA			
	Cd		Cadmium	NA			
	Cr		Chromium	NA			
	Cu		Copper	NA			
	Pb		Lead	NA			
	Hg		Mercury	NA			
	Ni		Nickel	NA			
	Ag		Silver	NA			
	Zn		Zinc	NA			
	SEM:AVS		SEM-AVS	NA			
PAH	T167NAP	2245387	1,6,7-Trimethylnaphthalene	4.61	b	4.53	34034
	M1NAPH	90120	1-Methylnaphthalene	3.97	b	3.90	7994
	M1PHEN	832699	1-Methylphenanthrene	5.08	b	4.99	98610
	D26NAPH	581420	2,6-Dimethylnaphthalene	4.61	b	4.53	34034
	M2NAPH	91576	2-Methylnaphthalene	3.97	b	3.90	7994
	ACENAPH	83329	Acenaphthene	3.92	a	3.85	7139
	ACENAPL	208968	Acenaphthylene	4.05	b	3.98	9581
	ANTHRAC	120127	Anthracene	4.55	a	4.47	29712
	BENAAN	56553	Benzo(a)anthracene	5.70	a	5.60	401218
	BENAPYR	50328	Benzo(a)pyrene	6.11	a	6.01	1014869
	BENBFLU	205992	Benzo(b)fluoranthene	6.20	a	6.09	1244171
	BENEPYR	192972	Benzo(e)pyrene	6.11	b	6.01	1014869
	BGHIPER	191242	Benzo(g,h,i)perylene	6.70	a	6.59	3858156
	BENKFLU	207089	Benzo(k)fluoranthene	6.20	a	6.09	1244171
	BIPHEN	92524	Biphenyl	3.96	a	3.89	7816
	CHRYSEN	218019	Chrysene	5.70	a	5.60	401218
	DBAHANT	53703	Dibenz(a,h)anthracene	6.69	a	6.58	3771812
	FLUORAN	206440	Fluoranthene	5.12	a	5.03	107954
	FLUOREN	86737	Fluorene	4.21	a	4.14	13763
	I123CDP	193395	Indeno(1,2,3-cd)pyrene	6.65	a	6.54	3445323
	NAPH	91203	Naphthalene	3.36	a	3.30	2010
	PERYL	198550	Perylene	6.05	b	5.95	885992
	PHENAN	85018	Phenanthrene	4.55	a	4.47	29712
	PYRENE	129000	Pyrene	5.11	a	5.02	105538
	LMWPAH	NA	Low Molecular Weight PAH	4.09	c	4.02	10489
	HMWPAH	NA	High Molecular Weight PAH	5.88	c	5.78	596216
	TOTPAH	NA	Total PAHs[3]	4.98	c	4.90	79082
PCB	PCB101	37680732	101 (2 2'3 5 5')	6.38	b	6.27	1869907
	PCB105	32598144	105 (2 3 3'4 4')	6.65	b	6.54	3445323
	PCB118	31508006	118 (2 3'4 4'5)	6.74	b	6.63	4223767
	PCB128	39380073	128 (2 2'3 3'4 4')	6.74	b	6.63	4223767
	PCB138	35065282	138 (2 2'3 4 4'5)	6.83	b	6.71	5178095
	PCB153	35065271	153 (2 2'4 4'5 5')	6.92	b	6.80	6348045
	PCB170	35065306	170 (2 2'3 3'4 4'5)	7.27	b	7.15	14018127
	PCB18	37680652	18 (2 2'5)	5.24	b	5.15	141645
	PCB180	35065293	180 (2 2'3 4 4'5 5')	7.36	b	7.24	17185414
	PCB187	52663680	187 (2 2'3 4'5 5'6)	7.17	b	7.05	11178687
	PCB195	52663782	195 (2 2'3 3'4 4'5 6)	7.56	b	7.43	27024645
	PCB206	40186729	206 (2 2'3 3'4 4'5 5'6)	8.09	b	7.95	89691234
	PCB209	2051243	209 (2 2'3 3'4 4'5 5'6 6')	8.18	b	8.04	109956270
	PCB28	7012375	28 (2 4 4')	5.67	b	5.57	374878
	PCB44	41464395	44 (2 2'3 5')	5.75	a	5.65	449293
	PCB52	35693993	52 (2 2'5 5)	5.84	b	5.74	550908
	PCB66	32598100	66 (2 3'4 4')	6.20	b	6.09	1244171
	PCB8	34883437	8 (2 4)	5.07	b	4.98	96403
	TOTPCB	NA	Total PCBs[4]	6.54	b	6.43	2685963
PST	ALDRIN	309002	Aldrin	6.50	a	6.39	2453456
	HCB	118741	Hexachlorobenzene	5.89	a	5.79	616806
	MIREX	2385855	Mirex	6.89	a	6.77	5931301
	DDE_OP	3424826	o,p'-DDE	6.76	a	6.65	4419366
	DDE_PP	72559	p,p'-DDE	6.76	a	6.65	4419366

1 - Literature source of $Log_{10}K_{ow}$ values.

a - Karickhoff and Long, 1995

b - Karickhoff *et al.*, 1989

c - Calculated value

2 $\log_{10}K_{oc} = 0.00025 + 0.983 * \log_{10}K_{ow}$, Karickhoff *et al.* 1989

3 LMW PAH = ten 2-ring & 3-ring PAHs; HMW-PAH = eight 4-ring and 5-ring PAHs, Total PAH = sum of LMW and HMW PAHs (NOAA 1991)

LMW PAH, HMW PAH Kow = median of analyte specific Kow, Total PAH Kow = mean of LMW, HMW PAH Kow

4 Sum of Congeners X 2

NA = not applicable

Table A-2.1A Concentrations of chemical contaminants in surface sediment (0-15 cm) collected in the Derecktor Shipyard/Coddington Cove study area.

ERA investigation.

Class	Analyte[1]	DSY-25	DSY-26	DSY-27	DSY-28	DSY-29[2]	DSY-30	DSY-31	DSY-32	DSY-33	DSY-34	DSY-35	DSY-36	DSY-37	DSY-38	DSY-39	DSY-40	DSY-41
Metals	Arsenic	6.36	9.43	11.60	8.68	12.46	10.30	10.22	10.93	7.39	9.66	3.39	11.21	7.41	8.94	7.58	6.79	11.43
	Cadmium	0.34	0.18	1.03	0.55	1.45	1.20	0.76	0.72	0.19	0.32	0.09	0.40	0.32	0.25	0.18	0.50	0.18
	Chromium	55.00	53.50	103	80.50	86.50	79.25	76.75	84.75	46.50	64.25	24.25	83.25	56.50	66.00	56.50	44.50	36.75
	Copper	23.50	39.25	166	71.75	158	81.25	80.75	66.75	17.25	33.50	1.88	54.00	27.00	28.00	20.00	29.75	9.25
	Lead	35.90	40.40	151	77.70	186	80.00	81.00	125	40.00	47.80	14.00	78.80	56.90	62.20	54.00	42.10	17.00
	Mercury	0.13	0.14	0.59	0.32	0.50	0.47	0.40	0.37	0.13	0.15	0.07	0.38	0.28	0.26	0.15	0.19	0.02
	Nickel	21.00	20.50	43.50	24.25	34.75	27.25	24.75	25.75	18.25	20.50	5.00	25.75	16.75	22.00	17.75	17.25	14.50
	Silver	0.26	0.19	0.69	0.51	0.79	0.74	0.51	0.81	0.24	0.29	0.07	0.56	0.39	0.16	0.26	0.21	0.07
	Zinc	110	102	547	169	393	193	167	201	72.25	106	28.50	144	93.50	109	97.25	100	47.25
	SEM-AVS																	
PAHs	1,6,7-Trimethylnaphthalene	6.19	4.34	7.87	8.41	27.94	19.25	7.90	7.89	2.04	4.43	0.16	6.41	4.74	4.04	4.57	4.66	0.45
	1-Methylnaphthalene	10.93	7.83	20.47	19.85	50.07	55.11	20.42	17.57	5.11	12.70	0.37	16.71	12.63	9.17	9.27	9.41	1.27
	1-Methylphenanthrene	52.56	43.54	61.44	38.57	267	114	32.53	51.57	6.88	18.31	0.50	33.92	39.80	30.93	20.22	38.26	2.22
	2,6-Dimethylnaphthalene	27.20	18.65	38.46	34.23	112	70.71	34.64	43.59	9.91	9.56	1.69	46.60	18.82	18.31	14.31	17.33	2.35
	2-Methylnaphthalene	11.22	13.86	32.72	43.87	73.47	88.19	36.86	32.08	9.66	24.22	0.65	23.00	17.64	13.96	15.17	16.39	2.01
	Acenaphthene	41.74	12.21	23.89	17.27	189	197	17.14	14.29	3.31	8.55	0.23	11.00	7.41	6.53	10.15	16.20	1.71
	Acenaphthylene	75.65	93.84	142	74.63	300	91.94	71.00	131	11.85	28.68	0.61	74.94	34.51	25.06	22.52	95.65	0.77
	Anthracene	302	268	383	183	1220	456	200	298	31.49	64.35	1.60	158	141	94.02	77.19	234	11.10
	Benzo(a)anthracene	328	518	809	294	2700	697	281	388	50.03	101	2.76	222	144	112	97.70	234	13.76
	Benzo(a)pyrene	396	434	924	377	2380	812	421	495	67.85	148	4.14	319	164	120	143	317	18.55
	Benzo(b)fluoranthene																	
	Benzo(e)pyrene	345	365	829	362	1950	773	401	417	63.45	141	5.02	275	140	112	126	333	19.44
	Benzo(g,h,i)perylene	200	201	500	247	1110	452	215	287	50.33	97.60	4.12	195	126	94.65	96.67	184	12.18
	Benzo(k)fluoranthene	877	999	2240	911	5350	1640	1040	1100	155	348	10.95	700	308	260	302	836	47.26
	Biphenyl	6.89	6.66	15.06	12.61	29.91	23.76	14.41	15.37	3.18	6.42	0.42	10.50	5.79	5.70	5.64	6.02	0.66
	Chrysene	485	592	912	364	2800	716	399	491	58.78	128	3.63	287	154	107	120	444	20.65
	Dibenz(a,h)anthracene	60.86	61.34	131	66.60	317	130	62.93	72.22	12.41	26.45	0.92	48.30	28.80	21.03	27.35	52.77	3.18
	Fluoranthene	490	686	801	459	4970	1490	399	535	95.23	208	7.22	345	262	230	216	779	37.83
	Fluorene	44.13	53.89	61.63	31.45	294	177	28.12	25.73	6.57	13.92	0.58	18.02	9.74	6.42	14.73	19.09	2.09
	Indeno(1,2,3-cd)pyrene	195	209	473	223	1020	398	218	264	45.31	93.27	3.15	178	100	80.23	91.28	166	11.44
	Naphthalene	17.96	16.16	41.75	37.54	76.08	136	45.30	42.67	10.87	22.27	0.66	34.06	26.88	23.22	23.66	21.00	1.84
	Perylene	104	133	249	133	611	207	142	150	23.92	61.03	2.11	97.64	53.29	51.09	51.92	78.70	7.31
	Phenanthrene	283	317	335	220	1610	1270	216	182	46.16	110	3.69	138	83.10	67.14	116	304	20.16
	Pyrene	584	740	1950	650	5300	1750	846	917	107	250	6.45	482	362	254	227	1190	49.54
	Low Molecular Weight PAHs	597	539	828	502	2639	1429	509	680	103	213	7.46	433	319	237	217	478	26.49
	High Molecular Weight PAHs	4318	5256	10153	4308	30118	10334	4640	5298	776	1712	54.18	3286	1926	1509	1615	4917	261
	Sum of PAHs	4944	5795	10981	4809	32757	11763	5149	5978	879	1925	61.65	3719	2245	1746	1832	5395	288
PCBs	Total PCBs (Sum Congeners x2)	93.61	98.24	3310	134	546	315	221	201	39.93	64.56	6.70	113	99.90	59.33	58.16	84.13	13.75
Pesticides	Aldrin	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	Hexachlorobenzene	0.08	0.12	0.12	0.06	0.16	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
	Mirex	0.10	0.19	2.59	0.17	0.10	5.03	0.33	0.71	0.10	0.29	0.10	0.37	0.36	0.34	0.10	0.23	0.10
	o,p'-DDE	0.10	1.52	65.22	1.67	4.96	5.66	3.63	0.26	0.63	0.90	0.26	0.25	0.10	0.10	0.71	1.07	0.40
	p,p'-DDE	0.87	0.61	7.00	2.03	6.29	4.44	1.95	2.38	0.42	0.96	0.03	2.60	1.35	1.29	0.73	1.14	0.08
TOC	% TOC	1.78	1.47	3.72	4.01	6.00	3.79	3.84	3.57	1.66	3.18	0.61	3.54	2.21	3.07	2.66	1.47	0.81

Units: Metals=µg/g, PAHs, PCBs and Pesticides=ng/g

1- TOC value for DSY-29 = average for DSY-29 and DSY-29FD samples: see ERA Table A-1-5.2

Mean TOC%[1]
2.78

Table A-2.1B. Concentrations of chemical contaminants in surface sediment (0-2 cm) collected in the Derecktor Shipyard/Coddington Cove study area.

URI investigation[1]

Class	Analyte	DSY-1	DSY-2	DSY-3	DSY-4	DSY-5	DSY-6	DSY-7	DSY-8	DSY-9	DSY-10	DSY-11	DSY-12	DSY-13	DSY-14	DSY-15	DSY-16	DSY-17	DSY-18	DSY-19	DSY-20	DSY-21	DSY-22	DSY-23	DSY-24
Metals	Arsenic																								
	Cadmium	0.20	0.15	1.00	0.12	0.22	0.21	0.17	0.19	0.85	0.07	0.31	0.23	0.04	1.60E-03	0.05	0.03	0.04	0.22	0.17	0.25	0.19	0.21	0.21	0.01
	Chromium	95.99	152	195	84.79	106	109	79.30	103	65.30	60.85	132	114	56.46	60.54	72.28	55.45	57.34	107	105	89.23	142	106	98.85	71.90
	Copper	45.52	197	262	62.84	52.29	57.77	27.93	76.01	3.99	12.47	81.46	53.87	18.09	7.75	18.61	6.41	17.23	81.67	66.91	79.68	29.66	51.26	49.44	14.43
	Lead	35.39	181	201	51.35	43.30	48.58	31.70	50.60	14.86	22.13	46.08	45.99	35.20	28.94	42.03	31.53	32.90	60.23	57.62	76.91	41.83	52.53	54.19	39.15
	Mercury																								
	Nickel	38.60	85.28	128	37.11	38.35	40.84	37.41	40.24	33.90	31.42	168	40.40	16.87	9.16	10.13	4.44	5.90	25.36	22.79	23.07	7.91	25.28	23.20	11.74
	Silver	0.60	0.82	1.27	13.78	2.32	1.59	5.41	1.74	0.73	0.56	1.22	1.58	0.06	0.05	0.05	0.05	0.05	0.16	0.40	0.88	0.08	0.12	0.12	0.06
	Zinc	149	593	1231	190	173	175	119	184	58.82	63.84	1104	161	89.48	67.60	63.13	48.32	71.29	163	139	156	175	143	141	98.08
	SEM AVS																								
PAHs	1,6,7-Trimethylnaphthalene	2.36	16.10	51.69	0	10.33	3.91	4.02	11.00	0	1.01	8.15	0	0	1.61	0	1.82	0	1.01	0	4.30	4.19	7.06	9.73	3.28
	1-Methylnaphthalene	0.84	0.50	9.71	0	1.75	0	3.47	0.12	0	0	10.97	9.85	0	6.92	0	2.36	0	0	0	0	14.95	78.68	35.72	10.82
	1-Methylphenanthrene	27.68	308	441	15.40	42.66	14.03	34.59	81.87	4.33	1.27	51.06	21.94	59.60	4.16	177	21.19	82.13	228	311	421	15.41	28.68	108	9.02
	2,6-Dimethylnaphthalene	6.55	7.55	23.04	0	3.35	0	1.79	1.89	0	0	12.33	7.35	0	0.73	0	0.67	0	0	0	0	3.04	1.18	5.39	3.48
	2-Methylnaphthalene	0	2.47	8.22	0	4.74	0	0	2.37	0	0.74	6.93	0.98	0	11.32	0	1.46	0	0	0	0	20.10	35.18	53.40	14.58
	Acenaphthene	18.26	63.47	193	0	12.70	16.16	18.28	11.93	0	2.29	20.89	10.01	0	1.00	0	1.05	0	14.84	0	17.13	7.12	10.79	21.57	2.20
	Acenaphthylene	58.86	427	867	89.27	26.56	24.65	28.05	37.66	2.74	1.03	57.61	95.69	1.99	8.33	0	2.78	32.21	167	0	64.60	30.23	42.38	65.31	31.85
	Anthracene	201	1330	3360	260	129	203	161	181	18.58	17.37	254	284	59.38	15.76	257	7.83	213	753	799	922	99.90	130	166	38.28
	Benzo(a)anthracene	166	7380	10600	414	378	405	277	562	34.55	26.14	274	185	28.21	40.13	134	14.48	168	898	399	1420	196	272	414	66.15
	Benzo(a)pyrene	164	3320	4710	431	402	468	302	461	49.13	38.47	206	249	43.73	26.07	245	11.76	311	1190	496	880	110	182	239	54.52
	Benzo(b)fluoranthene	358	10100	9230	646	683	801	399	874	67.28	70.46	381	438	80.42	34.34	324	20.17	477	1890	1050	1500	159	252	318	69.42
	Benzo(e)pyrene	273	5140	5600	443	404	452	303	487	53.22	40.07	257	388	51.55	20.88	221	11.44	265	1020	576	743	88.94	146	187	38.08
	Benzo(g,h,i)perylene	97.41	2070	3060	272	313	355	233	328	19.41	29.52	132	226	41.20	32.57	165	13.71	163	563	280	280	134	215	310	61.29
	Benzo(k)fluoranthene	224	2070	1980	489	248	287	245	294	55.60	24.16	245	347	130	13.19	230	32.56	243	699	791	2300	47.04	75.13	118	106
	Biphenyl	5.01	12.81	40.77	0.62	11.03	8.90	1.66	11.37	0	0	18.53	13.32	0	1.85	0	1.50	0	9.37	0	0	5.62	9.35	10.93	2.67
	Chrysene	406	4980	6390	764	479	603	376	624	70.60	47.47	538	523	140	27.18	444	13.57	387	1460	1170	1580	122	193	234	57.66
	Dibenz(a,h)anthracene	21.20	784	1460	93.38	85.16	89.09	52.05	118	14.96	9.34	28.43	35.93	9.31	11.72	20.50	3.62	54.18	243	39.28	56.80	43.99	63.36	117	16.11
	Fluoranthene	1050	12000	13600	886	644	788	831	818	114	94.27	1320	817	117	66.58	464	34.36	477	1590	1830	5850	325	550	827	224
	Fluorene	42.73	439	859	25.15	42.69	55.07	53.56	53.56	4.86	0.92	74.94	48.75	0	8.49	0	4.95	24.42	92.44	0	216	29.36	78.14	63.94	18.21
	Indeno(1,2,3-cd)pyrene	98.85	1720								18.33	132	168	36.45	25.85	143	9.44	143	529	255	276	99.71	164	226	45.89
	Naphthalene	0.27	1.97	2.94	0	8.02	3.82	0	3.53	0	1.00	11.75	12.71	0	5.15	0	2.59	0	0	0	9.13	2.98	15.99	11.92	1.65
	Perylene	57.17	1050	1338	165	147	203	116	203	17.40	22.57	95.53	131	41.60	16.32	130	12.63	90.70	311	244	300	54.42	95.61	118	26.20
	Phenanthrene	305	3990	4890	217	224	264	385	309	41.14	21.15	392	263	41.00	52.73	112	18.25	201	627	550	1400	171	548	478	180
	Pyrene	794	9390	10100	710	518	601	661	758	79.30	93.92	990	723	113	67.98	496	41.29	409	1640	1550	3820	373	514	823	198
	Low Molecular Weight PAHs	369	2662	5856	391	293	332	307	398	30.51	26.53	528	504	121	65.32	434	48.21	351	1266	1110	1854	233	437	551	136
	High Molecular Weight PAHs	4013	63994	72956	5532	4526	5336	4198	5856	617	536	4991	4494	873	436	3129	237	3418	12860	9212	20406	1923	3271	4409	1162
	Sum of PAHs	4383	66655	78812	5922	4818	5668	4505	6252	647	562	5519	4998	994	501	3563	285	3769	14126	10322	22060	2156	3708	4960	1298
PCBs	Total PCBs (Sum Congeners x2)	67.58	209	733	195	105	132	73.36	148	28.15	11.73	656	176	22.32	22.98	54.84	9.40	244	293	217	367	92.31	178	150	25.87
Pesticides	Aldrin	0	0.06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.09	0	0.18	0	0	0	0
	Hexachlorobenzene	0	0.24	0.17	0	0	0	0	0.06	0	0	0	0.06	0	0	0.06	0	0.07	0.10	0.10	0.12	0.24	0.08	1.47	0
	Mirex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.17	0.39	0.23	0.32	0.09	0.28	0.22	0
	o,p'-DDE	0.98	5.71	3.81	4.03	2.92	2.58	1.54	2.10	0.38	0.74	8.71	2.43	0.75	0.42	1.57	0	0.65	4.34	2.39	6.26	1.18	2.53	1.58	0.30
	p,p'-DDE	0.18	3.13	13.61	0	1.75	2.12	3.58	1.82	0.78	3.46	1.45	2.51	0.63	0.40	1.20	0.36	0.44	0	1.79	0	0.76	2.02	3.71	0.47
TOC	% TOC	2.06	1.30	2.63	3.17	6.70	4.37	2.67	4.63	1.51	1.53	6.17	5.33	0.64	1.01	2.06	0.25	1.01	2.95	4.21	3.29	1.15	2.94	2.86	1.40
																								Mean TOC%	
																								2.74	

Units: Metals=µg/g, PAHs, PCBs and Pesticides=ng/g

1 Quinn et al. (1994)

Table A-2.1C. Concentrations of PCB congeners and calculation of Total PCBs in surface sediment (0-15 cm) collected in the Derecktor Shipyard/Coddington Cove study area.

ERA investigation.

Class	Analyte	DSY-25	DSY-26	DSY-27	DSY-28	DSY-29	DSY-30	DSY-31	DSY-32	DSY-33	DSY-34	DSY-35	DSY-36	DSY-37	DSY-38	DSY-39	DSY-40	DSY-41
PCBs	PCB101	6.48	5.72	220	5.51	16.70	19.00	12.75	14.32	1.74	2.87	0.51	6.73	6.36	2.80	2.09	3.93	0.52
	PCB105	1.75	1.82	137	2.04	6.61	7.04	4.39	2.63	0.56	0.79	0.04	1.37	1.41	0.58	0.54	1.55	0.11
	PCB118	5.02	6.20	242	7.09	18.38	19.56	13.74	11.28	2.34	3.51	0.14	6.11	5.30	2.49	2.25	4.85	0.36
	PCB128	1.37	1.34	73.00	1.89	5.14	6.25	3.07	3.14	0.55	0.87	0.04	1.86	1.77	0.83	0.60	1.42	0.23
	PCB138	5.92	7.21	265	10.86	27.04	26.57	16.11	15.16	2.89	4.86	0.14	9.08	7.39	5.13	4.14	7.10	0.59
	PCB153	4.37	6.16	174	9.97	22.80	20.54	14.43	12.23	2.72	4.81	0.21	8.00	5.85	4.46	4.42	5.87	0.52
	PCB170	0.89	1.53	44.16	3.13	7.25	6.29	3.83	2.30	0.80	1.39	0.13	1.75	1.40	1.34	1.52	1.71	0.17
	PCB18	0.67	0.79	8.36	0.45	0.68	1.30	1.34	0.91	0.26	0.24	0.02	0.49	0.34	0.68	0.25	0.34	0.27
	PCB180	1.86	2.74	53.17	5.77	13.79	11.57	6.80	4.52	1.50	2.46	0.28	3.20	2.54	2.52	2.77	3.46	0.33
	PCB187	1.81	1.92	25.82	3.94	8.54	7.02	4.66	4.26	1.19	1.89	0.08	3.40	2.40	1.91	1.85	2.26	0.29
	PCB195	0.16	0.51	2.93	0.96	3.83	1.01	1.80	0.53	0.19	0.49	0.09	0.32	0.18	0.27	0.57	0.56	0.17
	PCB206	1.52	2.13	7.45	3.12	17.39	6.27	4.33	2.68	1.12	1.81	0.44	2.23	2.79	1.12	1.93	2.39	0.69
	PCB209	0.91	2.04	5.05	3.99	105	6.82	4.50	4.34	1.29	1.98	0.38	2.40	3.10	1.55	2.07	2.84	0.79
	PCB28	2.06	1.26	12.92	1.50	1.66	2.54	3.67	2.61	0.57	0.88	0.24	1.27	0.76	0.56	0.79	0.67	0.20
	PCB44	2.04	1.98	65.05	1.47	3.94	4.49	3.69	2.59	0.54	0.85	0.36	1.12	1.05	0.47	0.93	0.80	0.52
	PCB52	3.21	3.62	130	2.85	9.69	9.22	7.23	4.43	0.96	1.37	0.51	1.37	2.10	0.71	1.20	1.47	0.73
	PCB66	6.16	1.63	180	1.65	3.87	0.94	2.72	11.28	0.46	0.88	0.12	5.36	4.77	2.08	0.90	0.71	0.24
	PCB8	0.59	0.53	5.64	0.66	0.60	1.22	1.43	1.23	0.29	0.33	0.06	0.60	0.46	0.17	0.26	0.15	0.17
	SUMPCB	46.81	49.12	1650	66.85	273	158	110	100	19.97	32.29	3.35	56.64	49.95	29.67	29.08	42.07	6.88
	TOTPCB	93.61	98.24	3310	134	546	315	221	201	39.93	64.58	6.70	113	99.90	59.33	58.16	84.13	13.75
TOC	% TOC	1.79	1.47	3.73	4.01	6.09	3.79	3.84	3.57	1.66	3.18	0.61	3.55	2.21	3.08	2.55	1.48	0.81

Units: PCBs =ng/g dry wt.

SUMPCB = Sum of congener concentrations.

TOTPCB = Total PCBs - SUMPCB x 2.

Table A-2.2. Geotechnical characteristics of reference sediments in Narragansett Bay, Rhode Island.

Site	Station	Depth	%Sand	%Silt	%Clay	%TOC
MCL	JCC-D1	SUR	92.14	6.67	1.19	0.84
MCL	JCC-M1	SUR	90.49	7.63	1.88	0.85
MCL	JCC-S1	SUR	75.02	10.30	14.67	2.07
DSY	JPC-1	SUR	88.10	11.90	0	1.06
DSY	JPC-2	SUR	66.65	33.17	0.18	1.71
AH	JSC-D1	SUR	99.88	0.12	3.74E-05	0.45
AH	JSC-V1	SUR	97.49	2.50	0.02	0.67
AH	JSC-W1	SUR	94.12	5.88	0	0.65
AH	PCC-D1	SUR	99.99	6.21E-03	1.87E-05	0.39
AH	PCC-V1	SUR	86.52	13.43	0.05	1.60
AH	PCC-W1	SUR	97.02	2.94	0.04	1.36
		Mean:	89.77	8.60	1.64	1.06
		S.D.	10.53	9.32	4.37	0.55

MCL = McAllister Point Landfill ERA (SAIC and URI, 1997a)
AH = Allen Harbor Landfill ERA (SAIC, 1996)
DSY= Derecktor Shipyard ERA (SAIC and URI, 1997b)
Data Sources: SAIC, 1996 (JSC/PCC - Allen Harbor ERA reference locations), Appendix A-1-1 (sediment concentrations) and A-1-3 (porewater concentrations); SAIC and URI, 1997a (JCC - McAllister Point ERA reference location), Appendix A-1-1-1 (sediment organic chemistry), A-1-2-1 (sediment metals chemistry), and A-1-2-3 (porewater metals chemistry); and
SAIC and URI, 1997b (JPC/CHC - Derecktor Shipyard ERA reference locations), Appendix A-1-1 (sediment chemistry) and A-1-2 (elutriate chemistry).

Table A-2.3. Lipid and solids content data for species collected for the Derecktor Shipyard ERA.

	Solids content (g dry/g live wt)						Lipid content (%)				
FIELDID	CN/MF	HC	IBM	LOB	MM	PM	CN	IBM	LOB	MM	PM
DSY-24			0.09					5.41			
DSY-25			0.09	0.15				4.44	2.53		
DSY-26	0.15		0.13				9.09	5.40			
DSY-27			0.13	0.15				6.77	2.33		
DSY-28	0.17		0.11	0.14			11.40	5.40	2.83		
DSY-29	0.16			0.14			8.69		2.44		
DSY-31						0.09					2.79
DSY-32						0.11					3.25
DSY-33				0.17		0.09			2.51		3.21
DSY-34						0.10					3.69
DSY-35		0.14	0.14	0.15		0.12		5.00	2.36	2.01	2.40
DSY-36	0.15		0.12	0.14		0.07	8.37	5.37	1.79		2.40
DSY-37						0.03					1.10
DSY-38				0.11		0.10			2.57		4.03
DSY-39				0.15					2.02		
DSY-40			0.14					6.31			
DSY-41		0.15				0.12				2.14	2.11
JPC-1	0.17		0.11	0.12	0.18	0.09	12.47	6.07	2.53	2.59	0.93
CHC-1	0.15		0.10	0.13			11.83	4.28	2.28		
Species Mean	0.16	0.15	0.11	0.14	0.18	0.09	10.31	5.45	2.38	2.25	2.59
N	6.00	2.00	10.00	11.00	1.00	10.00	6.00	10.00	11.00	3.00	10.00
Mean % solids/lipid content	0.14						4.59				

CN = cunner, HC = hard clam, IBM = indigenous blue mussels, LOB = lobster, MM = *Mercenaria mercenaria*, PM = *Pitar morrhuana*, MF = mummichog.

Table A-2.4. Concentrations of selected contaminants in tissues of prey in the Derecktor Shipyard/Coddington Cove study area available for consumption by avian predators and subsistence fishermen[1].

Class	Analyte	DSY-24-IBM	DSY-25-IBM	DSY-25-LOB	DSY-26-CN	DSY-26-DM	DSY-25-IBM	DSY-27-IBM	DSY-27-LOB	DSY-28-CN	DSY-28-DM	DSY-28-IBM	DSY-28-LOB	DSY-29-CN	DSY-29-DM	DSY-29-LOB	DSY-31-DM	DSY-31-PM	DSY-32-PM	DSY-33-DM	DSY-33-LOB	DSY-33-PM	DSY-34-PM	DSY-35-IBM	DSY-35-LOB
MET	Arsenic	10.22	12.56	28.64	3.64	5.32	9.22	6.68	17.19	4.89	15.81	2.69		7.67	9.94	28.66	5.21	9.36	4.92	12.43	22.25	5.88	8.62	6.23	18.23
MET	Cadmium	1.86	1.21	0.36	0.83	0.94	0.73	0.77	0.26	1.09	0.77	0.62		1.15	0.81	0.47	0.64	0.78	0.69	0.93	0.16	0.66	0.71	0.73	0.50
MET	Chromium	3.15	3.00	1.68	1.39	2.16	2.44	2.80	2.11	0.94	2.39	2.64		1.18	2.02	1.71	2.29	1.98	1.74	2.53	1.99	1.85	2.13	2.22	2.16
MET	Copper	4.16	11.94	152	17.48	13.28	7.69	14.80	167	15.30	19.98	1.13		21.81	5.32	100	8.91	14.39	10.92	8.44	60.35	8.64	10.14	7.50	128
MET	Lead	5.81	3.00E-04	0.16	0.79	1.36	3.00E-04	3.02	0.07	3.00E-04	3.00E-04	3.00E-04		0.81	0.94	0.22	1.34	1.74	2.77	1.47	0.47	3.00E-04	1.68	1.75	0.78
MET	Mercury	0.28	0.17	0.26	0.13	0.16	0.12	0.15	0.45	0.10	0.13	0.14		0.17	0.17	0.29	0.15	0.14	0.16	0.10	0.23	0.12	0.12	0.17	0.27
MET	Nickel	5.44	3.43	1.52	1.02	1.82	3.00E-04	4.74	1.20	1.29	4.87	3.00E-04		1.74	2.87	1.74	2.07	3.99	2.17	1.74	1.74	3.00E-04	2.11	3.00E-04	0.91
MET	Silver	1.00E-04	1.00E-04	5.47	0.52	1.00E-04	1.00E-04	1.00E-04	0.87	0.31	1.18	1.00E-04		1.00E-04	1.00E-04	6.94	1.00E-04	1.00E-04	1.38	1.00E-04	3.43	1.00E-04	1.00E-04	1.00E-04	8.54
MET	Zinc	76.33	112	87.87	41.51	103	80.87	142	113	26.47	95.25	121		28.54	74.94	129	164	87.34	113	122	106	102	92.42	130	110
MET	SEM/AVS																								
PAH	1,6,7-Trimethylnaphthalene	3.76	3.76	3.76	3.76	3.76	3.76	19.18	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76
PAH	1-Methylnaphthalene		14.87	5.67	5.67	5.67	5.67	5.67	5.27	12.46	5.67	5.67	13.26	32.77	5.67	9.85	5.67	5.67	5.67	5.67	11.58	5.67	5.67	5.67	
PAH	1-Methylphenanthrene	8.52	20.00	9.05	9.05	9.05	36.34	49.75	44.61	1210	9.05	9.05	83.72	32.56	9.05	78.63	9.05		40.70	9.05	99.91	159	125	9.89	9.05
PAH	2,6-Dimethylnaphthalene	43.87	13.81	5.25	5.25	26.95	16.69	24.70	5.25	5.25	6.25	5.25	12.56	5.25	47.15	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	19.25	5.25
PAH	2-Methylnaphthalene		28.67	9.40	9.40	9.40	9.40	9.40	7.65	14.12	9.40	9.40	12.28	23.85	9.40	14.88	9.40	9.40	9.40	9.40	13.77	9.40	9.40	9.40	
PAH	Acenaphthene	2.65	15.68	2.65	28.90	57.31	2.65	2.65	32.54	45.70	2.65	2.65	2.65	39.49	151	2.85	2.65	2.65	2.65	2.65	2.65	2.83	2.65	2.65	2.65
PAH	Acenaphthylene	11.61	74.60	2.89	2.89	49.62	89.51	59.11	2.89	3.91	2.89	34.78	2.89	2.89	31.21	2.88	2.89	2.89	13.52	2.89	2.89	2.89	2.89	2.89	2.89
PAH	Anthracene	17.73	184	8.00	8.00	64.97	237	167	8.21	5.95	23.68	69.19	4.15	6.15	40.24	8.00	33.41	30.36	27.53	8.00	8.00	13.37	19.82	25.48	3.11
PAH	Benzo(a)anthracene	15.26	291	3.36	12.70	75.61	1040	290	28.01	42.87	42.26	71.77	24.30	3.36	53.86	3.36	56.92	133	79.21	3.36	3.36	35.25	46.15	31.11	3.36
PAH	Benzo(a)pyrene	7.91	115	3.62	19.10	3.62	548	73.10	28.73	1.58	3.62	33.86	24.95	11.98	3.62	13.09	3.62	44.99	42.80	3.62	3.62	22.19	22.44	3.62	3.62
PAH	Benzo(b)fluoranthene	43.30	661	8.20	48.20	120	2316	393	60.86	6.20	78.69	128	58.37	28.97	70.97	23.65	89.30	129	94.37	6.20	22.87	35.59	48.65	88.03	6.20
PAH	Benzo(g,h,i)perylene	36.94	274	3.90	21.70	99.63	820	234	20.01	3.90	60.79	108	20.12	3.90	59.32	9.66	45.64	3.90	3.90	3.90	11.69	3.90	3.90	52.26	3.90
PAH	Benzo(k)fluoranthene	20.84	48.05	1.58	19.50	1.58	148	29.20	8.21	1.58	1.58	1.58	11.71	1.58	1.58	12.67	1.58	26.77	34.22	1.58	1.58	13.25	11.20	14.16	1.58
PAH	Biphenyl	5.70	11.63	5.70	14.20	5.70	5.70	12.89	5.70	7.40	5.70	5.70	8.09	6.31	5.70	5.70	5.70	5.70	6.70	5.70	14.24	5.70	5.70	5.70	5.70
PAH	Chrysene	20.78	301	5.28	15.40	88.45	826	297	30.79	32.18	29.40	85.89	38.59	5.26	37.35	5.28	38.25	67.37	59.73	5.28	5.26	42.27	24.42	40.24	5.26
PAH	Dibenz(a,h)anthracene	7.62	13.54	0.49	0.49	0.49	49.67	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.40	0.49	0.49
PAH	Fluoranthene	59.94	741	100	31.90	343	1319	1169	98.46	24.84	118	246	72.90	38.51	171	38.03	119	179	152	87.34	32.14	57.16	73.39	105	32.98
PAH	Fluorene	6.88	29.69	1.95	24.10	1.95	30.37	39.15	1.95	37.92	1.95	25.14	1.95	25.80	1.95	14.92	1.95	1.95	1.95	1.95	1.95	5.19	5.21	11.62	1.95
PAH	Indeno(1,2,3-c,d)pyrene	11.87	35.47	1.54	14.20	1.54	121	26.78	8.64	1.54	1.54	1.54	1.54	1.54	1.54	10.57	1.54	20.43	26.87	1.54	1.54	8.78	7.89	10.38	1.54
PAH	Naphthalene		136	1.68	1.68	1.68	183	1.68	12.00	1.68	1.68	1.68	12.00	1.68	1.68	18.42	1.68	1.68	1.68	1.68	35.20	1.68	1.68	1.68	
PAH	Perylene		81.99	3.50	3.50	3.50	184		10.78	2.63	3.50		11.09	3.23	3.50	3.50	3.50		10.34	3.50	3.50	6.32	3.91		3.50
PAH	Phenanthrene	23.91	152	9.45	40.30	77.74	227	272	20.07	30.76	43.94	114	32.15	47.32	47.36	28.17	40.99	23.80	28.75	9.45	19.84	14.31	35.14	41.71	13.19
PAH	Pyrene	48.22	306	95.84	21.30	271	1040	819	93.01	24.70	117	175	124	36.39	163	69.49	117	187	182	88.38	53.14	55.57	77.45	78.56	24.59
PAH	LMW PAHs	62.67	619	36.02	115	273	782	551	85.31	140	86.18	256	68.07	147	282	90.93	92.86	72.72	85.49	36.02	84.30	49.66	76.79	95.41	23.78
PAH	HMW PAHs	169	1955	109	101	762	4814	2638	289	127	309	613	285	99.01	429	131	337	621	516	188	99.01	213	244	259	70.20
PAH	Total PAHs	384	3639	186	322	1250	6020	3970	508	1500	510	1090	565	331	872	344	543	850	812	176	302	470	501	505	74.00
PCB	Total PCBs	612	528	469	2200	1700	931	1150	748	3870	689	992	861	3170	868	355	766	951	367	636	469	524	311	696	317
PST	Aldrin	0.15	0.15	0.15	0.40	0.16	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.16	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
PST	Hexachlorobenzene	0.15	0.15	0.23	0.15	40.52	0.15	0.15	1.12	0.15	0.15	0.15	1.16	0.15	2.30	1.18	0.15	0.97	0.34	0.15	0.49	1.14	0.52	0.15	1.26
PST	Mirex	3.55	0.46	0.76		5.32	2.24	2.02	1.24		3.02	3.69	0.65		2.08	1.07	3.66	0.48	1.09	2.70	1.55	0.66	0.66	1.32	0.59
PST	p,p'-DDE	4.23	4.77	0.15	3.62	11.43	5.64	8.95	0.15	5.47	13.00	5.81	0.15	3.20	10.75	0.15	15.16	3.83	0.15	10.23	0.15	0.15	0.15	3.94	0.15
PST	p,p'-DDE	7.85	4.85	5.88	29.10	12.65	7.56	11.60	8.43	44.83		7.30	9.80	67.05	15.68	6.31	14.54	2.99	2.62	12.98	6.64	3.80	1.52	12.15	4.88
Total	Mercury	13.62	25.04	3.00	10.53	32.71	19.88	977	3.00	33.45	11.00	49.08	3.00	34.52	18.06	3.00	9.60	47.81		20.56	3.00	53.80	39.25	9.18	3.00

units: metals (µg/g); organics (ng/g dry wt)

[1] Tissue concentration data as reported in Derecktor Shipyard ERA, Appendix A-1-3 (SAIC and URI, 1997)

Table A-2.4 (continued). Concentrations of selected contaminants in tissues of prey in the Derecktor Shipyard/Coddington Cove study area available for consumption by avian predators and subsistence fishermen[1].

Class	Analyte	DSY-35-MM	DSY-35-PM	DSY-35-OM	DSY-36-IBM	DSY-36-LOB	DSY-36-PM	DSY-37-PM	DSY-38-DM	DSY-38-LOB	DSY-38-PM	DSY-39-DM	DSY-39-LOB	DSY-40-DM	DSY-40-IBM	DSY-41-MM	DSY-41-PM
MET	Arsenic	6.42	8.47	3.58	6.15	15.84	7.43	7.43	6.09	26.08	6.09	8.94	18.66	5.96	5.27	7.46	2.18
MET	Cadmium	0.64	0.66	0.97	0.39	3.00E-04	0.03	0.04	0.82	0.48	0.59	0.32	0.30	0.61	0.63	0.90	0.72
MET	Chromium	2.38	2.01	0.86	2.84	1.97	2.46	1.73	2.62	1.95	1.84	2.89	1.64	2.71	2.23	1.76	1.84
MET	Copper	6.42	8.43	15.64	7.04	49.16	11.98	6.93	11.44	165	10.44	8.68	197	6.32	6.99	13.15	11.90
MET	Lead	3.00E-04	1.68	0.97	3.00E-04	0.34	2.18	2.97	1.93	0.28	3.00E-04	3.00E-04	0.18	2.97	2.44	1.81	3.00E-04
MET	Mercury	0.12	0.10	0.15	0.19	0.33	0.15	0.15	0.13	0.33	0.17	0.14	0.41	0.13	0.17	0.12	0.15
MET	Nickel	2.92	1.55	1.43	4.33	1.46	1.87	1.57	2.91	1.88	3.00E-04	3.34	1.46	3.43	3.00E-04	3.00E-04	1.98
MET	Silver	1.00E-04	1.00E-04	1.00E-04	1.00E-04	2.87	1.00E-04	0.85	1.72	6.10	1.00E-04	0.99	0.82	1.00E-04	1.00E-04	1.26	1.00E-04
MET	Zinc	111	125	54.89	84.58	116	121	105	89.39	171	131	131	129	117	105	65.75	83.67
MET	SEM-AVS																
PAH	1,6,7-Trimethylnaphthalene	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76
PAH	1-Methylnaphthalene	5.67	5.67				5.67			5.67	5.67	5.67	5.67	5.67	5.67	5.67	5.67
PAH	1-Methylphenanthrene	4.28	47.05	209	6.79	9.05	120	9.05	9.05	9.05	75.52	9.05	9.05	9.05	9.05	6.68	76.66
PAH	2,6-Dimethylnaphthalene	5.25	5.25	5.25	4.58	5.25	5.25	5.25	6.36	5.25	5.25	13.09	5.25	32.85	5.25	5.25	5.25
PAH	2-Methylnaphthalene	9.40	9.40				9.40			9.40	9.40	9.40	9.40	9.40	9.40	9.40	9.40
PAH	Acenaphthene	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	5.58	67.41	2.65	131	2.65	6.53	6.44
PAH	Acenaphthylene	2.89	2.89	2.89	15.30	2.89	2.89	2.89	11.89	2.89	5.40	32.51	2.89	49.97	72.04	4.58	9.54
PAH	Anthracene	9.00	6.00	8.00	28.00	5.29	29.88	10.14	11.90	2.84	10.66	8.00	1.80	40.94	34.15	10.91	19.67
PAH	Benzo(a)anthracene	16.72	21.53		30.26	3.36	66.19	55.88	14.79	3.36	45.70	17.76	3.36	42.12	24.89		41.39
PAH	Benzo(a)pyrene	8.97	16.15	3.62	12.53	3.62	32.32	23.14	8.07	3.62	20.67	3.62	3.62	3.62	6.24	11.08	17.34
PAH	Benzo(b)fluoranthene	9.17	16.37	6.20	70.95	30.77	90.62	58.08	32.66	6.20	40.49	6.20	6.20	6.20	65.47	13.26	22.82
PAH	Benzo(e)pyrene	1.81	3.70	3.90	18.57	3.90	3.90	8.20	30.75	3.90	3.90	44.38	3.90	48.57	47.00	3.05	3.00
PAH	Benzo(g,h,i)perylene	1.56	1.56	1.56	10.06	1.56	14.82	28.35	1.56	1.56	12.83	23.08	1.56	1.56	1.56	3.71	1.56
PAH	Benzo(k)fluoranthene																
PAH	Biphenyl	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70
PAH	Chrysene	6.82	11.18		40.52	5.26	61.24	37.63	14.40	5.26	27.97	19.70	5.26	22.76	29.48		31.39
PAH	Dibenz(a,h)anthracene	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	33.16	0.49	0.49	0.49	0.49	0.49
PAH	Fluoranthene	47.51	89.25	19.44	105	38.05	124	74.78	38.98	16.55	43.50	40.91	9.23	144	105	60.50	78.70
PAH	Fluorene	2.89	5.49	19.96	6.01	1.95	1.95	1.95	1.95	1.95	4.74	1.95	1.95	1.95	14.34	3.92	7.95
PAH	Indeno(1,2,3-cd)pyrene	1.54	1.54	1.54	5.99	1.54	10.99	1.54	1.54	1.54	9.15	27.66	1.54	1.54	1.54	1.54	1.54
PAH	Naphthalene	1.68	1.68				1.68			1.68	1.68	1.68	1.68	1.68	16.08	1.68	1.68
PAH	Perylene	12.81	18.13	10.44		3.50	16.58	25.61	1.44	3.50	4.05	3.50	3.50	3.50		12.41	13.51
PAH	Phenanthrene	18.55	29.29	18.65	28.31	18.64	31.69	27.39	19.48	10.06	9.19	9.46	7.46	68.90	59.34	13.31	16.35
PAH	Pyrene	35.55	54.92	48.77	85.28	43.14	116	63.17	43.21	9.04	43.25	43.31	10.56	124	81.47	85.47	83.17
PAH	LMW PAHs	48.06	57.00	52.14	80.27	31.32	80.23	45.02	46.87	31.46	46.85	130	27.82	303	168	50.22	70.03
PAH	HMW PAHs	113	174	72.31	274	84.52	390	275	120	39.32	182	158	32.52	337	248	148	253
PAH	Total PAHs	162	267	326	488	136	704	430	233	39.00	358	363	29.00	704	495	223	428
PCB	Total PCBs	156	404	3130	895	840	493	427	549	291		461	643	556	912	251	274
PST	Aldrin	0.15	0.15	0.97	0.15	0.15	0.15		0.15	0.15		0.15	0.15	0.15	0.15	0.15	0.15
PST	Hexachlorobenzene	0.16	0.71	0.15	0.15	0.42	2.82		0.67	0.58		0.93	0.03	0.48	0.15	0.15	0.58
PST	Mirex		0.06		2.94	0.35	0.41	0.20	5.54	0.30		3.21	0.81	2.24	2.83		0.40
PST	o,p' DDE	1.11	0.15	1.84	4.05	3.69	2.60	2.09	7.09	0.15		9.84	7.09	5.42	5.08	0.15	1.82
PST	p,p'-DDE	1.97	4.75	53.56	8.10	4.10	2.88	2.93	8.84	7.06		9.82	2.39	9.96	10.37	4.33	1.81
Total	Total	39.10		12.57	36.48	3.00	67.14		8.32	3.00		9.66	3.00	3.00	31.70	30.61	

units: metals (µg/g); organics (ng/g dry wt)

1 - Tissue concentration data as reported in Derecktor Shipyard ERA, Appendix A-1-3 (SAIC and URI, 1997).

Table A-3.1A. Equilibrium-partitioning calculated concentrations of organic contaminants in sediment porewaters from the Derecktor Shipyard/Coddington Cove study area[1].

Class	Analyte[2,3,4,5]	Logkoc[2]	DSY-25	DSY-26	DSY-27	DSY-28	DSY-29	DSY-30	DSY-31	DSY-32	DSY-33	DSY-34	DSY-35	DSY-36	DSY-37	DSY-38	DSY-39	DSY-40	DSY-41
MET	Arsenic																		
MET	Cadmium																		
MET	Chromium																		
MET	Copper																		
MET	Lead																		
MET	Mercury																		
MET	Nickel																		
MET	Silver																		
MET	Zinc																		
MET	SEM AVS	NA	-21.70	-2.09	-164.35	-55.48	-175.56	-19.50	-47.27	-14.51	1.07	-28.69	-0.32	-35.50	0.38	-27.87	-19.24	-15.62	-3.21
PAH	1,6,7-Trimethylnaphthalene	4.53	0.01	8.88E-03	6.22E-03	6.16E-03	0.01	0.01	6.04E-03	8.49E-03	3.62E-03	4.09E-03	7.80E-04	5.32E-03	6.30E-03	3.86E-03	5.26E-03	9.32E-03	1.63E-03
PAH	1-Methylnaphthalene	3.90	0.08	0.07	0.07	0.06	0.10	0.18	0.07	0.06	0.04	0.05	7.53E-03	0.06	0.07	0.04	0.05	0.08	0.02
PAH	1-Methylphenanthrene	4.99	0.03	0.03	0.02	9.75E-03	0.05	0.03	8.55E-03	0.01	5.42E-03	5.84E-03	8.05E-04	9.72E-03	0.02	0.01	8.04E-03	0.03	2.77E-03
PAH	2,6-Dimethylnaphthalene	4.53	0.04	0.04	0.03	0.03	0.06	0.05	0.03	0.04	0.02	8.83E-03	8.14E-03	0.04	0.03	0.02	0.02	0.03	8.58E-03
PAH	2-Methylnaphthalene	3.90	0.08	0.12	0.11	0.14	0.15	0.29	0.12	0.11	0.07	0.10	0.01	0.08	0.10	0.05	0.07	0.14	0.03
PAH	Acenaphthene	3.85	0.33	0.12	0.09	0.06	0.44	0.73	0.06	0.06	0.03	0.04	5.24E-03	0.04	0.05	0.03	0.06	0.15	0.03
PAH	Acenaphthylene	3.58	0.44	0.67	0.40	0.19	0.52	0.25	0.19	0.38	0.07	0.09	0.01	0.22	0.16	0.09	0.09	0.68	9.92E-03
PAH	Anthracene	4.47	0.57	0.81	0.35	0.15	0.68	0.40	0.18	0.28	0.06	0.07	8.81E-03	0.15	0.21	0.10	0.10	0.54	0.05
PAH	Benzo(a)anthracene	5.60	0.05	0.09	0.05	0.02	0.11	0.05	0.02	0.03	7.51E-03	7.91E-03	1.13E-03	0.02	0.02	9.06E-03	8.55E-03	0.04	4.23E-03
PAH	Benzo(a)pyrene	6.01	0.02	0.03	0.02	9.28E-03	0.04	0.02	0.01	0.01	4.03E-03	4.57E-03	6.70E-04	8.89E-03	7.30E-03	3.86E-03	5.53E-03	0.02	2.26E-03
PAH	Benzo(b)fluoranthene	6.09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PAH	Benzo(e)pyrene	6.01	0.02	0.02	0.02	8.91E-03	0.03	0.02	0.01	0.01	3.77E-03	4.37E-03	8.11E-04	7.65E-03	6.22E-03	3.59E-03	4.87E-03	0.02	2.37E-03
PAH	Benzo(g,h,i)perylene	6.59	2.91E-03	3.55E-03	3.46E-03	1.60E-03	4.80E-03	3.09E-03	1.45E-03	2.08E-03	7.86E-04	7.95E-04	1.75E-04	1.43E-03	1.48E-03	7.99E-04	9.83E-04	3.24E-03	3.90E-04
PAH	Benzo(k)fluoranthene	6.09	0.04	0.05	0.05	0.02	0.07	0.03	0.02	0.02	7.52E-03	8.90E-03	1.44E-03	0.02	0.01	6.80E-03	9.53E-03	0.05	4.89E-03
PAH	Biphenyl	3.09	0.05	0.06	0.05	0.04	0.08	0.08	0.05	0.06	0.02	0.03	9.89E-03	0.04	0.03	0.02	0.03	0.05	0.01
PAH	Chrysene	5.60	0.07	0.10	0.08	0.02	0.12	0.05	0.03	0.03	8.83E-03	0.01	1.49E-03	0.02	0.02	8.70E-03	0.01	0.08	6.35E-03
PAH	Dibenz(a,h)anthracene	6.58	9.06E-04	1.11E-03	9.35E-04	4.40E-04	1.40E-03	9.10E-04	4.34E-04	5.36E-04	1.98E-04	2.21E-04	4.01E-05	3.62E-04	3.45E-04	1.02E-04	2.84E-04	9.52E-04	1.04E-04
PAH	Fluoranthene	5.03	0.26	0.43	0.20	0.11	0.77	0.38	0.10	0.14	0.05	0.06	0.01	0.09	0.11	0.07	0.08	0.49	0.04
PAH	Fluorene	4.14	0.18	0.27	0.12	0.08	0.36	0.34	0.05	0.05	0.03	0.03	6.90E-03	0.04	0.03	0.02	0.04	0.09	0.02
PAH	Indeno(1,2,3-cd)pyrene	6.54	3.19E-03	4.13E-03	3.69E-03	1.61E-03	4.93E-03	3.05E-03	1.65E-03	2.14E-03	7.92E-04	8.51E-04	1.50E-04	1.46E-03	1.32E-03	7.59E-04	1.04E-03	3.27E-03	4.10E-04
PAH	Naphthalene	3.39	0.50	0.55	0.56	0.47	0.63	1.79	0.59	0.59	0.33	0.35	0.05	0.48	0.61	0.38	0.46	0.71	0.11
PAH	Perylene	5.85	8.55E-03	0.01	7.55E-03	3.75E-03	0.01	6.18E-03	4.16E-03	4.76E-03	1.63E-03	2.17E-03	3.91E-04	3.11E-03	2.72E-03	1.88E-03	2.30E-03	6.04E-03	1.02E-03
PAH	Phenanthrene	4.47	0.54	0.73	0.30	0.19	0.90	1.13	0.19	0.17	0.09	0.12	0.02	0.13	0.13	0.07	0.15	0.70	0.08
PAH	Pyrene	5.02	0.31	0.48	0.50	0.15	0.84	0.44	0.21	0.24	0.08	0.07	0.01	0.13	0.16	0.08	0.08	0.77	0.06
PAH	LMW PAHs		2.40	2.58	1.70	1.20	3.44	5.02	1.34	1.44	0.70	0.79	0.13	1.07	1.27	0.74	0.99	2.52	0.36
PAH	HMW PAHs		0.73	1.16	0.87	0.32	1.92	0.94	0.37	0.47	0.14	0.16	0.03	0.28	0.32	0.19	0.20	1.42	0.12
PAH	Total PAHs		3.13	3.74	2.56	1.52	5.35	5.97	1.71	1.91	0.84	0.95	0.16	1.34	1.59	0.92	1.18	3.95	0.48
PCB	Total PCBs	6.43	4.40E-03	4.74E-03	0.05	1.70E-03	2.41E-03	4.47E-03	3.97E-03	3.73E-03	1.53E-03	1.10E-03	1.17E-03	1.80E-03	2.49E-03	1.08E-03	1.21E-03	2.39E-03	1.85E-03
PST	Alpha	6.39	2.29E-06	2.77E-06	1.10E-06	1.02E-06	6.79E-07	1.09E-06	1.08E-06	1.14E-06	2.46E-06	1.28E-06	6.68E-06	1.15E-06	1.84E-06	1.33E-06	1.80E-06	2.77E-06	5.03E-06
PST	Hexachlorobenzene	5.76	7.29E-06	1.31E-05	5.36E-06	2.24E-06	4.22E-06	3.42E-06	3.38E-06	3.63E-06	7.81E-06	4.08E-06	2.13E-05	3.65E-06	5.87E-06	4.22E-06	5.09E-06	8.82E-06	1.60E-05
PST	Mirex	6.77	9.47E-07	2.15E-06	1.18E-06	7.12E-07	2.81E-07	2.24E-06	1.44E-05	3.34E-06	1.02E-06	1.56E-06	2.76E-06	1.75E-06	2.76E-06	1.89E-06	8.81E-07	2.61E-06	2.08E-06
PST	o,p' DDE	6.69	1.27E-06	2.34E-05	3.97E-04	9.44E-06	1.87E-05	3.38E-05	2.14E-05	1.65E-06	8.63E-06	6.37E-06	9.58E-06	1.58E-06	1.02E-06	7.37E-07	6.33E-08	1.64E-05	1.11E-05
PST	p,p' DDE	6.69	1.11E-05	9.35E-05	4.26E-05	1.15E-05	2.37E-05	2.85E-05	1.15E-05	1.51E-05	5.70E-06	6.82E-06	9.27E-07	1.66E-05	1.38E-05	8.53E-06	6.50E-06	1.75E-05	2.15E-06
TOC	% TOC		1.78	1.47	3.72	4.01	6.03	3.76	3.84	3.57	1.66	3.18	0.61	3.54	2.21	3.07	2.55	1.47	0.81

1 - Porewater concentration (µg/L) = sediment concentration/(foc X Koc),(foc=%TOC/100).

2 - See Table A-1 for Koc values

3 - sum of Low Molecular Weight P: 1-Methylnaphthalene, 1-Methylphenanthrene, 2,6-Dimethylnaphthalene, 2-Methylnaphthalene, Acenaphthene, Anthracene, Biphenyl, Fluorene, Naphthalene, and Phenanthrene.

4 - sum of High Molecular Weight P: Benzo(a)anthracene, Benzo(a)pyrene, Benzo(e)pyrene, Chrysene, Dibenz(a,h)anthracene, Fluoranthene, Perylene, and Pyrene.

5 - Total PAHs - sum of LMW & HMW PAHs

6 - Sum of individual PCB congeners x 2, see Table A-3.1b

Table A-3 1B Concentrations of PCB congeners and calculation of Total PCBs in surface sediment (0-15 cm) collected in the Derecktor Shipyard/Coddington Cove study area.

PCB CONGENERS

ERA investigation.

Class	Analyte	$Log_{10}Koc$	DSY-25	DSY-26	DSY-27	DSY-28	DSY-29	DSY-30	DSY-31	DSY-32	DSY-33	DSY-34	DSY-35	DSY-36	DSY-37	DSY-38	DSY-39	DSY-40	DSY-41
PCB	PCB101	6.27	1.94E-04	2.08E-04	3.16E-03	7.34E-05	1.47E-04	2.68E-04	1.77E-04	2.14E-04	5.60E-05	4.83E-05	4.49E-05	1.01E-04	1.54E-04	4.87E-05	4.37E-05	1.42E-04	3.39E-05
PCB	PCB105	6.54	2.64E-06	3.59E-05	1.07E-03	1.48E-05	3.15E-05	5.39E-05	3.32E-05	2.14E-05	9.84E-06	7.24E-06	1.66E-06	1.12E-05	1.85E-05	5.44E-06	6.09E-06	3.04E-05	3.83E-06
PCB	PCB118	6.63	6.65E-05	9.96E-05	1.54E-03	4.18E-05	7.15E-05	1.22E-04	8.47E-05	7.48E-05	3.34E-05	2.61E-05	5.24E-06	4.08E-05	5.67E-05	1.91E-05	2.09E-05	7.76E-05	1.06E-05
PCB	PCB126	6.63	1.81E-06	2.15E-05	4.63E-04	1.11E-05	2.00E-05	3.90E-05	1.89E-05	2.08E-05	7.84E-06	6.49E-06	1.36E-06	1.24E-05	1.89E-05	6.41E-06	5.59E-06	2.27E-05	6.72E-06
PCB	PCB138	6.71	6.39E-05	9.45E-05	1.37E-03	5.23E-05	8.57E-05	1.35E-04	8.09E-05	8.20E-05	3.36E-05	2.95E-05	4.43E-06	4.94E-05	6.46E-05	3.22E-05	3.13E-05	9.27E-05	1.40E-05
PCB	PCB153	6.80	3.85E-05	6.58E-05	7.35E-04	3.92E-05	5.90E-05	8.53E-05	5.91E-05	5.40E-05	2.59E-05	2.38E-05	5.33E-06	3.55E-05	4.17E-05	2.28E-05	2.73E-05	6.25E-05	1.01E-05
PCB	PCB170	7.15	3.56E-06	7.43E-06	8.45E-05	5.56E-06	8.49E-06	1.18E-05	7.10E-06	4.60E-06	3.42E-06	3.12E-06	1.51E-06	3.52E-06	4.53E-06	3.11E-06	4.24E-06	8.24E-06	1.48E-06
PCB	PCB18	5.15	2.63E-04	3.76E-04	1.58E-03	7.92E-05	7.91E-05	2.42E-04	2.47E-04	1.79E-04	1.12E-04	5.22E-05	1.74E-05	9.79E-05	1.07E-04	1.56E-04	6.82E-05	1.62E-04	2.31E-04
PCB	PCB180	7.24	6.05E-06	1.08E-05	8.30E-05	8.37E-06	1.32E-05	1.78E-05	1.03E-05	7.37E-06	5.27E-06	4.51E-06	2.66E-06	5.24E-06	6.67E-06	4.76E-06	6.32E-06	1.36E-05	2.38E-06
PCB	PCB187	7.05	9.03E-06	1.17E-05	6.19E-05	8.78E-06	1.25E-05	1.66E-05	1.09E-05	1.07E-05	6.43E-06	5.30E-06	1.14E-06	8.57E-06	9.69E-06	5.55E-06	6.47E-06	1.37E-05	3.23E-06
PCB	PCB195	7.43	3.39E-07	1.27E-06	2.91E-06	8.90E-07	2.33E-06	9.82E-07	1.73E-06	5.53E-07	4.16E-07	5.74E-07	5.55E-07	3.38E-07	3.08E-07	3.25E-07	8.30E-07	1.40E-06	7.57E-07
PCB	PCB206	7.95	9.46E-07	1.61E-06	2.23E-06	8.66E-07	3.18E-06	1.84E-06	1.26E-06	8.38E-07	7.50E-07	6.34E-07	7.97E-07	7.01E-07	1.40E-06	4.05E-07	8.42E-07	1.80E-06	9.46E-07
PCB	PCB209	8.04	4.65E-07	1.26E-06	1.23E-06	9.05E-07	1.57E-05	1.63E-06	1.07E-06	1.10E-06	7.06E-07	5.66E-07	5.68E-07	6.14E-07	1.28E-06	4.60E-07	7.38E-07	1.75E-06	8.84E-07
PCB	PCB28	5.57	3.07E-04	2.28E-04	9.24E-04	9.95E-05	7.27E-05	1.79E-04	2.55E-04	1.95E-04	9.14E-05	7.33E-05	1.04E-04	9.56E-05	9.22E-05	4.88E-05	8.28E-05	1.20E-04	6.67E-05
PCB	PCB44	5.65	2.54E-04	2.98E-04	3.88E-03	8.14E-05	1.44E-04	2.63E-04	2.14E-04	1.61E-04	7.18E-05	5.93E-05	1.32E-04	7.00E-05	1.06E-04	3.41E-05	8.11E-05	1.21E-04	1.41E-04
PCB	PCB52	5.74	3.26E-04	4.46E-04	6.35E-03	1.29E-04	2.89E-04	4.41E-04	3.42E-04	2.25E-04	1.05E-04	7.82E-05	1.52E-04	7.00E-05	1.72E-04	4.17E-05	8.55E-05	1.81E-04	1.63E-04
PCB	PCB66	5.09	2.77E-04	8.67E-05	3.87E-03	3.31E-05	5.10E-05	1.99E-05	5.69E-05	2.54E-04	2.20E-05	2.23E-05	1.62E-05	1.21E-04	1.73E-04	5.45E-05	2.83E-05	3.87E-05	2.35E-05
PCB	PCB8	4.36	3.45E-04	3.76E-04	1.57E-03	1.72E-04	1.02E-04	3.34E-04	3.87E-04	3.58E-04	1.79E-04	1.07E-04	9.35E-05	1.74E-04	2.15E-04	5.71E-05	1.05E-04	1.03E-04	2.13E-04
PCB	SUMPCB	0	2.29E-03	2.37E-03	2.68E-02	8.52E-04	1.21E-03	2.23E-03	1.99E-03	1.87E-03	7.65E-04	5.48E-04	5.85E-04	8.99E-04	1.24E-03	5.42E-04	6.05E-04	1.20E-03	9.27E-04
PCB	TOTPCB	0	4.40E-03	4.74E-03	5.35E-02	1.70E-03	2.41E-03	4.47E-03	3.97E-03	3.73E-03	1.53E-03	1.10E-03	1.17E-03	1.80E-03	2.49E-03	1.08E-03	1.21E-03	2.39E-03	1.85E-03
TOC	% TOC		1.79	1.47	3.73	4.01	6.09	3.79	3.84	3.57	1.66	3.18	0.61	3.55	2.21	3.08	2.55	1.48	0.81

Units: µg/L

SUMPCB = Sum of congener concentrations

TOTPCB = Total PCBs = SUMPCB x 2

* Porewater concentration (µg/L) = sediment concentration/(foc X K_{oc}) The foc=%TOC/100; sediment PCB congener concentrations reported in Table A-2.1c.

2 See Table A-1 for Koc values

Table A-3.2. Hazard Quotients calculated for CoCs in sediment porewaters from the Derecktor Shipyard/Coddington Cove study area[1]

Class	Analyte	WQSV[2]	DSY-25	DSY-26	DSY-27	DSY-28	DSY-29	DSY-30	DSY-31	DSY-32	DSY-33	DSY-34	DSY-35	DSY-36	DSY-37	DSY-38	DSY-39	DSY-40	DSY-41
MET	Arsenic	36.00																	
MET	Cadmium	9.30																	
MET	Chromium	50.00																	
MET	Copper	2.90																	
MET	Lead	8.50																	
MET	Mercury	0.03																	
MET	Nickel	8.30																	
MET	Silver	0.92																	
MET	Zinc	86.00																	
MET	SEM AVS	5.00	-4.34	-0.58	-32.87	-11.10	-35.12	-3.90	-9.45	-2.90	0.21	-5.82	-0.06	-7.10	0.08	-5.57	-3.85	-3.32	-0.64
PAH	1,6,7-Trimethylnaphthalene																		
PAH	1-Methylnaphthalene																		
PAH	1-Methylphenanthrene																		
PAH	2,6-Dimethylnaphthalene																		
PAH	2-Methylnaphthalene	0.88	0.09	0.13	0.13	0.16	0.17	0.33	0.14	0.13	0.08	0.11	0.02	0.09	0.11	0.08	0.08	0.16	0.04
PAH	Acenaphthene	710	4.83E-04	1.64E-04	1.27E-04	8.50E-05	6.20E-04	1.03E-03	8.81E-05	7.90E-05	3.94E-05	5.31E-05	7.36E-06	6.13E-05	6.82E-05	4.20E-05	7.86E-05	2.17E-04	4.17E-05
PAH	Acenaphthylene	0.46	0.97	1.45	0.87	0.42	1.14	0.55	0.42	0.84	0.16	0.21	0.02	0.48	0.35	0.19	0.20	1.46	0.02
PAH	Anthracene	0.29	1.99	2.14	1.21	0.54	2.38	1.41	0.61	0.98	0.22	0.24	0.03	0.52	0.75	0.36	0.35	1.87	0.16
PAH	Benzo(a)anthracene	0.07	0.71	1.35	0.83	0.28	1.72	0.70	0.28	0.42	0.12	0.12	0.02	0.24	0.25	0.14	0.15	0.81	0.07
PAH	Benzo(a)pyrene	0.04	0.52	0.69	0.58	0.22	0.92	0.50	0.25	0.32	0.10	0.11	0.02	0.21	0.17	0.08	0.13	0.50	0.05
PAH	Benzo(b)fluoranthene																		
PAH	Benzo(e)pyrene																		
PAH	Benzo(g,h,i)perylene																		
PAH	Benzo(k)fluoranthene																		
PAH	Biphenyl																		
PAH	Chrysene	0.13	0.71	1.05	0.64	0.24	1.22	0.49	0.27	0.36	0.09	0.10	0.02	0.21	0.18	0.09	0.12	0.79	0.07
PAH	Dibenz(a,h)anthracene	1.85E-03	0.54	0.08	0.56	0.26	0.83	0.54	0.26	0.32	0.12	0.13	0.02	0.22	0.21	0.11	0.17	0.57	0.08
PAH	Fluoranthene	16.00	7.02	0.03	0.01	6.52E-03	0.05	0.02	6.02E-03	8.66E-03	3.32E-03	3.78E-03	6.85E-04	5.64E-03	6.87E-03	4.34E-03	4.90E-03	0.03	2.70E-03
PAH	Fluorene	0.14	1.30	1.93	0.87	0.41	2.58	2.45	0.39	0.38	0.21	0.23	0.05	0.27	0.23	0.11	0.30	0.68	0.14
PAH	Indeno(1,2,3-cd)pyrene																		
PAH	Naphthalene	620	5.11E-04	8.82E-04	9.31E-04	7.51E-04	1.02E-03	2.88E-03	9.47E-04	9.59E-04	5.25E-04	5.62E-04	6.67E-05	7.72E-04	9.76E-04	6.07E-04	7.45E-04	1.15E-03	1.82E-04
PAH	Perylene																		
PAH	Phenanthrene	0.61	0.68	0.90	0.38	0.23	1.12	1.40	0.23	0.21	0.12	0.14	0.03	0.16	0.16	0.09	0.19	0.86	0.10
PAH	Pyrene	0.63	0.49	0.76	0.79	0.24	1.33	0.60	0.33	0.39	0.10	0.12	0.02	0.20	0.25	0.12	0.13	1.22	0.09
PAH	LMW PAHs		4.05	5.10	2.58	1.34	6.26	5.60	1.37	1.70	0.63	0.72	0.12	1.05	1.25	0.63	0.93	3.57	0.44
PAH	HMW PAHs		2.98	4.53	3.41	1.25	6.07	2.95	1.40	1.81	0.52	0.59	0.09	1.09	1.06	0.56	0.71	3.71	0.34
PAH	Total PAHs		7.03	9.63	5.99	2.58	12.33	8.55	2.77	3.51	1.15	1.31	0.21	2.13	2.31	1.18	1.64	7.28	0.78
PCB	Total PCBs	0.03	0.15	0.16	1.78	0.06	0.08	0.15	0.13	0.12	0.05	0.04	0.04	0.06	0.08	0.04	0.04	0.08	0.08
PST	Aldrin	0.16	1.40E-05	1.70E-05	6.72E-08	6.24E-06	4.17E-06	6.60E-06	6.51E-06	7.00E-06	1.51E-05	7.86E-06	4.10E-05	7.00E-06	1.13E-05	8.15E-06	9.81E-06	1.70E-05	3.09E-05
PST	Hexachlorobenzene	3.68	1.98E-06	3.55E-06	1.40E-06	6.03E-07	1.15E-06	9.30E-07	9.18E-07	9.87E-07	2.12E-06	1.11E-06	5.78E-06	9.96E-07	1.59E-06	1.15E-06	1.38E-06	2.40E-06	4.35E-06
PST	Mirex	1.00E-03	9.47E-04	2.15E-03	0.01	7.12E-04	2.81E-04	0.02	1.44E-03	3.34E-03	1.02E-03	1.56E-03	2.76E-03	1.75E-03	2.70E-03	1.89E-03	6.61E-04	2.81E-03	2.08E-03
PST	o,p'-DDE	1.00E-03	1.27E-03	0.02	0.40	8.44E-03	0.02	0.03	0.02	1.65E-03	6.63E-03	6.37E-03	9.58E-03	1.58E-03	1.02E-03	7.37E-04	6.33E-03	0.02	0.01
PST	p,p'-DDE	1.00E-03	0.01	9.35E-03	0.04	0.01	0.02	0.03	0.01	0.02	5.70E-03	6.82E-03	9.27E-04	0.02	0.01	9.53E-03	6.50E-03	0.02	2.15E-03

1 - Hazard Quotients calculated as EqP-calculated porewater concentration (Table A-3.1A)/WQSV

2 - Water Quality Screening Value (Table 4)

Table A-3.3A. Porewater Hazard Quotients[1] (PW-HQs) for Derecktor Shipyard Marine ERA stations exhibiting **NO TOXICITY**[2] to amphipods (*Ampelisca abdita*).

Class	Analyte	DSY-25	DSY-26	DSY-29	DSY-30	DSY-31	DSY-32	DSY-33	DSY-34	DSY-35	DSY-36	DSY-37	DSY-38	DSY-39	DSY-40	DSY-41	n	Mean	95% UCL[3]
MET	Arsenic																0		
MET	Cadmium																0		
MET	Chromium																0		
MET	Copper																0		
MET	Lead																0		
MET	Mercury																0		
MET	Nickel																0		
MET	Silver																0		
MET	Zinc																0		
MET	SEM:AVS	-4.34	-0.58	-35.12	-3.90	-9.45	-2.90	0.21	-5.62	-0.06	-7.10	0.08	-5.57	-3.85	-3.32	-0.04	15	-5.48	-0.07
PAH	1,6,7-Trimethylnaphthalene																0		
PAH	1-Methylnaphthalene																0		
PAH	1-Methylphenanthrene																0		
PAH	2,6-Dimethylnaphthalene																0		
PAH	2-Methylnaphthalene	0.09	0.13	0.17	0.33	0.14	0.13	0.08	0.11	0.02	0.09	0.11	0.06	0.08	0.16	0.04	15.00	0.12	0.16
PAH	Acenaphthene	4.65E-04	1.64E-04	6.20E-04	1.03E-03	8.81E-05	7.90E-05	3.94E-05	5.31E-05	7.38E-06	6.13E-05	6.62E-05	4.20E-05	7.86E-05	2.17E-04	4.17E-05	15.00	2.03E-04	3.60E-04
PAH	Acenaphthylene	0.97	1.45	1.14	0.55	0.42	0.84	0.16	0.21	0.02	0.48	0.35	0.19	0.20	1.48	0.02	15.00	0.56	0.84
PAH	Anthracene	1.99	2.14	2.38	1.41	0.61	0.98	0.22	0.24	0.03	0.52	0.75	0.36	0.35	1.87	0.16	15.00	0.93	1.38
PAH	Benzo(a)anthracene	0.71	1.35	1.72	0.70	0.28	0.42	0.12	0.12	0.02	0.24	0.25	0.14	0.15	0.61	0.07	15.00	0.46	0.73
PAH	Benzo(a)pyrene	0.52	0.69	0.92	0.50	0.25	0.32	0.10	0.11	0.02	0.21	0.17	0.09	0.13	0.50	0.05	15.00	0.31	0.45
PAH	Benzo(b)fluoranthene																0		
PAH	Benzo(e)pyrene																0		
PAH	Benzo(g,h,i)perylene																0		
PAH	Benzo(k)fluoranthene																0		
PAH	Biphenyl																0		
PAH	Chrysene	0.71	1.05	1.22	0.49	0.27	0.36	0.09	0.10	0.02	0.21	0.18	0.09	0.12	0.79	0.07	15.00	0.38	0.59
PAH	Dibenz(a,h)anthracene	0.54	0.66	0.83	0.54	0.26	0.32	0.12	0.13	0.02	0.22	0.21	0.11	0.17	0.67	0.06	15.00	0.32	0.45
PAH	Fluoranthene	0.02	0.03	0.05	0.02	6.02E-03	8.69E-03	3.32E-03	3.78E-03	6.85E-04	5.64E-03	6.87E-03	4.34E-03	4.90E-03	0.03	2.70E-03	15.00	0.01	0.02
PAH	Fluorene	1.30	1.93	2.58	2.45	0.39	0.38	0.21	0.23	0.05	0.27	0.23	0.11	0.30	0.68	0.14	15.00	0.75	1.23
PAH	Indeno(1,2,3-cd)pyrene																0		
PAH	Naphthalene	6.11E-04	8.82E-04	1.02E-03	2.86E-03	9.47E-04	9.59E-04	5.25E-04	5.62E-04	8.67E-05	7.72E-04	9.76E-04	6.07E-04	7.45E-04	1.15E-03	1.82E-04	15.00	8.73E-04	1.22E-03
PAH	Perylene																0		
PAH	Phenanthrene	0.63	0.90	1.12	1.40	0.23	0.21	0.12	0.14	0.03	0.16	0.16	0.09	0.19	0.86	0.10	15.00	0.42	0.67
PAH	Pyrene	0.49	0.76	1.33	0.69	0.33	0.39	0.10	0.12	0.02	0.20	0.25	0.12	0.13	1.22	0.09	15.00	0.42	0.64
PAH	LMW PAHs	4.05	5.10	6.25	5.60	1.37	1.70	0.63	0.72	0.12	1.05	1.25	0.63	0.93	3.57	0.44	15.00	2.23	3.38
PAH	HMW PAHs	2.98	4.53	6.07	2.95	1.40	1.81	0.52	0.59	0.09	1.09	1.06	0.56	0.71	3.71	0.34	15.00	1.89	2.87
PAH	Total PAHs	7.03	9.63	12.33	8.55	2.77	3.51	1.15	1.31	0.21	2.13	2.31	1.18	1.64	7.28	0.78	15.00	4.12	6.22
PCB	Total PCBs	0.15	0.16	0.08	0.15	0.13	0.12	0.05	0.04	0.04	0.06	0.08	0.04	0.04	0.08	0.06	15.00	0.09	0.11
PST	Aldrin	1.40E-05	1.70E-05	4.17E-06	6.60E-06	6.51E-06	7.00E-06	1.51E-05	7.86E-06	4.10E-05	7.06E-06	1.13E-05	8.15E-06	9.81E-06	1.70E-05	3.09E-05	15.00	1.36E-05	1.91E-05
PST	Hexachlorobenzene	1.98E-06	3.55E-06	1.15E-06	9.30E-07	9.18E-07	9.87E-07	2.12E-06	1.11E-06	5.78E-06	9.96E-07	1.59E-06	1.15E-06	1.38E-06	2.40E-06	4.35E-06	15.00	2.03E-06	2.83E-06
PST	Mirex	9.47E-04	2.15E-03	2.81E-04	0.02	1.44E-03	3.34E-03	1.02E-03	1.50E-03	2.76E-03	1.75E-03	2.76E-03	1.89E-03	0.61E-04	2.61E-03	2.08E-03	15.00	3.18E-03	6.14E-03
PST	o,p'-DDE	1.27E-03	0.02	0.02	0.03	0.02	1.65E-03	8.63E-03	6.37E-03	9.58E-03	1.58E-03	1.02E-03	7.37E-04	6.33E-03	0.02	0.01	15.00	0.01	0.02
PST	p,p'-DDE	0.01	9.35E-03	0.02	0.03	0.01	0.02	5.70E-03	6.62E-03	9.27E-04	0.02	0.01	9.53E-03	6.50E-03	0.02	2.15E-03	15.00	0.01	0.02

1 - Hazard Quotients from Table A-3.2

2 - Toxicity data contained in Derecktor Shipyard Marine ERA (SAIC and URI, 1997), Table 5-2-1

3 - 95% Upper Confidence Limit based on sample size as follows: Mean+($t_{0.95}$(df)*(STDEV/SQRT(n))), where STDEV=standard deviation; n=sample size; $t_{0.95}$(df)=sample size dependent percentage points of the t distribution (Ott, 1993)

Table A-3.3B. Porewater Hazard Quotients[1] (PW-HQs) for the Derecktor Shipyard Marine ERA stations exhibiting **TOXICITY**[2] to amphipods (*Ampelisca abdita*).

Class	Analyte	DSY-27	DSY-28	N	Mean	Maximum HQ
MET	Arsenic			0		
MET	Cadmium			0		
MET	Chromium			0		
MET	Copper			0		
MET	Lead			0		
MET	Mercury			0		
MET	Nickel			0		
MET	Silver			0		
MET	Zinc			0		
MET	SEM:AVS	-32.87	-11.10	2.00	-21.98	-11.10
PAH	1,6,7-Trimethylnaphthalene			0		
PAH	1-Methylnaphthalene			0		
PAH	1-Methylphenanthrene			0		
PAH	2,6-Dimethylnaphthalene			0		
PAH	2-Methylnaphthalene	0.13	0.16	2.00	0.14	0.16
PAH	Acenaphthene	1.27E-04	8.50E-05	2.00	1.06E-04	1.27E-04
PAH	Acenaphthylene	0.87	0.42	2.00	0.65	0.87
PAH	Anthracene	1.21	0.54	2.00	0.87	1.21
PAH	Benzo(a)anthracene	0.83	0.28	2.00	0.56	0.83
PAH	Benzo(a)pyrene	0.58	0.22	2.00	0.40	0.58
PAH	Benzo(b)fluoranthene			0		
PAH	Benzo(e)pyrene			0		
PAH	Benzo(g,h,i)perylene			0		
PAH	Benzo(k)fluoranthene			0		
PAH	Biphenyl			0		
PAH	Chrysene	0.64	0.24	2.00	0.44	0.64
PAH	Dibenz(a,h)anthracene	0.56	0.26	2.00	0.41	0.56
PAH	Fluoranthene	0.01	6.62E-03	2.00	9.55E-03	0.01
PAH	Fluorene	0.87	0.41	2.00	0.64	0.87
PAH	Indeno(1,2,3-cd)pyrene			0		
PAH	Naphthalene	9.01E-04	7.61E-04	2.00	8.26E-04	9.01E-04
PAH	Perylene			0		
PAH	Phenanthrene	0.38	0.23	2.00	0.30	0.38
PAH	Pyrene	0.79	0.24	2.00	0.52	0.79
PAH	LMW PAHs	2.58	1.34	2.00	1.96	2.58
PAH	HMW PAHs	3.41	1.25	2.00	2.33	3.41
PAH	Total PAHs	5.99	2.58	2.00	4.28	5.99
PCB	Total PCBs	1.78	0.06	2.00	0.92	1.78
PST	Aldrin	6.72E-06	6.24E-06	2.00	6.48E-06	6.72E-06
PST	Hexachlorobenzene	1.46E-06	6.09E-07	2.00	1.03E-06	1.46E-06
PST	Mirex	0.01	7.12E-04	2.00	6.23E-03	0.01
PST	o,p'-DDE	0.40	9.44E-03	2.00	0.20	0.40
PST	p,p'-DDE	0.04	0.01	2.00	0.03	0.04

1 - Hazard Quotients from Table A-3.2.

2 - Toxicity data contained in Derecktor Shipyard Marine ERA (SAIC and URI 1997), Table 5.2-1

Table A-4 1. Elutriate concentrations for sediments collected from the Derecktor Shipyard study area[1].

Class	Analyte[2]	DSY-25	DSY-26	DSY-27	DSY-28	DSY-29	DSY-30	DSY-31	DSY-32	DSY-33	DSY-34	DSY-35	DSY-36	DSY-37	DSY-38	DSY-39	DSY-40	DSY-41
MET	Arsenic	12.40						27.20	24.80	2.50			40.40	19.60	40.70	76.00	30.00	
MET	Cadmium	0.10						0.10	0.10	0.10			0.10	0.10	0.10	0.10	0.10	
MET	Chromium	0.40						0.40	0.40	0.40			0.40	0.40	0.40	0.40	0.40	
MET	Copper	1.25						5.10	1.25	1.25			1.25	1.25	1.25	1.25	1.25	
MET	Lead	9.40						8.50	9.40	15.90			8.30	12.90	10.70	14.60	9.00	
MET	Mercury	0.10						0.10	0.10	0.10			0.10	0.10	0.10	0.10	0.10	
MET	Nickel	4.00						4.00	4.00	4.00			4.00	4.00	4.00	4.00	4.00	
MET	Silver	0.25						0.25	0.25	0.25			0.25	0.25	0.25	0.25	0.25	
MET	Zinc	4.50						4.50	4.50	4.50			4.50	4.50	4.50	4.50	4.50	
MET	SEM-AVS	2.88	1.18	12.10	7.47	7.57	5.51	2.79	2.70	1.88	1.43	1.02	1.44	2.77	1.91	2.43	2.18	1.31
PAH	1,6,7-Trimethylnaphthalene																	
PAH	1-Methylnaphthalene																	
PAH	1-Methylphenanthrene																	
PAH	2,6-Dimethylnaphthalene																	
PAH	2-Methylnaphthalene	11.35						4.58	4.81	9.76			5.75	6.21	8.07	5.08	4.27	
PAH	Acenaphthene	27.69		1.95		3.95		2.22	2.65	2.22			1.97	1.70	2.07	2.13	2.45	
PAH	Acenaphthylene	12.65		1.70		1.70		2.89	3.92	6.82			2.99	1.60	1.11	2.18	4.84	
PAH	Anthracene	40.78				8.05		6.33	9.60	8.08			5.91	4.44	2.97	4.43	14.08	
PAH	Benzo(a)anthracene	46.47				42.13		8.77	7.50	11.94			6.56	4.53	3.78	4.82	12.15	
PAH	Benzo(a)pyrene	40.92		6.56		16.10		11.01	11.25	17.42			7.76	3.73	1.77	7.74	11.69	
PAH	Benzo(b)fluoranthene																	
PAH	Benzo(e)pyrene																	
PAH	Benzo(g,h,i)perylene																	
PAH	Benzo(k)fluoranthene																	
PAH	Biphenyl																	
PAH	Chrysene	31.67						3.85	4.17	12.12			4.55	3.25	2.38	3.98	5.80	
PAH	Dibenz(a,h)anthracene	8.25		11.50		11.50		1.99	4.51	3.80			0.59	1.40	11.50	11.50	1.61	
PAH	Fluoranthene	78.24		17.03		118		11.30	12.47	25.27			13.31	12.53	11.00	12.02	19.00	
PAH	Fluorene	24.80		6.15		6.15		1.62	2.18	4.75			1.99	1.84	2.40	1.96	1.82	
PAH	Indeno(1,2,3-cd)pyrene																	
PAH	Naphthalene	14.80						5.24	11.64	12.82			9.58	8.22	10.91	6.65	7.66	
PAH	Perylene																	
PAH	Phenanthrene	26.71		8.73		10.07		10.75	8.92	14.97			8.99	12.67	8.37	9.06	11.28	
PAH	Pyrene	327		203		311		87.72	79.89	31.70			33.60	27.37	14.17	14.49	274	
PAH	LMW PAHs	154		16.84		28.23		30.72	39.81	53.21			34.19	35.09	32.80	29.31	41.56	
PAH	HMW PAHs	433		238		499		125	120	102			66.37	52.82	44.60	54.55	325	
PAH	Total PAHs	586		255		527		155	160	155			101	87.90	77.39	83.85	368	
PCB	Total PCBs	77.02		59.45		54.32		56.60	39.09	26.02			26.26	37.43	19.20	25.87	36.66	
PST	Aldrin	1.60		0.88		0.94		1.60	1.60	1.60			1.60	1.60	1.60	1.60	1.60	
PST	Hexachlorobenzene	0.08		0.11		0.90		0.26	0.06	0.08			0.90	0.05	0.05	0.05	0.11	
PST	Mirex	0.40		0.09		0.71		0.60	0.13	0.60			0.60	0.09	0.10	0.05	0.10	
PST	o,p'-DDE	3.52		2.80		2.97		3.21	1.90	1.33			2.04	3.39	1.44	2.25	2.48	
PST	p,p'-DDE	0.42		0.42		0.63		0.64	0.30	0.31			0.39	0.71	0.25	0.61	0.59	

Units: metals - µg/L, organics- ng/L

1 - Elutriate concentration as reported in Derecktor Shipyard ERA, Appendix A-1-2 (SAIC, 1997)

2 - SEM concentration used; AVS assumed = 0 in resuspended sediment

Table A-4.2. Elutriate Hazard Quotients (ELU-HQs) for sediments collected from the Derecktor Shipyard study area[1].

Class	Analyte	WQSV[2]	DSY-25	DSY-26	DSY-27	DSY-28	DSY-29	DSY-30	DSY-31	DSY-32	DSY-33	DSY-34	DSY-35	DSY-36	DSY-37	DSY-38	DSY-39	DSY-40	DSY-41
MET	Arsenic	38.00	0.34						0.76	0.69	0.07			1.12	0.54	1.13	2.11	0.83	
MET	Cadmium	9.30	0.01						0.01	0.01	0.01			0.01	0.01	0.01	0.01	0.01	
MET	Chromium	53.00	8.00E-03						8.00E-03	8.00E-03	8.00E-03			8.00E-03	8.00E-03	8.00E-03	8.00E-03	8.00E-03	
MET	Copper	2.90	0.43						1.70	0.43	0.43			0.43	0.43	0.43	0.43	0.43	
MET	Lead	8.50	1.11						1.00	1.11	1.87			0.98	1.52	1.26	1.72	1.06	
MET	Mercury	0.03	4.00						4.00	4.00	4.00			4.00	4.00	4.00	4.00	4.00	
MET	Nickel	8.30	0.48						0.48	0.48	0.48			0.48	0.48	0.48	0.48	0.48	
MET	Silver	0.92	0.27						0.27	0.27	0.27			0.27	0.27	0.27	0.27	0.27	
MET	Zinc	85.00	0.05						0.05	0.05	0.05			0.05	0.05	0.05	0.05	0.05	
MET	SEM AVS	5.00	0.58	0.24	2.42	1.48	1.51	1.10	0.56	0.54	0.37	0.29	0.20	0.29	0.55	0.38	0.49	0.43	0.26
PAH	1,6,7-Trimethylnaphthalene																		
PAH	1-Methylnaphthalene																		
PAH	1-Methylphenanthrene																		
PAH	2,6-Dimethylnaphthalene																		
PAH	2-Methylnaphthalene	0.96	0.01						5.21E-03	5.49E-03	0.01			6.57E-03	7.10E-03	6.94E-03	5.80E-03	4.86E-03	
PAH	Acenaphthene	710	3.90E-05		2.75E-06		5.56E-06		3.13E-06	3.74E-06	3.13E-06			2.77E-06	2.39E-06	2.91E-06	3.01E-06	3.45E-06	
PAH	Acenaphthylene	0.46	0.03		3.70E-03		3.70E-03		6.30E-03	8.54E-03	0.01			6.52E-03	3.49E-03	2.41E-03	4.75E-03	0.01	
PAH	Anthracene	0.29	0.16				0.03		0.02	0.03	0.03			0.02	0.02	0.01	0.02	0.05	
PAH	Benzo(a)anthracene	0.07	0.71				0.06		0.13	0.12	0.18			0.10	0.07	0.06	0.07	0.19	
PAH	Benzo(a)pyrene	0.04	0.97		0.15		0.38		0.28	0.27	0.41			0.18	0.09	0.04	0.18	0.28	
PAH	Benzo(b)fluoranthene																		
PAH	Benzo(e)pyrene																		
PAH	Benzo(g,h,i)perylene																		
PAH	Benzo(k)fluoranthene																		
PAH	Biphenyl																		
PAH	Chrysene	0.10	0.33						0.04	0.04	0.13			0.05	0.03	0.02	0.04	0.06	
PAH	Dibenz(a,h)anthracene	1.08E-03	4.91		6.84		6.84		1.18	2.68	2.26			0.35	0.83	6.84	6.84	0.96	
PAH	Fluoranthene	16.00	4.09E-03		1.06E-03		7.36E-03		7.07E-04	7.79E-04	1.56E-03			8.32E-04	7.83E-04	6.87E-04	7.51E-04	1.19E-03	
PAH	Fluorene	0.14	0.16		0.04		0.04		0.01	0.02	0.03			0.01	0.01	0.02	0.01	0.01	
PAH	Indeno(1,2,3-cd)pyrene																		
PAH	Naphthalene	620	2.36E-05						8.45E-06	1.88E-05	2.07E-05			1.55E-05	1.33E-05	1.76E-05	1.07E-05	1.24E-05	
PAH	Perylene																		
PAH	Phenanthrene	0.51	0.04		0.01		0.01		0.01	0.01	0.02			0.01	0.02	0.01	0.01	0.01	
PAH	Pyrene	0.03	0.36		0.32		0.49		0.14	0.13	0.05			0.05	0.04	0.02	0.02	0.44	
PAH	LMW PAHs		0.39		0.05		0.09		0.05	0.07	0.09			0.05	0.05	0.05	0.05	0.08	
PAH	HMW PAHs		7.20		7.32		8.37		1.76	3.23	3.03			0.74	1.07	6.90	7.16	1.92	
PAH	Total PAHs		7.68		7.37		8.46		1.81	3.30	3.13			0.79	1.12	7.03	7.21	2.00	
PCB	Total PCBs	0.03	2.59		2.31		1.81		1.98	1.30	0.89			0.88	1.25	0.64	0.88	1.22	
PST	Aldrin	0.16	9.82E-03		5.17E-02		6.79E-03		9.82E-03	9.82E-03	9.82E-03			9.82E-03	9.82E-03	9.82E-03	9.82E-03	9.82E-03	
PST	Hexachlorobenzene	3.68	2.14E-05		3.01E-05		2.45E-04		7.19E-05	1.58E-05	2.27E-05			2.45E-04	1.36E-05	1.38E-05	1.45E-05	3.03E-05	
PST	Dieldrin	1.00E-03	0.40		0.03		0.71		0.60	0.13	0.60			0.60	0.09	0.10	0.05	0.10	
PST	o,p'-DDE	1.00E-03	3.52		2.80		2.97		3.21	1.90	1.33			2.04	3.39	1.44	2.25	2.46	
PST	p,p'-DDE	1.00E-03	0.42		0.42		0.63		0.64	0.30	0.31			0.39	0.71	0.25	0.61	0.59	

1. ELU-HQ calculated as elutriate concentration (Table A-4.1)/WQSV
2. Water Quality Screening Value (Table 4)

Table A-4 3A. Elutriate Hazard Quotients[1] (ELU-HQs) for Derecktor Shipyard Marine ERA stations exhibiting **NO TOXICITY**[2] to sea urchin (*Arbacia punctulata*) FERTILIZATION.

Class	Analyte[3]	DSY-25	DSY-26	DSY-27	DSY-28	DSY-29	DSY-30	DSY-31	DSY-32	DSY-33	DSY-34	DSY-35	DSY-36	DSY-37	DSY-38	DSY-39	DSY-40	DSY-41	n	Mean	95% UCL[3]
MET	Arsenic	0.34						0.76	0.69	0.07			1.12	0.54	1.13	2.11	0.83		9.00	0.84	0.84
MET	Cadmium	0.01						0.01	0.01	0.01			0.01	0.01	0.01	0.01	0.01		9.00	0.01	0.01
MET	Chromium	8.00E-03						8.00E-03	8.00E-03	8.00E-03			8.00E-03	8.00E-03	8.00E-03	8.00E-03	8.00E-03		9.00	8.00E-03	8.00E-03
MET	Copper	0.43						1.76	0.43	0.43			0.43	0.43	0.43	0.43	0.43		9.00	0.58	0.58
MET	Lead	1.11						1.00	1.11	1.67			0.98	1.52	1.26	1.72	1.00		9.00	1.29	1.29
MET	Mercury	4.00						4.00	4.00	4.00			4.00	4.00	4.00	4.00	4.00		9.00	4.00	4.00
MET	Nickel	0.48						0.48	0.48	0.48			0.48	0.48	0.48	0.48	0.48		9.00	0.48	0.48
MET	Silver	0.27						0.27	0.27	0.27			0.27	0.27	0.27	0.27	0.27		9.00	0.27	0.27
MET	Zinc	0.05						0.05	0.05	0.05			0.05	0.05	0.05	0.05	0.05		9.00	0.05	0.05
MET	SEM:AVS	0.58	0.24	2.42	1.49	1.51	1.10	0.58	0.54	0.37	0.29	0.20	0.29	0.55	0.38	0.49	0.43	0.26	17.00	0.69	1.06
PAH	1,6,7-Trimethylnaphthalene																		0		
PAH	1-Methylnaphthalene																		0		
PAH	1-Methylphenanthrene																		0		
PAH	2,6-Dimethylnaphthalene																		0		
PAH	2-Methylnaphthalene	0.01						5.21E-03	5.49E-03	0.01			6.57E-03	7.10E-03	6.94E-03	5.80E-03	4.86E-03		9.00	7.34E-03	7.34E-03
PAH	Acenaphthene	3.90E-05		2.75E-06		5.56E-06		3.13E-06	3.74E-06	3.13E-06			2.77E-06	2.39E-06	2.91E-06	3.01E-06	3.45E-06		11.00	6.53E-06	6.53E-06
PAH	Acenaphthylene	0.03		3.70E-03		3.70E-03		6.30E-03	8.54E-03	0.01			6.52E-03	3.49E-03	2.41E-03	4.75E-03	0.01		11.00	8.44E-03	8.44E-03
PAH	Anthracene	0.16				0.03		0.02	0.03	0.03			0.02	0.02	0.01	0.02	0.05		10.00	0.04	0.04
PAH	Benzo(a)anthracene	0.71				0.65		0.13	0.12	0.18			0.10	0.07	0.06	0.07	0.19		10.00	0.23	0.23
PAH	Benzo(a)pyrene	0.97		0.15		0.39		0.26	0.27	0.41			0.18	0.09	0.04	0.18	0.28		11.00	0.29	0.29
PAH	Benzo(b)fluoranthene																		0		
PAH	Benzo(e)pyrene																		0		
PAH	Benzo(g,h,i)perylene																		0		
PAH	Benzo(k)fluoranthene																		0		
PAH	Biphenyl																		0		
PAH	Chrysene	0.33						0.04	0.04	0.13			0.05	0.03	0.02	0.04	0.06		9.00	0.08	0.08
PAH	Dibenzo(a,h)anthracene	4.91		6.84		6.84		1.18	2.68	2.28			0.35	0.83	6.84	6.84	0.96		11.00	3.89	3.89
PAH	Fluoranthene	4.80E-03		1.06E-03		7.36E-03		7.07E-04	7.79E-04	1.58E-03			8.32E-04	7.83E-04	6.87E-04	7.51E-04	1.19E-03		11.00	1.87E-03	1.87E-03
PAH	Fluorene	0.18		0.04		0.04		0.01	0.02	0.03			0.01	0.01	0.02	0.01	0.01		11.00	0.04	0.04
PAH	Indeno(1,2,3-cd)pyrene																		0		
PAH	Naphthalene	2.36E-05						8.45E-06	1.88E-05	2.07E-05			1.55E-05	1.33E-05	1.76E-05	1.07E-05	1.24E-05		9.00	1.57E-05	1.57E-05
PAH	Perylene																		0		
PAH	Phenanthrene	0.04		0.01		0.01		0.01	0.01	0.02			0.01	0.02	0.01	0.01	0.01		11.00	0.01	0.01
PAH	Pyrene	0.36		0.32		0.49		0.14	0.13	0.05			0.05	0.04	0.02	0.02	0.44		11.00	0.19	0.19
PAH	LMW PAHs	0.39		0.06		0.09		0.05	0.07	0.09			0.05	0.05	0.05	0.05	0.08		11.00	0.09	0.09
PAH	HMW PAHs	7.29		7.32		8.37		1.76	3.23	3.03			0.74	1.07	6.99	7.16	1.92		11.00	4.44	4.44
PAH	Total PAHs	7.68		7.37		8.46		1.81	3.30	3.13			0.79	1.12	7.03	7.21	2.00		11.00	4.54	4.54
PCB	Total PCBs	2.59		2.31		1.81		1.96	1.30	0.89			0.86	1.25	0.64	0.86	1.22		11.00	1.43	1.43
PST	Aldrin	9.62E-03		5.37E-03		5.79E-03		9.82E-03	9.82E-03	9.82E-03			9.82E-03	9.82E-03	9.82E-03	9.82E-03	9.82E-03		11.00	9.05E-03	9.05E-03
PST	Hexachlorobenzene	2.14E-05		3.01E-05		2.45E-04		7.19E-05	1.56E-05	2.27E-05			2.45E-04	1.36E-05	1.38E-05	1.45E-05	3.03E-05		11.00	6.58E-05	6.58E-05
PST	Mirex	0.40		0.09		0.71		0.60	0.13	0.60			0.60	0.09	0.10	0.05	0.10		11.00	0.32	0.32
PST	o,p'-DDE	3.52		2.80		2.97		3.21	1.93	1.33			2.04	3.38	1.44	2.25	2.48		11.00	2.48	2.48
PST	p,p'-DDE	0.42		0.42		0.83		0.64	0.30	0.31			0.39	0.71	0.25	0.61	0.59		11.00	0.48	0.48

1 ELU-HQ from Table A-4.2

2 Toxicity data contained in Derecktor Shipyard Marine ERA (SAIC and URI, 1997), Table 5.2-1

3 95% Upper Confidence Limit based on sample size as follows: Mean+($t_{0.975}$(df)*(STDEV/SQRT(n))) where STDEV=standard deviation; n=sample size; $t_{0.975}$(df)=sample size-dependent percentage points of the t distribution (Olt, 1993)

Table A-4.3B Elutriate Hazard Quotients[1] (ELU-HQs) based on data from the Derecktor Shipyard Marine ERA for stations exhibiting **TOXICITY**[2] to sea urchin (*Arbacia punctulata*) FERTILIZATION.

Class	Analyte			c	Mean	Maximum HQ
MET	Arsenic			0		
MET	Cadmium			0		
MET	Chromium			0		
MET	Copper			0		
MET	Lead			0		
MET	Mercury			0		
MET	Nickel			0		
MET	Silver			0		
MET	Zinc			0		
PAH	1,6,7-Trimethylnaphthalene			0		
PAH	1-Methylnaphthalene			0		
PAH	1-Methylphenanthrene			0		
PAH	2,6-Dimethylnaphthalene			0		
PAH	2-Methylnaphthalene			0		
PAH	Acenaphthene			0		
PAH	Acenaphthylene			0		
PAH	Anthracene			0		
PAH	Benzo(a)anthracene			0		
PAH	Benzo(a)pyrene			0		
PAH	Benzo(b)fluoranthene			0		
PAH	Benzo(e)pyrene			0		
PAH	Benzo(g,h,i)perylene			0		
PAH	Benzo(k)fluoranthene			0		
PAH	Biphenyl			0		
PAH	Chrysene			0		
PAH	Dibenz(a,h)anthracene			0		
PAH	Fluoranthene			0		
PAH	Fluorene			0		
PAH	Indeno(1,2,3-cd)pyrene			0		
PAH	Naphthalene			0		
PAH	Perylene			0		
PAH	Phenanthrene			0		
PAH	Pyrene			0		
PAH	LMW PAHs			0		
PAH	HMW PAHs			0		
PAH	Total PAHs			0		
PCB	Total PCBs			0		
PST	Aldrin			0		
PST	Hexachlorobenzene			0		
PST	Mirex			0		
PST	o,p'-DDE			0		
PST	p,p'-DDE			0		

1 - ELU-HQ from Table A-4.2.

2 - Toxicity data contained in Derecktor Shipyard Marine ERA (SAIC and URI, 1997), Table 5.2-1

No samples found to be toxic to sea urchin fertilization.

Table A-4.4A. Elutriate Hazard Quotients[1] (ELU-HQs) for Dorecktor Shipyard Marine ERA stations exhibiting NO TOXICITY[2] to sea urchin (*Arbacia punctulata*) normal larval development.

Class	Analyte[1]			DSY-27	DSY-30	DSY-34	DSY-35	DSY-36	DSY-40		n	Mean	95% UCL[3]
MET	Arsenic							1.12	0.83		2.00	0.98	1.12
MET	Cadmium							0.01	0.01		2.00	0.01	0.01
MET	Chromium							8.00E-03	8.00E-03		2.00	8.00E-03	8.00E-03
MET	Copper							0.43	0.43		2.00	0.43	0.43
MET	Lead							0.98	1.06		2.00	1.02	1.06
MET	Mercury							4.00	4.00		2.00	4.00	4.00
MET	Nickel							0.48	0.48		2.00	0.48	0.48
MET	Silver							0.27	0.27		2.00	0.27	0.27
MET	Zinc							0.05	0.05		2.00	0.05	0.05
MET	SEM AVS			2.42	1.10	0.29	0.20	0.29	0.43		6.00	0.79	1.70
PAH	1,6,7-Trimethylnaphthalene										0		
PAH	1-Methylnaphthalene										0		
PAH	1-Methylphenanthrene										0		
PAH	2,6-Dimethylnaphthalene										0		
PAH	2-Methylnaphthalene							6.57E-03	4.86E-03		2.00	5.72E-03	6.57E-03
PAH	Acenaphthene			2.75E-06				2.77E-06	3.45E-06		3.00	2.99E-06	3.45E-06
PAH	Acenaphthylene			3.70E-03				6.52E-03	0.01		3.00	6.92E-03	0.01
PAH	Anthracene							0.02	0.05		2.00	0.03	0.05
PAH	Benzo(a)anthracene							0.10	0.19		2.00	0.14	0.19
PAH	Benzo(a)pyrene			0.15				0.18	0.28		3.00	0.20	0.28
PAH	Benzo(b)fluoranthene										0		
PAH	Benzo(e)pyrene										0		
PAH	Benzo(g,h,i)perylene										0		
PAH	Benzo(k)fluoranthene										0		
PAH	Biphenyl										0		
PAH	Chrysene							0.05	0.06		2.00	0.05	0.06
PAH	Dibenz(a,h)anthracene			6.84				0.35	0.96		3.00	2.72	6.84
PAH	Fluoranthene			1.06E-03				8.32E-04	1.19E-03		3.00	1.03E-03	1.19E-03
PAH	Fluorene			0.04				0.01	0.01		3.00	0.02	0.04
PAH	Indeno(1,2,3-cd)pyrene										0		
PAH	Naphthalene							1.55E-05	1.24E-05		2.00	1.39E-05	1.55E-05
PAH	Perylene										0		
PAH	Phenanthrene			0.01				0.01	0.01		3.00	0.01	0.01
PAH	Pyrene			0.32				0.05	0.44		3.00	0.27	0.44
PAH	LMW PAHs			0.06				0.05	0.08		3.00	0.06	0.08
PAH	HMW PAHs			7.32				0.74	1.92		3.00	3.33	7.32
PAH	Total PAHs			7.37				0.79	2.00		3.00	3.39	7.37
PCB	Total PCBs			2.31				0.68	1.22		3.00	1.47	2.31
PST	Aldrin			5.37E-03				9.82E-03	9.82E-03		3.00	8.33E-03	9.82E-03
PST	Hexachlorobenzene			3.01E-05				2.45E-04	3.03E-05		3.00	1.02E-04	2.45E-04
PST	Mirex			0.09				0.09	0.10		3.00	0.26	0.60
PST	o,p'-DDE			2.60				2.04	2.48		3.00	2.44	2.80
PST	p,p'-DDE			0.47				0.39	0.59		3.00	0.47	0.59

1 - ELU-HQ data from Table A-4.2

2 - Toxicity data contained in Dorecktor Shipyard Marine ERA (SAIC and ORI, 1997), Table 5.2-1.

3 - 95% Upper Confidence Limit based on sample size as follows: Mean+($t_{0.975}$(df)*(STDEV/SQRT(n))); where STDEV=standard deviation, n=sample size; $t_{0.975}$(df)=sample size-dependent percentage points of the t distribution (Ott, 1993). Maximum values or range taken where no samples<3.

Table A-4.4B. Elutriate Hazard Quotients[1] (ELU-HQs) for Derecktor Shipyard Marine ERA stations exhibiting **TOXICITY**[2] to sea urchin (*Arbacia punctulata*) normal larval development.

Class	Analyte	DSY-25	DSY-29	DSY-31	DSY-32	DSY-33	DSY-37	DSY-38	DSY-39	n	Mean	Maximum HQ
MET	Arsenic	0.34		0.76	0.69	0.07	0.54	1.13	2.11	7.00	0.81	2.11
MET	Cadmium	0.01		0.01	0.01	0.01	0.01	0.01	0.01	7.00	0.01	0.01
MET	Chromium	8.00E-03		8.00E-03	8.00E-03	8.00E-03	8.00E-03	8.00E-03	8.00E-03	7.00	8.00E-03	8.00E-03
MET	Copper	0.43		1.76	0.43	0.43	0.43	0.43	0.43	7.00	0.62	1.76
MET	Lead	1.11		1.00	1.11	1.87	1.52	1.26	1.72	7.00	1.37	1.87
MET	Mercury	4.00		4.00	4.00	4.00	4.00	4.00	4.00	7.00	4.00	4.00
MET	Nickel	0.48		0.48	0.48	0.48	0.48	0.48	0.48	7.00	0.48	0.48
MET	Silver	0.27		0.27	0.27	0.27	0.27	0.27	0.27	7.00	0.27	0.27
MET	Zinc	0.05		0.05	0.05	0.05	0.05	0.05	0.05	7.00	0.05	0.05
MET	SEM:AVS	0.58	1.51	0.56	0.54	0.37	0.55	0.38	0.49	8.00	0.62	1.51
PAH	1,6,7-Trimethylnaphthalene									0		
PAH	1-Methylnaphthalene									0		
PAH	1-Methylphenanthrene									0		
PAH	2,6-Dimethylnaphthalene									0		
PAH	2-Methylnaphthalene	0.01		5.21E-03	5.49E-03	0.01	7.10E-03	6.94E-03	5.80E-03	7.00	7.81E-03	0.01
PAH	Acenaphthene	3.90E-05	5.56E-06	3.13E-06	3.74E-06	3.13E-06	2.39E-06	2.91E-06	3.01E-06	8.00	7.86E-06	3.90E-05
PAH	Acenaphthylene	0.03	3.70E-03	6.30E-03	8.54E-03	0.01	3.49E-03	2.41E-03	4.75E-03	8.00	9.00E-03	0.03
PAH	Anthracene	0.16	0.03	0.02	0.03	0.03	0.02	0.01	0.02	8.00	0.04	0.16
PAH	Benzo(a)anthracene	0.71	0.65	0.13	0.12	0.18	0.07	0.06	0.07	8.00	0.25	0.71
PAH	Benzo(a)pyrene	0.97	0.38	0.26	0.27	0.41	0.09	0.04	0.18	8.00	0.32	0.97
PAH	Benzo(b)fluoranthene									0		
PAH	Benzo(e)pyrene									0		
PAH	Benzo(g,h,i)perylene									0		
PAH	Benzo(k)fluoranthene									0		
PAH	Biphenyl									0		
PAH	Chrysene	0.33		0.04	0.04	0.13	0.03	0.02	0.04	7.00	0.09	0.33
PAH	Dibenz(a,h)anthracene	4.91	6.64	1.18	2.68	2.26	0.83	6.84	6.84	8.00	4.05	6.84
PAH	Fluoranthene	4.89E-03	7.36E-03	7.07E-04	7.79E-04	1.58E-03	7.83E-04	6.87E-04	7.51E-04	8.00	2.19E-03	7.36E-03
PAH	Fluorene	0.18	0.04	0.01	0.02	0.03	0.01	0.02	0.01	8.00	0.04	0.18
PAH	Indeno(1,2,3-cd)pyrene									0		
PAH	Naphthalene	2.36E-05		8.45E-06	1.88E-05	2.07E-05	1.33E-05	1.76E-05	1.07E-05	7.00	1.61E-05	2.36E-05
PAH	Perylene									0		
PAH	Phenanthrene	0.04	0.01	0.01	0.01	0.02	0.02	0.01	0.01	8.00	0.02	0.04
PAH	Pyrene	0.35	0.49	0.14	0.13	0.05	0.04	0.02	0.02	8.00	0.16	0.49
PAH	LMW PAHs	0.39	0.09	0.05	0.07	0.09	0.05	0.05	0.05	8.00	0.10	0.39
PAH	HMW PAHs	7.28	8.37	1.76	3.23	3.03	1.07	6.99	7.16	8.00	4.86	8.37
PAH	Total PAHs	7.68	8.46	1.81	3.30	3.13	1.12	7.03	7.21	8.00	4.97	8.46
PCB	Total PCBs	2.59	1.81	1.95	1.30	0.89	1.25	0.64	0.86	8.00	1.41	2.59
PST	Aldrin	9.82E-03	5.79E-03	9.82E-03	9.82E-03	9.82E-03	9.82E-03	9.82E-03	9.82E-03	8.00	9.31E-03	9.82E-03
PST	Hexachlorobenzene	2.14E-05	2.45E-04	7.19E-05	1.58E-05	2.27E-05	1.36E-05	1.38E-05	1.45E-05	8.00	5.23E-05	2.45E-04
PST	Mirex	0.40	0.71	0.60	0.13	0.60	0.09	0.10	0.05	8.00	0.34	0.71
PST	o,p'-DDE	3.52	2.97	3.21	1.90	1.33	3.39	1.44	2.25	8.00	2.50	3.52
PST	p,p'-DDE	0.42	0.63	0.64	0.30	0.31	0.71	0.25	0.61	8.00	0.48	0.71

1 - Hazard Quotients from Table A-4.2.

2 - Toxicity data contained in Derecktor Shipyard Marine ERA (SAIC and URI, 1997), Table 5.2-1.

Table A-5 Comparing aquatic Threshold Effects Value Hazard Quotients[1] for CoCs in porewaters and elutriates for identification of Limiting CoCs for the Derecktor Shipyard/Coddington Cove study area.

Class	Analyte[3,4]	Aquatic Pathway[2]	Aquatic TEV (µg/L)	DSY-25	DSY-26	DSY-27	DSY-28	DSY-29	DSY-30	DSY-31	DSY-32	DSY-33	DSY-34	DSY-35	DSY-36	DSY-37	DSY-38	DSY-39	DSY-40	DSY-41
PAH	HMW PAHs	PW	0.61	0.89	1.42	1.06	0.39	2.34	1.15	0.46	0.58	0.17	0.20	0.03	0.34	0.39	0.21	0.24	1.74	0.14
PCB	Total PCBs	PW	0.03	0.15	0.16	1.78	0.06	0.08	0.15	0.13	0.12	0.05	0.04	0.04	0.06	0.08	0.04	0.04	0.08	0.06
	SUM TEV-HQ			1.04	1.58	2.84	0.45	2.42	1.30	0.59	0.70	0.22	0.24	0.07	0.40	0.47	0.25	0.28	1.82	0.21
	MAX TEV-HQ			0.89	1.42	1.78		2.34	1.15										1.74	
	Limiting CoC			HMW PAHs	HMW PAHs	Total PCBs		HMW PAHs	HMW PAHs										HMW PAHs	
MET	Arsenic	ELU	40.40	0.31						0.67	0.61	0.06			1.00	0.49	1.01	1.88	0.74	
MET	Copper	ELU	2.90	0.43						1.76	0.43	0.43			0.43	0.43	0.43	0.43	0.43	
MET	Lead	ELU	13.20	0.71						0.64	0.71	1.20			0.63	0.98	0.81	1.11	0.68	
PAH	HMW PAHs	ELU	2.09	0.21		0.11		0.24		0.06	0.06	0.05			0.03	0.03	0.02	0.03	0.16	
PAH	Total PAHs	ELU	37.51	0.02		6.79E-03		0.01		4.14E-03	4.25E-03	4.14E-03			2.68E-03	2.34E-03	2.06E-03	2.24E-03	9.77E-03	
PCB	Total PCBs	ELU	0.07	1.12		1.00		0.78		0.85	0.56	0.38			0.38	0.54	0.28	0.37	0.53	
PST	o,p'-DDE	ELU	2.59E-03	0.98		0.78		0.83		0.89	0.53	0.37			0.57	0.94	0.40	0.62	0.69	
	SUM TEV-HQ			3.76	0	1.89	0	1.85	0	4.86	2.91	2.50	0	0	3.04	3.40	2.95	4.44	3.23	0
	MAX TEV-HQ			1.12		1.00		0.83		1.76	0.71	1.20			1.00	0.98	1.01	1.88	0.74	
	Limiting CoC			Total PCBs		Total PCBs		o,p'-DDE		Copper	Lead	Lead			Arsenic	Lead	Arsenic	Arsenic	Arsenic	

1 - Threshold Effects Value Hazard Quotient (TEV-HQ) = CoC concentration/Threshold Effect Value (TEV) (Table 7).

2 - PW - bedded sediment exposure pathway. CoCs measured in porewater (PW, Table A-3.1a). ELU- Resuspended sediment exposure pathway, CoCs measured in sediment elutriates (ELU; Table A-4.1).

3 - TEV units: µg/g dry weight for metals, ng/g dry weight for organics

4 - Sum TEV-HQ = sum of TEV-HQs for all analytes at a given station

Max TEV-HQ = maximum TEV-HQs observed for all analytes at a given station

Table A-6. Avian predator Threshold Effects Value Hazard Quotients[1] for CoCs in tissue of prey species consumed by avian aquatic predators in the Derecktor Shipyard/Coddington Cove study area.

Class	Analyte[3]	Avian TEV[3]	DSY-24-IBM	DSY-25-IBM	DSY-25-LOB	DSY-26-CN	DSY-26-DM	DSY-26-IBM	DSY-27-IBM	DSY-27-LOB	DSY-28-CN	DSY-28-DM	DSY-28-IBM	DSY-28-LOB	DSY-29-CN	DSY-29-DM	DSY-29-LOB	DSY-31-DM	DSY-31-PM	DSY-32-PM	DSY-33-DM	DSY-33-LOB	DSY-33-PM	DSY-34-PM
MET	Arsenic	14.96	0.69	0.84	1.91	0.24	0.36	0.55	0.45	1.15	0.33	1.13	0.18		0.51	0.60	1.91	0.35	0.63	0.33	0.83	1.49	0.39	0.58
MET	Cadmium	1.83	1.02	0.66	0.20	0.45	0.51	0.40	0.42	0.14	0.60	0.42	0.34		0.63	0.44	0.26	0.29	0.43	0.32	0.51	0.09	0.36	0.39
MET	Chromium	3.28	1.02	0.97	0.54	0.46	0.70	0.79	0.93	0.69	0.31	0.77	0.83		0.38	0.66	0.56	0.74	0.64	0.57	0.82	0.65	0.60	0.69
MET	Copper	60.71	0.07	0.20	2.50	0.29	0.22	0.13	0.25	2.75	0.25	0.18	0.02		0.36	0.10	1.65	0.15	0.24	0.18	0.14	0.99	0.14	0.17
MET	Lead	3.11	1.87	9.65E-05	0.05	0.26	0.44	9.65E-05	0.97	0.02	9.65E-05	9.65E-05	9.65E-05		0.29	0.30	0.07	0.43	0.56	0.89	0.47	0.15	9.65E-05	0.53
MET	Mercury	0.28	0.73	0.46	0.69	0.34	0.43	0.31	0.39	1.19	0.27	0.35	0.38		0.44	0.44	0.75	0.36	0.36	0.41	0.27	0.60	0.32	0.31
MET	Silver	1.41	7.12E-05	7.12E-05	3.89	0.37	7.12E-05	7.12E-05	7.12E-05	4.89	0.22	0.84	7.12E-05		7.12E-05	7.12E-05	4.16	7.12E-05	7.12E-05	0.98	7.12E-05	2.44	7.12E-05	7.12E-05
MET	Zinc	124	0.62	0.91	0.71	0.34	0.83	0.74	1.15	0.91	0.21	0.77	0.98		0.23	0.61	1.05	1.33	0.71	0.91	0.99	0.85	0.82	0.75
PCB	Total PCBs	266	0.80	0.69	0.61	2.87	2.32	1.08	1.50	0.95	5.05	0.90	1.05	1.12	4.14	1.13	0.46	1.03	1.24	0.48	0.63	0.61	0.68	0.41
	MAX TEV-HQ		1.87	0.97	3.89	2.87	2.32	1.08	1.50	4.89	5.05	1.13	1.05	1.12	4.14	1.13	4.16	1.33	1.24	0.98	0.99	2.44	0.82	0.75
	MAX CoC[4]		Lead		Silver	Total PCBs	Total PCBs	Total PCBs	Total PCBs	Silver	Total PCBs	Arsenic	Total PCBs	Total PCBs	Total PCBs	Total PCBs	Silver	Zinc	Total PCBs			Silver		
	Limiting CoC		Lead	Silver		Total PCBs			Silver		Total PCBs				Silver			Zinc			Silver			

1 - Threshold Effects Value Hazard Quotient (TEV-HQ) = CoC concentration (Table A-2.4)/Threshold Effect Value (TEV) (Table 9)

2 - Sum TEV-HQ = sum of TEV-HQs for all analytes at a given station.

Max TEV-HQ = maximum TEV-HQs observed for all analytes at a given station.

3 - TEV units: µg/g dry weight for metals, ng/g dry weight for organics.

4 - CoC associated with maximum observed TEV-HQ by sample.

Table A-6 (continued). Avian predator Threshold Effects Value Hazard Quotients[1] for CoCs in tissue of prey species consumed by avian aquatic predators in the Derecktor Shipyard/Coddington Cove study area.

Class	Analyte[2]	Avian TEV[3]	DSY-35-IBM	DSY-35-LOB	DSY-35-MM	DSY-35-PM	DSY-36-CN	DSY-36-IBM	DSY-36-LOB	DSY-36-PM	DSY-37-PM	DSY-38-DM	DSY-38-LOB	DSY-38-PM	DSY-39-DM	DSY-39-LOB	DSY-40-DM	DSY-40-IBM	DSY-41-MM	DSY-41-PM
MET	Arsenic	14.96	0.42	1.09	0.43	0.57	0.24	0.41	1.33	0.50	0.50	0.41	1.74	0.41	0.60	1.25	0.40	0.35	0.50	0.14
MET	Cadmium	1.83	0.40	0.31	0.35	0.36	0.53	0.21	1.64E-04	0.45	0.35	0.34	0.27	0.32	0.17	0.16	0.33	0.34	0.49	0.39
MET	Chromium	3.08	0.72	0.70	0.77	0.65	0.28	0.92	0.64	0.80	0.56	0.65	0.63	0.60	0.97	0.53	0.88	0.72	0.57	0.63
MET	Copper	60.71	0.12	2.11	0.11	0.14	0.26	0.12	0.81	0.20	0.15	0.19	2.72	0.17	0.14	3.24	0.10	0.12	0.22	0.20
MET	Lead	3.11	0.56	0.24	9.65E-05	0.53	0.31	9.65E-05	0.11	0.70	0.95	0.62	0.08	9.65E-05	9.65E-05	0.06	0.95	0.78	0.52	9.65E-05
MET	Mercury	0.38	0.44	0.70	0.32	0.26	0.38	0.50	0.86	0.39	0.40	0.34	0.86	0.44	0.37	1.08	0.34	0.43	0.31	0.39
MET	Silver	1.41	7.12E-05	4.66	7.12E-05	7.12E-05	7.12E-05	7.12E-05	2.04	7.12E-05	0.46	1.22	4.34	7.12E-05	0.70	0.58	7.12E-05	7.12E-05	0.90	7.12E-05
MET	Zinc	124	1.05	0.89	0.90	1.01	0.44	0.68	0.93	0.98	0.86	0.72	1.39	1.06	1.06	1.04	0.95	0.85	0.53	0.68
PCB	Total PCBs	760	0.91	0.41	0.21	0.63	4.08	1.17	1.10	0.64	0.56	0.72	0.38		0.60	0.84	0.73	1.19	0.33	0.36
	MAX TEV-HQ		1.05	4.66	0.90	1.01	4.08	1.17	2.04	0.98	0.95	1.22	4.34	1.06	1.06	3.24	0.95	1.19	0.90	0.68
	MAX CoC[4]		Zinc	Silver		Zinc	Total PCBs	Total PCBs	Silver			Silver	Silver	Zinc	Zinc	Copper		Total PCBs		
	2 metal CoC		Silver				Total PCBs					Silver			Copper		Total PCBs			

1 - Threshold Effects Value Hazard Quotient (TEV-HQ) = CoC concentration (Table A-2 4)/Threshold Effect Value (TEV) (Table 9)

2 Sum TEV-HQ = sum of TEV-HQs for all analytes at a given station

Max TEV-HQ = maximum TEV-HQs observed for all analytes at a given station

3 See Table 14 for TEVs TEV units µg/g dry weight for metals, ng/g dry weight for organics

4 - CoC associated with maximum observed TEV-HQ by sample

Table A-7. Human Health Threshold Effects Value Hazard Quotients[1] based on concentrations of selected contaminants in tissues of shellfish harvested from lower Narragansett Bay for consumption by subsistence fishermen.

Class	Analyte	[3] TEV	DSY-24-IBM	DSY-25-IBM	DSY-25-LOB	DSY-26-DM	DSY-26-IBM	DSY-27-IBM	DSY-27-LOB	DSY-28-DM	DSY-28-IBM	DSY-28-LOB	DSY-29-DM	DSY-29-LOB	DSY-31-DM	DSY-31-PM	DSY-32-PM	DSY-33-DM	DSY-33-LOB	DSY-33-PM	DSY-34-PM
MET	Arsenic	17.27	0.59	0.73	1.66	0.31	0.48	0.39	1.00	0.98	0.16		0.62	1.65	0.30	0.54	0.28	0.72	1.29	0.34	0.50
PAH	Benzo(a)anthracene	107	0.14	2.63	0.03	0.71	9.74	2.71	0.27	0.40	0.67	0.23	0.60	0.03	0.55	1.24	0.74	0.03	0.03	0.33	0.43
PAH	Benzo(a)pyrene	10.68	0.74	10.72	0.34	0.34	51.30	6.84	2.69	0.34	3.17	2.34	0.34	1.22	0.34	4.21	3.99	0.34	0.34	2.08	2.10
PAH	Dibenz(a,h)anthracene	10.68	0.74	1.27	0.05	0.05	4.65	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
PAH	Indeno(1,2,3-cd)pyrene	107	0.11	0.33	0.01	0.01	1.13	0.25	0.08	0.01	0.01	0.01	0.01	0.10	0.01	0.19	0.25	0.01	0.01	0.08	0.07
PCB	Total PCBs	1300	0.47	0.41	0.36	1.37	0.64	0.88	0.58	0.53	0.62	0.66	0.67	0.27	0.60	0.73	0.28	0.49	0.36	0.40	0.24
	MAX TEV-HQ		0.74	10.72	1.66	1.37	51.30	6.84	2.69	0.98	3.17	2.34	0.67	1.65	0.60	4.21	3.99	0.72	1.29	2.08	2.10
	MAX CoC[4]		Dibenz(a,h)anthracene	Benzo(a)pyrene	Arsenic	Total PCBs	Benzo(a)pyrene	Benzo(a)pyrene	Benzo(a)pyrene	Arsenic	Benzo(a)pyrene	Benzo(a)pyrene	Total PCBs	Arsenic	Total PCBs	Benzo(a)pyrene	Benzo(a)pyrene	Arsenic	Arsenic	Benzo(a)pyrene	Benzo(a)pyrene
	Limiting CoC			Benzo(a)pyrene		Benzo(a)pyrene		Benzo(a)pyrene		Benzo(a)pyrene			Arsenic		Benzo(a)pyrene		Benzo(a)pyrene	Benzo(a)pyrene			Benzo(a)pyrene

1 - Threshold Effects Value Hazard Quotient (TEV-HQ) = CoC concentration (Table A-2.4)/Threshold Effect Value (TEV) (Table 14)

2 - Sum TEV-HQ = sum of TEV-HQs for all analytes at a given station

Max TEV-HQ = maximum TEV-HQs observed for all analytes at a given station

3 - TEV units: µg/g dry weight for metals, ng/g dry weight for organics.

4 - CoC associated with maximum observed TEV-HQ by sample

5 - Arsenic selected as L-CoC for this station (see Text Section 2.4).

Table A-7 (continued). Human Health Threshold Effects Value Hazard Quotients[1] based on concentrations of selected contaminants in tissues of shellfish harvested from lower Narragansett Bay for consumption by subsistence fishermen.

Class	Analyte[3]	H-H TEV[3]	DSY-35-IBM	DSY-35-LOB	DSY-35-MM	DSY-35-PM	DSY-36-IBM	DSY-36-LOB	DSY-36-PM	DSY-37-PM	DSY-38-DM	DSY-38-LOB	DSY-38-PM	DSY-39-DM	DSY-39-LOB	DSY-40-DM	DSY-40-IBM	DSY-41-MM	DSY-41-PM
MCI	Arsenic	17.27	0.36	0.94	0.37	0.49	0.36	1.15	0.43	0.43	0.35	1.51	0.35	0.52	1.08	0.35	0.31	0.43	0.13
PAH	Benzo(a)anthracene	107	0.29	0.03	0.15	0.20	0.28	0.03	0.62	0.52	0.14	0.03	0.43	0.17	0.03	0.39	0.23		0.39
PAH	Benzo(a)pyrene	10.68	0.34	0.34	0.65	1.51	1.17	0.34	3.02	2.17	0.76	0.34	1.93	0.34	0.34	0.34	0.58	1.04	1.62
PAH	Dibenz(a,h)anthracene	10.68	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	3.10	0.05	0.05	0.05	0.05	0.05
PAH	Indeno(1,2,3-cd)pyrene	107	0.10	0.01	0.01	0.01	0.06	0.01	0.10	0.01	0.01	0.01	0.09	0.26	0.01	0.01	0.01	0.01	0.01
PCB	Total PCBs	1300	0.54	0.24	0.12	0.37	0.69	0.65	0.38	0.33	0.42	0.22		0.35	0.50	0.43	0.70	0.19	0.21
	MAX TEV-HQ		0.54	0.94	0.65	1.51	1.17	1.15	3.02	2.17	0.76	1.51	1.93	3.10	1.08	0.43	0.70	1.04	1.62
	MAX CoC[4]		Total PCBs	Arsenic	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Arsenic	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Arsenic	Benzo(a) pyrene	Dibenz(a, h)anthracene	Arsenic	Total PCBs	Total PCBs	Benzo(a) pyrene	Benzo(a) pyrene
	Limiting CoC		Benzo(a)pyrene				Benzo(a)pyrene			Benzo(a) pyrene	Benzo(a)pyrene			Arsenic[5]				Benzo(a)pyrene	

1 - Threshold Effects Value Hazard Quotient (TEV-HQ) = CoC concentration (Table A-2.4)/Threshold Effect Value (TEV) (Table 14).

2 - Sum TEV-HQ = sum of TEV-HQs for all analytes at a given station.
Max TEV-HQ = maximum TEV-HQs observed for all analytes at a given station

3 - TEV units: µg/g dry weight for metals, ng/g dry weight for organics

4 - CoC associated with maximum observed TEV-HQ by sample.

5 - Arsenic selected as L-CoC for this station (see Text Section 2.4)

Table A-8. Derivation of aquatic PRGs for CoCs in porewaters and elutriates obtained from sediments collected in the Derecktor Shipyard/Coddington Cove study area[1].

Class	Analyte[2]	Aquatic Pathway[2]	DSY-25	DSY-26	DSY-27	DSY-28	DSY-29	DSY-30	DSY-31	DSY-32	DSY-33	DSY-34	DSY-35	DSY-36	DSY-37	DSY-38	DSY-39	DSY-40	DSY-41	n	PRG Mean[3,4]
PAH	HMW PAHs	PW	4886	3700	9589	10922	12858	8969	10129	9146	4530	8530	1738	9776	4996	7048	6710	2826	1819	17.00	6951
PCB	Total PCBs	PW	638	621	1855	2354	6788	2117	1668	1616	783	1767	172	1891	1205	1643	1443	1056	222	17.00	1638
MET	Arsenic	ELU	20.72						15.18	17.81	119			11.21	15.27	8.87	4.03	9.14		9.00	24.63
MET	Copper	ELU	54.52						45.92	155	40.02			125	62.64	64.96	46.40	69.02		9.00	73.74
MET	Lead	ELU	50.41						126	175	33.21			125	58.22	76.73	48.82	61.75		9.00	83.94
PCB	Total PCBs	ELU	83.53		3310		699		261	357	104			300	185	215	156	159		11.00	530
PST	o,p'-DDE	ELU	0.10		83.81		5.99		4.06	0.49	1.71			0.44	0.11	0.25	1.14	1.55		11.00	9.06

1 - Station-specific estimate of PRG = sediment concentration (Table A-2.1)/TEV-HQ (Table A-5).

2 - Analytes include Limiting CoCs identified in Table A-5.

3 - PW - bedded sediment exposure pathway, CoCs measured in porewater (PW); ELU- Resuspended sediment exposure pathway, CoCs measured in sediment elutriates (ELU).

4 - Baseline PRG calculated as the mean of station-specific estimates.

Table A-9 Comparison of sediment concentrations measured in URI (Quinn et al., 1994) and ERA (1997) investigations of the Derecktor Shipyard/Coddington Cove study area[1].

Class	Analyte	DSY-1	DSY-40	RPD[2]	DSY-1	DSY-41	RPD	DSY-2	DSY-28	RPD	DSY-3	DSY-29	RPD	DSY-10	DSY-41	RPD	DSY-11	DSY-31	RPD	DSY-18	DSY-28	RPD
Metals	Arsenic		9.79			11.43			8.68			12.46			11.43			10.22			9.43	
	Cadmium	0.20	0.59	-0.85	0.20	0.18	0.11	0.15	0.55	-1.13	1.00	1.45	-0.37	0.07	0.18	-0.86	0.31	0.76	-0.84	0.22	0.18	0.21
	Chromium	95.99	44.50	3.73	95.99	36.75	0.89	152	80.50	0.82	195	88.50	0.77	80.85	36.75	0.49	132	76.75	0.53	107	53.50	0.66
	Copper	45.52	29.75	0.42	45.52	9.25	1.32	187	71.75	0.93	262	158	0.50	12.47	9.25	0.30	81.46	80.75	0.01	81.87	39.25	0.70
	Lead	35.39	42.10	-0.17	35.39	17.00	0.70	181	77.70	0.80	201	186	0.08	22.13	17.00	0.26	46.09	81.00	-0.55	60.23	40.40	0.39
	Mercury		0.19			0.02			0.32	-2.00		0.50			0.02			0.40			0.14	
	Nickel	38.60	17.25	0.76	38.60	14.60	0.91	85.28	24.25	1.11	128	34.75	1.15	31.42	14.50	0.74	168	24.75	1.49	25.38	20.50	0.21
	Silver	0.60	0.21	0.95	0.60	0.07	1.61	0.02	0.51	0.46	1.27	0.79	0.47	0.56	0.07	1.59	1.22	0.51	0.82	0.18	0.19	-0.16
	Zinc	149	109	0.39	149	47.25	1.04	593	169	1.11	1231	393	1.03	63.64	47.25	0.30	1104	167	1.47	163	102	0.47
	SEM-AVS																					
PAHs	1,6,7-Trimethylnaphthalene	2.38	4.66	-0.65	2.38	0.46	1.36	10.10	8.41	0.18	51.89	27.94	0.60	1.01	0.45	0.77	9.15	7.90	0.03	1.01	4.34	-1.25
	1-Methylnaphthalene	6.84	9.41	-0.32	6.84	1.27	1.37	0.50	19.85	-1.90	9.71	50.07	-1.35		1.27		10.97	20.42	-0.60		7.83	
	1-Methylphenanthrene	27.68	38.26	-0.32	27.68	2.22	1.70	368	38.57	1.62	441	267	0.49	1.27	2.22	-0.54	51.06	32.53	0.44	228	43.54	1.36
	2,6-Dimethylnaphthalene	6.56	17.33	-0.90	6.56	2.36	0.84	7.55	34.23	-1.28	23.04	112	-1.32		2.36		12.33	34.64	-0.95		18.65	
	2-Methylnaphthalene	0	16.35	-2.00		2.01		2.47	43.87	-1.79	8.22	73.47	-1.80	0.74	2.01	-0.93	5.93	38.80	-1.37		13.86	
	Acenaphthene	18.26	16.20	0.12	18.26	1.71	1.68	83.47	17.27	1.14	193	189	0.02	2.29	1.71	0.29	20.89	17.14	0.20	14.84	12.21	0.19
	Acenaphthylene	58.88	95.65	-0.48	58.86	0.77	1.95	427	74.63	1.40	867	300	0.97	1.03	0.77	0.29	57.61	71.00	-0.21	167	83.84	0.56
	Anthracene	201	234	-0.15	201	11.10	1.79	1330	103	1.52	3360	1220	0.93	17.37	11.10	0.44	254	200	0.24	753	268	0.95
	Benzo(a)anthracene	166	234	-0.34	166	13.76	1.69	7360	294	1.85	10600	2700	1.19	26.14	13.76	0.62	274	281	-0.02	898	518	0.54
	Benzo(a)pyrene	164	317	-0.64	164	18.55	1.59	3320	377	1.59	4710	2380	0.66	38.47	18.55	0.70	206	421	-0.68	1180	434	0.93
	Benzo(b)fluoranthene	358			358			10100			9230			70.46			361			1890		
	Benzo(e)pyrene	273	333	-0.20	273	19.44	1.73	5140	362	1.74	5600	1950	0.97	40.07	19.44	0.89	257	401	-0.44	1020	365	0.95
	Benzo(g,h,i)perylene	97.41	184	-0.61	97.41	12.18	1.56	2070	247	1.57	3060	1110	0.94	29.52	12.18	0.83	132	215	-0.48	563	201	0.95
	Benzo(k)fluoranthene	224	836	-1.18	224	47.26	1.30	2070	911	0.78	1980	5350	-0.82	24.16	47.26	-0.65	245	1040	-1.24	899	999	-0.11
	Biphenyl	5.01	6.02	-0.18	5.01	0.66	1.53	12.81	12.61	0.02	40.77	29.91	0.31	0	0.66	-2.00	18.53	14.41	0.25	9.37	8.66	0.34
	Chrysene	406	444	-0.09	406	20.65	1.81	4980	364	1.73	6390	2800	0.78	47.47	20.65	0.79	538	399	0.30	1460	592	0.85
	Dibenz(a,h)anthracene	21.20	52.77	-0.85	21.20	3.18	1.48	784	66.60	1.69	1460	317	1.29	9.34	3.18	0.99	28.43	62.83	-0.76	243	81.34	1.19
	Fluoranthene	1350	773	0.30	1050	37.83	1.88	12000	458	1.85	13600	4970	0.93	94.27	37.83	0.65	1320	399	1.07	1590	686	0.79
	Fluorene	42.73	19.06	0.78	42.73	2.09	1.81	439	31.45	1.73	859	294	0.98	0.92	2.09	-0.78	74.94	28.12	0.91	92.44	53.89	0.53
	Indeno(1,2,3-cd)pyrene	98.85	105	-0.50	98.85	11.44	1.58	1720	223	1.54		1020		18.33	11.44	0.46	132	210	-0.49	529	209	0.87
	Naphthalene	9.27	21.90	-1.95	9.27	1.84	-1.49	1.97	37.54	-1.80	2.94	76.08	-1.86	1.90	1.84	0.03	11.75	45.30	-1.16		18.16	
	Perylene	57.17	78.10	-0.32	57.17	7.31	1.55	1050	133	1.55	1338	611	0.74	22.57	7.31	1.02	85.53	142	-0.39	311	133	0.80
	Phenanthrene	305	394	0.60	305	20.16	1.75	3920	223	1.79	4890	1610	1.01	21.15	20.16	0.05	392	216	0.58	627	317	0.68
	Pyrene	794	1190	-0.40	794	49.54	1.76	9390	850	1.74	10100	5300	0.62	93.92	49.54	0.62	990	846	0.16	1640	740	0.76
	Low Molecular Weight PAHs	369	478	-0.26	369	26.49	1.73	2862	502	1.37	5856	2639	0.76	26.53	26.49	0.00	528	509	0.04	1266	539	0.81
	High Molecular Weight PAHs	4013	4917	-0.20	4013	281	1.76	60994	4308	1.75	72958	30118	0.83	536	281	0.69	4951	4640	0.07	12860	5258	0.84
	Sum of PAHs	4383	5395	-0.21	4383	288	1.75	66656	4809	1.73	78812	32757	0.83	562	288	0.65	5519	5149	0.07	14126	5795	0.84
PCBs	Total PCBs (Sum Congeners x2)	67.59	84.13	-0.22	67.59	13.75	1.32	209	134	0.44	733	546	0.29	11.73	13.75	-0.16	558	221	0.99	293	98.24	0.99
Pesticides	Alpha		0.10			0.10		0.06	0.10	-0.57		0.10			0.10			0.10		0.09	0.10	-0.14
	Hexachlorobenzene		0.08			0.08		0.24	0.06	1.26	0.17	0.16	0.11		0.08			0.08		0.10	0.12	-0.12
	Mirex		0.03			0.10		0	0.17	-2.00		0.10			0.10			0.33		0.39	0.19	0.70
	p,p'-DDE	0.98	1.07	-0.09	0.98	0.40	0.84	5.71	1.67	1.09	3.81	4.96	-0.26	0.74	0.40	0.60	8.71	3.93	0.82	4.34	1.52	0.96
	p,p'-DDE	0.18	1.14	-1.44	0.18	0.08	0.82	3.13	2.03	0.42	13.61	6.29	0.74	3.46	0.08	1.91	1.45	1.95	-0.29		0.81	
TOC	% TOC	2.26	1.48	0.33	2.06	0.81	0.87	1.30	4.01	-1.02	2.63	6.09	-0.79	1.53	0.81	0.61	6.17	3.84	0.46	2.85	1.47	0.67
	All CoDs	-3.07E-01			1.35			0.69			0.37			0.33			2.72E-04			0.67		
	PRGs[4]	-4.37E-02			1.28			0.88			0.42			0.27			0.13			0.73		
	Station Separation Distance (m)	46.27			47.24			44.42			24.98			61.06			27.21			41.24		

1 - ERA Sediment data source: Table A-2.1A. URI Sediment data source: Table A-2.1B
2 - RPD = Relative Percent Difference of co-located station sediment concentrations (URI vs. ERA, respectively). See Figure 3.2-1 for station locations.
3 - CV = Coefficient of Variation of mean RPD across station pairs
4 - PRGs identified in Table 13 for aquatic exposure pathways

Table A-9 (continued). Comparison of sediment concentrations measured in URI (Quinn et al., 1994) and ERA (1997) investigations of the Derecktor Shipyard/Coddington Cove study area[1].

											All Data			Separation Distance <30m			Separation Distance >30m		
Class	Analyte	DSY-19	DSY-22	RPD	DSY-20	DSY-21	RPD	DSY-21	DSY-33	RPD	RPD Mean	RPD STDEV	RPD CV[3]	RPD Mean	RPD STDEV	RPD CV[3]	RPD Mean	RPD STDEV	RPD CV[3]
Metals	Arsenic		10.93			10.22			7.39										
	Cadmium	0.17	9.72	-1.23	0.25	0.76	-1.00	0.19	0.19	0.00	-5.95E-01	0.54	-0.90	-7.34E-01	0.33	-0.45	-0.53	0.62	-1.15
	Chromium	105	84.75	0.21	99.20	76.75	0.26	142	46.50	1.02	0.62	0.26	0.41	0.52	0.26	0.50	0.68	0.26	0.40
	Copper	68.91	66.75	0.00	79.68	80.75	-0.01	29.66	17.25	0.53	0.47	0.43	0.92	0.16	0.29	1.76	0.60	0.43	0.72
	Lead	57.82	125	-0.73	76.91	81.00	-0.05	41.83	40.00	0.04	0.08	0.49	6.37	-1.74E-01	0.33	-1.90	0.18	0.53	2.87
	Mercury		0.37			0.40			0.13										
	Nickel	22.79	25.75	-0.12	23.07	24.75	-0.07	7.91	18.25	-0.79	0.54	0.71	1.31	0.85	0.82	0.96	0.40	0.68	1.68
	Silver	0.46	0.81	-0.68	0.88	0.51	0.53	0.08	0.24	-0.97	0.46	0.88	1.87	0.61	0.19	0.31	0.40	1.04	2.61
	Zinc	139	201	-0.36	158	167	-0.06	175	72.25	0.83	0.62	0.57	0.92	0.02	0.79	0.97	0.54	0.51	0.94
	SEM AVS																		
PAHs	1 & 2-Trimethylnaphthalene		7.89		4.30	7.60	-0.59	4.19	2.04	0.69	0.13	0.83	6.56	0.01	0.59	47.07	0.18	0.97	5.31
	1-Methylnaphthalene		17.57		0	20.42	-2.00	14.95	5.11	0.98	-5.45E-01	1.33	-2.44	-1.32E+00	0.70	-0.53	0.03	1.46	44.03
	1-Methylphenanthrene	311	51.57	1.43	421	32.53	1.71	15.41	8.68	0.54	0.84	0.84	1.00	0.88	0.72	0.81	0.83	0.94	1.14
	2,6-Dimethylnaphthalene		43.59			34.64		3.04	9.91	-1.05	-7.61E-01	0.85	-1.12	-1.13E+00	0.28	-0.23	-0.57	1.02	-1.78
	2-Methylnaphthalene		32.08			36.88		20.10	9.66	0.70	-1.16E+00	0.99	-0.85	-1.49E+00	0.16	-0.11	-1.00	1.23	-1.22
	Acenaphthene		14.29		17.13	17.14	0.00	7.12	3.31	0.73	0.48	0.58	1.19	0.07	0.11	1.48	0.69	0.61	0.89
	Acenaphthylene		131		64.60	71.00	-0.06	30.23	11.85	0.87	0.59	0.80	1.36	0.22	0.85	2.92	0.77	0.85	1.11
	Anthracene	789	258	0.91	922	200	1.29	59.80	31.49	1.04	0.90	0.58	0.66	0.82	0.53	0.65	0.93	0.65	0.70
	Benzo(a)anthracene	399	388	0.03	1420	281	1.34	196	50.03	1.19	0.81	0.76	0.94	0.83	0.75	0.89	0.80	0.82	1.03
	Benzo(a)pyrene	496	495	0.00	880	421	0.71	110	87.65	0.47	0.53	0.79	1.48	0.23	0.79	3.48	0.66	0.81	1.22
	Benzo,b)fluoranthene	1000			1500			159											
	Benzo(e)pyrene	576	417	0.32	743	401	0.60	88.94	63.45	0.33	0.67	0.72	1.08	0.38	0.73	1.94	0.80	0.73	0.92
	Benzo(g,h,i)perylene	260	287	-0.10	280	215	0.26	134	59.33	0.81	0.58	0.78	1.34	0.24	0.71	2.93	0.73	0.81	1.12
	Benzo(k)fluoranthene	791	1100	-0.33	2300	1040	0.75	47.04	155	-1.07	-2.63E-01	0.92	-3.49	-4.68E-01	1.07	-2.29	-0.18	0.92	-5.27
	Biphenyl		15.37			14.41		5.62	3.18	0.55	0.10	0.98	9.72	0.26	0.04	0.14	0.04	1.17	27.10
	Chrysene	1170	491	0.82	1590	399	1.19	122	58.78	0.70	0.89	0.58	0.65	0.76	0.45	0.59	0.94	0.65	0.69
	Dibenz(a,h)anthracene	39.28	72.22	-0.59	56.80	62.93	-0.10	43.98	12.41	1.12	0.54	1.00	1.84	0.14	1.04	7.30	0.72	1.01	1.41
	Fluoranthene	1830	535	1.09	5850	399	1.74	325	85.23	1.09	1.16	0.51	0.44	1.25	0.44	0.35	1.12	0.57	0.51
	Fluorene		25.73		218	28.12	1.54	29.38	6.57	1.27	0.97	0.79	0.81	1.14	0.34	0.30	0.89	0.96	1.08
	Indeno(1,2,3-cd)pyrene	256	264	-0.03	276	218	0.24	99.71	45.31	0.75	0.49	0.77	1.58	-1.29E-01	0.52	-4.00	0.87	0.77	1.15
	Naphthalene		42.67		9.13	45.30	-1.33	2.98	10.87	-1.14	-1.34E+00	0.63	-0.47	-1.45E+00	0.35	-0.24	-1.27	0.78	-0.62
	Perylene	244	150	0.48	300	142	0.72	54.42	23.92	0.78	0.69	0.65	0.94	0.38	0.65	1.80	0.84	0.65	0.77
	Phenanthrene	550	182	1.01	1400	216	1.47	171	46.16	1.15	0.95	0.63	0.67	1.02	0.44	0.44	0.92	0.73	0.80
	Pyrene	1550	917	0.51	3820	846	1.27	373	107	1.11	0.82	0.68	0.83	0.69	0.56	0.82	0.87	0.76	0.87
	Low Molecular Weight PAHs	1110	680	0.48	1654	509	1.06	233	103	0.77	0.68	0.63	0.93	0.62	0.53	0.85	0.70	0.70	1.01
	High Molecular Weight PAHs	9212	5298	0.54	20406	4640	1.26	1923	776	0.85	0.84	0.63	0.76	0.72	0.60	0.83	0.89	0.69	0.78
	Sum of PAHs	10322	5978	0.53	22060	5148	1.24	2156	879	0.84	0.83	0.63	0.77	0.71	0.59	0.83	0.88	0.69	0.79
PCBs	Total PCBs (Sum Congeners x2)	217	201	0.07	367	221	0.50	92.31	39.93	0.78	0.50	0.52	1.03	0.59	0.38	0.61	0.46	0.60	1.29
Pesticides	Aldrin		0.10		0.18	0.10	0.56		0.10		-5.03E-02	0.57	-11.40	0.56		0.00	-0.36	0.31	-0.86
	Hexachlorobenzene	0.15	0.08	0.26	0.12	0.08	0.39	0.24	0.08	1.01	0.48	0.54	1.11	0.25	0.20	0.80	0.60	0.64	1.07
	Mirex	0.23	0.71	-1.02	0.32	0.33	-0.01	0.09	0.10	-0.14	-4.94E-01	1.04	-2.11	-8.90E-03		0.00	-0.62	1.16	-1.89
	o,p'-DDE	2.39	0.26	1.61	6.26	3.63	0.53	1.19	0.63	0.60	0.67	0.54	0.81	0.36	0.56	1.54	0.60	0.52	0.85
	p,p'-DDE	1.79	2.38	-0.28		1.95		0.76	0.42	0.58	0.31	0.99	3.24	0.22	0.73	3.26	0.33	1.13	3.37
TOC	% TOC	4.21	3.57	0.16	3.29	3.94	-0.16	1.15	1.66	-0.36	0.08	0.64	-1.57	-1.81E-01	0.63	-3.50	0.19	0.67	3.70
	All CoCs	0.17			0.45			0.52			0.36	0.72	0.79	0.24	0.52	1.98	0.42	0.78	2.49
	PRGs[4]				0.42			0.55			0.47	0.52	2.27	0.33	0.40	0.32	0.53	0.56	1.41
	Mean Separation Distance (m)	29.03			26.09			47.87											

1 - ERA Sediment data source: Table A-2.1A; URI Sediment data source: Table A-2.1B.
2 - RPD = Relative Percent Difference of co-located station sediment concentrations (URI vs. ERA, respectively). See Figure 3.2-1 for station locations
3 - CV = Coefficient of Variation of mean RPD across station pairs.
4 - PRGs identified in Table 16 for aquatic exposure pathways

Table A-10A. PRG Hazard Quotients[1] for CoCs in the aquatic exposure pathways for the Derecktor Shipyard/Coddington Cove study area:

ERA investigation.

Class	Analyte[2]	Aquatic Pathway[3]	Aquatic PRG	DSY-25	DSY-26	DSY-27	DSY-28	DSY-29	DSY-30	DSY-31	DSY-32	DSY-33	DSY-34	DSY-35	DSY-36	DSY-37	DSY-38	DSY-39	DSY-40	DSY-41
PAH	HMW PAHs	PW	6951	0.63	0.76	1.46	0.62	4.33	1.49	0.67	0.76	0.11	0.25	7.79E-03	0.47	0.28	0.22	0.23	0.71	0.04
PCB	Total PCBs	PW	1638	0.06	0.06	2.02	0.08	0.33	0.19	0.13	0.12	0.02	0.04	4.09E-03	0.07	0.06	0.04	0.04	0.05	8.40E-03
PST	o,p'-DDE	PW																		
	SUM PRG-HQ			0.68	0.82	3.48	0.70	4.67	1.68	0.80	0.88	0.14	0.29	0.01	0.54	0.34	0.25	0.27	0.76	0.05
	MAX PRG-HQ					2.02		4.33	1.49											
	MAX CoC					Total PCBs		HMW PAHs	HMW PAHs											
MET	Arsenic	ELU	24.63	0.26	0.38	0.47	0.35	0.51	0.42	0.41	0.44	0.30	0.39	0.14	0.46	0.30	0.36	0.31	0.28	0.46
MET	Copper	ELU	73.74	0.32	0.53	2.25	0.97	2.14	1.10	1.10	0.91	0.23	0.45	0.03	0.73	0.37	0.38	0.27	0.40	0.13
MET	Lead	ELU	83.94	0.43	0.48	1.80	0.93	2.21	0.95	0.96	1.49	0.48	0.57	0.17	0.94	0.68	0.74	0.64	0.50	0.20
PCB	Total PCBs	ELU	530	0.18	0.19	6.25	0.25	1.03	0.59	0.42	0.38	0.08	0.12	0.01	0.21	0.19	0.11	0.11	0.16	0.03
PST	o,p'-DDE	ELU	9.06	0.01	0.17	7.20	0.18	0.55	0.63	0.40	0.03	0.07	0.10	0.03	0.03	0.01	0.01	0.08	0.12	0.04
	SUM PRG-HQ			1.19	1.75	17.97	2.69	6.44	3.69	3.29	3.24	1.16	1.63	0.37	2.37	1.54	1.61	1.41	1.46	0.86
	MAX PRG-HQ			0.43	0.53	7.20	0.97	2.21	1.10	1.10	1.49	0.48	0.57		0.94	0.68	0.74	0.64	0.50	
	MAX PRG CoC					o,p'-DDE		Lead	Copper	Copper	Lead									

1 - Aquatic PRG-HQ = sediment CoC concentration(Table A-2.1A)/Aquatic pathway-specific Preliminary Remediation Goal (PRG) (Table 16).

2 - Sum PRG-HQ = sum of PRG-HQs for all analytes at a given station.

Max PRG-HQ = maximum PRG-HQs observed for all analytes at a given station.

3 - PW - bedded sediment exposure pathway, CoCs measured in porewater (PW); ELU- Resuspended sediment exposure pathway, CoCs measured in sediment elutriates (ELU).

Table A-10B. PRG Hazard Quotients[1] for CoCs in the aquatic exposure pathways for the Derecktor Shipyard/Coddington Cove study area:

URI Investigations.

Class	Analyte[2]	Aquatic Pathway[3]	Aquatic PRG	DSY-1	DSY-2	DSY-3	DSY-4	DSY-5	DSY-6	DSY-7	DSY-8	DSY-9	DSY-10	DSY-11	DSY-12	DSY-13	DSY-14	DSY-15	DSY-16	DSY-17	DSY-18	DSY-19
PAH	HMW PAHs	PW	6951	0.58	9.21	10.50	0.80	0.65	0.77	0.60	0.84	0.09	0.08	0.72	0.65	0.13	0.06	0.45	0.03	0.49	1.85	1.33
PCB	Total PCBs	PW	1638	0.04	0.13	0.45	0.12	0.06	0.08	0.04	0.09	0.02	0.01	0.40	0.11	0.01	0.01	0.03	0.01	0.15	0.18	0.13
PST	o,p'-DDE	PW																				
	SUM PRG-HQ			0.62	9.33	10.94	0.91	0.72	0.85	0.65	0.93	0.11	0.08	1.12	0.75	0.14	0.08	0.48	0.04	0.64	2.03	1.46
	MAX PRG-HQ				9.21	10.50								0.72							1.85	1.33
	MAX CoC				HMW PAHs	HMW PAHs															HMW PAHs	HMW PAHs
MET	Arsenic	ELU	24.63																			
MET	Copper	ELU	73.74	0.62	2.67	3.56	0.85	0.71	0.78	0.38	1.03	0.05	0.17	1.10	0.73	0.25	0.11	0.25	0.09	0.23	1.11	0.91
MET	Lead	ELU	83.94	0.42	2.15	2.40	0.61	0.52	0.58	0.38	0.60	0.18	0.26	0.55	0.55	0.42	0.34	0.50	0.38	0.39	0.72	0.69
PCB	Total PCBs	ELU	530	0.13	0.39	1.38	0.37	0.20	0.25	0.14	0.28	0.05	0.02	1.24	0.33	0.04	0.04	0.10	0.02	0.46	0.55	0.41
PST	o,p'-DDE	ELU	9.06	0.11	0.63	0.42	0.44	0.32	0.29	0.17	0.23	0.04	0.08	0.96	0.27	0.08	0.05	0.17	0	0.07	0.48	0.26
	SUM PRG-HQ			1.27	5.85	7.76	2.28	1.75	1.90	1.07	2.15	0.33	0.54	3.86	1.88	0.79	0.54	1.03	0.48	1.16	2.86	2.27
	MAX PRG-HQ			0.62	2.67	3.56	0.85	0.71	0.78	0.38	1.03			1.24	0.73			0.50		0.46	1.11	0.91
	MAX PRG CoC				Copper	Copper					Copper			PCBs							Copper	

1 - Aquatic PRG-HQ = sediment CoC concentration(Table A-2.1B)/Aquatic pathway-specific Preliminary Remediation Goal (PRG) (Table 16).

2 - Sum PRG-HQ = sum of PRG-HQs for all analytes at a given station.

Max PRG-HQ = maximum PRG-HQs observed for all analytes at a given station.

3 - PW - bedded sediment exposure pathway, CoCs measured in porewater (PW); ELU- Resuspended sediment exposure pathway, CoCs measured in sediment elutriates (ELU).

Table A-10B (continued). PRG Hazard Quotients[1] for CoCs in the aquatic exposure pathways for the Derecktor Shipyard/Coddington Cove study area:

URI Investigations.

Class	Analyte[2]	Aquatic Pathway[3]	Aquatic PRG	DSY-20	DSY-21	DSY-22	DSY-23	DSY-24
PAH	HMW PAHs	PW	6951	2.94	0.28	0.47	0.03	0.49
PCB	Total PCBs	PW	1638	0.22	0.06	0.11	0.01	0.15
PST	o,p'-DDE	PW						
	SUM PRG-HQ			3.16	0.33	0.58	0.04	0.64
	MAX PRG-HQ			2.94				
	MAX CoC			HMW PAHs				
MET	Arsenic	ELU	24.63					
MET	Copper	ELU	73.74	1.08	0.40	0.70	0.09	0.23
MET	Lead	ELU	83.94	0.92	0.50	0.63	0.38	0.39
PCB	Total PCBs	ELU	530	0.69	0.17	0.34	0.02	0.46
PST	o,p'-DDE	ELU	9.06	0.69	0.13	0.28	0	0.07
	SUM PRG-HQ			3.38	1.20	1.94	0.48	1.16
	MAX PRG-HQ			1.08	0.50	0.70		0.46
	MAX PRG CoC			Copper				

1 - Aquatic PRG-HQ = sediment CoC concentration(Table A-2.1B)/Aquatic pathway-specific Preliminary Remediation Goal (PRG) (Table 16).

2 - Sum PRG-HQ = sum of PRG-HQs for all analytes at a given station.
Max PRG-HQ = maximum PRG-HQs observed for all analytes at a given station.

3 - PW - bedded sediment exposure pathway, CoCs measured in porewater (PW); ELU- Resuspended sediment exposure pathway, CoCs measured in sediment elutriates (ELU).

Table A-11A PRG Hazard Quotients[1] for CoCs in the avian predator exposure pathway for the Derecktor Shipyard/Coddington Cove study area.

ERA investigation.

Class	Analyte[2]	AV-PRG	DSY-25	DSY-26	DSY-27	DSY-28	DSY-29	DSY-30	DSY-31	DSY-32	DSY-33	DSY-34	DSY-35	DSY-36	DSY-37	DSY-38	DSY-39	DSY-40	DSY-41
MET	Arsenic	17.09	0.37	0.55	0.68	0.51	0.73	0.60	0.60	0.64	0.43	0.57	0.20	0.66	0.43	0.52	0.44	0.40	0.67
MET	Copper	184	0.13	0.21	0.90	0.39	0.86	0.44	0.44	0.36	0.09	0.18	0.01	0.29	0.15	0.15	0.11	0.16	0.05
MET	Lead	622000	5.77E-05	6.50E-05	2.42E-04	1.25E-04	2.99E-04	1.29E-04	1.30E-04	2.01E-04	6.43E-05	7.85E-05	2.25E-05	1.27E-04	9.15E-05	1.00E-04	8.68E-05	6.77E-05	2.73E-05
MET	Silver	2342	1.12E-04	8.00E-05	2.94E-04	2.19E-04	3.36E-04	3.15E-04	2.19E-04	3.47E-04	1.01E-04	1.23E-04	2.77E-05	2.40E-04	1.65E-04	6.94E-05	1.12E-04	9.07E-05	2.77E-05
MET	Zinc	118	0.94	0.86	4.65	1.44	3.34	1.64	1.42	1.71	0.61	0.90	0.24	1.23	0.79	0.93	0.83	0.85	0.40
PCB	Total PCBs	92.82	1.01	1.06	35.66	1.44	5.89	3.40	2.38	2.16	0.43	0.70	0.07	1.22	1.08	0.64	0.63	0.91	0.15
	SUM PRG-HQ		2.44	2.69	41.90	3.78	10.81	6.08	4.84	4.88	1.57	2.34	0.52	3.40	2.45	2.24	2.01	2.32	1.27
	MAX PRG-HQ		1.01	1.06	35.66	1.44	5.89	3.40	2.38	2.16				1.23	1.08				
	MAX PRG CoC		Total PCBs	Total PCBs	Total PCBs	Total PCBs	Total PCBs	Total PCBs	Total PCBs	Total PCBs				Zinc	Total PCBs				

1 - Avian PRG-HQ = sediment CoC concentration (Table A-2 1)/Avian (HQ=1) Preliminary Remediation Goal (PRG) (Table 16).

2 Sum PRG-HQ = sum of PRG-HQs for all analytes at a given station

Max PRG-HQ = maximum PRG-HQs observed for all analytes at a given station.

Table A-11B. PRG Hazard Quotients[1] for CoCs in the avian predator exposure pathway for the Derecktor Shipyard/Coddington Cove study area.

URI Investigation.

Class	Analyte[2]	AV-PRG	DSY-1	DSY-2	DSY-3	DSY-4	DSY-5	DSY-6	DSY-7	DSY-8	DSY-9	DSY-10	DSY-11	DSY-12	DSY-13	DSY-14	DSY-15	DSY-16
MET	Arsenic	17.09																
MET	Copper	184	0.25	1.07	1.43	0.34	0.28	0.31	0.15	0.41	0.02	0.07	0.44	0.29	0.10	0.04	0.10	0.03
MET	Lead	622000	5.69E-05	2.91E-04	3.23E-04	8.26E-05	6.96E-05	7.81E-05	5.10E-05	8.14E-05	2.39E-05	3.56E-05	7.41E-05	7.39E-05	5.66E-05	4.65E-05	6.76E-05	5.07E-05
MET	Silver	2342	2.56E-04	3.51E-04	5.41E-04	5.88E-03	9.91E-04	6.80E-04	2.31E-03	7.42E-04	3.13E-04	2.41E-04	5.23E-04	6.75E-04	2.72E-05	2.27E-05	2.28E-05	2.02E-05
MET	Zinc	118	1.27	5.04	10.47	1.61	1.47	1.49	1.01	1.57	0.50	0.54	9.39	1.37	0.76	0.57	0.71	0.41
PCB	Total PCBs	92.82	0.73	2.25	7.90	2.10	1.14	1.42	0.79	1.60	0.30	0.13	7.09	1.90	0.24	0.25	0.59	0.10
	SUM PRG-HQ		2.25	8.37	19.80	4.05	2.89	3.23	1.95	3.58	0.83	0.74	16.92	3.56	1.10	0.86	1.40	0.55
	MAX PRG-HQ		1.27	5.04	10.47	2.10	1.47	1.49	1.01	1.60			9.39	1.90				
	MAX PRG CoC		Zinc	Zinc	Zinc	Total PCBs	Zinc	Zinc	Zinc	Total PCBs			Zinc	Total PCBs				

1 - Avian PRG-HQ = sediment CoC concentration (Table A-2.1)/Avian (HQ=1) Preliminary Remediation Goal (PRG) (Table 16).

2 - Sum PRG-HQ = sum of PRG-HQs for all analytes at a given station

Max PRG-HQ = maximum PRG-HQs observed for all analytes at a given station.

Table A-11B (continued). PRG Hazard Quotients[1] for CoCs in the avian predator exposure pathway for the Shipyard/Coddington Cove study area.

URI investigation.

Class	Analyte[2]	DSY-17	DSY-18	DSY-19	DSY-20	DSY-21	DSY-22	DSY-23	DSY-24
MET	Arsenic								
MET	Copper	0.09	0.44	0.36	0.43	0.16	0.28	0.27	0.08
MET	Lead	5.29E-05	9.68E-05	9.30E-05	1.24E-04	6.73E-05	8.44E-05	8.71E-05	6.29E-05
MET	Silver	2.28E-05	6.79E-05	1.71E-04	3.77E-04	3.51E-05	5.22E-05	5.22E-05	2.36E-05
MET	Zinc	0.61	1.39	1.19	1.34	1.49	1.21	1.19	0.83
PCB	Total PCBs	2.63	3.15	2.33	3.95	0.99	1.92	1.62	0.28
	SUM PRG-HQ	3.33	4.99	3.88	5.73	2.64	3.41	3.08	1.19
	MAX PRG-HQ	2.63	3.15	2.33	3.95	1.49	1.92	1.62	
	MAX PRG CoC	Total PCBs	Total PCBs	Total PCBs	Total PCBs	Zinc	Total PCBs	Total PCBs	

1 - Avian PRG-HQ = sediment CoC concentration (Table A-2.1)/Avian (HQ=1) Preliminary Remediation Goal (PRG) (Table 16).

2 - Sum PRG-HQ = sum of PRG-HQs for all analytes at a given station.

Max PRG-HQ = maximum PRG-HQs observed for all analytes at a given station

Table A-12A. PRG Hazard Quotients[1] for CoCs in the human health exposure pathway for the Derecktor Shipyard/Coddington Cove study area.

ERA investigation.

Class	Analyte[2]	HH-PRG	DSY-25	DSY-26	DSY-27	DSY-28	DSY-29	DSY-30	DSY-31	DSY-32	DSY-33	DSY-34	DSY-35	DSY-36	DSY-37	DSY-38	DSY-39	DSY-40	DSY-41
MET	Arsenic	19.74	0.32	0.48	0.59	0.44	0.63	0.52	0.52	0.55	0.37	0.49	0.17	0.57	0.38	0.45	0.38	0.34	0.58
PAH	Benzo(a)pyrene	53.92	7.34	8.05	17.14	7.00	44.14	15.06	7.80	9.17	1.26	2.74	0.08	5.92	3.04	2.22	2.65	5.87	0.34
	SUM PRG-HQ		7.66	8.53	17.72	7.44	44.77	15.58	8.32	9.73	1.63	3.23	0.25	6.49	3.41	2.68	3.04	6.22	0.92
	MAX PRG-HQ		7.34	8.05	17.14	7.00	44.14	15.06	7.80	9.17	1.26	2.74		5.92	3.04	2.22	2.65	5.87	
	MAX PRG CoC		Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene		Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	

1 - Human Health PRG-HQ = sediment CoC concentration(Table A-2.1)/HH (HQ=1) Preliminary Remediation Goal (PRG) (Table 16).

2 - Sum PRG-HQ = sum of PRG-HQs for all analytes at a given station.

Max PRG-HQ = maximum PRG-HQs observed for all analytes at a given station.

Table A-12B. PRG Hazard Quotients[1] for CoCs in the human health exposure pathway for the Derecktor Shipyard/Coddington Cove study area.

URI Investigation.

Class	Analyte[2]	HH-PRG	DSY-1	DSY-2	DSY-3	DSY-4	DSY-5	DSY-6	DSY-7	DSY-8	DSY-9	DSY-10	DSY-11	DSY-12	DSY-13	DSY-14	DSY-15	DSY-16	DSY-17	DSY-18	DSY-19	DSY-20	DSY-21	DSY-22	DSY-23	DSY-24
MET	Arsenic	19.74																								
PAH	Benzo(a)pyrene	53.92	3.04	61.57	87.35	8.00	7.45	9.06	5.60	8.92	0.91	0.71	3.83	4.61	0.81	0.48	4.54	0.22	5.76	22.07	9.20	16.33	2.03	3.38	4.44	1.01
	SUM PRG-HQ		3.04	61.57	87.35	8.00	7.45	9.06	5.60	8.92	0.91	0.71	3.83	4.61	0.81	0.48	4.54	0.22	5.76	22.07	9.20	16.33	2.03	3.38	4.44	1.01
	MAX PRG-HQ		3.04	61.57	87.35	8.00	7.45	9.06	5.60	8.92			3.83	4.61			4.54		5.76	22.07	9.20	16.33	2.03	3.38	4.44	1.01
	MAX PRG CoC		Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene			Benzo(a) pyrene	Benzo(a) pyrene			Benzo(a) pyrene		Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene

1 Human Health PRG-HQ = sediment CoC concentration(Table A-2.1)/HH (HQ=1) Preliminary Remediation Goal (PRG) (Table 16).

2 Sum PRG-HQ = sum of PRG-HQs for all analytes at a given station

Max PRG-HQ = maximum PRG-HQs observed for all analytes at a given station

Table A-13. Summary of maximum PRG-HQs and identification of Limiting CoCs by sampling location for aquatic, avian, and human health exposure pathways for the Derecktor Shipyard study area.

Exposure Pathway	*Parameter*	DSY-1	DSY-2	DSY-3	DSY-4	DSY-5	DSY-6	DSY-7	DSY-8	DSY-9	DSY-10	DSY-11	DSY-12	DSY-13	DSY-14	DSY-15	DSY-16
Aquatic (A-B)	*PRG-HQ1,2*		9.21	10.50								0.72					
Bedded Sediment	*L-CoC*		HMW PAHs	HMW PAHs													
Aquatic (A-R)	*PRG-HQ1,2*	0.62	2.67	3.56	0.85	0.71	0.78	0.38	1.03			1.24	0.73			0.50	
Resuspended Sediment	*L-CoC*		Copper	Copper					Copper			Total PCBs					
Avian Predator (P)	*PRG-HQ1,3*	1.27	5.04	10.47	2.10	1.47	1.49	1.01	1.60			9.39	1.90				
	L-CoC	Zinc	Zinc	Zinc	Total PCBs	Zinc	Zinc	Zinc	Total PCBs			Zinc	Total PCBs				
Human Health (HH)	*PRG-HQ1,4*	3.04	61.57	87.35	8.00	7.45	9.06	5.60	8.92			3.83	4.61			4.54	
	L-CoC	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene			Benzo(a) pyrene	Benzo(a) pyrene			Benzo(a) pyrene	
Combined	*PRG-HQ 1,5*	3.04	61.57	87.35	8.00	7.45	9.06	5.60	8.92			3.83	4.61			4.54	
Exposure	*L-CoC*	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene			Benzo(a) pyrene	Benzo(a) pyrene			Benzo(a) pyrene	
Pathway	*Pathway*	HH	HH	HH	HH	HH	HH	HH	HH			HH	HH			HH	

PRG-HQ=Preliminary Remediation Goal Hazard Quotient. L-CoC=Limiting Chemical of Concern. See text, Section 1.0. PRG-HQs<1 not reported.

1 - PRG-HQ = analyte pathway-specifc concentration/analyte-pathway-specific TEV value.

2 - Values presented are maximum of Aquatic PRG-HQs by station. Complete PRG-HQ values presented in Tables A-10A and A-10B.

3 - Values presented are maximum of Avian Predator PRG-HQs by station. Complete PRG-HQ values presented in Table A-11A and A-11-B.

4 - Values presented are maximum of Human Health PRG-HQs by station. Complete PRG-HQ values presented in Table A-12A and A-12B.

5 - Values presented are maximum of individual exposure pathway PRG-HQs by station.

Table A-13 (continued). Summary of maximum PRG-HQs and identification of Limiting CoCs by sampling location for aquatic, avian, and human health exposure pathways for the Derecktor Shipyard study area.

Exposure Pathway	Parameter	DSY-17	DSY-18	DSY-19	DSY-20	DSY-21	DSY-22	DSY-23	DSY-24	DSY-25	DSY-26	DSY-27	DSY-28	DSY-29	DSY-30	DSY-31	DSY-32
Aquatic (A-B)	PRG-HQ1,2		1.85	1.33	2.94							2.02		4.33	1.49		
Bedded Sediment	L-CoC		HMW PAHs	HMW PAHs	HMW PAHs							Total PCBs		HMW PAHs	HMW PAHs		
Aquatic (A-R)	PRG-HQ1,2	0.46	1.11	0.91	1.08	0.50	0.70		0.46	0.43	0.53	7.20	0.97	2.21	1.10	1.10	1.49
Resuspended Sediment	L-CoC		Copper		Copper							o,p'-DDE		Lead	Copper	Copper	Lead
Avian Predator (P)	PRG-HQ1,3	2.63	3.15	2.33	3.95	1.49	1.92	1.62		1.01	1.06	35.66	1.44	5.89	3.40	2.38	2.16
	L-CoC	Total PCBs	Total PCBs	Total PCBs	Total PCBs	Zinc	Total PCBs	Total PCBs		Total PCBs	Total PCBs	Total PCBs	Total PCBs	Total PCBs	Total PCBs	Total PCBs	Total PCBs
Human Health (HH)	PRG-HQ1,4	5.76	22.07	9.20	16.33	2.03	3.38	4.44	1.01	7.34	8.05	17.14	7.00	44.14	15.06	7.80	9.17
	L-CoC	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene
Combined	PRG-HQ 1,5	5.76	22.07	9.20	16.33	2.03	3.38	4.44	1.01	7.34	8.05	17.14	7.00	44.14	15.06	7.80	9.17
Exposure	L-CoC	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene
Pathway	Pathway	HH	HH	HH	HH	HH	HH	HH	HH	HH	HH	HH	HH	HH	HH	HH	HH

PRG-HQ=Preliminary Remediation Goal Hazard Quotient. L-CoC=Limiting Chemical of Concern. See text, Section 1.0. PRG-HQs<1 not reported.

1 - PRG-HQ = analyte pathway-specifc concentration/analyte-pathway-specific TEV value.

2 - Values presented are maximum of Aquatic PRG-HQs by station. Complete PRG-HQ values presented in Tables A-10A and A-10B.

3 - Values presented are maximum of Avian Predator PRG-HQs by station. Complete PRG-HQ values presented in Table A-11A and A-11-B.

4 - Values presented are maximum of Human Health PRG-HQs by station. Complete PRG-HQ values presented in Table A-12A and A-12B.

5 - Values presented are maximum of individual exposure pathway PRG-HQs by station.

Table A-13 (continued). Summary of maximum PRG-HQs and identification of Limiting CoCs by sampling location for aquatic, avian, and human health exposure pathways for the Derecktor Shipyard study area.

Exposure Pathway	*Parameter*	DSY-33	DSY-34	DSY-35	DSY-36	DSY-37	DSY-38	DSY-39	DSY-40	DSY-41
Aquatic (A-B)	*PRG-HQ1,2*									
Bedded Sediment	*L-CoC*									
Aquatic (A-R)	*PRG-HQ1,2*	0.48	0.57		0.94	0.68	0.74	0.64	0.50	
Resuspended Sediment	*L-CoC*									
Avian Predator (P)	*PRG-HQ1,3*				1.23	1.08				
	L-CoC				Zinc	Total PCBs				
Human Health (HH)	*PRG-HQ1,4*	1.26	2.74		5.92	3.04	2.22	2.65	5.87	
	L-CoC	Benzo(a) pyrene	Benzo(a) pyrene		Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	
Combined	*PRG-HQ 1,5*	1.26	2.74		5.92	3.04	2.22	2.65	5.87	
Exposure	*L-CoC*	Benzo(a) pyrene	Benzo(a) pyrene		Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	Benzo(a) pyrene	
Pathway	*Pathway*	HH	HH		HH	HH	HH	HH	HH	

PRG-HQ=Preliminary Remediation Goal Hazard Quotient. L-CoC=Limiting Chemical of Concern. See text, Section 1.0. PRG-HQs<1 not reported.

1 - PRG-HQ = analyte pathway-specifc concentration/analyte-pathway-specific TEV value.

2 - Values presented are maximum of Aquatic PRG-HQs by station. Complete PRG-HQ values presented in Tables A-10A and A-10B.

3 - Values presented are maximum of Avian Predator PRG-HQs by station. Complete PRG-HQ values presented in Table A-11A and A-11-B.

4 - Values presented are maximum of Human Health PRG-HQs by station. Complete PRG-HQ values presented in Table A-12A and A-12B.

5 - Values presented are maximum of individual exposure pathway PRG-HQs by station.

APPENDIX B

HISTORICAL DOCUMENTS

B-1 – LOAD RESTRICTIONS ON PIERS 1 AND 2

15 June 2012

Naval Station Newport
PIER 1
Load Restrictions

Load Restrictions

1. Uniform Live Load: 200 PSF

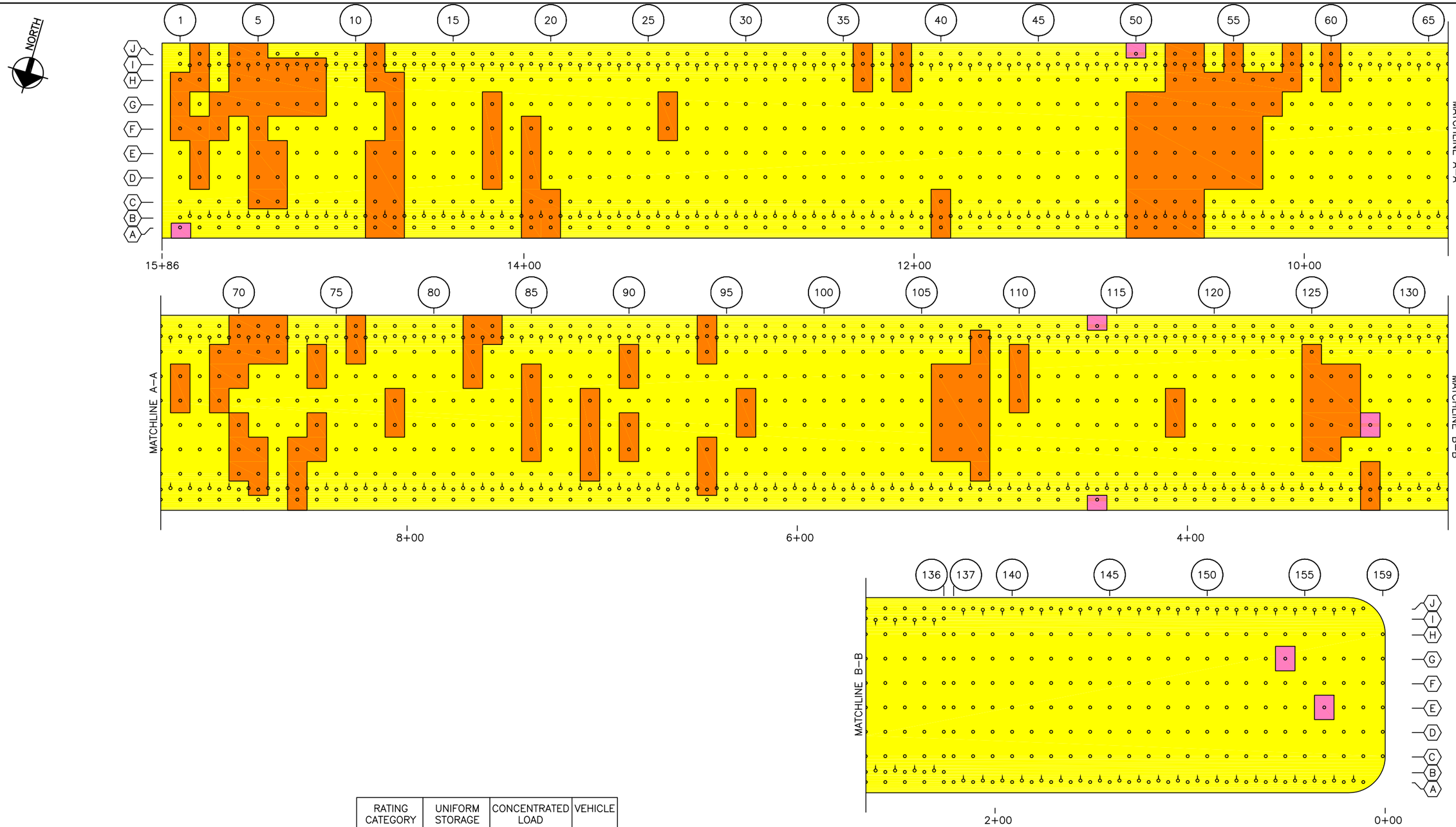
2. AASHTO HS-20 Truck load (72,000 LBS GVW)

3. Crane Limit: Maximum 25 ton truck crane. Maximum 50,000 lb float load, utilizing crane mats.

Exception: There are several locations on the pier that cannot support these loads. Referring to the attached plan of the pier, Figure 1, "red" and "magenta" areas shown on the sketch are limited to POV traffic only. These areas represent locations where pile capacity is rated at 1000 LBS and 20,000 LBS respectively.

Pier is presently posted for HS-20 loading (36 TON GVW MAX)

Reference: NAVFAC ESC Waterfront Inspection and Assessment Report # CR-6527-OCN (NOV 2009), Appendix E - Pier 1 Weight Handling Study - NFESC ECDET & Appledore Marine Engineering



RATING CATEGORY	UNIFORM STORAGE LOAD (PSF)	CONCENTRATED LOAD (K)	VEHICLE
	300	39	HS–20
	200	39	HS–20
	100	20	POV
	40	1	POV

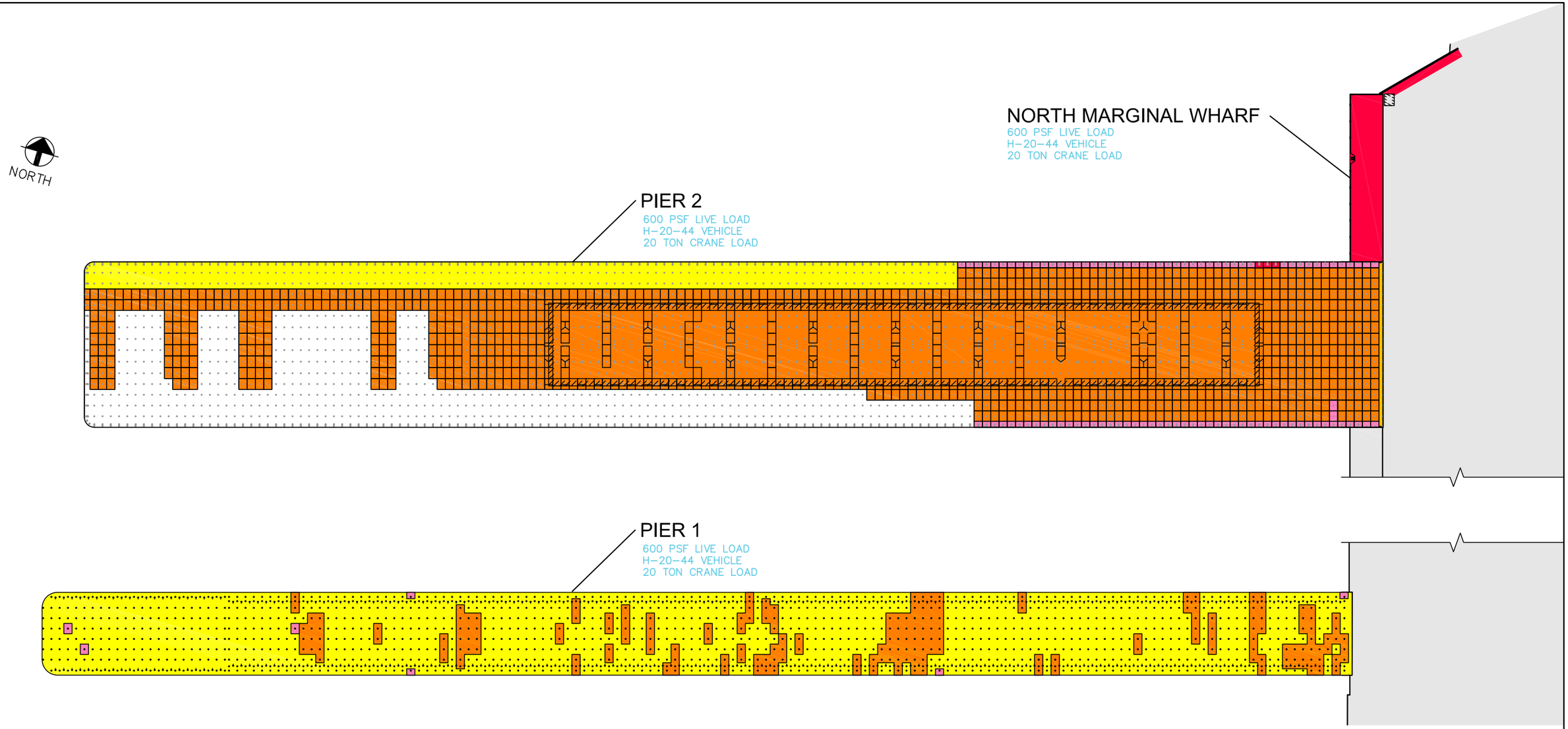
LEGEND:

(1) PILE BENT DESIGNATION

(A) PILE ROW DESIGNATION

GRAPHIC SCALE	DATE		
50 25 0 50 (FEET)	NOVEMBER 2009	APPLEDORE MARINE ENGINEERING, INC. PORTSMOUTH, N.H. Contract Number: N62473–06–D–3004	NAVAL FACILITIES ENGINEERING SERVICE CENTER EAST COAST DETACHMENT WASHINGTON, D.C.
			NAVAL STATION NEWPORT NEWPORT, RHODE ISLAND PIER 1 CURRENT DECK CAPACITY
			FIG. NO. 2

5024II Pier 1 Pile Cond Plan.dwg



LEGEND:

600 PSF ARCHIVE DESIGN INFORMATION

RATING CATEGORY	UNIFORM STORAGE LOAD (PSF)	CONCENTRATED LOAD (K)	VEHICLE
	300	39	HS-20
	200	39	HS-20
	100	20	POV
	0	0	NONE
	N/A	N/A	N/A

N/A – NOT INSPECTED

REFERENCES:

1. UNDERWATER FACILITIES INSPECTIONS AND ASSESSMENTS AT PIER 1, APRIL 1998.
2. PIER 1 WEIGHT HANDLING STUDY, NOVEMBER 2009.
3. PIER 2 WEIGHT HANDLING STUDY, MARCH 2009.
4. DECK PLAN, DWG NO 13102-138, 10/20/56

NOTES:

1. THE MAXIMUM SIZED MOBILE CRANE FOR PIER 1 HAS BEEN REDUCED FROM THE 120 TON TRUCK CRANE (PREVIOUSLY ESTABLISHED IN THE 1999 HPA REPORT) TO A MAXIMUM OF A 25 TON TRUCK CRANE, OR 50 KIP FLOAT LOAD, UTILIZING CRANE MATS. THE MATS MUST BE ALIGNED WITH THE PILE CAP (LONG AXIS OF MAT LAYING TRANSVERSE TO THE PIER DIRECTION). UNDER THIS ARRANGEMENT, 25-TON CRANES CAN ACCESS ALL AREAS OF PIER 1 EXCEPT THOSE WHICH ARE IN SERIOUS CONDITION.
2. UNINSPECTED PILES ON PIER 2 ARE SHOWN IN WHITE AND ARE ASSUMED TO HAVE THE FOLLOWING LOAD RESTRICTIONS:
   a. MAXIMUM UNIFORM STORAGE LOAD OF 100 PSF
   b. MAXIMUM TRUCK OR CRANE AXLE LOAD OF 16,000 LBS (HS10)

CRANE LOADING PLAN

NO SCALE

NAVSTA FACILITIES

NAVAL STATION NEWPORT
NEWPORT, RI

DATE:
NOVEMBER 2009

FIGURE 5

50241 Appendix B.dwg

NAVAL STATION NEWPORT
Pier 2 Load Restrictions

Revised 29 May 2009

The Commanding Officer of Naval Station Newport is imposing new load restrictions on Pier 2 which are effective 20 May 2009. These restrictions are the result of the Pier 2 Weight Handling Operations Study Report prepared by Appledore Marine Engineering, which includes a piling survey finding advanced pile corrosion and degradation.

The load restrictions will require that all weight handling operations be performed on the northern side of the pier, which was repaired in 2002-2003. This repaired area is approximately 30 ft wide by 1,000 ft long (Bents 52 to 157). See load restriction (3).

To access this area, a drive lane will be delineated on the deck surface on the north side of the pier. Truck traffic is only permitted on the drive lane and the repaired area of the deck. See load restriction (2).

At all other deck areas, load restriction (1) is in effect.

LOAD RESTRICTIONS

(1) All pier deck areas EXCEPT area listed in (2) and (3) below:

- Uniform Live Load: 100 psf
- 16,000 lbs axle (H 10 Vehicle)

(2) Truck Drive Lane, North side, bents 1 to 52/ pile row A.5 to C.5

- Uniform Live Load: 250 psf
- 32,000 lbs axle (HS 20 Vehicle)
- Maximum Concentrated Load: 25,000 lbs.

(3) Repaired pier deck, North side, bents 52 to 157 / pile row A to C.5:

- Uniform Live Load: 400 psf
- 32,000 lbs axle (HS 20 Vehicle)
- Maximum Concentrated Load Load: 40,000 lbs. (Crane Outrigger)

The following weight handling operation and vehicle restrictions are in effect:

- Sinkers (20,000 lbs & 12,500 lbs) and large buoys (8x and 9x buoys) must be transported to the improved/repaired deck area on a flat bed trailer one piece at a time.

- Smaller buoys (7x and under), sinkers 8500 lbs and under, chain, and other equipment must be delivered to this "laydown" area one piece at a time on either a flatbed trailer or the USCG DAEWOO forklift. Do not exceed the DAEWOO forklift lift capacity.

- USCG Grove IND 1012 Crane is not permitted to lift any objects on any area of the deck EXCEPT the repaired deck area on the north side of the pier.

- Multiple buoys, sinkers, and chain may be staged on the repaired area of the deck. Large buoys (8x and 9x) and large sinkers (20,000 and 12,500 lbs) must be spaced a minimum of 15 ft apart. Smaller buoys (7x) and sinkers (8500 lbs) must be spaced a minimum of 10 ft apart.

- Fuel tanker trucks are only permitted on the north side of the pier. Fueling can only occur on the repaired pier area. When a fuel tanker truck is on the pier for refueling, no other truck traffic or weight handling operation is permitted on the deck. Only one tanker is permitted on pier at one time. Fuel tanker GVW shall not exceed 72,000 lbs.

- Multi-axle tractor trailer trucks must proceed with caution when traversing the pier deck and must remain within limits of drive lane. Only one semi tractor trailer is allowed on the north side of the pier at any one time. Two semi's cannot concurrently be on the same side of the pier. <u>Trucks exceeding 20,000 GVW (H 10) are NOT permitted on the south side of the pier.</u> Obtain permission from NAVSTA Port Ops prior to driving semi tractor trailers onto the pier.

- The maximum size mobile crane allowed on the pier is one which will not exceed a 32,000 axle load or 72,000 GVW (HS20) loading. THE CURRENT NSNPT MOBILE CRANES (70 TON TEREX AND 50 TON GROVE) EXCEED LOAD LIMITS AND ARE NOT PERMITTED ON THE PIER.

- The mobile crane can only set up for lifts on the repaired area of the pier deck and it must utilize outriggers and outrigger floats.

- When the mobile crane is traversing the truck drive lane to reach the improved portion, no other truck traffic or weight handling operation is permitted on the deck. Once the crane reaches the improved deck area, operations may resume.

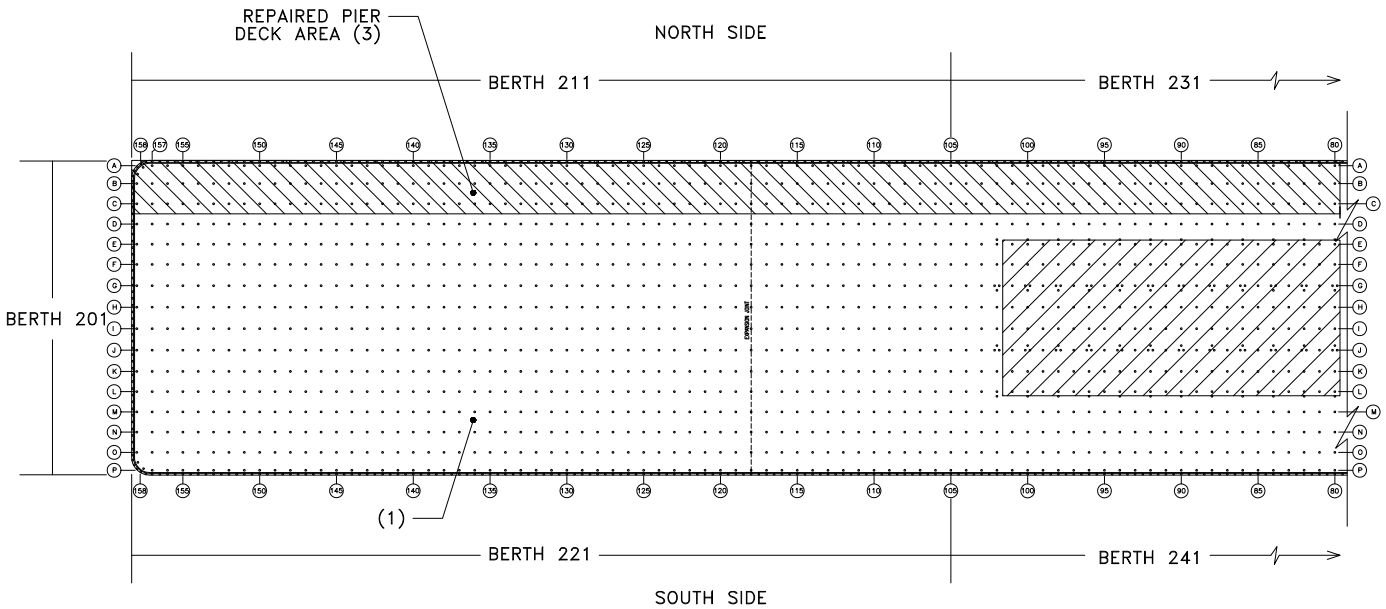
- POV's, cars, and light two-axle commercial vehicles (not exceeding 20,000 GVW) are permitted on the pier at any time.

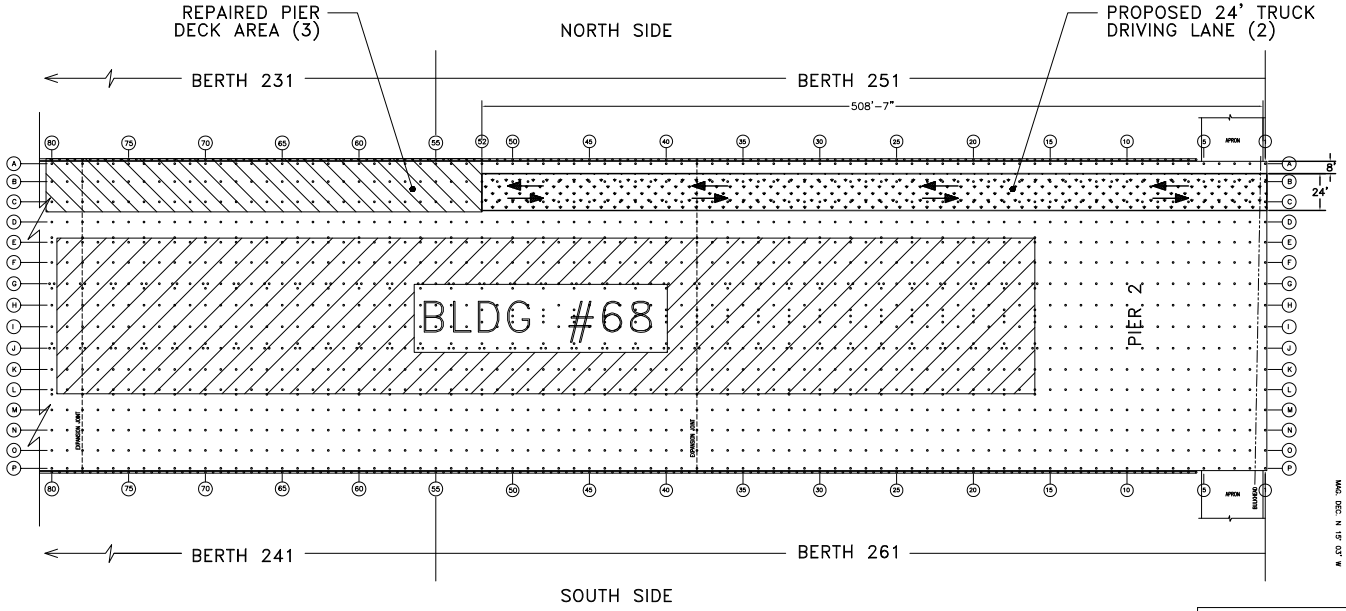
- The NSNPT Fire Department's Pierce 105 HDL Ladder-Pumper Apparatus (70,800 lbs) exceeds maximum load limits and is not permitted on the pier.

- Consult with Port Ops for any other situation not fully described.

Definitions/Current equipment and vehicle loads on the pier:

- AASHTO HS20 Design Vehicle (3 axles): 72,000 lbs GVW (maximum axle load of 32,000 lbs)
- AASHTO HS10 Design Vehicle (3 axles): 36,000 lbs GVW (maximum axle load of 16,000 lbs)
- Fuel Tanker Truck (5 axles): 72,000 lbs GVW (maximum tandem axle load of 32,000 lbs)
- Flat-bed semi truck (4 or 5 axles): 30,000 lbs GVW (Unloaded)
- 50 ton rated mobile truck crane: 89,000 lbs GVW (49,700 lbs rear tandem axle) [No Longer Permitted]
- Industrial mobile Grove crane (USCG): 56,100 lbs GVW (31,000 lbs forward axle)
- DAEWOO D100 (USCG) Forklift: 29,660 lbs GVW with 10,000 max lift capacity
- Buoy 9x35: 18,500 lbs
- Buoy 8x26: 11,800 lbs
- Buoy 7x17: 7,800 lbs
- Sinkers: 20,000 lbs, 12,500 lbs & 8,500 lbs
- Chain: 1 shot = 2000 lbs, 5 shot = 10,000 lbs
- Emergency/Fire Response Vehicle (Pierce 105 HDL): 70,800 lbs GVW (48,000 lbs rear tandem axle) [No Longer Permitted]





REF: LOAD RESTRICTION CASE (1), (2), (3)

22 MAY 2009

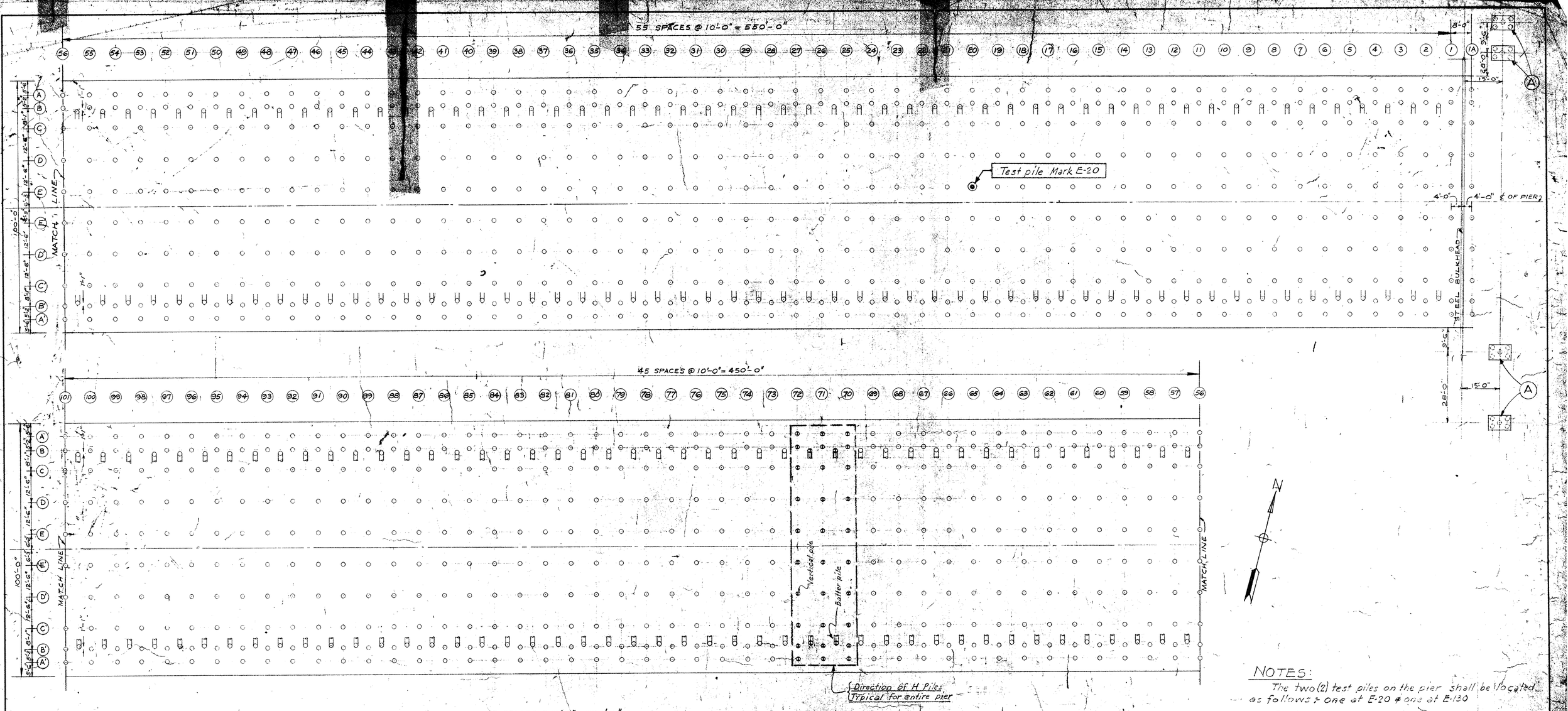
DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

PIER 2 LOAD RESTRICTIONS

SIZE	CODE IDENT NO.	NAVFAC DRAWING NO.
A	80091	CONSTR. CONTR. NO.
SCALE: NONE		SPEC. / SHEET 1 OF 1

B-2 – HISTORIC BATHYMETRY AND DREDGING RECORDS

NAVAL COMPLEX NEWPORT, R.I. Coddington Cove

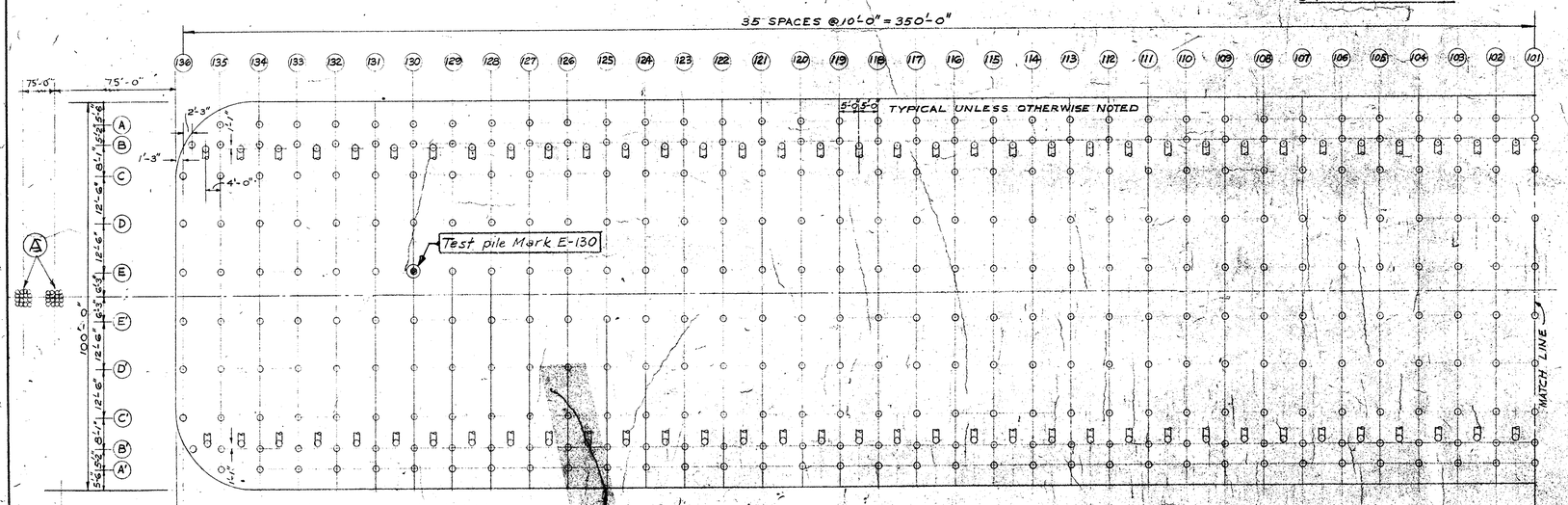


NOTES:

The two (2) test piles on the pier shall be located as follows: one at E-20 & one at E-130

For location and spacing of wood fender piles see Y & D Dwg # 627060.

For types of vertical and batter piles on pier see Drawings Nos 627068 and 627074



LEGEND:

- ○ VERTICAL PILES
- BATTER PILES
- ◉ TEST PILES
- 16 PILE DOLPHIN

PLAN SHOWING PILE SPACING

SCALE: 1/16" = 1'-0"

GRAPHIC SCALE

1/16" = 1'-0"

11849-125

SYMBOL	DESCRIPTION	DATE	APPROVAL
A	PILES FOR SUPPORTING TWO BOLLARDS ON PAVED AREA ON EACH SIDE OF PIER 15'0 EAST OF STEEL BULKHEAD; INSTALLED TWO DOLPHINS ONE 75 FT & THE OTHER 150 FT. BEYOND OUTBOARD END OF PIER. AMEND. NB-6	9/16/55	Santos

REVISIONS

DPWO DRAWING No. NBN-11 S-2

DEPARTMENT OF THE NAVY BUREAU OF YARDS AND DOCKS
DISTRICT PUBLIC WORKS OFFICE
FIRST NAVAL DISTRICT, BOSTON, MASS.

DRAWN BY: Swartz / CASTALDO
TRACED BY: CASTALDO
CHECKED BY: Swartz
SUBMITTED: Santos
BRANCH MANAGER
APPROVED:
DIRECTOR OF DESIGN
SATISFACTORY TO:
DATE

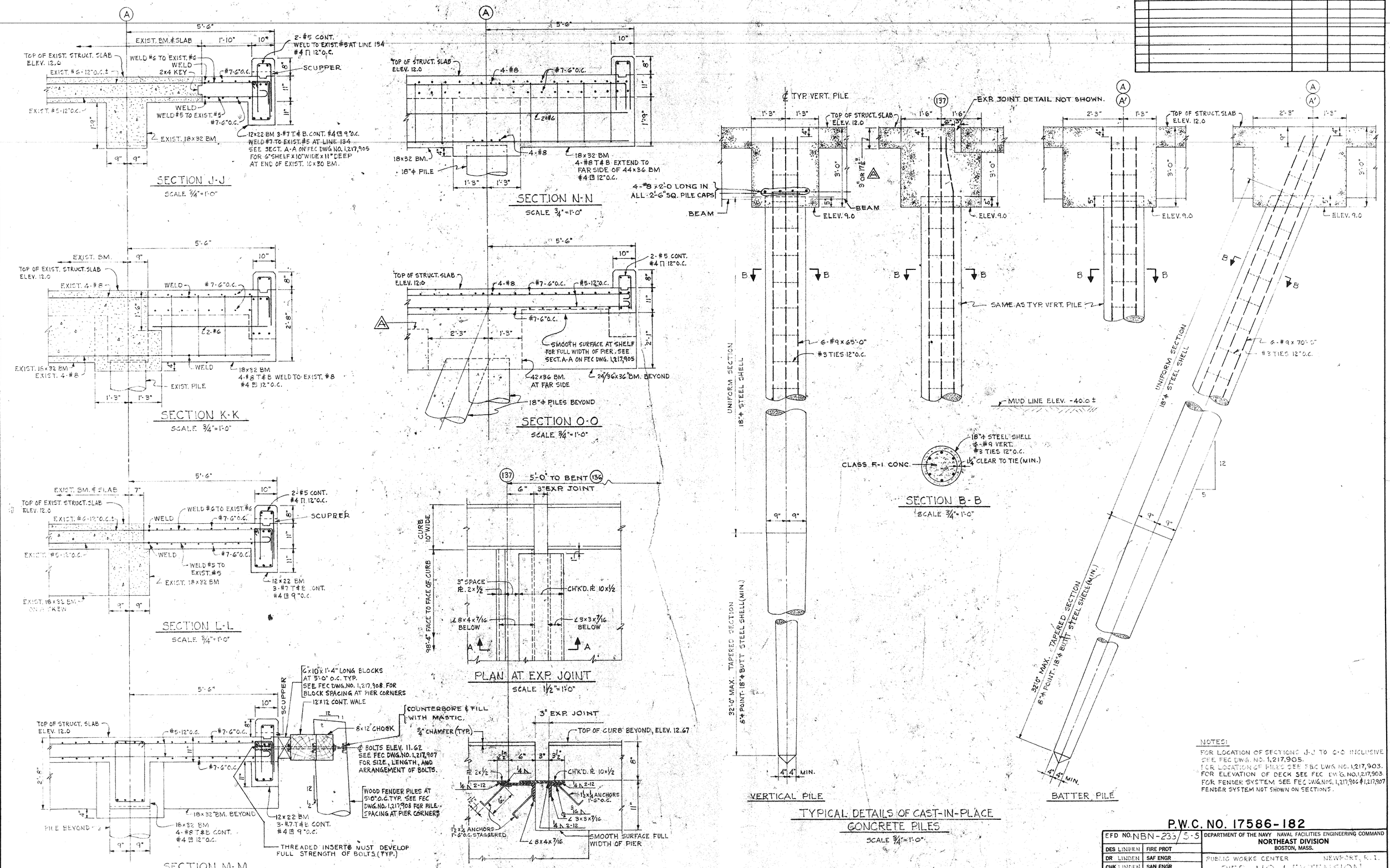
U. S. NAVAL BASE
NEWPORT, R.I.
FLEET BERTHING FACILITIES
PILING PLAN

APPROVED: DPWO FOR CHIEF OF BUREAU DATE 6 APR 1956

SCALE: 1/16" = 1'-0" SPEC. No.
SHEET No. 21 OF 48 NOV 1955
Y & D DRAWING No. 627066

11849-125

REVISION				
SYM	DESCRIPTION	PREP'D BY	DATE	APPROVED
3	SLAB S-6 INDICATED	LINDEN	5/3/68	SANTOS



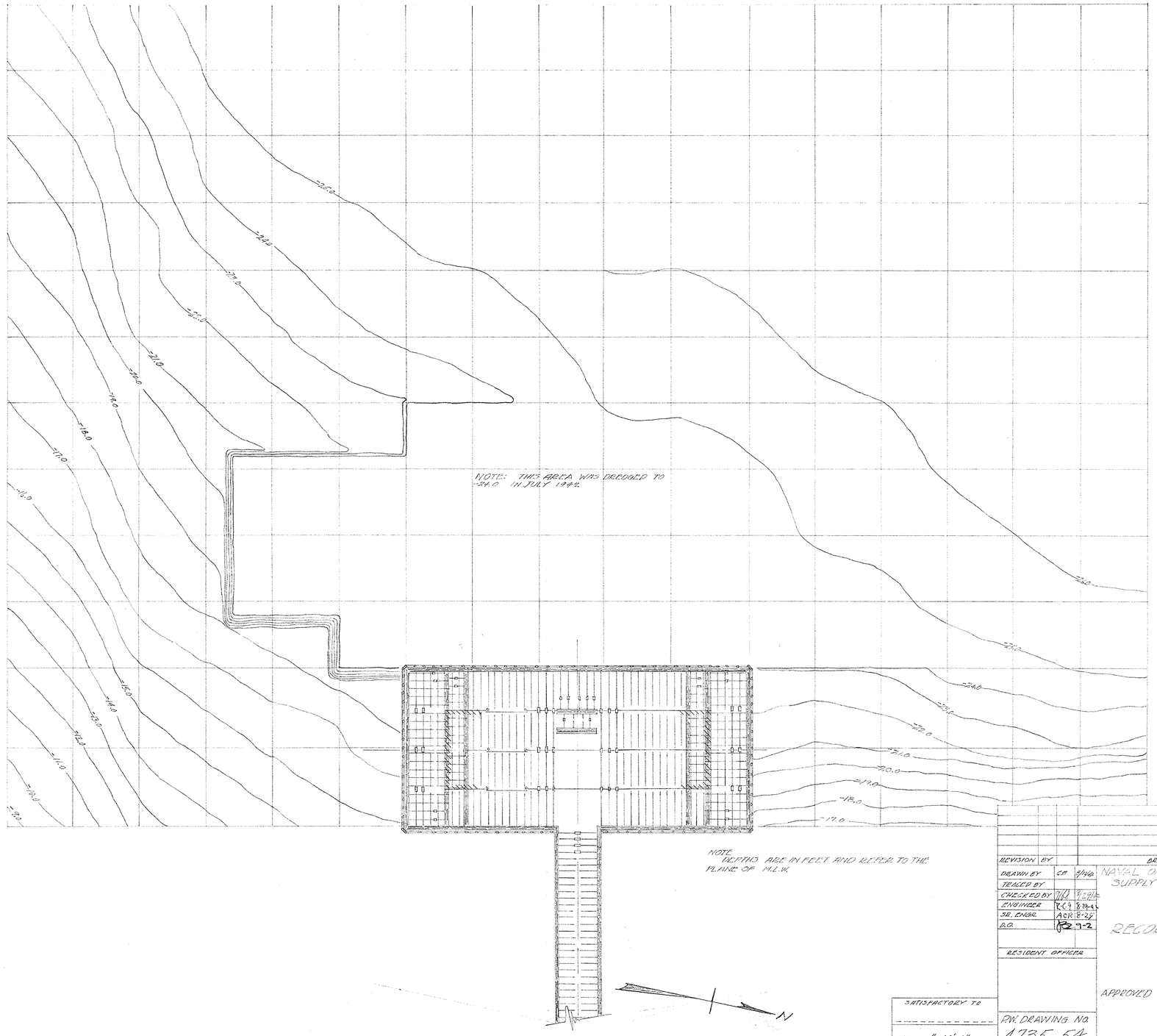
NOTES:

FOR LOCATION OF SECTIONS J-J TO O-O INCLUSIVE SEE FEC DWG. NO. 1,217,905.
FOR LOCATION OF PILES SEE FEC DWG NO. 1,217,903.
FOR ELEVATION OF DECK SEE FEC DWG. NO. 1,217,903.
FOR FENDER SYSTEM SEE FEC DWG. NOS. 1,217,906 & 1,217,907
FENDER SYSTEM NOT SHOWN ON SECTIONS.

P.W.C. NO. 17586-182

EFD NO. NBN-233 5-5	DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND NORTHEAST DIVISION BOSTON, MASS.	
DES LINDEN / FIRE PROT	PUBLIC WORKS CENTER NEWPORT, R.I.	
DR LINDEN / SAF ENGR	PIER NO. 1 EXTENSION	
CHK LINDEN / SAN ENGR	PILE DETAILS & SECTIONS	
SUP T.S.	STRUCTURAL	
PROJ ENGR Santos		
DIRECTOR SELDON		
APPROVED F.R. Cline 4/18/68 DATE / EFD FOR COMMANDER NFEC	CODE IDENT NO 80091 / SIZE F / FEC DRAWING NO. 1,217,906	
SCALE GRAPHIC	SPEC 83565 / 67NBY 83565	CONST. CONTRACT NO. N62464-67-C-0311 / SHEET 6 OF 17

17586-182



REVISION BY		BRIEF DESCRIPTION	APPROVED BY
DRAWN BY	CB 8/46	NAVAL OPERATING BASE NEWPORT, R.I. SUPPLY DEPOT COddINGTON COVE	
TRACED BY			
CHECKED BY	JHL 8-24-46		
ENGINEER	RCG 8-29-46		
SR. ENGR.	ACR 8-27		
P.O.	RB 9-2		
RESIDENT OFFICER			

PIER
RECORD OF DREDGING

APPROVED SEPT. 2, 1942
J. Callaran
PUBLIC WORKS OFFICER

SATISFACTORY TO

SCALE 1" = 40'-0"

P.W. DRAWING NO.
4735-54

Depths are referred to M.L.W.

NOTES:

Soundings are in feet and tenths and are referred to the plane of Mean Low Water.

Hydrography from surveys of Sept. 15 to Oct. 6, 1942 by A.L. Reed.

Topography from previous surveys

B.M. 4 (1934) is a standard disk, stamped "No. 4 1934", set in a drill hole in the concrete walk, east of the road and perpendicular to the main dock of the Naval Training Station. It is located about 1 foot west of the east face of the bulkhead and 1 foot north of the northeast corner of a small red brick building that houses the motors for the marine railway. Elevation above M.L.W. 7.23 feet.

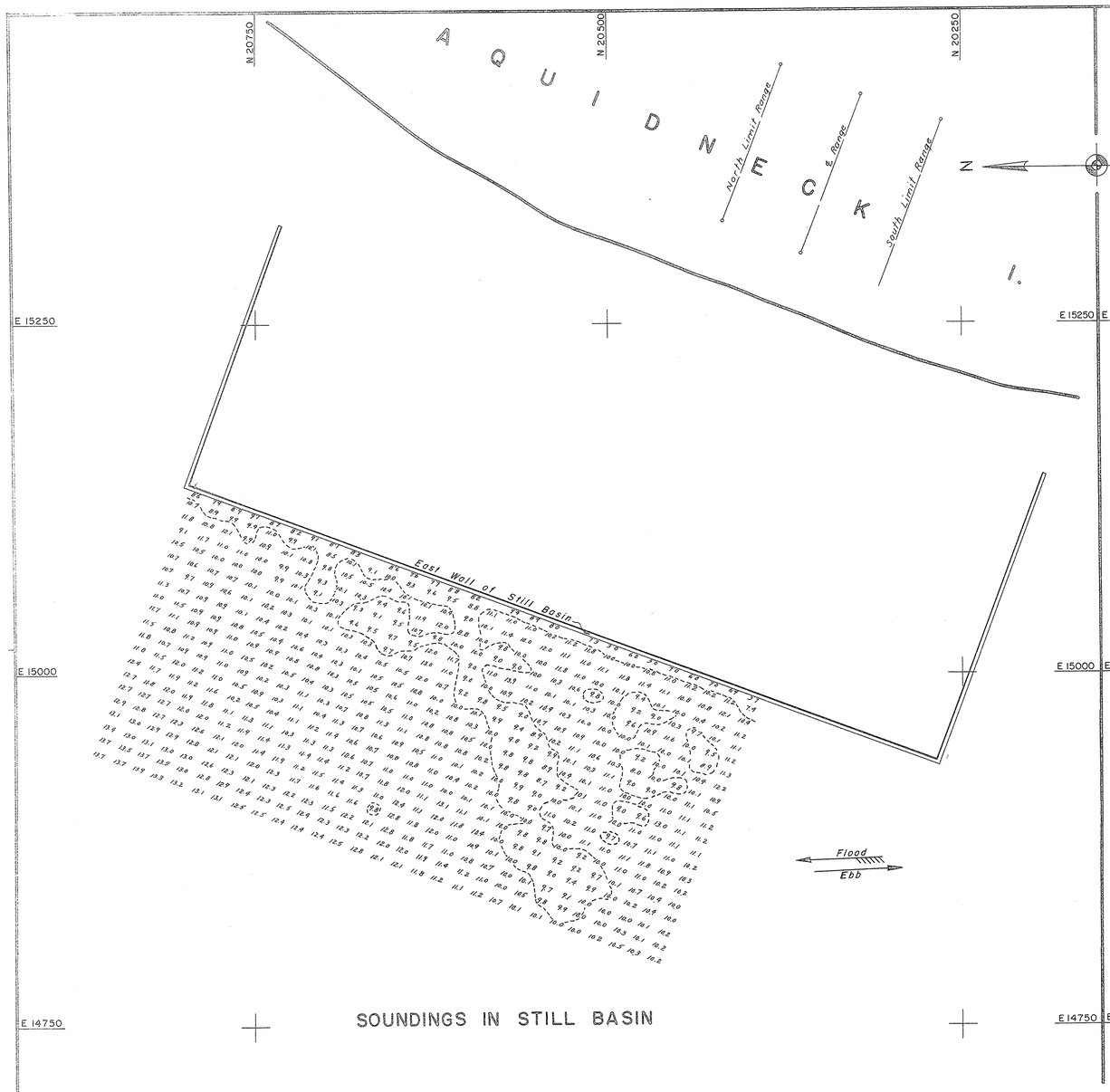
Origin of coordinates is U.S.C.&G.S. △ Dumplin No. 2 (1869). True meridian through ⊕ 7 (U.S.E.D.).

23-foot contour shown thus: ————————

Outer limit of dredging shown thus: ·····

Field books: 2956, 3069, 3077, 3078, 3248, 3273, 3276, 3284, 3285, 3286, 3289, 3294, 4020.

DRAWN BY: A.E.E. TRACED BY: A.E.E. CHECKED BY: J.H.F. IN CHARGE:	U.S. NAVAL OPERATING BASE, NEWPORT, R.I. NAVAL SUPPLY STATION CODDINGTON COVE, R.I. NARRAGANSETT BAY, R.I. NORTH OF CODDINGTON PT. EXAMINATION AFTER DREDGING 23-FOOT AREA SCALE: 1 INCH = 100 FEET 50 0 100 200 300 400 FT. APPROVED: ———
SURVEY MADE AND MAP PREPARED BY U.S. ENGINEER OFFICE, PROVIDENCE, R.I. U.S.E.D. FILE NO. Nor.B.194 DATED OCT. 9, 1942	F.W. DRAWING NO. 5936-66
	PUBLIC WORKS OFFICE



SOUNDINGS IN STILL BASIN

SWEEPINGS IN STILL BASIN

NOTES.

Soundings and sweepings are in feet and tenths and are referred to the plane of Mean Low Water.

Hydrography from survey of July 15 & 16, 1942 by A. L. Reed, Jr.

Topography from previous surveys.

B.M. 4 (1934) is a standard disk, stamped "No. 4 1934," set in a drill hole in the concrete walk, east of the road, and perpendicular to the main dock of the Naval Training Station. It is located about 1 foot west of the east face of the bulkhead and 1 foot north of the northeast corner of a small red brick building that houses the motors for the marine railway. Elevation above M.L.W. 7.29 feet.

Origin of coordinates is U.S.C. & G.S. △ Dumplin 2 (1869). True meridian through △ 7 (U.S.E.D.).

10 foot contour shown thus: ----------

Area shown thus: was swept clear to 10 feet at M.L.W.

Area shown thus: denote shoal areas.

Sweepings were made using a 20 ft. sweep.

Field books: 3058 & 3276.

Ranges shown above are ranges used for dredging.

SURVEY MADE AND MAP PREPARED BY U.S. ENGINEER OFFICE, PROVIDENCE, R.I. U.S.E.D. FILE NO. Nor. B. 182 DATED JULY 20, 1942

DRAWN BY: R.L.H.
TRACED BY: R.L.H.
CHECKED BY: R.M.H.
IN CHARGE:

P.W. DRAWING NO. 6126-68

U.S. NAVAL OPERATING BASE, NEWPORT, R.I.
NAVAL SUPPLY STATION CODDINGTON COVE, R.I.

NARRAGANSETT BAY, R.I.

EXAMINATION AFTER DREDGING

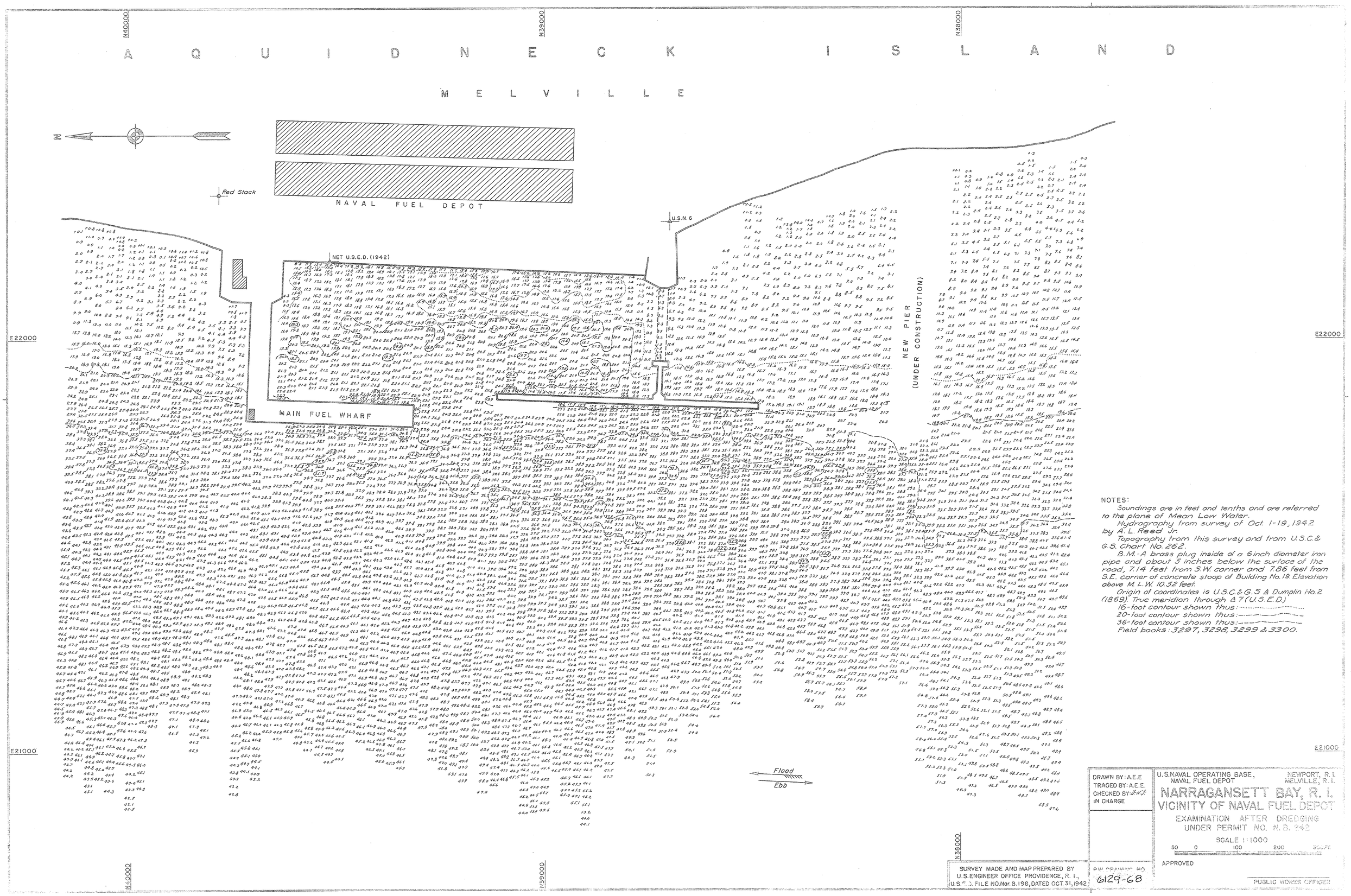
NORTH OF CODDINGTON PT.

SCALE: 1 INCH = 40 FEET

40 0 40 80 120 160 FT.

APPROVED: _____

PUBLIC WORKS OFFICER



NOTES:

Soundings are in feet and tenths and are referred to the plane of Mean Low Water.

Hydrography from survey of Oct. 1-19, 1942 by A. L. Reed Jr.

Topography from this survey and from U.S.C.& G.S. Chart No. 262.

B.M.-A brass plug inside of a 6 inch diameter iron pipe and about 5 inches below the surface of the road, 7.14 feet from S.W. corner and 7.86 feet from S.E. corner of concrete stoop of Building No. 19. Elevation above M.L.W. 10.32 feet.

Origin of coordinates is U.S.C.& G.S Δ Dumplin No. 2 (1869). True meridian through Δ 7 (U.S.E.D.)

16-foot contour shown thus: .....

20-foot contour shown thus: ———————

36-foot contour shown thus: — — — — —

Field books: 3297, 3298, 3299 & 3300.

DRAWN BY: A.E.E.
TRACED BY: A.E.E.
CHECKED BY: J.F.J.
IN CHARGE

U.S. NAVAL OPERATING BASE, NAVAL FUEL DEPOT — NEWPORT, R.I. MELVILLE, R.I.

NARRAGANSETT BAY, R. I.

VICINITY OF NAVAL FUEL DEPOT

EXAMINATION AFTER DREDGING UNDER PERMIT NO. N.B. 242

SCALE 1:1000

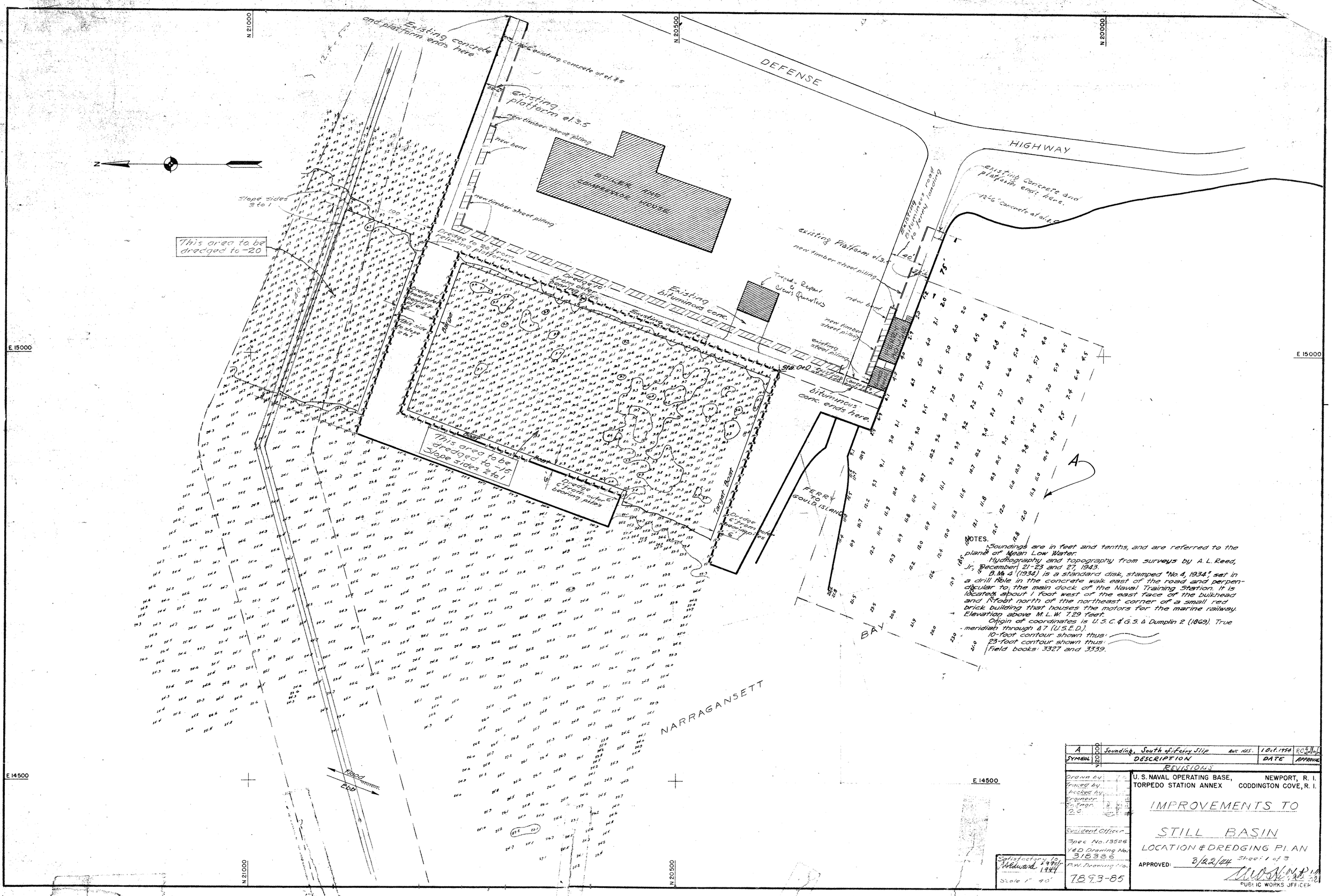
50 0 100 200 300 FT.

APPROVED

PUBLIC WORKS OFFICER

SURVEY MADE AND MAP PREPARED BY U.S. ENGINEER OFFICE PROVIDENCE, R. I., U.S.E.D. FILE NO. Nor 8.198, DATED OCT. 31, 1942

P.W. DRAWING NO. 6129-68



NOTES.

Soundings are in feet and tenths, and are referred to the plane of Mean Low Water.

Hydrography and topography from surveys by A. L. Reed, Jr., December 21-23 and 27, 1943.

B.M. 4 (1934) is a standard disk, stamped "No. 4, 1934," set in a drill hole in the concrete walk east of the road and perpendicular to the main dock of the Naval Training Station. It is located about 1 foot west of the east face of the bulkhead and 1 foot north of the northeast corner of a small red brick building that houses the motors for the marine railway. Elevation above M.L.W. 7.29 feet.

Origin of coordinates is U.S.C. & G.S. Δ Dumplin 2 (1869). True meridian through Δ 7 (U.S.E.D.).

10-foot contour shown thus:

23-foot contour shown thus:

Field books: 3327 and 3339.

SYMBOL	DESCRIPTION	DATE	APPROVAL
A	Sounding, South of Ferry Slip AWC NES.	1 Oct. 1954	RCS

REVISIONS

Drawn by
Traced by
Checked by
Engineer
Sr. Engr.
O.C.

Resident Officer
Spec No. 13526
Y&D Drawing No. 318386
P.W. Drawing No. 7893-85

Satisfactory to Edward 28 Feb 1944

Scale 1" 40'

U. S. NAVAL OPERATING BASE, NEWPORT, R. I.
TORPEDO STATION ANNEX CODDINGTON COVE, R. I.

IMPROVEMENTS TO

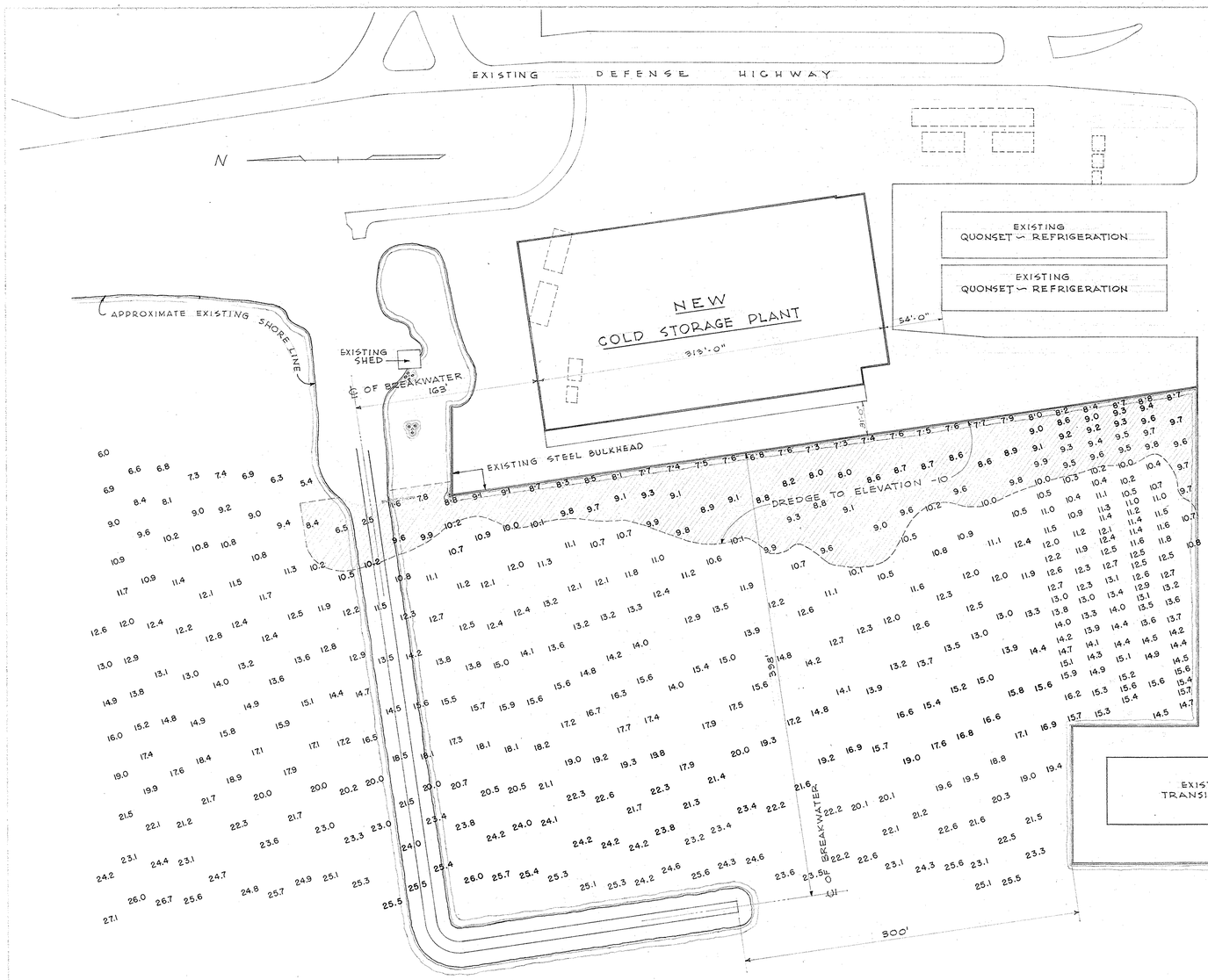
STILL BASIN

LOCATION & DREDGING PLAN

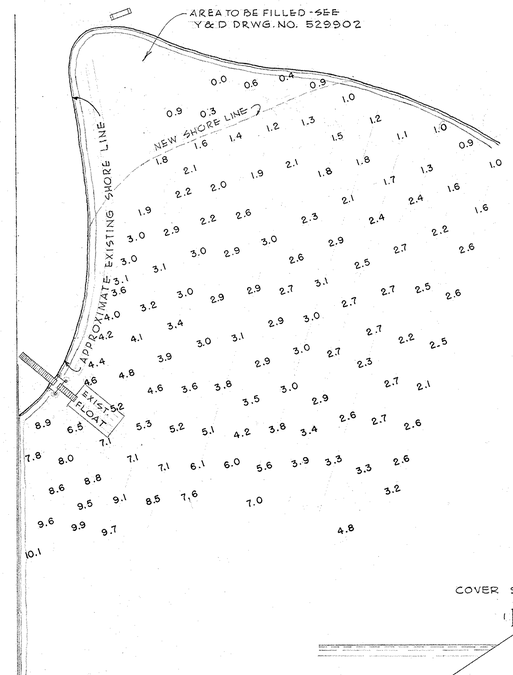
Sheet 1 of 3

APPROVED: 3/22/44

PUBLIC WORKS OFFICER



HYDROGRAPHIC PLAN
SCALE: 1" = 50'-0"



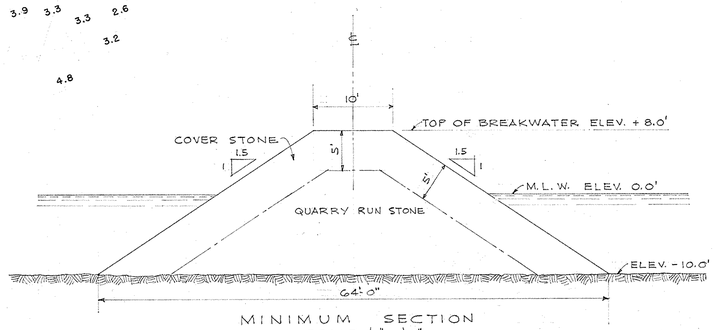
NOTES

SOUNDINGS ARE IN FEET AND TENTHS AND ARE REFERRED TO THE PLANE OF MEAN LOW WATER.

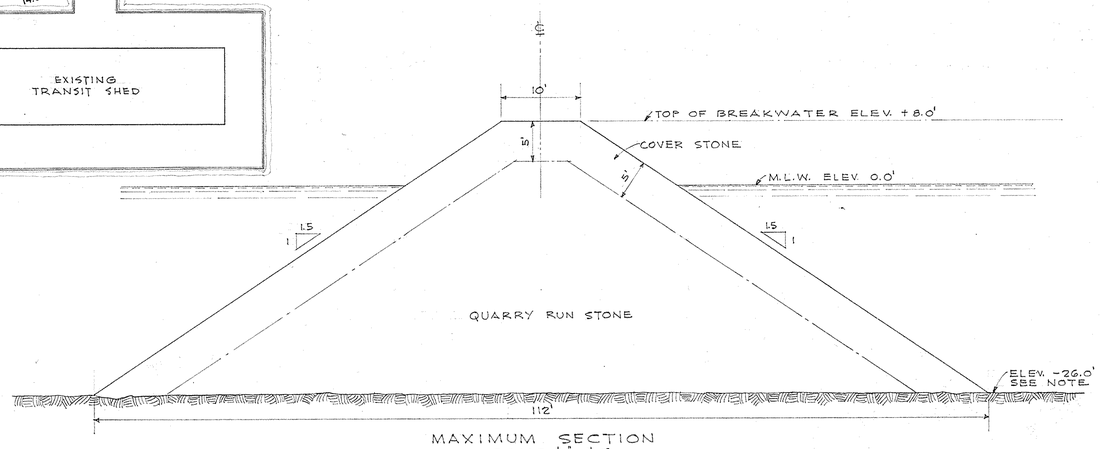
HYDROGRAPHY FROM SURVEY OF JUNE 25, 27, 28, 29, AND JULY 2, 3, 5 - 1951; BY GANTEAUME & McMULLEN-ENGR.

TOPOGRAPHY FROM SURVEY OF JULY, 1951; BY GANTEAUME & McMULLEN-ENGR.

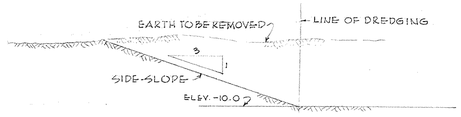
ELEV. -26.0' AT MAXIMUM BREAKWATER SECTION FROM SURVEY MADE BY U.S. ENGINEER OFFICE, PROVIDENCE, R.I.; U.S.E.D. FILE NO. Nar. B. 155 DATED AUG. 7, 1941.



MINIMUM SECTION
SCALE 1/8" = 1'-0"



MAXIMUM SECTION
SCALE 1/8" = 1'-0"



SECTION SHOWING ALLOWABLE SIDE-SLOPE
N. T. S.

GRAPHIC SCALES

SCALE: 1/8" = 1'-0" 0 5' 10' 15' 20' 25' 30' 35' 40' 45'

SCALE: 1" = 50'-0" 0 10' 20' 30' 40' 50' 100' 150' 200' 250' 300'

NAVSTA # 11005-117

SYMBOL	DESCRIPTION	DATE	APPROVAL
	REVISIONS		

ENGINEERS JOB NO. 2302
ENGINEERS DWG. NO. 6

DEPARTMENT OF THE NAVY — BUREAU OF YARDS & DOCKS
DISTRICT PUBLIC WORKS OFFICE — 1ST ND BOSTON, MASS.
GANTEAUME & McMULLEN — ENGR. & ARCH.
BOSTON 11, MASS.

DRAWN BY MEYER
TRACED BY
CHECKED BY KING

U. S. NAVAL SUPPLY DEPOT
NEWPORT, R.I.

COLD STORAGE PLANT

BREAKWATER & DREDGING
PLAN & DETAILS

DPWO DWG. NO. NBN-2 / C-5

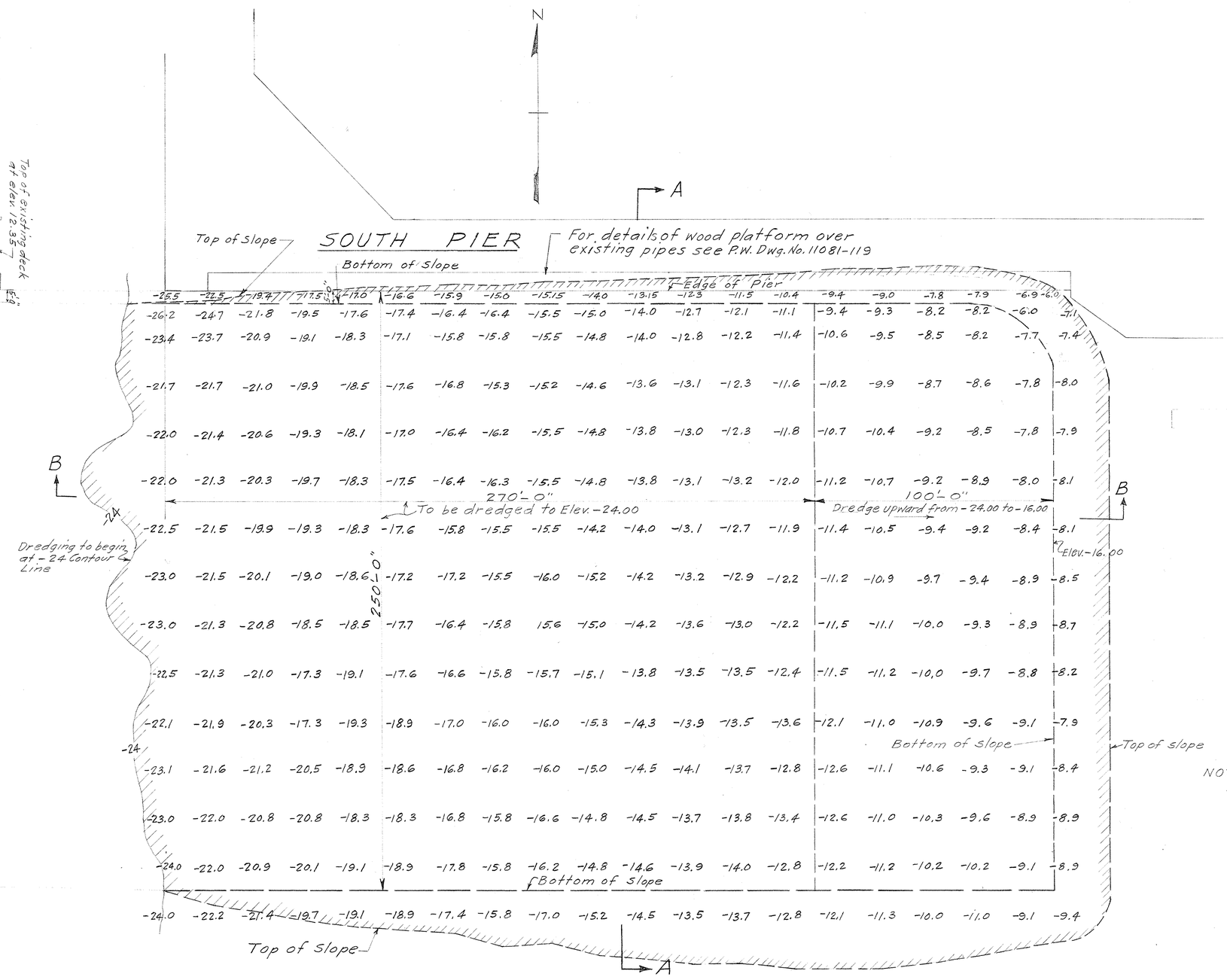
PROJ. ENGR. T.A.Q. — APPROVED [signature] — DATE 8 May 1952
DIRECTOR [signature]

APPROVED FOR BUREAU OF YARDS & DOCKS
DPWO FOR CHIEF OF BUREAU
DATE 8 May 1952

SCALE: GRAPHIC — SPEC. 31223
SHEET 6 OF 51 — NOY 29553
Y & D DRAWING NO. 529900

SATISFACTORY TO [signature]
DATE 7 May 1952

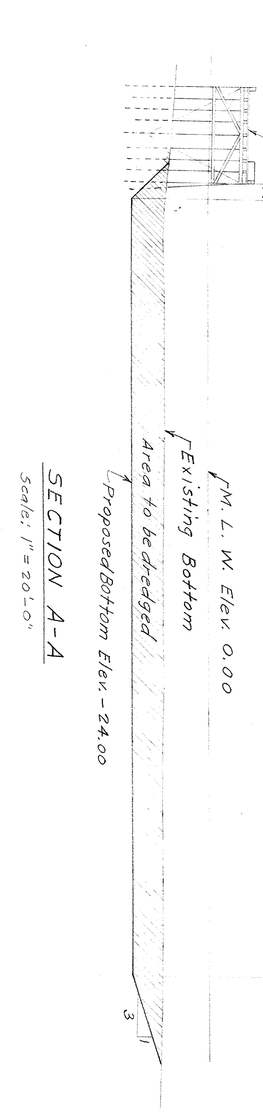
~~11005-117~~



PLAN OF DREDGING

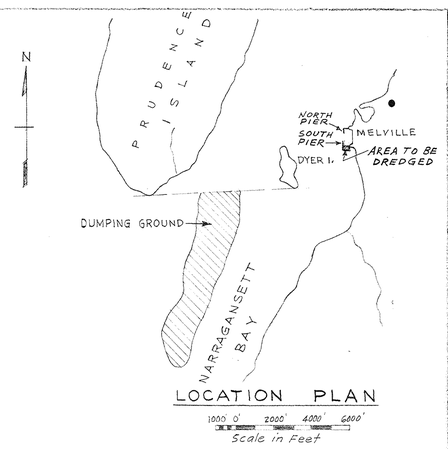
Elevations given are existing sounding elevations
Scale: 1" = 20'-0"

NOTE:
All elevations are to M.L.W. = 0.00

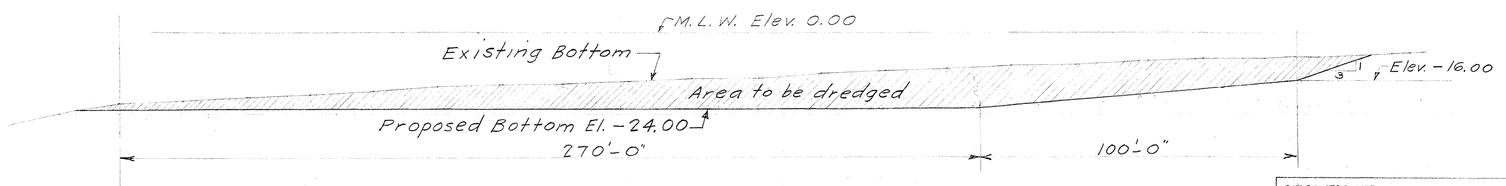


SECTION A-A

Scale: 1" = 20'-0"



LOCATION PLAN



SECTION B-B

Scale: 1" = 20'-0"

1" = 20'-0"
Scale in Feet

SYMBOL	DESCRIPTION	DATE	APPROVAL
	REVISIONS		

PWD DRAWING NO. 11280-119

DEPARTMENT OF THE NAVY — BUREAU OF YARDS & DOCKS
U.S. NAVAL STATION NEWPORT R.I.
PUBLIC WORKS DEPARTMENT

DRAWN BY: J. NURDIN
SUBMITTED:
APPROVED:

U.S. NAVAL SUPPLY DEPOT - NEWPORT, R.I.
FUEL DIVISION - MELVILLE
DREDGING FOR ALONGSIDE BERTHING
SOUTH PIER
PLANS & SECTIONS

APPROVED — PUBLIC WORKS OFFICER — DATE 5-15-53

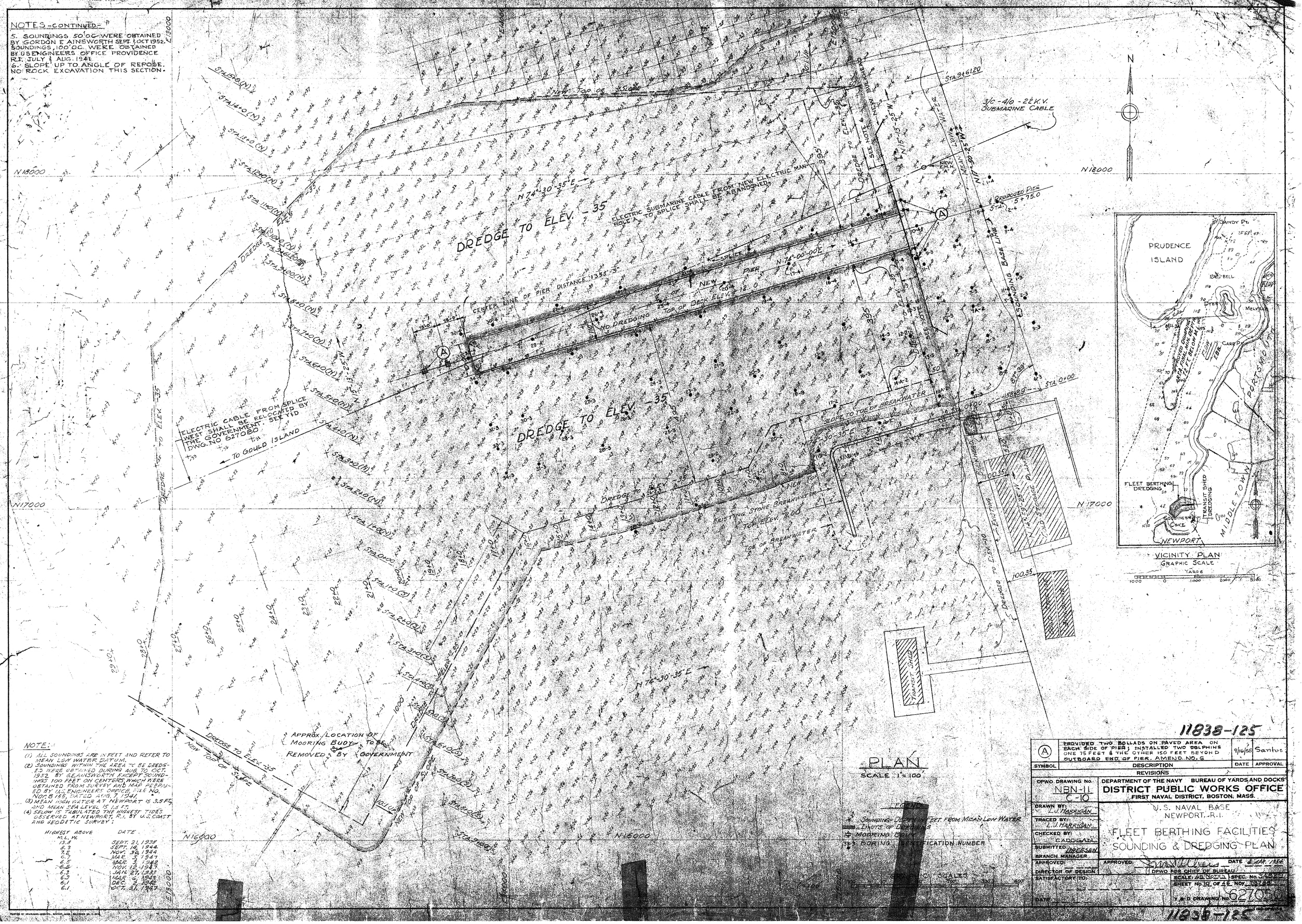
SATISFACTORY TO — DATE 5/12/53

APPROVED FOR BUREAU OF YARDS & DOCKS — DPWO FOR CHIEF OF BUREAU — DATE 22 May 1953

SCALE As Noted — SPEC. 36705
SHEET 1 of 2 — NO. 77770
Y&D DRAWING NO. 614016

NOTES -CONTINUED-

5. SOUNDINGS 50' O.C. WERE OBTAINED BY GORDON E AINSWORTH SEPT & OCT 1952. SOUNDINGS, 100' O.C. WERE OBTAINED BY U.S. ENGINEERS OFFICE PROVIDENCE R.I. JULY & AUG. 1941.
6. SLOPE UP TO ANGLE OF REPOSE. NO ROCK EXCAVATION THIS SECTION.



NOTE:

(1) ALL SOUNDINGS ARE IN FEET AND REFER TO MEAN LOW WATER DATUM.
(2) SOUNDINGS WITHIN THE AREA TO BE DREDGED WERE OBTAINED DURING AUG. TO OCT. 1952 BY G.E. AINSWORTH EXCEPT SOUNDINGS 100 FEET ON CENTERS, WHICH WERE OBTAINED FROM SURVEY AND MAP REFERRED BY U.S. ENGINEERS OFFICE, FILE NO. NOR. B 155, DATED AUG. 7, 1941.
(3) MEAN HIGH WATER AT NEWPORT IS 3.5 FT. AND MEAN SEA LEVEL IS 1.8 FT.
(4) BELOW IS TABULATED THE HIGHEST TIDES OBSERVED AT NEWPORT, R.I. BY U.S. COAST AND GEODETIC SURVEY:

HIGHEST ABOVE M.L.W.	DATE
13.8	SEPT. 21, 1938
6.3	SEPT. 18, 1944
7.2	NOV. 30, 1944
6.7	MAR. 3, 1947
6.5	MAR. 3, 1962
6.5	NOV. 12, 1947
6.3	JAN. 27, 1933
6.3	MAR. 6, 1943
6.1	DEC. 3, 1942
6.1	OCT. 21, 1947

PLAN
SCALE 1" = 100'

LEGEND
+ SOUNDING - DEPTH IN FEET FROM MEAN LOW WATER
LIMITS OF DREDGING
MOORING BUOY
BORING IDENTIFICATION NUMBER

11838-125

SYMBOL	DESCRIPTION	DATE	APPROVAL
A	PROVIDED TWO BOLLADS ON PAVED AREA ON EACH SIDE OF PIER; INSTALLED TWO DOLPHINS ONE 75 FEET & THE OTHER 150 FEET BEYOND OUTBOARD END OF PIER. AMEND. NO. 6	9/16/55	Santos

REVISIONS

OPWO DRAWING No. NBN-11 C-10

DEPARTMENT OF THE NAVY BUREAU OF YARDS AND DOCKS
DISTRICT PUBLIC WORKS OFFICE
FIRST NAVAL DISTRICT, BOSTON, MASS.

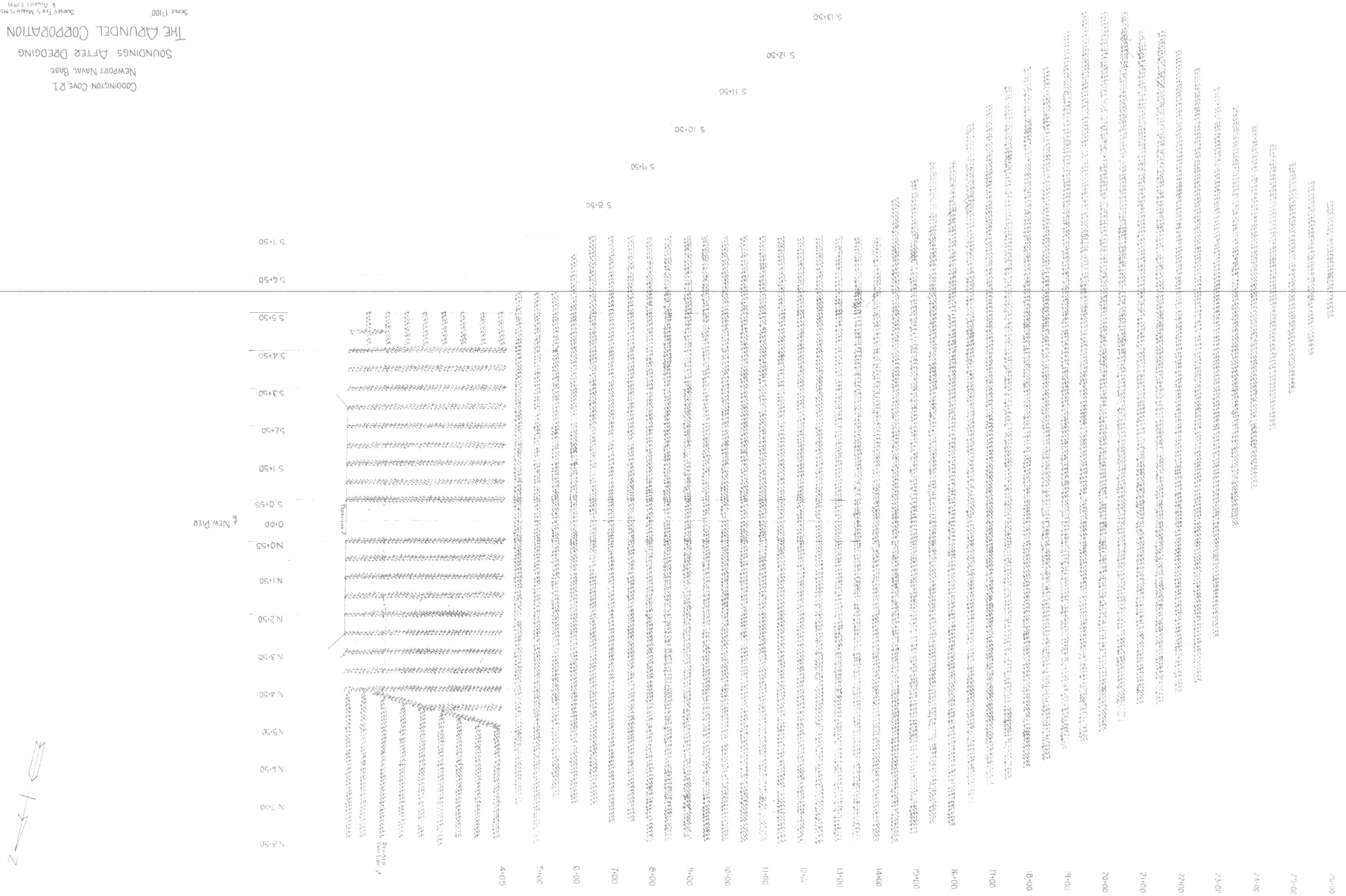
U.S. NAVAL BASE
NEWPORT, R.I.

FLEET BERTHING FACILITIES
SOUNDING & DREDGING PLAN

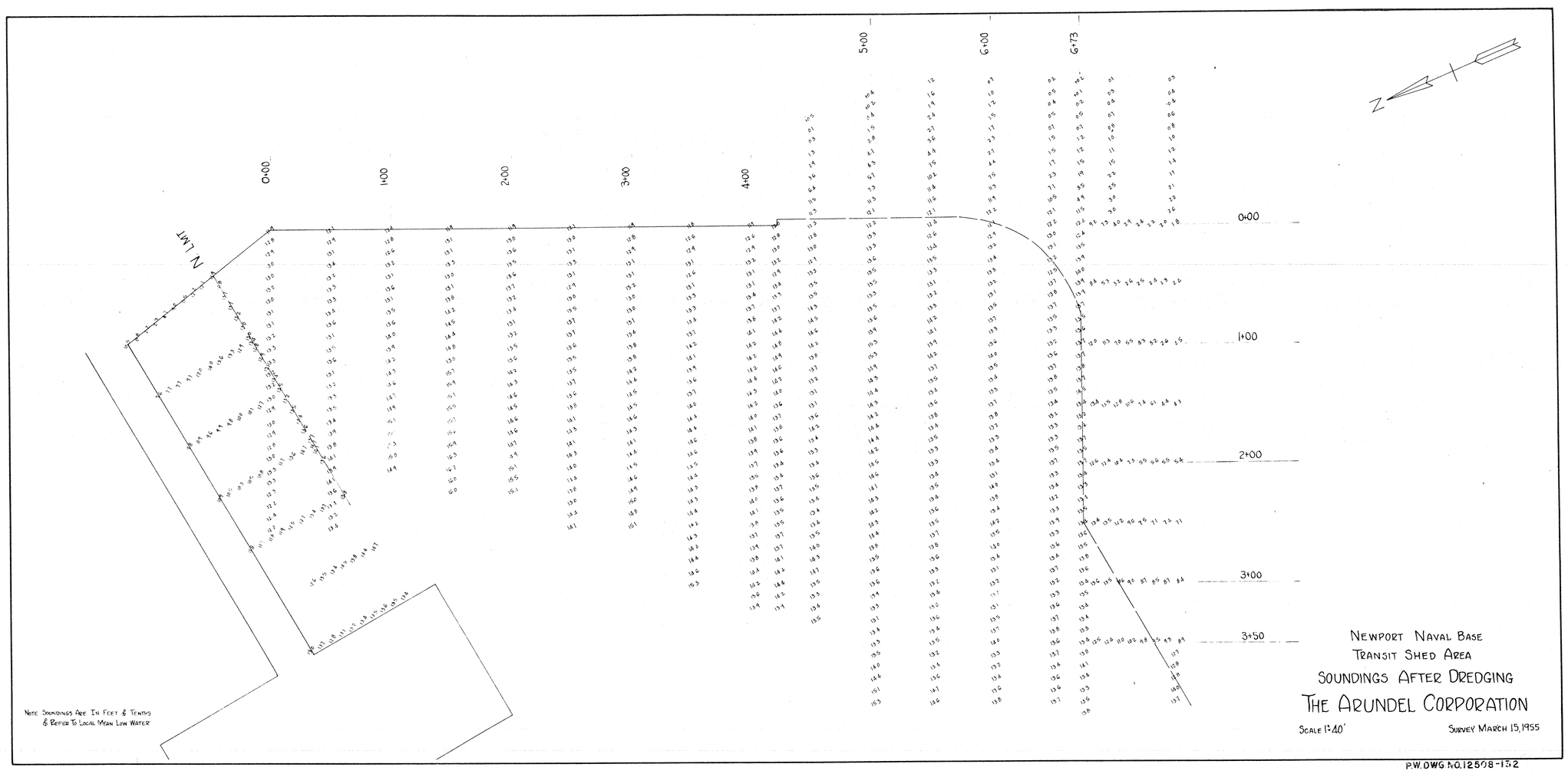
DRAWN BY: L.J. HARRIGAN
TRACED BY: L.J. HARRIGAN
CHECKED BY: C. ADDIGAN
SUBMITTED: DREESEN
BRANCH MANAGER
APPROVED:
DIRECTOR OF DESIGN
SATISFACTORY TO:
DATE

APPROVED: DATE 6 MAR. 1956
DPWO FOR CHIEF OF BUREAU
SCALE: AS NOTED SPEC. No. 3-4-2-29
SHEET No. 12 OF 16 NOV. 1952
Y & D DRAWING No. 627080

11838-125



Coddington Cove, R.I.
Newport Naval Base
Soundings After Dredging
The Arundel Corporation
Scale 1"=100'
Survey Fr S. Mason 15 1955
& August 1 1955
P.W. DWG. NO. 12507-122



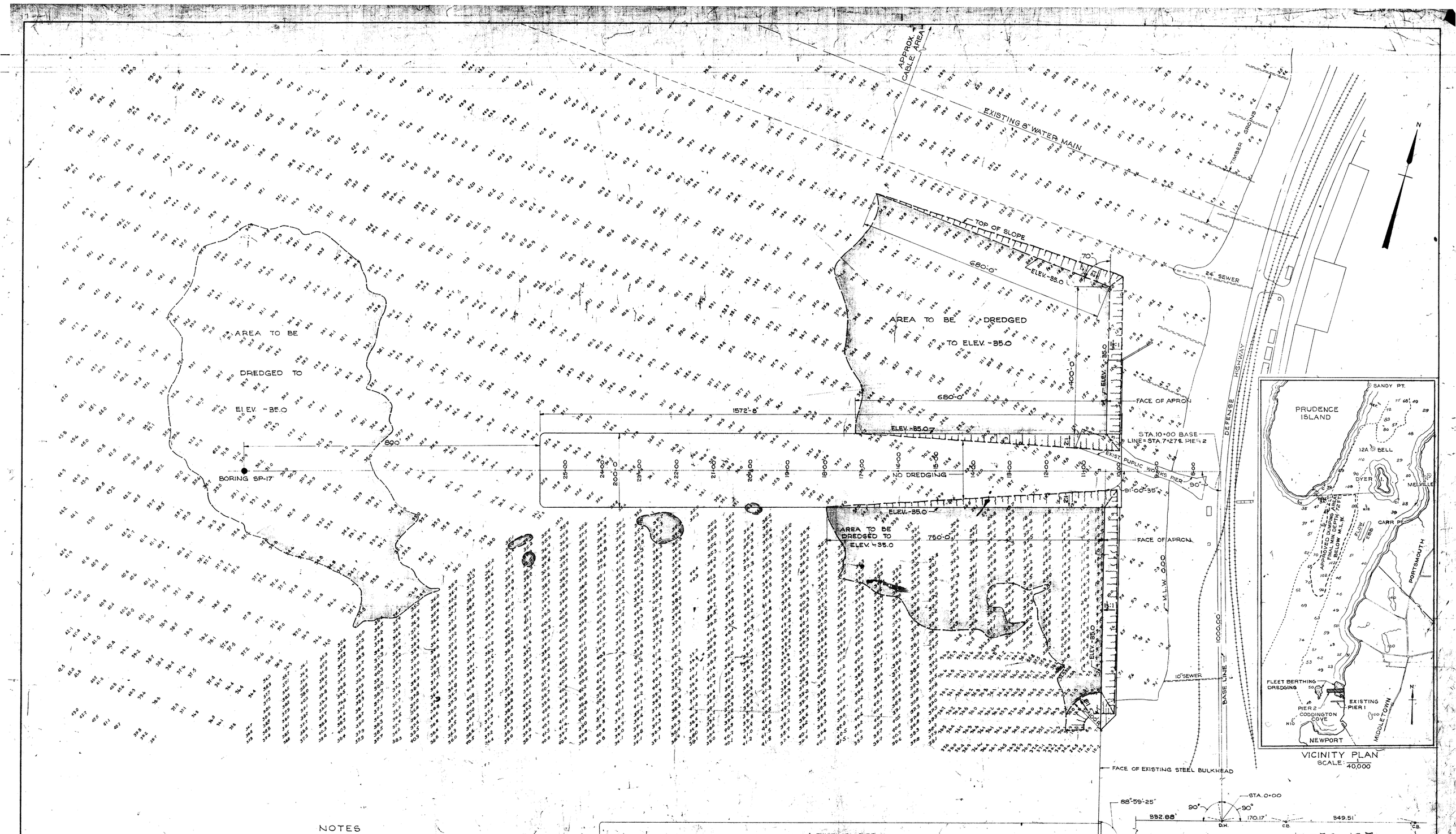
Note Soundings Are In Feet & Tenths
& Refer To Local Mean Low Water

Newport Naval Base
Transit Shed Area
Soundings After Dredging
The Arundel Corporation

Scale 1"=40'

Survey March 15, 1955

P.W. DWG NO. 12508-132



NOTES

SOUNDINGS COMPILED FROM:-
"SURVEY MADE AND MAP PREPARED BY U.S. ENGINEER OFFICE, PROVIDENCE, R.I. U.S.E.D. FILE NO. NAR. B. 155, AUG. 7, 1941"
AND
"SOUNDINGS AFTER DREDGING THE ARUNDEL CORPORATION FEB. 1, MARCH 15 & AUG. 1, 1955" F.S. & T. INC. Tn-17.

B.M. 4 (1934)
STANDARD DISK, SET IN DRILL HOLE IN CONCRETE WALK, EAST OF ROAD AND PERPENDICULAR TO MAIN DOCK OF NAVAL TRAINING STATION.
IT IS LOCATED ABOUT 1 FOOT WEST OF EAST FACE OF BULKHEAD AND 1 FOOT NORTH OF NORTHEAST CORNER OF SMALL RED BRICK BUILDING THAT HOUSES MOTORS OF MARINE RAILWAY.
ELEVATION ABOVE MEAN LOW WATER 7.29 FEET.

SOUNDINGS ARE IN FEET AND TENTHS AND ARE REFERRED TO THE PLANE OF MEAN LOW WATER.
FOR BORING LOG OF SP-17 SEE Y&D DWG. NO. 717704

GRAPHIC SCALES
1/40,000 — 0' 4000' 8000' 12000
1"=100'-0" — 0' 100' 200' 300' 400'

13072-137

SYMBOL	DESCRIPTION	DATE	APPROVAL

REVISIONS

DPWO DRAWING NO. NBN-60 C-2
A & E
DR. BY U.G.M.
TR. BY R.G.McC.
CHK. BY H.D.H.

DEPARTMENT OF THE NAVY
DISTRICT PUBLIC WORKS OFFICE
FAY, SPOFFORD & THORNDIKE, INC. – CHARLES A. MAGUIRE & ASSOCIATES
BOSTON, MASS. ARCHITECT-ENGINEER
BUREAU OF YARDS & DOCKS
1st ND BOSTON, MASS.
PROVIDENCE, R.I.

U.S. NAVAL BASE NEWPORT, R.I.
PIER NO. 2, BULKHEAD AND [illegible]
SOUNDING AND DREDGING PLAN

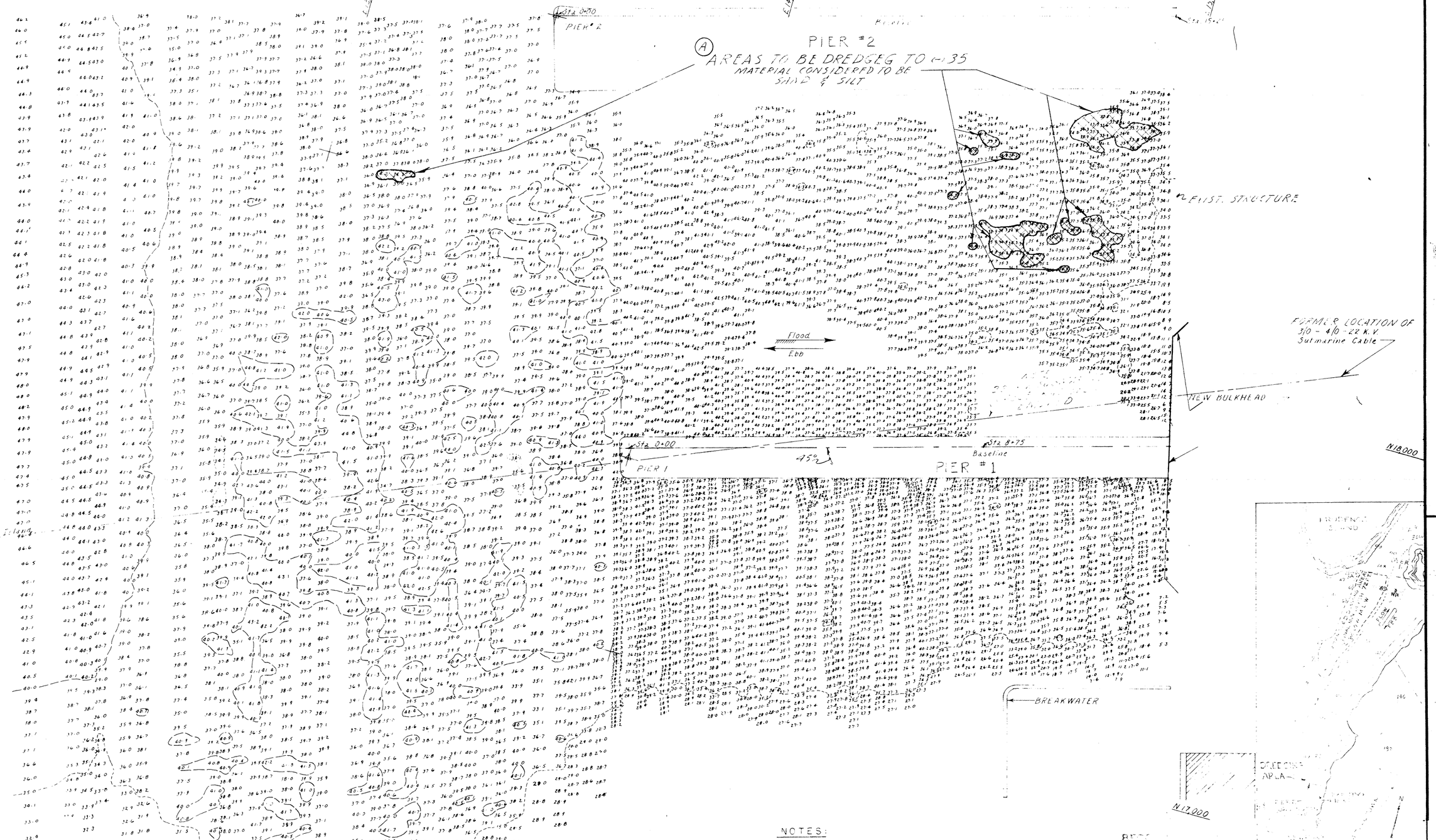
DPWO 1ST ND
SAFETY PICCIO
FIRE PROT. GLEASON
PROJ ENGR. PREESEN
DIRECTOR SADDAY
APPROVED FOR BUREAU OF YARDS & DOCKS
DATE
APPROVED [redacted] OFFICER IN CHARGE DATE
SCALE AS NOTED SPEC. 1756
SHEET 12 OF 136 NBS
Y&D DRAWING NO. 717702

SATISFACTORY TO
DATE
SATISFACTORY TO
DATE

DIRECTION PROJECT NO. Tn-17
REFERENCE DRAWING NO.

CORPS OF ENGINEERS

U. S. ARMY



NOTES:

Survey of January 12 to February 8, 1941, by H.A. Fishlock. B.M. H3 (1943) At Coddington Cove set in the south end of an island curbing on the west side of building No. 6, about 0.1 mile east of the Naval Supply Depot Shed, 69 feet north of center line of the road to the shed, 30 feet northwest of the southwest corner of building, 7 feet north of the south end of the island. A B.M. disc. Elev. above M.L.W. is 25.55 feet.

35 — foot contour shown thus: ————————

40 — foot contour shown thus: — — — — — —

Field book: P.S.H. 1656, 1657, 1658, & 1924.

All soundings are referred to the datum of Mean Low Water (0.0').

GRAPHIC SCALE

1"=100' 100' 0 200 400 600 800' 1,000'

SURVEY MADE AND MAP PREPARED BY U.S. ARMY ENG. DIV. NEW ENGLAND CORPS OF ENGR'S. WALTHAM, MASS. DWG. NO. N.P. 204 MARCH 6, 1961

REF. 10-22-63

P.W.C. DWG. No. 15225-159

REVISION	DATE	DESCRIPTION	BY
A	5-5-62	FROM NATED OVERALL SWEEPING. ADDED EXACT AREAS TO BE DREDGED	FIFE

DPW DRAWING No. N.B.N-131 C-1

DEPARTMENT OF THE NAVY BUREAU OF YARDS AND DOCKS
DISTRICT PUBLIC WORKS OFFICE
FIRST NAVAL DISTRICT, BOSTON, MASS.

U.S. NAVAL BASE NEWPORT, R.I.

DREDGING PIER 1 & 2 AREA (SOUTH FROM PIER 2)

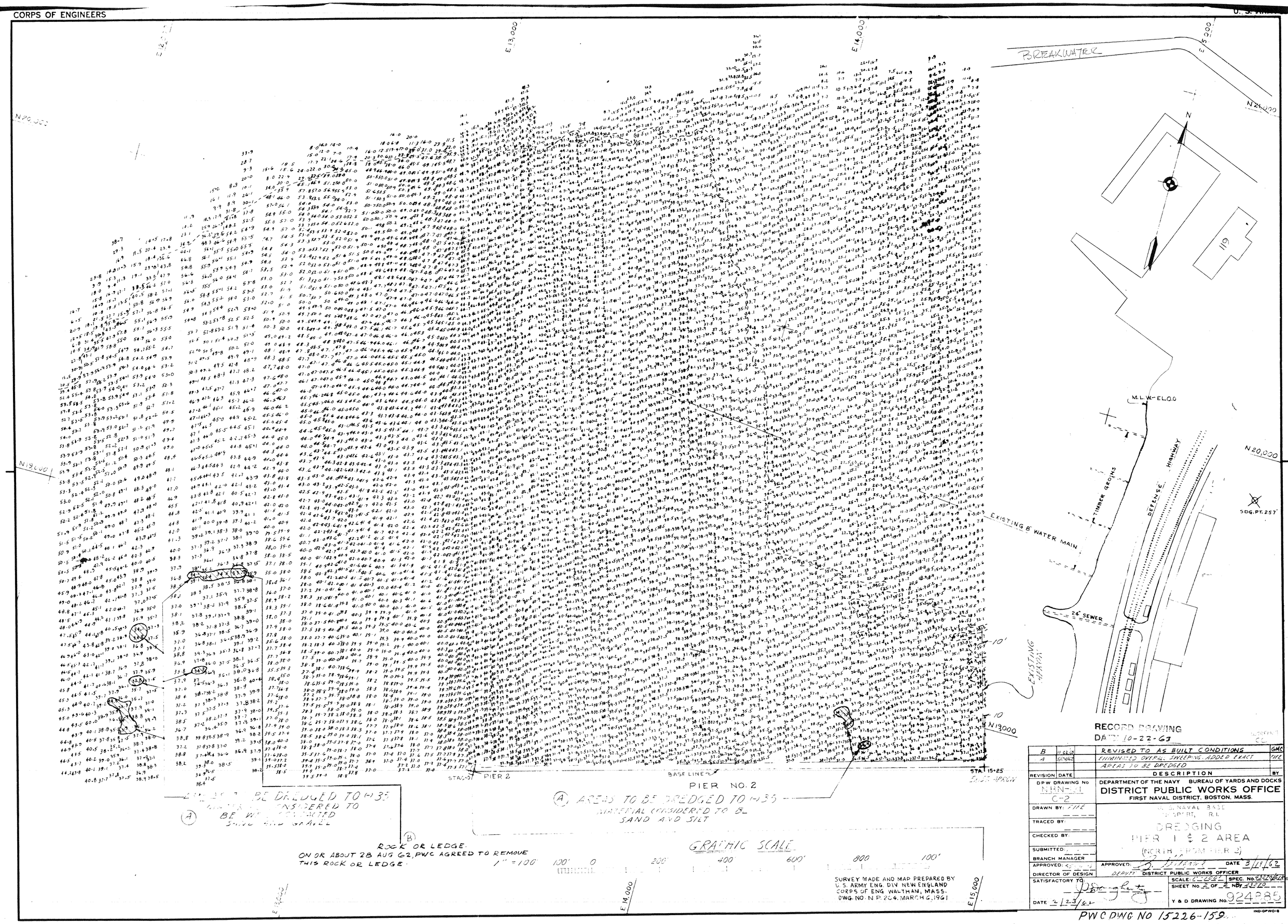
DRAWN BY: FIFE
TRACED BY:
CHECKED BY:
SUBMITTED:
BRANCH MANAGER
APPROVED: SEDDEN
DIRECTOR OF DESIGN
APPROVED: DEPUTY DISTRICT PUBLIC WORKS OFFICER
DATE 3/19/62
SATISFACTORY TO:
DATE 3/23/62
SCALE: 1"=100'
SPEC. No. B-270/CIR-V.
SHEET No. 1 OF 3 NDY 32220
Y & D DRAWING No. 904894

IND-DPWO-8

BILLING MOSS CO. BOSTON, MASS.

CORPS OF ENGINEERS

U. S. ARMY



REVISION	DATE	DESCRIPTION	BY
B	10-22-63	REVISED TO AS BUILT CONDITIONS	GMC
A	5/10/62	ELIMINATED OVERALL SWEEPING. ADDED EXACT AREAS TO BE DREDGED	FILE

DEPARTMENT OF THE NAVY BUREAU OF YARDS AND DOCKS
DISTRICT PUBLIC WORKS OFFICE
FIRST NAVAL DISTRICT, BOSTON, MASS.

DPW DRAWING No. NBN-61 C-2

DRAWN BY: FILE

TRACED BY:

CHECKED BY:

SUBMITTED:

BRANCH MANAGER

APPROVED:

DIRECTOR OF DESIGN

SATISFACTORY TO:

DATE 2/23/62

U. S. NAVAL BASE NEWPORT, R.I.

DREDGING
PIER 1 & 2 AREA
(NORTH FROM PIER 2)

APPROVED: DATE 3/14/62
DEPUTY DISTRICT PUBLIC WORKS OFFICER

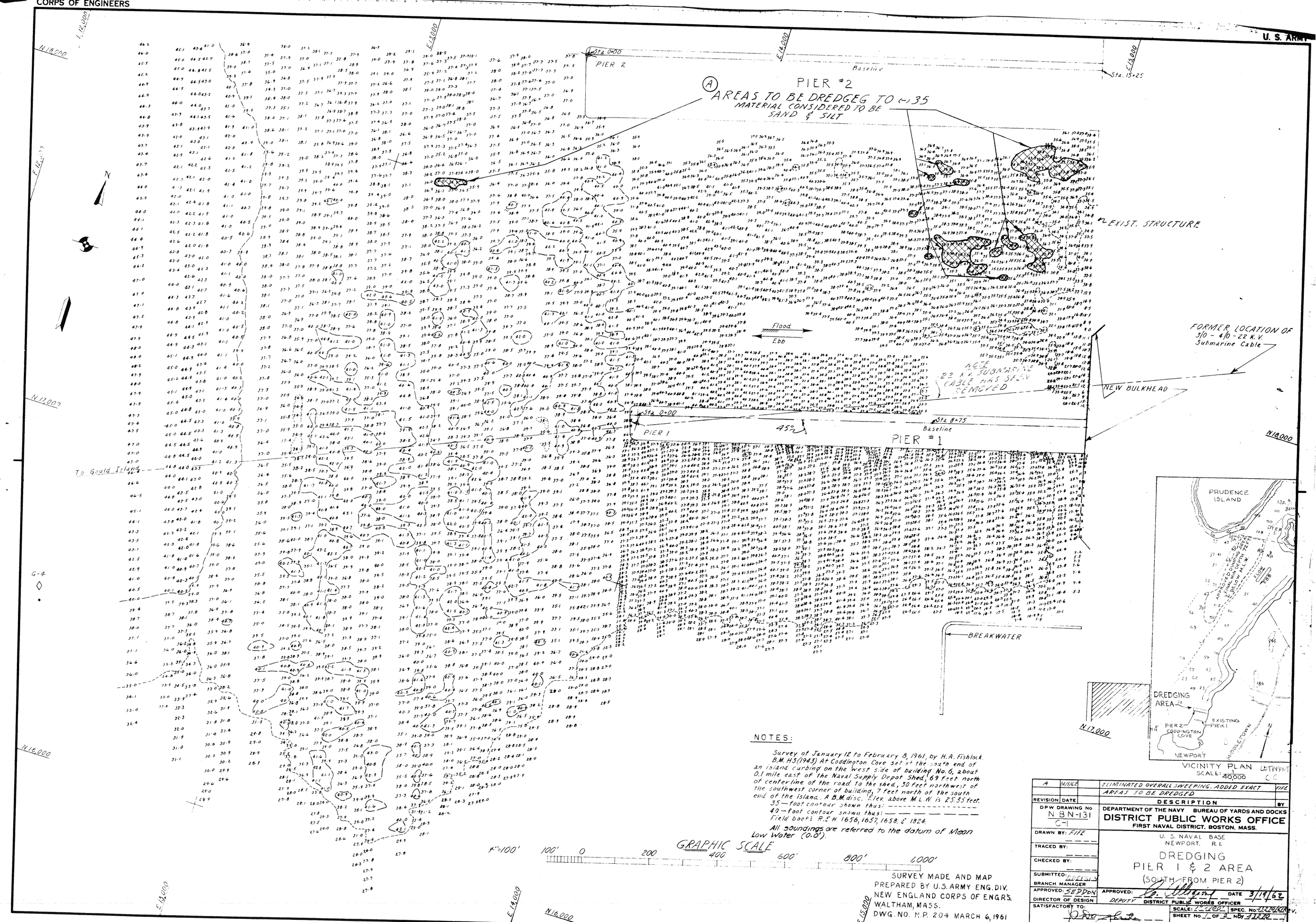
SCALE: 1"=100' | SPEC. No. 23270/FLR-V.
SHEET No. 2 OF 2 NBY 23270
Y & D DRAWING No. 924285

IND-DPWO-8

PWC DWG NO 15226-159

CORPS OF ENGINEERS

U. S. ARMY



NOTES:

Survey of January 12 to February 8, 1961, by H.A. Fishlock. B.M. H3 (1943) At Coddington Cove set at the south end of an island curbing on the west side of building No. 6, about 0.1 mile east of the Naval Supply Depot Shed, 69 feet north of centerline of the road to the shed, 30 feet northwest of the southwest corner of building, 7 feet north of the south end of the island. A B.M. disc. Elev. above M.L.W. is 25.35 feet.

35 — foot contour shown thus: ----------

40 — foot contour shown thus: — — — — — —

Field books R.S.H. 1656, 1657, 1658, & 1824.

All soundings are referred to the datum of Mean Low Water (0.0').

1"=100' 100' 0 200 400 600' 800' 1000'

GRAPHIC SCALE

SURVEY MADE AND MAP PREPARED BY U.S. ARMY ENG. DIV. NEW ENGLAND CORPS OF ENGR'S. WALTHAM, MASS. DWG. NO. N.P. 204 MARCH 6, 1961

REVISION	DATE	DESCRIPTION	BY
A	3/13/62	ELIMINATED OVERALL SWEEPING. ADDED EXACT AREAS TO BE DREDGED	FIFE

DPW DRAWING No N.B.N-131 C-1

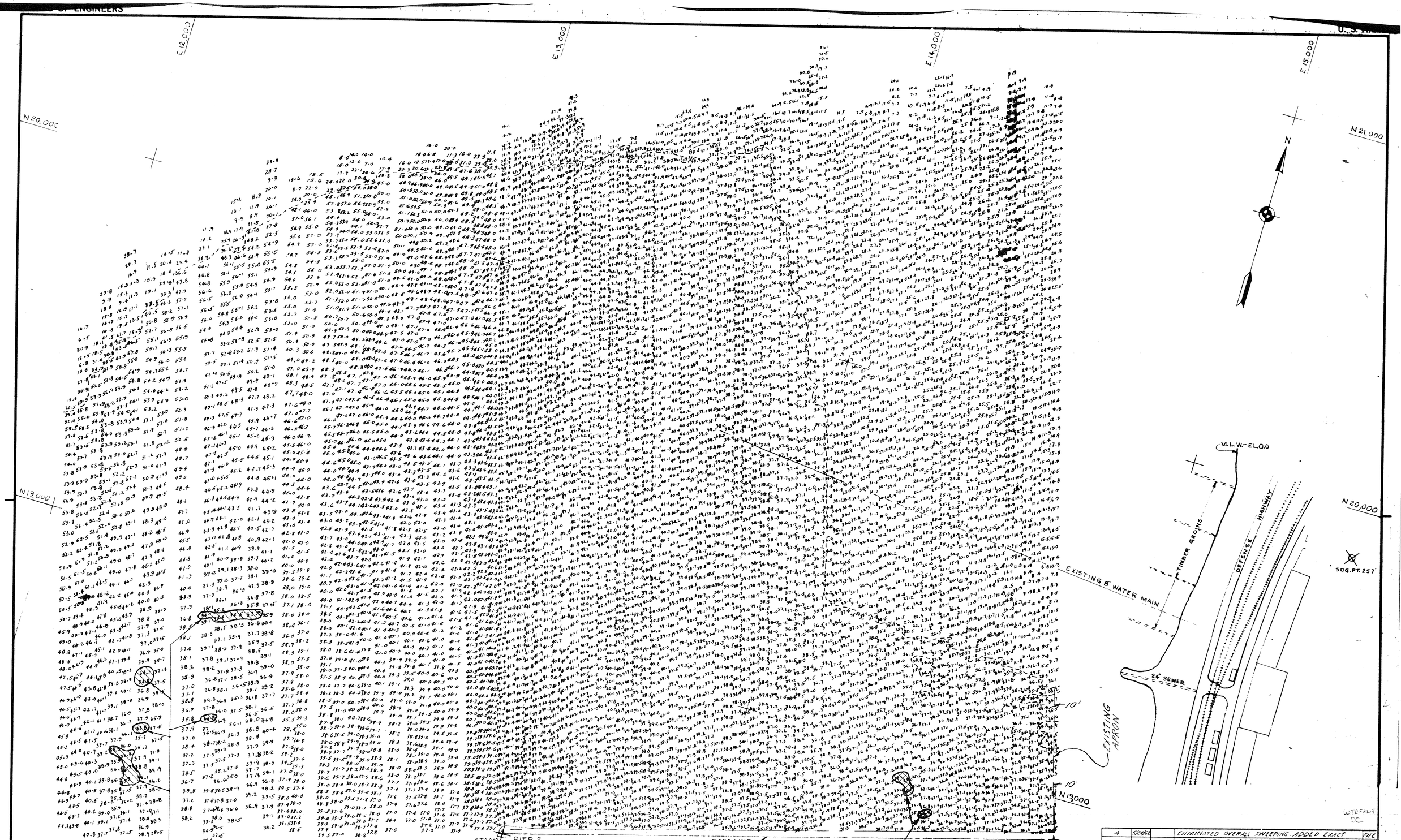
DEPARTMENT OF THE NAVY BUREAU OF YARDS AND DOCKS
DISTRICT PUBLIC WORKS OFFICE
FIRST NAVAL DISTRICT, BOSTON, MASS.

DRAWN BY: FIFE
TRACED BY:
CHECKED BY:
SUBMITTED: BRANCH MANAGER
APPROVED: SEDDON DIRECTOR OF DESIGN
APPROVED: DEPUTY DATE 3/19/62 DISTRICT PUBLIC WORKS OFFICER
SATISFACTORY TO: DATE 3/23/62

U. S. NAVAL BASE NEWPORT, R.I.

DREDGING PIER 1 & 2 AREA (SOUTH FROM PIER 2)

SCALE: 1" = 100' SPEC. No 33270/REV.
SHEET No. 1 OF 2 No. 33270
Y & D DRAWING No 924884



SURVEY MADE AND MAP PREPARED BY
U. S. ARMY ENG. DIV NEW ENGLAND
CORPS OF ENG WALTHAM, MASS.
DWG. NO. N.P. 204. MARCH 6, 1961

REVISION	DATE	DESCRIPTION	BY
A	5/24/62	ELIMINATED OVERALL SWEEPING. ADDED EXACT AREAS TO BE DREDGED	FIFE

DPW DRAWING No NBN-131 C-2

DEPARTMENT OF THE NAVY BUREAU OF YARDS AND DOCKS
DISTRICT PUBLIC WORKS OFFICE
FIRST NAVAL DISTRICT, BOSTON, MASS.

DRAWN BY: FIFE
TRACED BY:
CHECKED BY:
SUBMITTED: BRANCH MANAGER
APPROVED: SEWON DIRECTOR OF DESIGN
SATISFACTORY TO: DATE 2/23/62

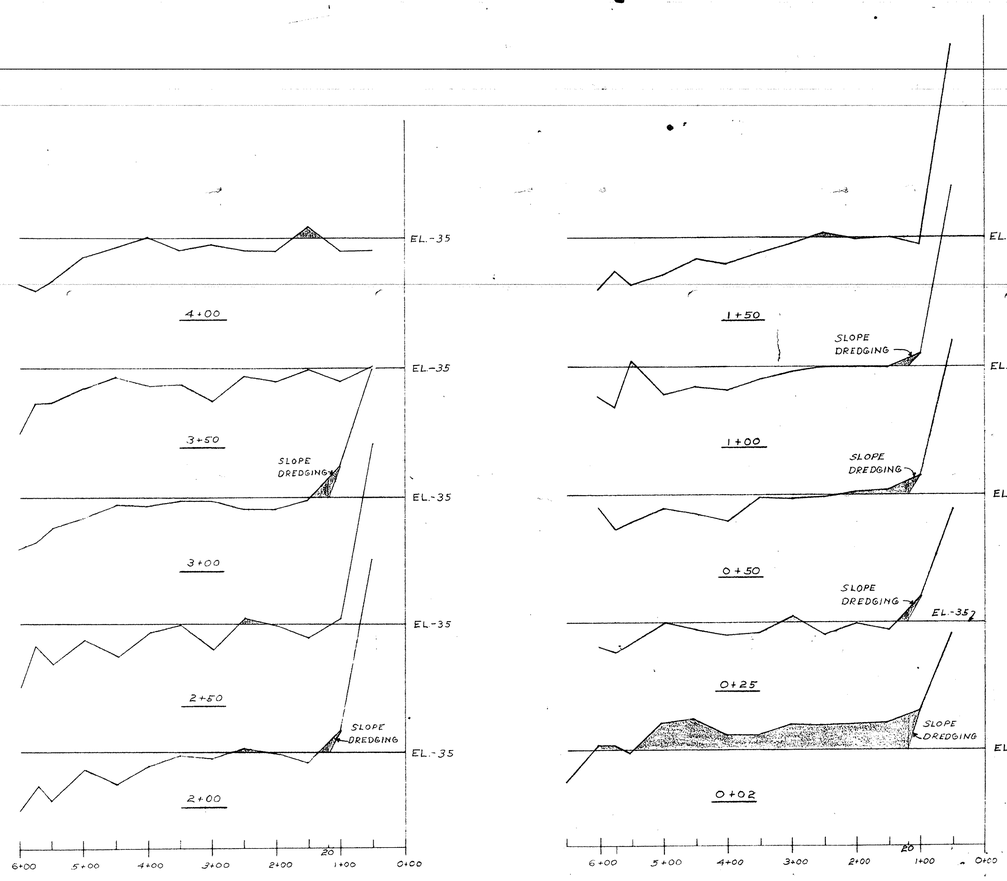
U. S. NAVAL BASE
NEWPORT, R.I.

DREDGING
PIER 1 & 2 AREA
(NORTH FROM PIER 2)

APPROVED: DATE 3/19/62
DEPUTY DISTRICT PUBLIC WORKS OFFICER

SCALE: 1"=100' SPEC. No. 8328/61R rev.
SHEET No. 2 OF 2 NBY 43-270
Y & D DRAWING No. 924885

LOTFIELD
SC

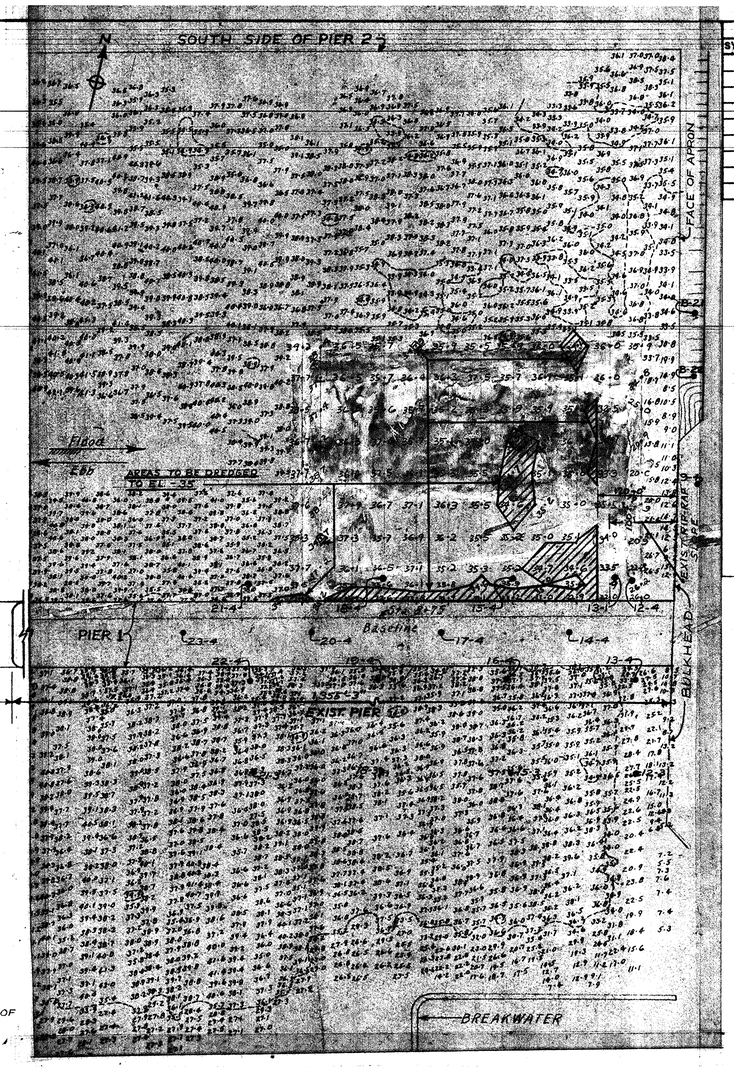


EXISTING CROSS-SECTIONS

SCALES: HOR 1"=100'-0"
VERT 1"= 5'-0"

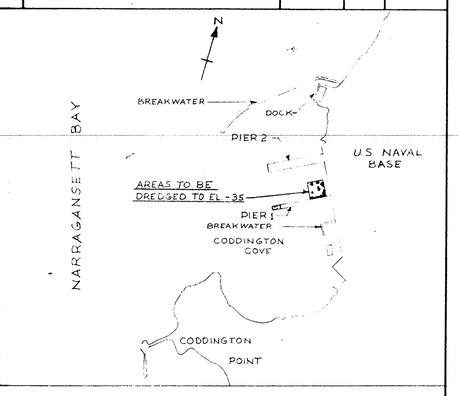
NOTES:

1. CROSS-SECTIONS TAKEN PARALLEL TO THE NORTH SIDE OF PIER 1. THE NORTH SIDE OF THE PIER IS STATION 0+00.
2. STATION 0+00 ALONG THE CROSS-SECTIONS IS AT THE BULKHEAD.
3. NO DREDGING SHALL BE DONE WITHIN 120 FEET OF THE BULKHEAD EXCEPT SLOPE DREDGING INDICATED.
4. SHADING INDICATES MATERIAL TO BE DREDGED TO ELEVATION -35.



DREDGING PLAN

SCALE: 1"=100'-0"

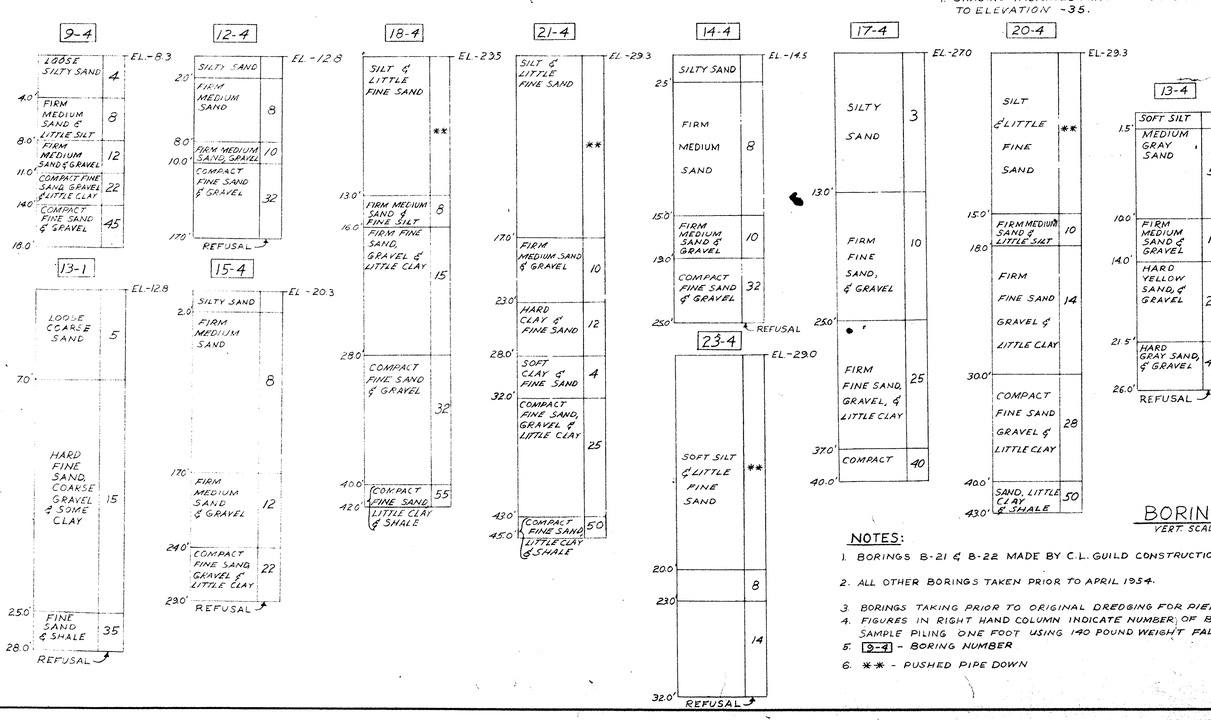


LOCATION PLAN

SCALE: NONE

NOTES:

1. ALL SOUNDINGS ARE REFERRED TO THE DATUM OF MEAN LOW WATER (0.0).
2. ALL SOUNDINGS, WITHIN STATION 0+25 TO 5+75 ALONG THE NORTH SIDE OF PIER 1, AND STATION 0+02 TO 4+00 PERPENDICULAR TO THE NORTH SIDE OF PIER 1, WERE TAKEN BY THE PUBLIC WORKS CENTER, NEWPORT MARCH 1965. ALL OTHER SOUNDINGS TAKEN BY US ARMY CORPS OF ENGINEERS, WALTHAM MASS. MARCH, 1961.
3. ALL AREAS SHOWN HATCHED ON THE DREDGING PLAN ARE TO BE DREDGED TO ELEVATION -35.
4. ●12-4, INDICATES BORING LOCATION AND LOG NUMBER.

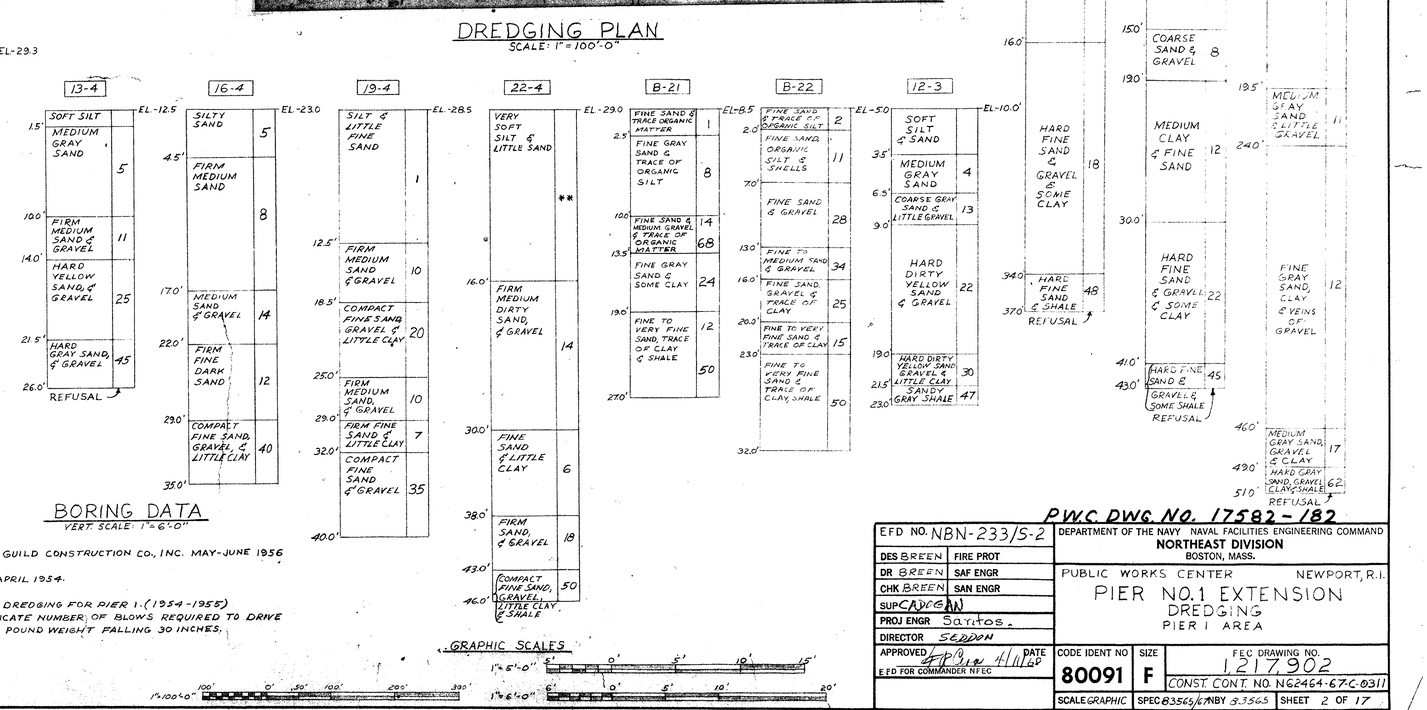


BORING DATA

VERT. SCALE: 1"=6'-0"

NOTES:

1. BORINGS B-21 & B-22 MADE BY C.L. GUILD CONSTRUCTION CO., INC. MAY-JUNE 1956
2. ALL OTHER BORINGS TAKEN PRIOR TO APRIL 1954.
3. BORINGS TAKING PRIOR TO ORIGINAL DREDGING FOR PIER 1. (1954-1955)
4. FIGURES IN RIGHT HAND COLUMN INDICATE NUMBER OF BLOWS REQUIRED TO DRIVE SAMPLE PILING ONE FOOT USING 140 POUND WEIGHT FALLING 30 INCHES.
5. 9-4 - BORING NUMBER
6. ** - PUSHED PIPE DOWN



GRAPHIC SCALES

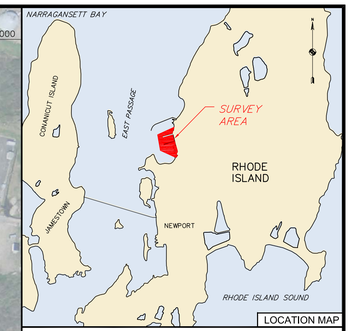
1"=100'-0" 100' 0' 50' 100' 200' 300'
1"=5'-0" 5' 0' 5' 10' 15'
1"=6'-0" 6' 0' 5' 10' 20'

PWC DWG. NO. 17582-182

REVISION				
SYM	DESCRIPTION	PREP'D BY	DATE	APPROVED

EFD NO. NBN-233/S-2	DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND NORTHEAST DIVISION BOSTON, MASS.	
DES BREEN / FIRE PROT	PUBLIC WORKS CENTER NEWPORT, R.I.	
DR BREEN / SAF ENGR	PIER NO.1 EXTENSION DREDGING PIER 1 AREA	
CHK BREEN / SAN ENGR		
SUP CADDEGAN		
PROJ ENGR Santos.		
DIRECTOR SEDDON		
APPROVED DATE 4/11/68 EFD FOR COMMANDER NFEC	CODE IDENT NO 80091 / SIZE F / FEC DRAWING NO. 1217902	
	SCALE GRAPHIC / SPEC 83565/67NBY 3356.5 / CONST. CONT. NO. N62464-67-C-0311 / SHEET 2 OF 17	

17582-182



LEGEND

29 MINOR CONTOUR

30 MAJOR CONTOUR

DEPTH (MLLW)

FEET: 0, 10, 20, 30, 40

DATUM INFORMATION:

- MHW = 3.60'
- NAVD 88 = 2.05'
- NGVD 29 = 1.18'
- MLLW

DISPLAYED TIDAL DATUMS, MEAN HIGH WATER (MHW), NORTH AMERICAN VERTICAL DATUM 1988 (NAVD 88), NATIONAL GEODETIC VERTICAL DATUM 1929 (NGVD 29), AND MEAN LOWER LOW WATER (MLLW) WERE PROVIDED BY THE NATIONAL GEODETIC SURVEY.

NOTES

1. GRID SYSTEM IS IN FEET AND IS THE RHODE ISLAND STATE PLANE COORDINATE SYSTEM, NAD 83.
2. DEPTHS ARE IN FEET AND ARE REFERENCED TO MEAN LOWER LOW WATER (MLLW) BASED ON BENCHMARK "560" WHICH HAS AN ELEVATION OF 13.12 FEET NGVD 29 AS PROVIDED BY LOUIS FREDERICI ASSOCIATES. THE PLANE OF NGVD 29 IS 1.18 FEET ABOVE THE PLANE OF MLLW. DEPTHS WERE DEVELOPED FROM ONE FOOT BY ONE FOOT BINNED DATA WITH THE AVERAGE DEPTH WITHIN EACH BIN POSTED IN THE CENTER OF THE BIN.
3. CONTOURS ARE IN FEET AND WERE GENERATED USING "QUICKSURF" OPERATING WITHIN AUTODESK "AUTOCAD".
4. SHORELINE AND ONSHORE FEATURES ARE APPROXIMATE AND WERE TAKEN FROM DIGITAL ORTHOPHOTO QUADRANGLES FLOWN IN 2009 AND OBTAINED FROM THE USGS SEAMLESS DATA WAREHOUSE.
5. THE INFORMATION PRESENTED ON THIS DRAWING REPRESENTS THE RESULTS OF A MULTIBEAM SURVEY PERFORMED BY OCEAN SURVEYS, INC. ON 25-27 MAY AND 3 JUNE 2011 AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS EXISTING AT THAT TIME. REUSE OF THIS INFORMATION BY CLIENT OR OTHERS BEYOND THE SPECIFIC SCOPE OF WORK FOR WHICH IT WAS ACQUIRED SHALL BE AT THE SOLE RISK OF THE USER AND WITHOUT LIABILITY TO OSI.

SURVEY VESSEL:	ECHOSOUNDER:
R/V ABLE	RESON SEABAT 8125

NAVIGATION SYSTEMS: APPLANIX POS MV IN REAL TIME KINEMATIC MODE

SURVEY ACQUISITION SOFTWARE: HYPACK VERSION 2010

SURVEY PROCESSING SOFTWARE: HYPACK MULTIBEAM EDITOR VERSION 2010

SCALE: 1"=200'

200 0 200 400 600

CHECK GRAPHIC SCALE BEFORE USING

OCEAN SURVEYS, INC.

OLD SAYBROOK, CONNECTICUT

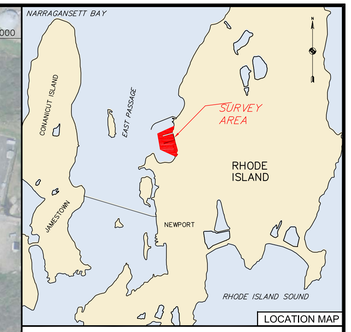
(860) 388-4631

www.oceansurveys.com

PREPARED FOR: TETRA TECH NUS, INC.

DEPTH CONTOURS
MULTIBEAM HYDROGRAPHY
CODDINGTON COVE
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

PROJECT MANAGER:	SURVEY DATE:	PROJECT NUMBER:
J. WETMUR	25-27 MAY, 3 JUNE 2011	11ES036
DRAFTED BY: A. RIZZO	DATE: 23 JUNE 2011	DRAWING: 1 / SHEET: 1 OF 1



DEPTH (MLLW)

FEET: 0, 10, 20, 30, 40

SHADED RELIEF INFORMATION:

SUN POSITION
ALTITUDE: 45°
AZIMUTH: 10°

DATUM INFORMATION:

- MHW = 3.60'
- NAVD 88 = 2.05'
- NGVD 29 = 1.18'
- MLLW

DISPLAYED TIDAL DATUMS, MEAN HIGH WATER (MHW), NORTH AMERICAN VERTICAL DATUM 1988 (NAVD 88), NATIONAL GEODETIC VERTICAL DATUM 1929 (NGVD 29), AND MEAN LOWER LOW WATER (MLLW) WERE PROVIDED BY THE NATIONAL GEODETIC SURVEY.

NOTES

1. GRID SYSTEM IS IN FEET AND IS THE RHODE ISLAND STATE PLANE COORDINATE SYSTEM, NAD 83.
2. DEPTHS ARE IN FEET AND ARE REFERENCED TO MEAN LOWER LOW WATER (MLLW) BASED ON BENCHMARK "560" WHICH HAS AN ELEVATION OF 13.12 FEET NGVD 29 AS PROVIDED BY LOUIS FREDERICI ASSOCIATES. THE PLANE OF NGVD 29 IS 1.18 FEET ABOVE THE PLANE OF MLLW. DEPTHS WERE DEVELOPED FROM ONE FOOT BY ONE FOOT BINNED DATA WITH THE AVERAGE DEPTH WITHIN EACH BIN POSTED IN THE CENTER OF THE BIN.
3. SHORELINE AND ONSHORE FEATURES ARE APPROXIMATE AND WERE TAKEN FROM DIGITAL ORTHOPHOTO QUADRANGLES FLOWN IN 2009 AND OBTAINED FROM THE USGS SEAMLESS DATA WAREHOUSE.
4. THE INFORMATION PRESENTED ON THIS DRAWING REPRESENTS THE RESULTS OF A MULTIBEAM SURVEY PERFORMED BY OCEAN SURVEYS, INC. ON 25–27 MAY AND 3 JUNE 2011 AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS EXISTING AT THAT TIME. REUSE OF THIS INFORMATION BY CLIENT OR OTHERS BEYOND THE SPECIFIC SCOPE OF WORK FOR WHICH IT WAS ACQUIRED SHALL BE AT THE SOLE RISK OF THE USER AND WITHOUT LIABILITY TO OSI.

SURVEY VESSEL: R/V ABLE	ECHOSOUNDER: RESON SEABAT 8125
NAVIGATION SYSTEMS: APPLANIX POS MV IN REAL TIME KINEMATIC MODE	
SURVEY ACQUISITION SOFTWARE: HYPACK VERSION 2010	
SURVEY PROCESSING SOFTWARE: HYPACK MULTIBEAM EDITOR VERSION 2010	

SCALE: 1"=200'

200 0 200 400 600

CHECK GRAPHIC SCALE BEFORE USING

OCEAN SURVEYS, INC.
OLD SAYBROOK, CONNECTICUT
(860) 388-4631
www.oceansurveys.com

PREPARED FOR: TETRA TECH NUS, INC.

SHADED RELIEF MAP
MULTIBEAM HYDROGRAPHY
CODDINGTON COVE
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

PROJECT MANAGER: J. WETMUR	SURVEY DATE: 25–27 MAY, 3 JUNE 2011	PROJECT NUMBER: 11ES036	
DRAFTED BY: A. RIZZO	DATE: 23 JUNE 2011	DRAWING: 2	SHEET: 1 OF 1

MARINE AND FRESHWATER
SURVEY SERVICES

OCEAN SURVEYS, INC.
129 MILL ROCK ROAD EAST
OLD SAYBROOK, CT 06475
TEL. (860) 388-4631 FAX (860) 388-5879
www.oceansurveys.com

23 June 2011

Mr. Stephen S. Parker
Tetra Tech NUS, Inc.
250 Andover Street
Wilmington, MA 01887

SUBJECT: OPERATIONS REPORT (OSI REPORT NO. 11ES036)
MULTIBEAM HYDROGRAPHIC SURVEY
CODDINGTON COVE
NAVAL STATION NEWPORT, NEWPORT, RI

Dear Mr. Parker:

During the period 25-27 May and 3 June 2011, Ocean Surveys, Inc. (OSI) conducted a multibeam hydrographic survey within Coddington Cove, Naval Station Newport, Newport, RI. The objective of this investigation was to develop full bottom coverage of the harbor floor within the study area to generate bottom contours and surficial imagery. This letter report outlines the procedures and instrumentation employed during the survey.

SUMMARY OF FIELD INVESTIGATION & EQUIPMENT

Upon arrival on site, a Trimble MS 750 Real Time Kinematic Global Positioning System (RTK GPS) base station was established over the control point "Log 1, Base 2" which is a drill hole set into a concrete foundation situated on the north side of a small, ruined pier in the southeast corner of Coddington Cove. The coordinates of 'Log 1, Base 2" were derived by Louis Federici Associates and provided to OSI by Tetra Tech. Based on the known and the measured position of the RTK GPS base station reference antenna, the base unit generates correctors for each GPS satellite in view and transmits these values via radio modem to the shipboard RTK GPS unit. The shipboard RTK GPS unit employs the correctors in calculating position data with a manufacturers stated 1 cm horizontal and 2 cm vertical accuracy.

The coordinates of "Log 1, Base 2" as well as supplementary project control, also provided by Tetra Tech, were referenced horizontally to the Rhode Island State Plane Coordinate System, NAD 27, US Survey Feet. Project control was referenced vertically to the National Geodetic Vertical Datum of 1929 (NGVD29), Feet. The control point positions were converted to the horizontal and vertical datums used during data acquisition: Rhode Island State Plane Coordinate System, NAD 83, US Survey Feet and North American Vertical Datum of 1988 (NAVD88), Feet. The control point coordinates and elevations are provided in Tables 1 and 2 below.

Table 1
Project Control XYZ

STATION	NORTHING	EASTING	ELEVATION
	RI State Plane, NAD27, Feet		NGVD29, Feet
Log 1, Base 1, Nail	160768.87	551465.00	10.12
Log 1, Base 2, DH	160875.11	551435.44	13.12

Table 2
Converted Project Control XYZ

STATION	NORTHING	EASTING	ELEVATION
	RI State Plane, NAD83, Feet		NAVD88, Feet
Log 1, Base 1, Nail	160808.86	379685.06	9.24
Log 1, Base 2, DH	160915.11	379655.50	12.24

Survey operations were conducted from OSI's *R/V Able*, a 25-foot boat equipped with an array of survey and support equipment. A Real Time Kinematic Global Positioning System (RTK GPS) receiver, integral to the internal navigation electronics, was installed on the survey vessel. Communications between the vessel RTK GPS and the reference station GPS were made possible via radio link. This integrated 3-dimensional precision positioning system provided the field team with the ability to navigate the survey vessel precisely along pre-plotted tracklines throughout the survey area and the ability to correct soundings for water level variation. The vertical and horizontal accuracy of the positioning system was verified daily by comparing the observed position of the positioning system with the known coordinates of a control point provided by Tetra Tech.

A summary of the primary equipment installed on the survey vessel and employed to complete this investigation follows:

- Applanix POS MV, Version 4, Position and Orientation System (heave, pitch, roll, heading)
- Trimble RTK-GPS integral to the POS MV (vessel navigation)
- Trimble MS750 RTK-GPS interfaced to a Pacific Crest radio link (base station)
- HYPACK 2010 PC-based navigation and data-logging software package
- Reson SeaBat 8125 ultra high resolution multibeam echosounder
- Sea-Bird SBE19 CTD profiler for water mass speed of sound determination (water column)
- Sea-Bird SBE37 MicroCat sound velocity sensor (sound velocity determination at multibeam transducer face)

Before commencement of multibeam sounding operations, the sound velocity profile of the local water mass speed of sound was determined by means of a CTD cast. In addition to developing sound velocity profile information, real-time sound velocity determination at the transducer face was accomplished by means of the velocity sensor affixed directly to the multibeam transducer.

A sensor alignment test or "patch test" was preformed prior to survey operations. Initially, the precise vertical and horizontal offsets between multibeam system components (echosounder transducer, position-orientation system) were physically measured. Once the physical offsets were stored in the data collection platform, the required patch test data were acquired and analyzed to determine the system roll, pitch, and heading biases along with any navigation timing errors. The angular and timing values, along with water level (discussed below) and water column sound velocity profile information, were subsequently used during data processing to determine the final depth and position of each sounding.

Upon determination of all physical, angular, and timing offsets by means of the various methods described above, a "QA Performance Test" was carried out per specifications in the U.S. Army Corps of Engineers (ACOE) Hydrographic Surveying Manual "EM 1110-2-1003." Per the ACOE manual, "The performance test is used to evaluate the quality and confidence of multibeam data being collected. This test typically compares overlapping data sets from two different multibeam surveys, performed by either the same or different vessels."

The test consists of two phases. First, a "performance surface" is created by means of executing a small survey run over a flat area. Multiple runs (~400% overlap) are performed during development of the performance surface. The performance surface data are cleaned and bin-averaged into 1-foot by 1-foot cells resulting in an accurate (free from sensor alignment bias artifacts due to data density and averaging) and dense XYZ data set describing seafloor elevations. Next, a series of "multibeam check lines" is run over the performance surface. These data are input to the HYPACK Beam Angle Test program, which compares multibeam check lines to the performance surface and estimates the depth accuracy of the multibeam system at different beam angle limits. The estimated accuracy is used to determine if the multibeam system meets project requirements.

In the case of this survey, a performance surface was established on 25 May 2011 and a set of performance test values was derived the same day. On 3 June 2011 a second set of multibeam check lines were compared to the performance surface generated on 25 May and performance test values were derived. The 3 June check lines were collected at a time when the water level and water column sound velocity profile were different than during acquisition of the 25 May performance surface data. In both test cases each of the ACOE test parameters; depth outliers, mean bias, and standard deviation were considered. The quality of the data tested exceeded the most stringent accuracy requirements specified in the ACOE manual. Table 3 below presents the results of the QA performance tests as well as the ACOE standards for these QA/QC criteria.

Table 3
Performance Surface Beam Angle Test Results

Statistical Quantity Per Beam Angle Group	25 May Result	3 June Result	ACOE Maximum Allowed
Mean Difference (Reference Surface – Check Line)	0.01-0.04 ft.	0.02-0.03 ft.	0.1 ft.
Depth Standard Deviation (1-σ)	±0.08 ft.	±0.10 ft.	------
Depth Accuracy At 95% Confidence	±0.17 ft.	±0.19 ft.	±0.5 ft – 1.0 ft.

The depth measuring accuracy of the echosounder was confirmed by means of a daily "bar check". The bar check procedure consists of lowering an acoustical target on a graduated sounding line to the deepest practical depth. The target is then raised to successively shallower depths and the displayed digital depths noted.

During the course of the survey, the water column velocity profile was monitored by means of additional CTD casts and all observed changes in sound speed (as a result of changing tidal currents and temperature, etc.) recorded. During post processing, sound velocity profile data were applied to the multibeam soundings yielding maximum accuracy in the resulting depth data.

Sounding data were reduced to the NAVD 88 vertical datum based on RTK GPS water levels. The vertical accuracy afforded by the RTK GPS system (2 cm manufacturers' stated accuracy) allows for the collection of precise water level information. Water level values were recorded at the location of the survey platform as the vessel was maneuvered along each survey transect.

The data collection and processing software package HYPACK 2010 allows the surveyor to record the vertical component of the vessel RTK GPS solution by placing this value in the project raw data file while bathymetric data are being recorded. Procedurally, a measured vertical offset (height of the antenna over the water surface) is applied to the RTK GPS solution during data collection. Thus the elevation of the water surface is derived based on the vessel's RTK GPS antenna height.

Vessel RTK GPS water level values were compared to a physically measured water level value at least twice daily. Procedurally the vertical distance from the water surface to a control point provided by Tetra Tech was measured and the water level calculated. The calculated water level value was compared to a simultaneously observed RTK GPS water level to confirm the accuracy of the RTK GPS-derived value.

The survey site was centered on Pier 1 in Coddington Cove and extended approximately 300 feet north of Pier 2 and 2,000 feet south of Pier 1 (see Figure 1). Multibeam soundings were collected along a set of parallel tracklines oriented roughly parallel to Piers 1 and 2 and the coastline. The trackline plan consisted of lines offset at intervals intended to result in over 100% ensonification of the harbor floor. Additionally, shoreline features and near-shore shallow areas were mapped with the multibeam transducer oriented in a "side-looking" configuration. Multiple vessels were tied up alongside Piers 1 and 2 limiting the full coverage of the seafloor below these vessels. A large gap in multibeam coverage on the north side of Pier 1 is attributed to the *USS Saratoga*, an aircraft carrier permanently moored at the Newport Navy Base. A small gap in multibeam coverage along the north side of Pier 2, located approximately at 41-31-51 N, 71-18-55.5 W, denotes the location of the NOAA Ship *Henry B. Bigelow*, which was tied to the pier for the duration of data acquisition.

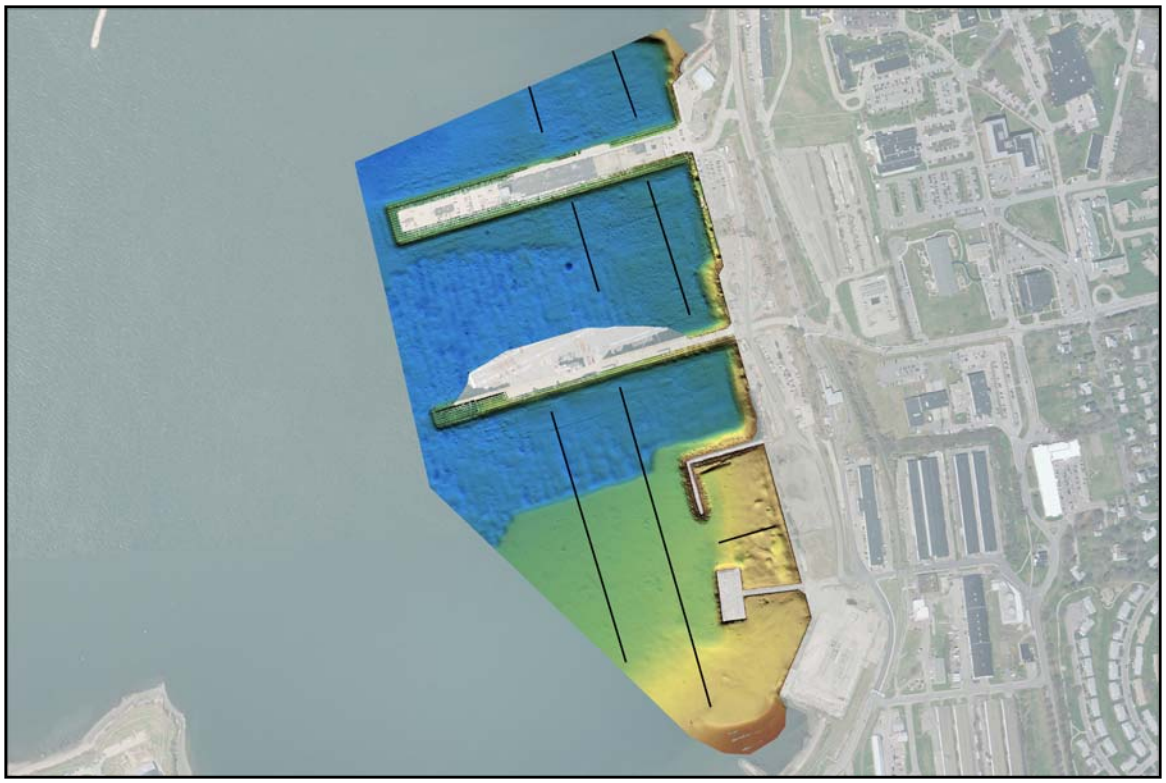


Figure 1. Coddington Cove Coverage Area. A 1-foot x 1-foot surface colored by depth is shown with an aerial photo of the survey area in the background. The location of the QA cross check lines are overlain on the surface in black.

To further evaluate the data quality and multibeam system setup, seven (7) QA cross check lines, "tie" lines, were acquired on a line plan perpendicular to the mainscheme multibeam survey lines (see Figure 1). Data from each tie line were compared to an XYZ data set generated from the mainscheme survey lines using the HYPACK Beam Angle Test program. Table 4 presents the results of the QA cross check line tests as well as the ACOE standards for these QA/QC criteria.

Table 4
Cross Check Line Beam Angle Test Results

Statistical Quantity Per Beam Angle Group	Tie Line 1636_1	Tie Line 1639_2	Tie Line 1657_5	Tie Line 1702_3	Tie Line 1708_5	Tie Line 1713_6	Tie Line 1854_7	ACOE Maximum Allowed
Mean Difference (Reference Surface – Check Line)	(-0.01) - 0.01 ft.	0.00 - 0.01 ft.	(-0.03) - (-0.07) ft.	(-0.03) - 0.02 ft.	(-0.09) - (-0.07) ft.	(-0.08) - (-0.05) ft.	(-0.04) - (-0.01) ft.	0.1 ft.
Depth Standard Deviation (1-σ)	±0.10 ft.	±0.11 ft.	±0.11 ft	±0.11 ft	±0.09 ft	±0.10 ft	±0.11 ft	------
Depth Accuracy At 95% Confidence	±0.19 ft.	±0.20 ft.	±0.21 ft.	±0.21 ft.	±0.17 ft.	±0.19 ft.	±0.21 ft.	±0.5 ft. – 1.0 ft.

DATA PROCESSING

Following completion of the field surveys, raw data files and records were returned to OSI's headquarters in Old Saybrook, Connecticut where data processing tasks were completed.

Procedurally, the raw multibeam data files for each trackline were sequentially loaded into the HYPACK 2010 MB Max multibeam editor. Within the editor, raw data files, consisting of multibeam range and beam information, water level, water column velocity profile, vessel position and attitude information, were "cleaned" (edited) to eliminate invalid sensor data or "fliers" using automated and manual editing tools. After the sensor data were cleaned datum-corrected X, Y, Z data points were computed. Final data products are horizontally referenced to Rhode Island State Plane, NAD 83, US Survey Feet, and vertically referenced to local Mean Lower Low Water (MLLW), feet. The plane of vertical datum NGVD29 is 1.18 feet above the plane of MLLW.

Sounding X, Y, Z data points were contoured using the QUICKSURF TIN Model program. Plan view depth contours with a 1-foot interval are presented on Drawing 1. Bottom contours were developed from 1-foot by 1-foot binned data with the average depth within each bin posted in the center of the bin. A shaded relief map colored by depth with a cell resolution of 1 foot by 1 foot is presented on Drawing 2. Drawings are provided as paper copies as well as AutoCAD DWG files, which are included with a sounding X, Y, Z file on a project DVD.

OSI appreciates the opportunity to support Tetra Tech on this project and we look forward to continuing this working relationship in the future. If you have any questions regarding any aspect of this survey, or we can be of service on other survey efforts, please do not hesitate to contact me.

Sincerely,

Bonnie L. Johnston
Hydrographer, Ocean Surveys, Inc.

BLJ/lf
Enclosures

APPENDIX C

ANALYTICAL RESULTS

C-1 SEDIMENT DATA 1993- 2004

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-JPC-01					DSY-JPC-02			
Sample Number	JPC-1-SUR	JPC-1-SURa	JPC-1-SURb	JPC-1-SUR-D	DSY-SD-JPC01-082604	JPC-2-SUR	JPC-2-SURa	JPC-2-SURb	JPC-2-SUR-D
Date Sampled	10/19/1995	10/19/1995	10/19/1995	10/19/1995	8/26/2004	10/27/1995	10/27/1995	10/27/1995	10/27/1995
QC Identifier									
Semivolatile Organic Analysis (UG/KG)									
1,1-BIPHENYL	1.3451	NA	NA	NA	NA	NA	NA	NA	NA
1-METHYLNAPHTHALENE	2.5806 J	NA	NA	NA	NA	NA	NA	NA	NA
1-METHYLPHENANTHRENE	9.4928	NA	NA	NA	NA	NA	NA	NA	NA
2,3,5-TRIMETHYLNAPHTHALENE	1.4564	NA	NA	NA	NA	NA	NA	NA	NA
2,6-DIMETHYLNAPHTHALENE	6.1762	NA	NA	NA	NA	NA	NA	NA	NA
2-METHYLNAPHTHALENE	3.83 J	NA	NA	NA	NA	NA	NA	NA	NA
ACENAPHTHENE	1.4241	NA	NA	NA	NA	NA	NA	NA	NA
ACENAPHTHYLENE	10.6569	NA	NA	NA	NA	NA	NA	NA	NA
ANTHRACENE	21.2143	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(A)ANTHRACENE	45.0965	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(A)PYRENE	62.8722	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(B+K)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(E)PYRENE	53.1865	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(G,H,I)PERYLENE	37.278	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(K)FLUORANTHENE	124.8111	NA	NA	NA	NA	NA	NA	NA	NA
CHRYSENE	49.9146	NA	NA	NA	NA	NA	NA	NA	NA
DIBENZO(A,H)ANTHRACENE	10.1029	NA	NA	NA	NA	NA	NA	NA	NA
FLUORANTHENE	99.2789	NA	NA	NA	NA	NA	NA	NA	NA
FLUORENE	4.5637	NA	NA	NA	NA	NA	NA	NA	NA
HIGH MOLECULAR WEIGHT PAHS	365.1931	NA	NA	NA	NA	NA	NA	NA	NA
INDENO(1,2,3-CD)PYRENE	34.5814	NA	NA	NA	NA	NA	NA	NA	NA
LOW MOLECULAR WEIGHT PAHS	90.8034	NA	NA	NA	NA	NA	NA	NA	NA
NAPHTHALENE	5.4	NA	NA	NA	NA	NA	NA	NA	NA
PERYLENE	19.271	NA	NA	NA	NA	NA	NA	NA	NA
PHENANTHRENE	43.7144	NA	NA	NA	NA	NA	NA	NA	NA
PYRENE	97.9279	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL PAHS	746	NA	NA	NA	NA	NA	NA	NA	NA
Low Concentration PAH (SIM) Analysis (UG/KG)									
2-METHYLNAPHTHALENE	NA	NA	NA	NA	4.4 U	NA	NA	NA	NA
ACENAPHTHENE	NA	NA	NA	NA	4.4 U	NA	NA	NA	NA
ACENAPHTHYLENE	NA	NA	NA	NA	5.6	NA	NA	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-JPC-01						DSY-JPC-02			
Sample Number	JPC-1-SUR	JPC-1-SURa	JPC-1-SURb	JPC-1-SUR-D	DSY-SD-JPC01-082604		JPC-2-SUR	JPC-2-SURa	JPC-2-SURb	JPC-2-SUR-D
Date Sampled	10/19/1995	10/19/1995	10/19/1995	10/19/1995	8/26/2004		10/27/1995	10/27/1995	10/27/1995	10/27/1995
QC Identifier										
ANTHRACENE	NA	NA	NA	NA	7.6		NA	NA	NA	NA
BENZO(A)ANTHRACENE	NA	NA	NA	NA	33		NA	NA	NA	NA
BENZO(A)PYRENE	NA	NA	NA	NA	46	J	NA	NA	NA	NA
BENZO(B)FLUORANTHENE	NA	NA	NA	NA	83	J	NA	NA	NA	NA
BENZO(G,H,I)PERYLENE	NA	NA	NA	NA	16	J	NA	NA	NA	NA
BENZO(K)FLUORANTHENE	NA	NA	NA	NA	26	J	NA	NA	NA	NA
CHRYSENE	NA	NA	NA	NA	40		NA	NA	NA	NA
DIBENZO(A,H)ANTHRACENE	NA	NA	NA	NA	4.4	UJ	NA	NA	NA	NA
FLUORANTHENE	NA	NA	NA	NA	73		NA	NA	NA	NA
FLUORENE	NA	NA	NA	NA	4.4	U	NA	NA	NA	NA
HIGH MOLECULAR WEIGHT PAHS	NA	NA	NA	NA	413		NA	NA	NA	NA
INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA	15	J	NA	NA	NA	NA
LOW MOLECULAR WEIGHT PAHS	NA	NA	NA	NA	43.2		NA	NA	NA	NA
NAPHTHALENE	NA	NA	NA	NA	4.4	U	NA	NA	NA	NA
PHENANTHRENE	NA	NA	NA	NA	30		NA	NA	NA	NA
PYRENE	NA	NA	NA	NA	81		NA	NA	NA	NA
TOTAL PAH	NA	NA	NA	NA	456.2		NA	NA	NA	NA
Pesticide/PCB Analysis (UG/KG)										
2,4'-DDE	0.5455	NA	NA	NA	NA		NA	NA	NA	NA
4,4'-DDE	0.2862	NA	NA	NA	NA		NA	NA	NA	NA
ALDRIN	0.10	NA	NA	NA	NA		NA	NA	NA	NA
HEXACHLOROBENZENE	0.080	NA	NA	NA	NA		NA	NA	NA	NA
MIREX	0.10	NA	NA	NA	NA		NA	NA	NA	NA
PCB Analysis (UG/KG)										
2,2',5-TRICHLOROBIPHENYL	NA	NA	NA	NA	0.00931	JEB	NA	NA	NA	NA
2,4'-DICHLOROBIPHENYL	NA	NA	NA	NA	0.0439	JEB	NA	NA	NA	NA
PCB-101	0.822	NA	NA	NA	1.2	J	NA	NA	NA	NA
PCB-104	NA	NA	NA	NA	NA		NA	NA	NA	NA
PCB-105	0.1837	NA	NA	NA	0.417		NA	NA	NA	NA
PCB-118	0.5703	NA	NA	NA	0.978		NA	NA	NA	NA
PCB-126	NA	NA	NA	NA	NA		NA	NA	NA	NA
PCB-128	0.2543	NA	NA	NA	0.252	J	NA	NA	NA	NA
PCB-138	0.9656	NA	NA	NA	1.44	J	NA	NA	NA	NA
PCB-153	0.9797	NA	NA	NA	1.13	J	NA	NA	NA	NA
PCB-170	0.342	NA	NA	NA	0.165		NA	NA	NA	NA
PCB-18	0.1503	NA	NA	NA	NA		NA	NA	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-JPC-01					DSY-JPC-02			
Sample Number	JPC-1-SUR	JPC-1-SURa	JPC-1-SURb	JPC-1-SUR-D	DSY-SD-JPC01-082604	JPC-2-SUR	JPC-2-SURa	JPC-2-SURb	JPC-2-SUR-D
Date Sampled	10/19/1995	10/19/1995	10/19/1995	10/19/1995	8/26/2004	10/27/1995	10/27/1995	10/27/1995	10/27/1995
QC Identifier									
PCB-180	0.5502	NA	NA	NA	0.317 J	NA	NA	NA	NA
PCB-187	0.4659	NA	NA	NA	0.277	NA	NA	NA	NA
PCB-188	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-195	0.2177	NA	NA	NA	0.0337 J	NA	NA	NA	NA
PCB-201	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-206	0.7117	NA	NA	NA	0.107 J	NA	NA	NA	NA
PCB-209	0.751	NA	NA	NA	0.183	NA	NA	NA	NA
PCB-28	0.3285	NA	NA	NA	0.0743 JEB	NA	NA	NA	NA
PCB-29	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-44	0.6077	NA	NA	NA	0.358 JEB	NA	NA	NA	NA
PCB-50	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-52	1.1141	NA	NA	NA	0.931 EB	NA	NA	NA	NA
PCB-66	0.331	NA	NA	NA	0.285	NA	NA	NA	NA
PCB-8	0.055	NA	NA	NA	NA	NA	NA	NA	NA
PCB-87	NA	NA	NA	NA	NA	NA	NA	NA	NA
SUM OF PCB CONGENERS X 2	18.9124	NA	NA	NA	16.4	NA	NA	NA	NA
TAL Metal Analysis (MG/KG)									
ALUMINUM	27475	NA	NA	20423.25	4240	30460	NA	NA	26535
ANTIMONY	NA	NA	NA	NA	R	NA	NA	NA	NA
ARSENIC	2.61	NA	NA	2.5	2.1 J	4.84	NA	NA	5.66
BARIUM	NA	NA	NA	NA	10.3 J	NA	NA	NA	NA
BERYLLIUM	NA	NA	NA	NA	0.29	NA	NA	NA	NA
CADMIUM	0.29 J	NA	NA	0.13 J	0.011 UJ	0.17 J	NA	NA	0.13 J
CALCIUM	NA	NA	NA	NA	1880	NA	NA	NA	NA
CHROMIUM	36.5	NA	NA	30.5	10.7 J	49.0	NA	NA	43.75
COBALT	NA	NA	NA	NA	3.0 J	NA	NA	NA	NA
COPPER	7.0	NA	NA	9.0	8.3 J	13.75	NA	NA	17.25
IRON	18091.5	NA	NA	16837.25	7800	18616.5	NA	NA	19103.5
LEAD	29.7	NA	NA	28.3	11.3 J	53.2	NA	NA	46.0
MAGNESIUM	NA	NA	NA	NA	2460	NA	NA	NA	NA
MANGANESE	293.5	NA	NA	253.5	98.6	284.25	NA	NA	256
MERCURY	0.2445	NA	NA	0.13	0.014 J	0.106	NA	NA	0.13
NICKEL	14.25	NA	NA	11.25	6.2 J	14.0	NA	NA	14.75
POTASSIUM	NA	NA	NA	NA	859	NA	NA	NA	NA
SELENIUM	NA	NA	NA	NA	0.22 U	NA	NA	NA	NA
SILVER	0.1375	NA	NA	0.0625 J	0.11 U	0.2625	NA	NA	0.1625
SODIUM	NA	NA	NA	NA	3590	NA	NA	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-JPC-01						DSY-JPC-02			
Sample Number	JPC-1-SUR	JPC-1-SURa	JPC-1-SURb	JPC-1-SUR-D	DSY-SD-JPC01-082604		JPC-2-SUR	JPC-2-SURa	JPC-2-SURb	JPC-2-SUR-D
Date Sampled	10/19/1995	10/19/1995	10/19/1995	10/19/1995	8/26/2004		10/27/1995	10/27/1995	10/27/1995	10/27/1995
QC Identifier										
THALLIUM	NA	NA	NA	NA	0.57	J	NA	NA	NA	NA
VANADIUM	NA	NA	NA	NA	10.2		NA	NA	NA	NA
ZINC	58.0	NA	NA	36.25	33.0	J	79.25	NA	NA	63.75
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (MG/KG)										
CADMIUM	NA	NA	NA	NA	0.1300	B	NA	NA	NA	NA
CHROMIUM	NA	NA	NA	NA	2.600		NA	NA	NA	NA
COPPER	NA	NA	NA	NA	3.400	*	NA	NA	NA	NA
LEAD	NA	NA	NA	NA	8.000		NA	NA	NA	NA
MERCURY	NA	NA	NA	NA	0.002300	B	NA	NA	NA	NA
NICKEL	NA	NA	NA	NA	1.100	BE	NA	NA	NA	NA
SULFIDE	NA	NA	NA	NA	NA		NA	NA	NA	NA
ZINC	NA	NA	NA	NA	18.40		NA	NA	NA	NA
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (UMOLE/G)										
CADMIUM	NA	NA	NA	NA	0.001460	U	NA	NA	NA	NA
CHROMIUM	NA	NA	NA	NA	0.05090		NA	NA	NA	NA
COPPER	NA	NA	NA	NA	0.05360	UJ	NA	NA	NA	NA
LEAD	NA	NA	NA	NA	0.03880		NA	NA	NA	NA
MERCURY	NA	NA	NA	NA	0.00003300	U	NA	NA	NA	NA
NICKEL	NA	NA	NA	NA	0.02789	UJ	NA	NA	NA	NA
SEM/AVS RATIO	-1.1934	0.3785	0.7266	NA	1.8959		0.1444	1.1926	0.8944	NA
SULFIDE	NA	NA	NA	NA	0.1959	J	NA	NA	NA	NA
TOTAL SIMULTANEOUSLY EXTRACTED METALS	NA	NA	NA	NA	0.3714		NA	NA	NA	NA
ZINC	NA	NA	NA	NA	0.2817	J	NA	NA	NA	NA
Miscellaneous Analysis (UG/KG)										
DIBUTYLTIN	0.50	NA	NA	NA	NA		0.50	NA	NA	NA
MONOBUTYLTIN	0.50	NA	NA	NA	NA		0.50	NA	NA	NA
TETRABUTYLTIN	0.50	NA	NA	NA	NA		0.37	J	NA	NA	NA
TRIBUTYLTIN	0.28	J	NA	NA	NA	NA	0.41	J	NA	NA	NA
Total Organic Carbon Analysis (MG/KG)										
CARBON	NA	NA	NA	NA	5400		NA	NA	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-JPC-03		MCA-JCC-S-01		MCA-JCC-MD-01					
Sample Number	DSY-SD-JPC03-082604	DSY-SD-DUP03-082604	JCC-S1	JCC-S1d	JCC-D1-SUR	JCC-D1-SURd	JCC-M1	JCC-M1d	JCC-D1-BOT	JCC-D1-BOTd
Date Sampled	8/26/2004	8/26/2004	8/29/1994	8/29/1994	8/29/1994	8/29/1994	8/29/1994	8/29/1994	6/1/1995	6/1/1995
QC Identifier	FIELD DUP	FIELD DUP								
Semivolatile Organic Analysis (UG/KG)										
1,1-BIPHENYL	NA	NA	2.98	NA	0.781	NA	1.42	NA	0.2393	NA
1-METHYLNAPHTHALENE	NA	NA	2.38	NA	0.3	NA	0.3	NA	3.255 U	NA
1-METHYLPHENANTHRENE	NA	NA	5.51	NA	8.258	NA	10.4	NA	0.2126	NA
2,3,5-TRIMETHYLNAPHTHALENE	NA	NA	1.24	NA	0.7037	NA	1.02	NA	0.54 U	NA
2,6-DIMETHYLNAPHTHALENE	NA	NA	8.38	NA	2.1089	NA	4.96	NA	3.6	NA
2-METHYLNAPHTHALENE	NA	NA	5.7	NA	1.63	NA	1.63	NA	5.3 U	NA
ACENAPHTHENE	NA	NA	3.1	NA	0.958	NA	1.01	NA	0.398	NA
ACENAPHTHYLENE	NA	NA	4.62	NA	3.2244	NA	4.17	NA	0.77 U	NA
ANTHRACENE	NA	NA	19.54	NA	6.27	NA	6.27	NA	0.4234	NA
BENZO(A)ANTHRACENE	NA	NA	44.55	NA	10.43	NA	10.43	NA	0.4941	NA
BENZO(A)PYRENE	NA	NA	33.66	NA	10.14	NA	10.14	NA	1.1865	NA
BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(B+K)FLUORANTHENE	NA	NA	64.81	NA	70.6566	NA	19.95	NA	3.5037	NA
BENZO(E)PYRENE	NA	NA	26.99	NA	9.92	NA	9.92	NA	1.4628	NA
BENZO(G,H,I)PERYLENE	NA	NA	62.33	NA	16.01	NA	16.01	NA	1.279	NA
BENZO(K)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHRYSENE	NA	NA	36.25	NA	10.24	NA	10.24	NA	0.6097	NA
DIBENZO(A,H)ANTHRACENE	NA	NA	9.7	NA	0.76	NA	0.76	NA	0.0954	NA
FLUORANTHENE	NA	NA	136.49	NA	43.2	NA	43.2	NA	2.6609	NA
FLUORENE	NA	NA	3.54	NA	0.18	NA	0.18	NA	1.34 U	NA
HIGH MOLECULAR WEIGHT PAHS	NA	NA	390.64	NA	116.63	NA	116.63	NA	8.307	NA
INDENO(1,2,3-CD)PYRENE	NA	NA	44.17	NA	8.41	NA	8.41	NA	0.9539	NA
LOW MOLECULAR WEIGHT PAHS	NA	NA	82.13	NA	27.4524	NA	28.45	NA	9.9683	NA
NAPHTHALENE	NA	NA	9.12	NA	1.92	NA	1.92	NA	0.3674	NA
PERYLENE	NA	NA	19.87	NA	7.52	NA	7.52	NA	16.6805	NA
PHENANTHRENE	NA	NA	36.51	NA	13.27	NA	13.27	NA	1.3695	NA
PYRENE	NA	NA	129.99	NA	41.86	NA	41.86	NA	3.2604	NA
TOTAL PAHS	NA	NA	711.43	NA	268.7505	NA	224.99	NA	50.0022	NA
Low Concentration PAH (SIM) Analysis (UG/KG)										
2-METHYLNAPHTHALENE	4.3 U	4.4 U	NA	NA	NA	NA	NA	NA	NA	NA
ACENAPHTHENE	4.3 U	4.4 U	NA	NA	NA	NA	NA	NA	NA	NA
ACENAPHTHYLENE	4.3 U	4.4 U	NA	NA	NA	NA	NA	NA	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Location	DSY-JPC-03		MCA-JCC-S-01		MCA-JCC-MD-01					
Sample Number	DSY-SD-JPC03-082604	DSY-SD-DUP03-082604	JCC-S1	JCC-S1d	JCC-D1-SUR	JCC-D1-SURd	JCC-M1	JCC-M1d	JCC-D1-BOT	JCC-D1-BOTd
Date Sampled	8/26/2004	8/26/2004	8/29/1994	8/29/1994	8/29/1994	8/29/1994	8/29/1994	8/29/1994	6/1/1995	6/1/1995
QC Identifier	FIELD DUP	FIELD DUP								
ANTHRACENE	4.3 U	4.4 U	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(A)ANTHRACENE	23	14	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(A)PYRENE	33 J	20 J	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(B)FLUORANTHENE	61 J	36 J	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(G,H,I)PERYLENE	11 J	6.6 J	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(K)FLUORANTHENE	18 J	10 J	NA	NA	NA	NA	NA	NA	NA	NA
CHRYSENE	30	20	NA	NA	NA	NA	NA	NA	NA	NA
DIBENZO(A,H)ANTHRACENE	4.3 UJ	4.4 UJ	NA	NA	NA	NA	NA	NA	NA	NA
FLUORANTHENE	47	32	NA	NA	NA	NA	NA	NA	NA	NA
FLUORENE	4.3 U	4.4 U	NA	NA	NA	NA	NA	NA	NA	NA
HIGH MOLECULAR WEIGHT PAHS	286	179.1	NA	NA	NA	NA	NA	NA	NA	NA
INDENO(1,2,3-CD)PYRENE	10 J	6.5 J	NA	NA	NA	NA	NA	NA	NA	NA
LOW MOLECULAR WEIGHT PAHS	19	13	NA	NA	NA	NA	NA	NA	NA	NA
NAPHTHALENE	4.3 U	4.4 U	NA	NA	NA	NA	NA	NA	NA	NA
PHENANTHRENE	19	13	NA	NA	NA	NA	NA	NA	NA	NA
PYRENE	53	34	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL PAH	305	192.1	NA	NA	NA	NA	NA	NA	NA	NA
Pesticide/PCB Analysis (UG/KG)										
2,4'-DDE	NA	NA	0.355	NA	0.245	NA	0.709	NA	0.00	NA
4,4'-DDE	NA	NA	0.721	NA	0.479	NA	0.384	NA	0.025 U	NA
ALDRIN	NA	NA	0.10 U	NA	0.10 U	NA	0.00 U	NA	0.00	NA
HEXACHLOROBENZENE	NA	NA	0.080 U	NA	0.338	NA	0.080 U	NA	0.080 U	NA
MIREX	NA	NA	0.10 U	NA	0.10 U	NA	0.10	NA	0.10 U	NA
PCB Analysis (UG/KG)										
2,2',5-TRICHLOROBIPHENYL	0.0311 U	0.016 U	NA	NA	NA	NA	NA	NA	NA	NA
2,4'-DICHLOROBIPHENYL	0.123 U	0.0571 U	NA	NA	NA	NA	NA	NA	NA	NA
PCB-101	0.0177 U	0.0359 J	0.442	NA	0.323	NA	0.104	NA	0.323	NA
PCB-104	NA	NA	0.0826	NA	0.2049	NA	0.050 U	NA	0.050 B	NA
PCB-105	0.0109 U	0.0129 J	0.357	NA	0.0992	NA	0.035 U	NA	0.035 U	NA
PCB-118	0.0474 J	0.0436 J	0.68	NA	0.552	NA	0.15 U	NA	0.1189	NA
PCB-126	NA	NA	0.020 U	NA	0.020 U	NA	0.020 U	NA	0.0606	NA
PCB-128	0.0181 U	0.0106 U	0.193	NA	0.0716	NA	0.035 U	NA	0.0798	NA
PCB-138	0.0949 J	0.0936 J	1.162	NA	0.483	NA	0.235	NA	0.13	NA
PCB-153	0.124 J	0.10 J	1.211	NA	0.67	NA	0.216	NA	0.1727	NA
PCB-170	0.0155 U	0.0105 U	0.556	NA	0.465	NA	1.863	NA	0.035 U	NA
PCB-18	NA	NA	0.015 U	NA	0.18	NA	0.015 U	NA	0.015 U	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-JPC-03		MCA-JCC-S-01		MCA-JCC-MD-01					
Sample Number	DSY-SD-JPC03-082604	DSY-SD-DUP03-082604	JCC-S1	JCC-S1d	JCC-D1-SUR	JCC-D1-SURd	JCC-M1	JCC-M1d	JCC-D1-BOT	JCC-D1-BOTd
Date Sampled	8/26/2004	8/26/2004	8/29/1994	8/29/1994	8/29/1994	8/29/1994	8/29/1994	8/29/1994	6/1/1995	6/1/1995
QC Identifier	FIELD DUP	FIELD DUP								
PCB-180	0.0563 J	0.0463 J	0.882	NA	0.577	NA	0.696	NA	0.0825	NA
PCB-187	0.0509 J	0.0462 J	0.402	NA	0.124	NA	0.531	NA	0.0575	NA
PCB-188	NA	NA	0.0866	NA	0.025 U	NA	0.025 U	NA	0.0685	NA
PCB-195	0.016 U	0.0109 U	0.367	NA	0.227	NA	0.208	NA	0.020 U	NA
PCB-201	NA	NA	0.010 U	NA	0.234	NA	0.0521	NA	0.010 B	NA
PCB-206	0.0145 U	0.0099 U	0.595	NA	0.374	NA	0.188	NA	0.015 U	NA
PCB-209	0.0138 U	0.0123 U	0.294	NA	0.161	NA	0.117	NA	0.0577	NA
PCB-28	0.0138 U	0.0071 U	0.0050 U	NA	0.0766	NA	0.0050 U	NA	0.0050 U	NA
PCB-29	NA	NA	0.050 U	NA	0.050 U	NA	0.050 U	NA	0.050 B	NA
PCB-44	0.0312 U	0.0127 U	0.0681	NA	0.0863	NA	0.030 U	NA	0.030 U	NA
PCB-50	NA	NA	0.035 U	NA	0.035 U	NA	0.035 U	NA	0.035 B	NA
PCB-52	0.0332 U	0.0135 U	0.33	NA	0.164	NA	0.115 U	NA	0.115 U	NA
PCB-66	0.0412 J	0.0196 J	0.545	NA	0.529	NA	0.153	NA	0.1119	NA
PCB-8	NA	NA	0.484	NA	0.0759	NA	0.055 U	NA	0.055 U	NA
PCB-87	NA	NA	0.155	NA	0.103	NA	0.10 U	NA	0.0834	NA
SUM OF PCB CONGENERS X 2	0.829	0.796	23.5386	NA	15.3836	NA	10.8382	NA	4.3774	NA
TAL Metal Analysis (MG/KG)										
ALUMINUM	3440	3400	45200	NA	45100	NA	45100	NA	22108	NA
ANTIMONY	0.18 UJ	0.18 UJ	NA	NA	NA	NA	NA	NA	NA	NA
ARSENIC	1.1 J	1.2 J	0.65 J	NA	2.01	NA	0.65 J	NA	0.65 J	NA
BARIUM	6.5 J	7.6 J	NA	NA	NA	NA	NA	NA	NA	NA
BERYLLIUM	0.18	0.18	NA	NA	NA	NA	NA	NA	NA	NA
CADMIUM	0.012 UJ	0.012 UJ	0.65 J	NA	0.65 J	NA	0.65 J	NA	0.65 J	NA
CALCIUM	559	483	NA	NA	NA	NA	NA	NA	NA	NA
CHROMIUM	6.8 J	6.9 J	38.148	NA	27.7	NA	31.011	NA	31.25	NA
COBALT	2.1 J	2.1 J	NA	NA	NA	NA	NA	NA	NA	NA
COPPER	4.2 UJ	3.9 UJ	7.518	NA	1.875 J	NA	1.875 J	NA	1.875 J	NA
IRON	6110	6050	28400	NA	21200	NA	30600	NA	21466.75	NA
LEAD	4.4 J	4.3 J	28.4024	NA	23.1756	NA	23.1756	NA	16.6	NA
MAGNESIUM	1940	1940	NA	NA	NA	NA	NA	NA	NA	NA
MANGANESE	68.0	65.9	861.86	NA	625.07	NA	1018.4	NA	372.5	NA
MERCURY	0.022	0.0089 J	0.10 J	NA	0.10 J	NA	0.10 J	NA	0.015 J	NA
NICKEL	4.7 J	4.8 J	16.6548	NA	10.5675	NA	14.0248	NA	12.75	NA
POTASSIUM	480	495	NA	NA	NA	NA	NA	NA	NA	NA
SELENIUM	0.25 U	0.24 U	NA	NA	NA	NA	NA	NA	NA	NA
SILVER	0.12 U	0.12 U	0.065 J	NA	0.15	NA	0.3314	NA	0.065 J	NA
SODIUM	2870	3150	NA	NA	NA	NA	NA	NA	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-JPC-03		MCA-JCC-S-01		MCA-JCC-MD-01					
Sample Number	DSY-SD-JPC03-082604	DSY-SD-DUP03-082604	JCC-S1	JCC-S1d	JCC-D1-SUR	JCC-D1-SURd	JCC-M1	JCC-M1d	JCC-D1-BOT	JCC-D1-BOTd
Date Sampled	8/26/2004	8/26/2004	8/29/1994	8/29/1994	8/29/1994	8/29/1994	8/29/1994	8/29/1994	6/1/1995	6/1/1995
QC Identifier	FIELD DUP	FIELD DUP								
THALLIUM	0.43 J	0.35 J	NA	NA	NA	NA	NA	NA	NA	NA
VANADIUM	6.3	6.3	NA	NA	NA	NA	NA	NA	NA	NA
ZINC	18.8	18.5 J	62.467	NA	45.721	NA	45.721	NA	42.0	NA
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (MG/KG)										
CADMIUM	0.08500 B	0.07100 B	NA	NA	NA	NA	NA	NA	NA	NA
CHROMIUM	1.200	1.100	NA	NA	NA	NA	NA	NA	NA	NA
COPPER	1.200 *	1.100 *	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	2.900	2.700	NA	NA	NA	NA	NA	NA	NA	NA
MERCURY	0.001500 U	0.001600 U	NA	NA	NA	NA	NA	NA	NA	NA
NICKEL	0.8000 BE	0.5500 BE	NA	NA	NA	NA	NA	NA	NA	NA
SULFIDE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ZINC	7.400	6.800	NA	NA	NA	NA	NA	NA	NA	NA
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (UMOLE/G)										
CADMIUM	0.001410 U	0.001460 U	NA	NA	NA	NA	NA	NA	NA	NA
CHROMIUM	0.02280	0.02180	NA	NA	NA	NA	NA	NA	NA	NA
COPPER	0.01870 UJ	0.01730 UJ	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	0.01400	0.01300	NA	NA	NA	NA	NA	NA	NA	NA
MERCURY	0.00003200 U	0.00003300 U	NA	NA	NA	NA	NA	NA	NA	NA
NICKEL	0.02702 UJ	0.02795 UJ	NA	NA	NA	NA	NA	NA	NA	NA
SEM/AVS RATIO	0.2000	2.5401	-5.5925	3.0425	1.8905	2.1505	1.289	1.849	0.3618	0.4118
SULFIDE	0.7471 J	0.05480 J	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL SIMULTANEOUSLY EXTRACTED METALS	0.1494	0.1392	NA	NA	NA	NA	NA	NA	NA	NA
ZINC	0.1126 J	0.1044 J	NA	NA	NA	NA	NA	NA	NA	NA
Miscellaneous Analysis (UG/KG)										
DIBUTYLTIN	NA	NA	2.3	NA	0.50 U	NA	0.50 U	NA	NA	NA
MONOBUTYLTIN	NA	NA	0.50 U	NA	0.50 U	NA	0.16	NA	NA	NA
TETRABUTYLTIN	NA	NA	0.50 U	NA	0.50 U	NA	0.50 U	NA	NA	NA
TRIBUTYLTIN	NA	NA	4.8	NA	0.50 U	NA	0.50 U	NA	NA	NA
Total Organic Carbon Analysis (MG/KG)										
CARBON	3100	4800	NA	NA	NA	NA	NA	NA	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	MCA-JCC-MD-01 cont.			DSY-JCC-02	DSY-CHC-01	DSY-CHC-02	DSY-01	DSY-02		
Sample Number	JCC-D1-MID	JCC-D1-MIDd	DSY-SD-CC01-082604	DSY-SD-CC02-082604	DSY-SD-CH01-082604	DSY-SD-CH02-082604	DSY-1	DSY-2	DSY-SD-02-082504	DSY-SD-DUP01-082504
Date Sampled	6/1/1995	6/1/1995	8/26/2004	8/26/2004	8/26/2004	8/26/2004	11/3/1993	11/3/1993	8/25/2004	8/25/2004
QC Identifier									FIELD DUP	FIELD DUP
Semivolatile Organic Analysis (UG/KG)										
1,1-BIPHENYL	0.00	NA	NA	NA	NA	NA	5.01	12.81	NA	NA
1-METHYLNAPHTHALENE	39.42	NA	NA	NA	NA	NA	6.84	0.5	NA	NA
1-METHYLPHENANTHRENE	995	NA	NA	NA	NA	NA	27.68	367.9	NA	NA
2,3,5-TRIMETHYLNAPHTHALENE	116	NA	NA	NA	NA	NA	2.36	10.1	NA	NA
2,6-DIMETHYLNAPHTHALENE	171	NA	NA	NA	NA	NA	6.56	7.55	NA	NA
2-METHYLNAPHTHALENE	30.53	NA	NA	NA	NA	NA	0.00	2.47	NA	NA
ACENAPHTHENE	109	NA	NA	NA	NA	NA	18.26	63.47	NA	NA
ACENAPHTHYLENE	296	NA	NA	NA	NA	NA	58.86	426.7	NA	NA
ANTHRACENE	2370	NA	NA	NA	NA	NA	200.62	1330	NA	NA
BENZO(A)ANTHRACENE	3420	NA	NA	NA	NA	NA	165.97	7380	NA	NA
BENZO(A)PYRENE	3000	NA	NA	NA	NA	NA	163.83	3320	NA	NA
BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	NA	357.91	10100	NA	NA
BENZO(B+K)FLUORANTHENE	4740	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(E)PYRENE	1700	NA	NA	NA	NA	NA	272.63	5140	NA	NA
BENZO(G,H,I)PERYLENE	1570	NA	NA	NA	NA	NA	97.41	2070	NA	NA
BENZO(K)FLUORANTHENE	NA	NA	NA	NA	NA	NA	223.5	2070	NA	NA
CHRYSENE	2650	NA	NA	NA	NA	NA	405.57	4980	NA	NA
DIBENZO(A,H)ANTHRACENE	283	NA	NA	NA	NA	NA	21.2	784.3	NA	NA
FLUORANTHENE	8190	NA	NA	NA	NA	NA	1050	12000	NA	NA
FLUORENE	597	NA	NA	NA	NA	NA	42.73	438.65	NA	NA
HIGH MOLECULAR WEIGHT PAHS	24703	NA	NA	NA	NA	NA	4013.39	63994.3	NA	NA
INDENO(1,2,3-CD)PYRENE	1550	NA	NA	NA	NA	NA	99.85	1720	NA	NA
LOW MOLECULAR WEIGHT PAHS	8020.53	NA	NA	NA	NA	NA	369.19	2662.12	NA	NA
NAPHTHALENE	328	NA	NA	NA	NA	NA	0.27	1.97	NA	NA
PERYLENE	994	NA	NA	NA	NA	NA	57.17	1050	NA	NA
PHENANTHRENE	4290	NA	NA	NA	NA	NA	304.79	3990	NA	NA
PYRENE	7160	NA	NA	NA	NA	NA	793.56	9390	NA	NA
TOTAL PAHS	44598.95	NA	NA	NA	NA	NA	4382.58	66656.42	NA	NA
Low Concentration PAH (SIM) Analysis (UG/KG)										
2-METHYLNAPHTHALENE	NA	NA	4.2 U	4.2 U	8.0 U	4.7 U	NA	NA	11 U	12 U
ACENAPHTHENE	NA	NA	5.8	4.2 U	11	4.7 U	NA	NA	11 U	12 U
ACENAPHTHYLENE	NA	NA	19	4.5	85	8.0	NA	NA	22	30

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	MCA-JCC-MD-01 cont.			DSY-JCC-02	DSY-CHC-01	DSY-CHC-02	DSY-01	DSY-02		
Sample Number	JCC-D1-MID	JCC-D1-MIDd	DSY-SD-CC01-082604	DSY-SD-CC02-082604	DSY-SD-CH01-082604	DSY-SD-CH02-082604	DSY-1	DSY-2	DSY-SD-02-082504	DSY-SD-DUP01-082504
Date Sampled	6/1/1995	6/1/1995	8/26/2004	8/26/2004	8/26/2004	8/26/2004	11/3/1993	11/3/1993	8/25/2004	8/25/2004
QC Identifier									FIELD DUP	FIELD DUP
ANTHRACENE	NA	NA	59	8.8	85	8.6	NA	NA	29	36
BENZO(A)ANTHRACENE	NA	NA	240	35	360	39	NA	NA	110 J	150 J
BENZO(A)PYRENE	NA	NA	270 J	42 J	470 J	60 J	NA	NA	160 J	200 J
BENZO(B)FLUORANTHENE	NA	NA	360 J	74 J	870 *	110 J	NA	NA	260 J	260 J
BENZO(G,H,I)PERYLENE	NA	NA	75 J	14 J	200 J	25 J	NA	NA	84 J	86 J
BENZO(K)FLUORANTHENE	NA	NA	130 J	22 J	260 J	33 J	NA	NA	75 J	110 J
CHRYSENE	NA	NA	190	35	430	58	NA	NA	130 J	150 J
DIBENZO(A,H)ANTHRACENE	NA	NA	19 J	4.2 UJ	55 J	6.5 J	NA	NA	20 J	23 J
FLUORANTHENE	NA	NA	560 *	69	430	63	NA	NA	120	150
FLUORENE	NA	NA	11	4.2 U	21	4.7 U	NA	NA	15	17
HIGH MOLECULAR WEIGHT PAHS	NA	NA	2461	384	3775	497.5	NA	NA	1392	1650
INDENO(1,2,3-CD)PYRENE	NA	NA	77 J	13 J	130 J	18 J	NA	NA	73 J	81 J
LOW MOLECULAR WEIGHT PAHS	NA	NA	231.9	42.3	371.3	44.6	NA	NA	127	165
NAPHTHALENE	NA	NA	7.1	4.2 U	9.3	4.7 U	NA	NA	11 U	12 U
PHENANTHRENE	NA	NA	130	29	160	28	NA	NA	61	82
PYRENE	NA	NA	540 *	80	570 J	85	NA	NA	360 J	440 J
TOTAL PAH	NA	NA	2692.9	426.3	4146.3	542.1	NA	NA	1519	1815
Pesticide/PCB Analysis (UG/KG)										
2,4'-DDE	0.95	NA	NA	NA	NA	NA	0.9781	5.7099	NA	NA
4,4'-DDE	0.30	NA	NA	NA	NA	NA	0.1845	3.1257	NA	NA
ALDRIN	0.00	NA	NA	NA	NA	NA	0.00	0.0554	NA	NA
HEXACHLOROBENZENE	0.080 U	NA	NA	NA	NA	NA	0.00	0.2432	NA	NA
MIREX	0.10 U	NA	NA	NA	NA	NA	0.00	0.00	NA	NA
PCB Analysis (UG/KG)										
2,2',5-TRICHLOROBIPHENYL	NA	NA	0.00829 JEB	0.0108 JEB	0.223 JEB	0.0141 JEB	NA	NA	0.213 JEB	0.229 JEB
2,4'-DICHLOROBIPHENYL	NA	NA	0.0343 JEB	0.0341 JEB	0.261 EB	0.0348 JEB	NA	NA	0.44 EB	0.416 JEB
PCB-101	0.907	NA	0.196 J	0.138 J	4.19 J	0.284 J	NA	NA	5.87 J	4.77 J
PCB-104	0.6488	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-105	0.2762	NA	0.0795	0.055	1.62	0.135	NA	NA	1.79	1.49
PCB-118	0.319	NA	0.241	0.179	5.2	0.372	NA	NA	5.31	4.73
PCB-126	0.1744	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-128	0.2017	NA	0.0678 J	0.0462 J	1.09 J	0.105 J	NA	NA	1.54 J	1.32 J
PCB-138	0.4422	NA	0.506 J	0.342 J	7.32 J	0.639 J	NA	NA	10.3 J	9.41 J
PCB-153	0.50	NA	0.524 J	0.372 J	7.39 J	0.637 J	NA	NA	10.2 J	9.08 J
PCB-170	0.0689	NA	0.112	0.0795	0.882	0.0982	NA	NA	1.74	1.73
PCB-18	0.3285	NA	NA	NA	NA	NA	NA	NA	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	MCA-JCC-MD-01 cont.			DSY-JCC-02	DSY-CHC-01	DSY-CHC-02	DSY-01	DSY-02		
Sample Number	JCC-D1-MID	JCC-D1-MIDd	DSY-SD-CC01-082604	DSY-SD-CC02-082604	DSY-SD-CH01-082604	DSY-SD-CH02-082604	DSY-1	DSY-2	DSY-SD-02-082504	DSY-SD-DUP01-082504
Date Sampled	6/1/1995	6/1/1995	8/26/2004	8/26/2004	8/26/2004	8/26/2004	11/3/1993	11/3/1993	8/25/2004	8/25/2004
QC Identifier									FIELD DUP	FIELD DUP
PCB-180	0.335	NA	0.255 J	0.184 J	2.24 J	0.257 J	NA	NA	4.2 J	4.11 J
PCB-187	0.2988	NA	0.231	0.165	2.34	0.296	NA	NA	4.23	4.21
PCB-188	0.363	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-195	0.020 U	NA	0.0336	0.0267 J	0.215	0.038	NA	NA	0.584	0.585
PCB-201	0.1074	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-206	0.5197	NA	0.134	0.109	1.42	1.4	NA	NA	1.41	1.45
PCB-209	0.6515	NA	0.221	0.171	1.78	0.785	NA	NA	2.76	3.49
PCB-28	0.1293	NA	0.0747 JEB	0.0624 JEB	1.56 JEB	0.0902 JEB	NA	NA	1.07 J	1.09 J
PCB-29	0.5787	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-44	0.79	NA	0.0502 JEB	0.0441 JEB	1.77 JEB	0.0782 JEB	NA	NA	1.21 JEB	1.07 JEB
PCB-50	0.1354	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-52	1.3751	NA	0.0548 JEB	0.0492 EB	1.9 EB	0.114 EB	NA	NA	2.17 EB	1.62 EB
PCB-66	0.4376	NA	0.124	0.0913	1.72	0.152	NA	NA	2.01	2.07
PCB-8	0.055 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-87	0.1863	NA	NA	NA	NA	NA	NA	NA	NA	NA
SUM OF PCB CONGENERS X 2	20.3913	NA	5.89	4.32	86.2	11.1	67.5772	209.0887	114	106
TAL Metal Analysis (MG/KG)										
ALUMINUM	24684.5	NA	4820	4350	11300	7990	NA	NA	13300	13200
ANTIMONY	NA	NA	R	R	R	R	NA	NA	0.58 UJ	0.51 UJ
ARSENIC	0.65 J	NA	2.6 J	1.9 J	8.9 J	4.3 J	NA	NA	11.5 J	11.0 J
BARIUM	NA	NA	8.8 J	8.2 J	39.9 J	17.2 J	NA	NA	42.1	40.0
BERYLLIUM	NA	NA	0.32	0.28	0.90	0.40	NA	NA	1.2	1.2
CADMIUM	0.65 J	NA	0.010 UJ	0.010 UJ	0.022 UJ	0.013 UJ	0.201	0.154	0.52 J	0.43 J
CALCIUM	NA	NA	1520	1490	4310	5940	NA	NA	11400 J	10600 J
CHROMIUM	33.75	NA	12.1 J	10.2 J	30.3 J	13.8 J	95.992	152.206	44.0	45.1
COBALT	NA	NA	3.5 J	3.1 J	7.4 J	5.4 J	NA	NA	7.6 J	8.0 J
COPPER	1.875 J	NA	8.6 J	6.8 J	75.1 J	22.4 J	45.522	196.827	62.0 J	69.2 J
IRON	22408.25	NA	8910	7900	19700	13900	NA	NA	25400	25600
LEAD	25.3	NA	9.6 J	8.4 J	65.7 J	21.3 J	35.393	180.764	48.2 J	50.8 J
MAGNESIUM	NA	NA	2700	2400	6620	4450	NA	NA	11000	10700
MANGANESE	314	NA	89.9	88.1	191	125	NA	NA	271	268
MERCURY	0.10 J	NA	0.036	0.031	0.26	0.13	NA	NA	0.21	0.38
NICKEL	34.5	NA	7.2 J	6.2 J	16.4 J	10.7 J	38.595	85.275	19.2 J	20.3 J
POTASSIUM	NA	NA	888	777	2780	1010	NA	NA	4240	4360
SELENIUM	NA	NA	0.21 U	0.21 U	0.43 U	0.27 U	NA	NA	0.62 U	0.67 U
SILVER	0.065 J	NA	0.10 U	0.10 U	0.22 U	0.13 U	0.5987	0.823	0.31 UJ	0.34 UJ
SODIUM	NA	NA	3000	2960	14700	4450	NA	NA	25200	26700

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Location	MCA-JCC-MD-01 cont.				DSY-JCC-02		DSY-CHC-01		DSY-CHC-02		DSY-01		DSY-02			
Sample Number	JCC-D1-MID		JCC-D1-MIDd		DSY-SD-CC01-082604		DSY-SD-CC02-082604		DSY-SD-CH01-082604		DSY-SD-CH02-082604		DSY-1	DSY-2	DSY-SD-02-082504		DSY-SD-DUP01-082504	
Date Sampled	6/1/1995		6/1/1995		8/26/2004		8/26/2004		8/26/2004		8/26/2004		11/3/1993	11/3/1993	8/25/2004		8/25/2004	
QC Identifier															FIELD DUP		FIELD DUP	
THALLIUM	NA		NA		0.66	J	0.59	J	1.6	J	0.95	J	NA	NA	1.7	UJ	1.8	UJ
VANADIUM	NA		NA		12.1		10.4		33.2		17.1		NA	NA	47.3		47.0	
ZINC	56.0		NA		40.3	J	28.9	J	168		52.6	J	149.431	593.456	141	J	158	J
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (MG/KG)																		
CADMIUM	NA		NA		0.06200	B	0.06900	B	0.5900		0.1600	B	NA	NA	0.2700	B	0.3000	B
CHROMIUM	NA		NA		2.200		2.100		4.600		2.100		NA	NA	9.700		9.800	
COPPER	NA		NA		3.300	*	2.600	*	20.50	*	13.60	*	NA	NA	28.50	N*	31.20	N*
LEAD	NA		NA		7.100		7.100		51.00		17.20		NA	NA	38.90		44.20	
MERCURY	NA		NA		0.001500	U	0.003800	B	0.002900	U	0.001700	B	NA	NA	0.001600	UN	0.001800	UN
NICKEL	NA		NA		0.9600	BE	1.100	BE	3.100	BE	20.20	E	NA	NA	4.800	N*	4.800	N*
SULFIDE	NA		NA		NA		NA		NA		NA		NA	NA	6.100		400.0	
ZINC	NA		NA		24.80		16.10		106.0		24.80		NA	NA	78.80		88.90	
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (UMOLE/G)																		
CADMIUM	NA		NA		0.001420	U	0.001420	U	0.005200		0.001520	U	NA	NA	0.003630	U	0.003940	U
CHROMIUM	NA		NA		0.04320		0.04130		0.08760		0.04050		NA	NA	0.1865		0.1882	
COPPER	NA		NA		0.05180	UJ	0.04170	UJ	0.3235	J	0.2145	J	NA	NA	0.4488	J	0.4918	J
LEAD	NA		NA		0.03410		0.03420		0.2463		0.08320		NA	NA	0.1878		0.2134	
MERCURY	NA		NA		0.00003200	U	0.00003200	U	0.00006000	U	0.00003400	U	NA	NA	0.00008100	UJ	0.00008800	UJ
NICKEL	NA		NA		0.02727	UJ	0.02717	UJ	0.05260	J	0.3448	J	NA	NA	0.08110	UJ	0.08190	UJ
SEM/AVS RATIO	0.4059		0.5359		13.0171		3.6029		0.2858		0.6606		NA	NA	10.7172		0.1814	
SULFIDE	NA		NA		0.03510	J	0.08940	J	8.1566	J	1.6083	J	NA	NA	0.1892	J	12.4186	J
TOTAL SIMULTANEOUSLY EXTRACTED METALS	NA		NA		0.4569		0.3221		2.331		1.0624		NA	NA	2.0277		2.2532	
ZINC	NA		NA		0.3796	J	0.2466	J	1.6158	J	0.3794	J	NA	NA	1.2046	J	1.3598	J
Miscellaneous Analysis (UG/KG)																		
DIBUTYLTIN	0.45		NA		NA		NA		NA		NA		NA	NA	NA		NA	
MONOBUTYLTIN	0.42		NA		NA		NA		NA		NA		NA	NA	NA		NA	
TETRABUTYLTIN	0.020		NA		NA		NA		NA		NA		NA	NA	NA		NA	
TRIBUTYLTIN	6.82		NA		NA		NA		NA		NA		NA	NA	NA		NA	
Total Organic Carbon Analysis (MG/KG)																		
CARBON	NA		NA		5500		4600		35000		7600		2.06	1.3	31000		26000	

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-03		DSY-04		DSY-05			DSY-06		DSY-07
Sample Number	DSY-3	DSY-SD-03-082604	DSY-4	DSY-SD-04-082604	DSY-5	DSY-SD-05-082604	DSY-SD-DUP02-082604	DSY-6	DSY-SD-06-082504	DSY-7
Date Sampled	11/3/1993	8/26/2004	11/3/1993	8/26/2004	11/3/1993	8/26/2004	8/26/2004	11/3/1993	8/25/2004	11/3/1993
QC Identifier						FIELD DUP	FIELD DUP			
Semivolatile Organic Analysis (UG/KG)										
1,1-BIPHENYL	40.77	NA	0.62	NA	11.03	NA	NA	8.9	NA	1.66
1-METHYLNAPHTHALENE	9.71	NA	0.00	NA	1.748	NA	NA	0.00	NA	3.47
1-METHYLPHENANTHRENE	440.82	NA	15.4	NA	42.658	NA	NA	14.03	NA	34.59
2,3,5-TRIMETHYLNAPHTHALENE	51.69	NA	0.00	NA	10.33	NA	NA	3.91	NA	4.02
2,6-DIMETHYLNAPHTHALENE	23.04	NA	0.00	NA	3.35	NA	NA	0.00	NA	1.79
2-METHYLNAPHTHALENE	8.22	NA	0.00	NA	4.74	NA	NA	0.00	NA	0.00
ACENAPHTHENE	192.85	NA	0.00	NA	12.7	NA	NA	18.16	NA	18.28
ACENAPHTHYLENE	867.22	NA	89.27	NA	26.56	NA	NA	24.65	NA	28.05
ANTHRACENE	3360	NA	260.1	NA	128.88	NA	NA	203.05	NA	161.16
BENZO(A)ANTHRACENE	10600	NA	413.96	NA	377.73	NA	NA	404.69	NA	277.05
BENZO(A)PYRENE	4710	NA	431.43	NA	401.78	NA	NA	488.3	NA	301.91
BENZO(B)FLUORANTHENE	9230	NA	646.47	NA	683.27	NA	NA	800.63	NA	398.98
BENZO(B+K)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(E)PYRENE	5600	NA	443.44	NA	403.67	NA	NA	451.78	NA	303.12
BENZO(G,H,I)PERYLENE	3060	NA	272.12	NA	313.41	NA	NA	355.15	NA	232.62
BENZO(K)FLUORANTHENE	1980	NA	488.58	NA	247.76	NA	NA	287.09	NA	244.66
CHRYSENE	6390	NA	764.26	NA	479.13	NA	NA	602.81	NA	375.63
DIBENZO(A,H)ANTHRACENE	1460	NA	93.38	NA	85.16	NA	NA	89.09	NA	52.05
FLUORANTHENE	13600	NA	885.66	NA	644.24	NA	NA	788.42	NA	830.68
FLUORENE	858.78	NA	25.15	NA	42.69	NA	NA	55.07	NA	53.58
HIGH MOLECULAR WEIGHT PAHS	72956	NA	5531.95	NA	4525.58	NA	NA	5336.06	NA	4197.97
INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LOW MOLECULAR WEIGHT PAHS	5856.04	NA	390.54	NA	292.706	NA	NA	331.59	NA	306.6
NAPHTHALENE	2.94	NA	0.00	NA	8.02	NA	NA	3.82	NA	0.00
PERYLENE	1336	NA	165.24	NA	147.23	NA	NA	202.71	NA	115.56
PHENANTHRENE	4890	NA	217.44	NA	224.34	NA	NA	264.29	NA	384.96
PYRENE	10100	NA	709.97	NA	517.86	NA	NA	601.1	NA	680.75
TOTAL PAHS	78812.04	NA	5922.49	NA	4818.286	NA	NA	5667.65	NA	4504.57
Low Concentration PAH (SIM) Analysis (UG/KG)										
2-METHYLNAPHTHALENE	NA	35 U	NA	9.4 U	NA	8.7 U	8.2 U	NA	15	NA
ACENAPHTHENE	NA	120	NA	9.4 U	NA	8.7 U	8.2 U	NA	25	NA
ACENAPHTHYLENE	NA	54	NA	18	NA	10 J	19	NA	39	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-03		DSY-04		DSY-05			DSY-06		DSY-07
Sample Number	DSY-3	DSY-SD-03-082604	DSY-4	DSY-SD-04-082604	DSY-5	DSY-SD-05-082604	DSY-SD-DUP02-082604	DSY-6	DSY-SD-06-082504	DSY-7
Date Sampled	11/3/1993	8/26/2004	11/3/1993	8/26/2004	11/3/1993	8/26/2004	8/26/2004	11/3/1993	8/25/2004	11/3/1993
QC Identifier						FIELD DUP	FIELD DUP			
ANTHRACENE	NA	280	NA	45	NA	11 J	25	NA	62	NA
BENZO(A)ANTHRACENE	NA	1000	NA	150 J	NA	47 J	92 J	NA	240	NA
BENZO(A)PYRENE	NA	1000	NA	150 J	NA	78 J	130 J	NA	370	NA
BENZO(B)FLUORANTHENE	NA	1700	NA	280 J	NA	110 J	190 J	NA	560	NA
BENZO(G,H,I)PERYLENE	NA	460	NA	65 J	NA	35 J	54 J	NA	170	NA
BENZO(K)FLUORANTHENE	NA	420	NA	110 J	NA	36 J	67 J	NA	170	NA
CHRYSENE	NA	1100	NA	180 J	NA	56 J	100 J	NA	220	NA
DIBENZO(A,H)ANTHRACENE	NA	140 J	NA	18 J	NA	15 J	18 J	NA	35	NA
FLUORANTHENE	NA	1700	NA	200	NA	34 J	90	NA	260	NA
FLUORENE	NA	140	NA	11	NA	8.7 U	10	NA	31	NA
HIGH MOLECULAR WEIGHT PAHS	NA	9760	NA	1644	NA	584	1043	NA	2945	NA
INDENO(1,2,3-CD)PYRENE	NA	440	NA	61 J	NA	33 J	52 J	NA	120	NA
LOW MOLECULAR WEIGHT PAHS	NA	1735	NA	150	NA	49	115	NA	418	NA
NAPHTHALENE	NA	41	NA	9.4 U	NA	8.7 U	8.2 U	NA	16	NA
PHENANTHRENE	NA	1100 J	NA	76	NA	28 J	61	NA	230	NA
PYRENE	NA	1800	NA	430 J	NA	140 J	250 J	NA	800	NA
TOTAL PAH	NA	11495	NA	1794	NA	633	1158	NA	3363	NA
Pesticide/PCB Analysis (UG/KG)										
2,4'-DDE	3.8079	NA	4.0305	NA	2.9225	NA	NA	2.5852	NA	1.5433
4,4'-DDE	13.6113	NA	0.00	NA	1.7493	NA	NA	2.1156	NA	3.5781
ALDRIN	0.00	NA	0.00	NA	0.00	NA	NA	0.00	NA	0.00
HEXACHLOROBENZENE	0.1739	NA	0.00	NA	0.00	NA	NA	0.00	NA	0.00
MIREX	0.00	NA	0.00	NA	0.00	NA	NA	0.00	NA	0.00
PCB Analysis (UG/KG)										
2,2',5-TRICHLOROBIPHENYL	NA	0.191 JEB	NA	0.551 JEB	NA	0.171 JEB	0.171 JEB	NA	1.18 JEB	NA
2,4'-DICHLOROBIPHENYL	NA	0.26 EB	NA	0.801 EB	NA	0.376 EB	0.354 JEB	NA	0.872 JEB	NA
PCB-101	NA	7.9 J	NA	11.6 J	NA	4.23 J	4.26 J	NA	34.2 J	NA
PCB-104	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-105	NA	2.89	NA	3.62	NA	1.21	1.25	NA	10.7	NA
PCB-118	NA	7.41	NA	12.2	NA	4.17	4.36	NA	28.5	NA
PCB-126	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-128	NA	3.15 J	NA	2.74 J	NA	1.26 J	1.26 J	NA	7.33 J	NA
PCB-138	NA	24.3 J	NA	16 J	NA	9.67 J	9.44 J	NA	45.9 J	NA
PCB-153	NA	22.2 J	NA	14.2 J	NA	10 J	9.57 J	NA	37.2 J	NA
PCB-170	NA	5.27	NA	2.43	NA	2.24	1.97	NA	7.21	NA
PCB-18	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-03		DSY-04		DSY-05			DSY-06		DSY-07
Sample Number	DSY-3	DSY-SD-03-082604	DSY-4	DSY-SD-04-082604	DSY-5	DSY-SD-05-082604	DSY-SD-DUP02-082604	DSY-6	DSY-SD-06-082504	DSY-7
Date Sampled	11/3/1993	8/26/2004	11/3/1993	8/26/2004	11/3/1993	8/26/2004	8/26/2004	11/3/1993	8/25/2004	11/3/1993
QC Identifier						FIELD DUP	FIELD DUP			
PCB-180	NA	12.7 J	NA	5.95 J	NA	5.4 J	4.42 J	NA	18.4 J	NA
PCB-187	NA	8.18	NA	5.03	NA	4.62	4.22	NA	15	NA
PCB-188	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-195	NA	1.56	NA	0.886	NA	0.808	0.628	NA	2.62	NA
PCB-201	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-206	NA	5.59	NA	1.74	NA	1.36	1.38	NA	3.67	NA
PCB-209	NA	66.3 J	NA	3.28 J	NA	2.4	2.3	NA	6.51	NA
PCB-28	NA	1.02 J	NA	2.08 J	NA	1.05 J	1.08 J	NA	2.52 J	NA
PCB-29	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-44	NA	1.17 JEB	NA	3.76 JEB	NA	0.902 JEB	0.97 JEB	NA	6.51 JEB	NA
PCB-50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-52	NA	1.96 EB	NA	7.1 EB	NA	1.24 EB	1.43 EB	NA	12.6 EB	NA
PCB-66	NA	2.25	NA	4.9	NA	1.99	2.09	NA	8.13	NA
PCB-8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-87	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SUM OF PCB CONGENERS X 2	733.3312	349	194.56	198	105.4064	106	102	132.0812	498	73.3573
TAL Metal Analysis (MG/KG)										
ALUMINUM	NA	16700	NA	12100	NA	11800	10900	NA	10700	NA
ANTIMONY	NA	0.76 UJ	NA	0.61 J	NA	0.35 UJ	0.33 UJ	NA	0.30 UJ	NA
ARSENIC	NA	13.5 J	NA	11.5 J	NA	9.8 J	10.6 J	NA	10.0 J	NA
BARIUM	NA	123	NA	36.2	NA	33.1	30.7	NA	29.6	NA
BERYLLIUM	NA	1.6	NA	1.1	NA	1.1	1.0	NA	0.91	NA
CADMIUM	1.002	2.7 J	0.121	0.63 J	0.217	0.43 J	0.42 J	0.209	0.52 J	0.174
CALCIUM	NA	7710 J	NA	14700 J	NA	24300 J	18800 J	NA	7540 J	NA
CHROMIUM	195.012	51.7 J	84.788	42.9	105.578	40.5	38.3	109.064	39.4	79.302
COBALT	NA	10.0 J	NA	7.3 J	NA	6.9 J	6.6 J	NA	6.8 J	NA
COPPER	262.344	150 J	62.843	63.7 J	52.291	63.9 J	59.8 J	57.769	55.7 J	27.93
IRON	NA	34400	NA	25400	NA	23200	22200	NA	21500	NA
LEAD	201.061	114 J	51.348	50.4 J	43.296	46.5 J	46.2 J	48.579	49.9 J	31.699
MAGNESIUM	NA	7120	NA	8440	NA	7630	7230	NA	6630	NA
MANGANESE	NA	250	NA	251	NA	262	236	NA	228	NA
MERCURY	NA	0.27	NA	0.25	NA	0.27	0.21	NA	0.33	NA
NICKEL	128.18	38.5 J	37.406	18.5 J	38.347	17.0 J	16.2 J	40.837	17.1 J	37.406
POTASSIUM	NA	3340 J	NA	3890 J	NA	3690	3520	NA	3050 J	NA
SELENIUM	NA	R	NA	0.54 U	NA	0.47 U	0.44 U	NA	R	NA
SILVER	1.2668	0.26 UJ	13.776	0.27 UJ	2.3207	0.23 UJ	0.22 UJ	1.5936	0.20 UJ	5.4065
SODIUM	NA	17100 J	NA	20500	NA	17500	16700	NA	14700	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-03			DSY-04			DSY-05						DSY-06			DSY-07
Sample Number	DSY-3	DSY-SD-03-082604		DSY-4	DSY-SD-04-082604		DSY-5	DSY-SD-05-082604		DSY-SD-DUP02-082604			DSY-6	DSY-SD-06-082504		DSY-7
Date Sampled	11/3/1993	8/26/2004		11/3/1993	8/26/2004		11/3/1993	8/26/2004		8/26/2004			11/3/1993	8/25/2004		11/3/1993
QC Identifier								FIELD DUP		FIELD DUP						
THALLIUM	NA	2.4	UJ	NA	1.9	UJ	NA	1.8	UJ	1.5	UJ		NA	1.4	UJ	NA
VANADIUM	NA	53.6		NA	41.7		NA	39.9		37.0			NA	36.1		NA
ZINC	1231.421	377		189.526	171	J	173.311	125	J	117	J		175.299	148	J	118.703
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (MG/KG)																
CADMIUM	NA	0.8100		NA	0.4400		NA	0.2300	B	0.2000	B		NA	0.5900		NA
CHROMIUM	NA	10.70		NA	24.70		NA	13.80		8.800			NA	9.500		NA
COPPER	NA	36.80	N*	NA	30.40	N*	NA	34.30	N*	33.50	N*		NA	47.70	N*	NA
LEAD	NA	73.40		NA	49.90		NA	44.30		38.60			NA	55.50		NA
MERCURY	NA	0.001300	UN	NA	0.001300	UN	NA	0.002600	BN	0.005100	BN		NA	0.003300	BN	NA
NICKEL	NA	75.50	N*	NA	24.00	N*	NA	4.600	N*	39.70	N*		NA	19.80	N*	NA
SULFIDE	NA	2400		NA	370.0		NA	2600		1100			NA	210.0		NA
ZINC	NA	233.0		NA	163.0		NA	84.20		68.30			NA	146.0		NA
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (UMOLE/G)																
CADMIUM	NA	0.007100		NA	0.003900		NA	0.002770	U	0.002660	U		NA	0.005200		NA
CHROMIUM	NA	0.2052	U	NA	0.4753	U	NA	0.2660	U	0.1690	U		NA	0.1820		NA
COPPER	NA	0.5791	J	NA	0.4783	UJ	NA	0.5401	J	0.5274	J		NA	0.7510	J	NA
LEAD	NA	0.3544		NA	0.2409		NA	0.2140		0.1863			NA	0.2680		NA
MERCURY	NA	0.00006600	UJ	NA	0.00006700	UJ	NA	0.00006200	UJ	0.00006000	UJ		NA	0.00005800	UJ	NA
NICKEL	NA	1.286	UJ	NA	0.4091	UJ	NA	0.07800	UJ	0.6757	UJ		NA	0.3381	J	NA
SEM/AVS RATIO	NA	0.05990		NA	0.2391		NA	0.02540		0.05170			NA	0.5787		NA
SULFIDE	NA	75.2023	J	NA	11.4438	J	NA	80.3209	J	33.9942	J		NA	6.5229	J	NA
TOTAL SIMULTANEOUSLY EXTRACTED METALS	NA	4.5028		NA	2.7358		NA	2.0418		1.7573			NA	3.7747		NA
ZINC	NA	3.5622	J	NA	2.491	J	NA	1.2877	J	1.0436	J		NA	2.2304	J	NA
Miscellaneous Analysis (UG/KG)																
DIBUTYLTIN	NA	NA		NA	NA		NA	NA		NA			NA	NA		NA
MONOBUTYLTIN	NA	NA		NA	NA		NA	NA		NA			NA	NA		NA
TETRABUTYLTIN	NA	NA		NA	NA		NA	NA		NA			NA	NA		NA
TRIBUTYLTIN	NA	NA		NA	NA		NA	NA		NA			NA	NA		NA
Total Organic Carbon Analysis (MG/KG)																
CARBON	2.63	25000		3.17	26000		6.7	25000		23000			4.37	22000		2.67

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-08		DSY-09		DSY-10	DSY-11		DSY-12	DSY-13	DSY-14
Sample Number	DSY-8	DSY-SD-08-082604	DSY-9	DSY-SD-09-082604	DSY-10	DSY-11	DSY-SD-11-082604	DSY-12	DSY-13	DSY-14
Date Sampled	11/3/1993	8/26/2004	11/3/1993	8/26/2004	11/3/1993	11/3/1993	8/26/2004	11/3/1993	6/13/1994	6/13/1994
QC Identifier										
Semivolatile Organic Analysis (UG/KG)										
1,1-BIPHENYL	11.37	NA	0.00	NA	0.00	18.53	NA	13.32	0.00	1.85
1-METHYLNAPHTHALENE	0.12	NA	0.00	NA	0.00	10.97	NA	9.85	0.00	6.92
1-METHYLPHENANTHRENE	81.87	NA	4.33	NA	1.27	51.06	NA	21.94	59.6	4.16
2,3,5-TRIMETHYLNAPHTHALENE	11	NA	0.00	NA	1.01	8.15	NA	0.00	0.00	1.61
2,6-DIMETHYLNAPHTHALENE	1.89	NA	0.00	NA	0.00	12.33	NA	7.35	0.00	0.73
2-METHYLNAPHTHALENE	2.37	NA	0.00	NA	0.74	6.93	NA	0.98	0.00	11.32
ACENAPHTHENE	11.93	NA	0.00	NA	2.29	20.89	NA	10.01	0.00	1
ACENAPHTHYLENE	37.66	NA	2.74	NA	1.03	57.61	NA	95.69	1.99	8.33
ANTHRACENE	180.83	NA	18.58	NA	17.37	254.49	NA	283.67	59.38	15.76
BENZO(A)ANTHRACENE	562.46	NA	34.55	NA	26.14	274.2	NA	184.77	28.21	40.13
BENZO(A)PYRENE	480.98	NA	49.13	NA	38.47	206.33	NA	248.81	43.73	26.07
BENZO(B)FLUORANTHENE	874.35	NA	67.28	NA	70.46	381.04	NA	438.4	80.42	34.34
BENZO(B+K)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(E)PYRENE	487.19	NA	53.22	NA	40.07	257.17	NA	387.85	51.55	20.86
BENZO(G,H,I)PERYLENE	327.54	NA	19.41	NA	29.52	132.09	NA	226.48	41.2	32.57
BENZO(K)FLUORANTHENE	293.51	NA	55.6	NA	24.16	244.85	NA	346.72	130.14	13.19
CHRYSENE	623.78	NA	70.6	NA	47.47	538.27	NA	523.21	139.59	27.18
DIBENZO(A,H)ANTHRACENE	118.13	NA	14.96	NA	9.34	28.43	NA	35.93	9.31	11.72
FLUORANTHENE	817.94	NA	113.99	NA	94.27	1320	NA	817.36	116.74	66.58
FLUORENE	53.58	NA	4.86	NA	0.92	74.94	NA	48.75	0.00	8.49
HIGH MOLECULAR WEIGHT PAHS	5855.67	NA	616.58	NA	535.87	4991.43	NA	4493.61	872.66	435.52
INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA	18.33	131.74	NA	168	36.45	25.85
LOW MOLECULAR WEIGHT PAHS	396.15	NA	30.51	NA	26.53	527.65	NA	504.27	120.97	65.32
NAPHTHALENE	3.53	NA	0.00	NA	1.9	11.75	NA	12.71	0.00	5.15
PERYLENE	202.68	NA	17.4	NA	22.57	95.53	NA	130.58	41.6	16.32
PHENANTHRENE	309.45	NA	41.14	NA	21.15	391.69	NA	262.55	41	52.73
PYRENE	757.66	NA	79.3	NA	93.92	990.09	NA	722.95	112.72	67.98
TOTAL PAHS	6251.82	NA	647.09	NA	562.4	5519.08	NA	4997.88	993.63	500.84
Low Concentration PAH (SIM) Analysis (UG/KG)										
2-METHYLNAPHTHALENE	NA	8.5 UJ	NA	4.5 U	NA	NA	11	NA	NA	NA
ACENAPHTHENE	NA	8.5 UJ	NA	4.5 U	NA	NA	10	NA	NA	NA
ACENAPHTHYLENE	NA	32 J	NA	4.5 U	NA	NA	20	NA	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-08			DSY-09			DSY-10	DSY-11			DSY-12	DSY-13	DSY-14
Sample Number	DSY-8	DSY-SD-08-082604		DSY-9	DSY-SD-09-082604		DSY-10	DSY-11	DSY-SD-11-082604		DSY-12	DSY-13	DSY-14
Date Sampled	11/3/1993	8/26/2004		11/3/1993	8/26/2004		11/3/1993	11/3/1993	8/26/2004		11/3/1993	6/13/1994	6/13/1994
QC Identifier													
ANTHRACENE	NA	42	J	NA	8.9		NA	NA	70		NA	NA	NA
BENZO(A)ANTHRACENE	NA	130	J	NA	34	J	NA	NA	240		NA	NA	NA
BENZO(A)PYRENE	NA	190	J	NA	46	J	NA	NA	320	J	NA	NA	NA
BENZO(B)FLUORANTHENE	NA	300	J	NA	71	J	NA	NA	620	J	NA	NA	NA
BENZO(G,H,I)PERYLENE	NA	80	J	NA	25	J	NA	NA	99	J	NA	NA	NA
BENZO(K)FLUORANTHENE	NA	88	J	NA	16	J	NA	NA	160	J	NA	NA	NA
CHRYSENE	NA	170	J	NA	37	J	NA	NA	320		NA	NA	NA
DIBENZO(A,H)ANTHRACENE	NA	20	J	NA	9.5	J	NA	NA	28	J	NA	NA	NA
FLUORANTHENE	NA	200	J	NA	47	J	NA	NA	220		NA	NA	NA
FLUORENE	NA	12	J	NA	4.5	U	NA	NA	22		NA	NA	NA
HIGH MOLECULAR WEIGHT PAHS	NA	1525		NA	378.5		NA	NA	2776		NA	NA	NA
INDENO(1,2,3-CD)PYRENE	NA	77	J	NA	22	J	NA	NA	89	J	NA	NA	NA
LOW MOLECULAR WEIGHT PAHS	NA	160		NA	31.9		NA	NA	308		NA	NA	NA
NAPHTHALENE	NA	8.5	UJ	NA	4.5	U	NA	NA	15		NA	NA	NA
PHENANTHRENE	NA	74	J	NA	23		NA	NA	160		NA	NA	NA
PYRENE	NA	270	J	NA	71	J	NA	NA	680		NA	NA	NA
TOTAL PAH	NA	1685		NA	410.4		NA	NA	3084		NA	NA	NA
Pesticide/PCB Analysis (UG/KG)													
2,4'-DDE	2.0961	NA		0.381	NA		0.7402	8.7102	NA		2.4326	0.7479	0.418
4,4'-DDE	1.8163	NA		0.7751	NA		3.4584	1.4549	NA		2.5068	0.6304	0.3951
ALDRIN	0.00	NA		0.00	NA		0.00	0.00	NA		0.00	0.00	0.00
HEXACHLOROBENZENE	0.0581	NA		0.00	NA		0.00	0.00	NA		0.0629	0.00	0.00
MIREX	0.00	NA		0.00	NA		0.00	0.00	NA		0.00	-0.0031	0.00
PCB Analysis (UG/KG)													
2,2',5-TRICHLOROBIPHENYL	NA	0.313	JEB	NA	0.0169	JEB	NA	NA	1.57	JEB	NA	NA	NA
2,4'-DICHLOROBIPHENYL	NA	0.465	EB	NA	0.019	JEB	NA	NA	1.68	EB	NA	NA	NA
PCB-101	NA	13.1	J	NA	1.1	J	NA	NA	24.6	J	NA	NA	NA
PCB-104	NA	NA		NA	NA		NA	NA	NA		NA	NA	NA
PCB-105	NA	4.17		NA	0.611		NA	NA	8.93		NA	NA	NA
PCB-118	NA	11.1		NA	1.31		NA	NA	23.8		NA	NA	NA
PCB-126	NA	NA		NA	NA		NA	NA	NA		NA	NA	NA
PCB-128	NA	2.4	J	NA	0.463	J	NA	NA	5.47	J	NA	NA	NA
PCB-138	NA	15.5	J	NA	2.7	J	NA	NA	31.8	J	NA	NA	NA
PCB-153	NA	13.5	J	NA	1.9	J	NA	NA	25.2	J	NA	NA	NA
PCB-170	NA	2.09		NA	0.545		NA	NA	5.03		NA	NA	NA
PCB-18	NA	NA		NA	NA		NA	NA	NA		NA	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-08			DSY-09			DSY-10	DSY-11			DSY-12	DSY-13	DSY-14
Sample Number	DSY-8	DSY-SD-08-082604		DSY-9	DSY-SD-09-082604		DSY-10	DSY-11	DSY-SD-11-082604		DSY-12	DSY-13	DSY-14
Date Sampled	11/3/1993	8/26/2004		11/3/1993	8/26/2004		11/3/1993	11/3/1993	8/26/2004		11/3/1993	6/13/1994	6/13/1994
QC Identifier													
PCB-180	NA	4.2	J	NA	1.21	J	NA	NA	11.9	J	NA	NA	NA
PCB-187	NA	3.94		NA	0.709		NA	NA	8.46		NA	NA	NA
PCB-188	NA	NA		NA	NA		NA	NA	NA		NA	NA	NA
PCB-195	NA	0.53		NA	0.126		NA	NA	1.62		NA	NA	NA
PCB-201	NA	NA		NA	NA		NA	NA	NA		NA	NA	NA
PCB-206	NA	1.27		NA	0.129		NA	NA	2.64		NA	NA	NA
PCB-209	NA	2.3		NA	0.241		NA	NA	3.34		NA	NA	NA
PCB-28	NA	1.31	J	NA	0.0892	J	NA	NA	3.94	JEB	NA	NA	NA
PCB-29	NA	NA		NA	NA		NA	NA	NA		NA	NA	NA
PCB-44	NA	3.14	JEB	NA	0.166	JEB	NA	NA	8.1	JEB	NA	NA	NA
PCB-50	NA	NA		NA	NA		NA	NA	NA		NA	NA	NA
PCB-52	NA	7.22	EB	NA	0.243	EB	NA	NA	16.5	EB	NA	NA	NA
PCB-66	NA	3.02		NA	0.336		NA	NA	8.1		NA	NA	NA
PCB-8	NA	NA		NA	NA		NA	NA	NA		NA	NA	NA
PCB-87	NA	NA		NA	NA		NA	NA	NA		NA	NA	NA
SUM OF PCB CONGENERS X 2	148.3893	179		28.1474	23.8		11.728	658.1613	385		176.009	22.3161	22.9766
TAL Metal Analysis (MG/KG)													
ALUMINUM	NA	12000		NA	6050		NA	NA	10900		NA	NA	NA
ANTIMONY	NA	0.38	UJ	NA	0.19	UJ	NA	NA		R	NA	NA	NA
ARSENIC	NA	11.0	J	NA	3.2	J	NA	NA	11.6	J	NA	NA	NA
BARIUM	NA	37.5		NA	7.2	J	NA	NA	33.0	J	NA	NA	NA
BERYLLIUM	NA	1.1		NA	0.22		NA	NA	0.97		NA	NA	NA
CADMIUM	0.194	0.42	J	0.851	0.13	J	0.072	0.311	0.023	UJ	0.232	0.0419	0.0016
CALCIUM	NA	8130	J	NA	3180	J	NA	NA	29300		NA	NA	NA
CHROMIUM	102.832	41.3		65.304	13.1	J	60.848	131.934	44.4		114.214	56.456	60.54
COBALT	NA	7.4	J	NA	4.4	J	NA	NA	6.6	J	NA	NA	NA
COPPER	76.006	51.9	J	3.988	18.3	J	12.469	81.459	74.5	J	53.865	18.093	7.746
IRON	NA	24000		NA	13900		NA	NA	21300		NA	NA	NA
LEAD	50.604	46.5	J	14.856	29.1	J	22.132	46.082	65.6	J	45.99	35.2	28.9404
MAGNESIUM	NA	7730		NA	2810		NA	NA	6660		NA	NA	NA
MANGANESE	NA	256		NA	102		NA	NA	234		NA	NA	NA
MERCURY	NA	0.37		NA	0.026	J	NA	NA	1.1		NA	NA	NA
NICKEL	40.238	17.9	J	33.898	12.6	J	31.421	167.916	17.6	J	40.399	16.87	9.155
POTASSIUM	NA	3830		NA	493	J	NA	NA	3270		NA	NA	NA
SELENIUM	NA	0.50	U	NA		R	NA	NA	0.46	U	NA	NA	NA
SILVER	1.7387	0.25	UJ	0.7328	0.12	UJ	0.5636	1.2244	0.23	U	1.5811	0.0638	0.0531
SODIUM	NA	16400		NA	3850		NA	NA	14400		NA	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-08			DSY-09			DSY-10	DSY-11			DSY-12	DSY-13	DSY-14
Sample Number	DSY-8	DSY-SD-08-082604		DSY-9	DSY-SD-09-082604		DSY-10	DSY-11	DSY-SD-11-082604		DSY-12	DSY-13	DSY-14
Date Sampled	11/3/1993	8/26/2004		11/3/1993	8/26/2004		11/3/1993	11/3/1993	8/26/2004		11/3/1993	6/13/1994	6/13/1994
QC Identifier													
THALLIUM	NA	1.8	UJ	NA		R	NA	NA	1.9	J	NA	NA	NA
VANADIUM	NA	40.7		NA	14.3		NA	NA	38.2		NA	NA	NA
ZINC	184.302	129	J	58.824	67.9	J	63.84	1104.448	162		160.599	89.479	67.598
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (MG/KG)													
CADMIUM	NA	0.2000	B	NA	0.05900	B	NA	NA	0.7600		NA	NA	NA
CHROMIUM	NA	9.300		NA	2.800		NA	NA	10.40		NA	NA	NA
COPPER	NA	26.00	N*	NA	23.10	N*	NA	NA	32.90	*	NA	NA	NA
LEAD	NA	40.70		NA	26.10		NA	NA	51.70		NA	NA	NA
MERCURY	NA	0.001800	BN	NA	0.0006700	UN	NA	NA	0.003200	B	NA	NA	NA
NICKEL	NA	24.50	N*	NA	70.20	N*	NA	NA	7.000	E	NA	NA	NA
SULFIDE	NA	510.0		NA	39.00		NA	NA		NA	NA	NA	NA
ZINC	NA	94.60		NA	37.70		NA	NA	120.0		NA	NA	NA
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (UMOLE/G)													
CADMIUM	NA	0.002760	U	NA	0.001500	U	NA	NA	0.006800		NA	NA	NA
CHROMIUM	NA	0.1797	U	NA	0.05340	U	NA	NA	0.2000		NA	NA	NA
COPPER	NA	0.4101	UJ	NA	0.3631	J	NA	NA	0.5185	J	NA	NA	NA
LEAD	NA	0.1965		NA	0.1259		NA	NA	0.2498		NA	NA	NA
MERCURY	NA	0.00006200	UJ	NA	0.00003400	UJ	NA	NA	0.00005500	U	NA	NA	NA
NICKEL	NA	0.4177	UJ	NA	1.1955	J	NA	NA	0.1200	J	NA	NA	NA
SEM/AVS RATIO	NA	0.1034		NA	1.8791		NA	NA	0.9544		NA	NA	NA
SULFIDE	NA	15.8906	J	NA	1.2031	J	NA	NA	3.0763	J	NA	NA	NA
TOTAL SIMULTANEOUSLY EXTRACTED METALS	NA	1.6427		NA	2.2607		NA	NA	2.936		NA	NA	NA
ZINC	NA	1.4462	J	NA	0.5762	J	NA	NA	1.8409	J	NA	NA	NA
Miscellaneous Analysis (UG/KG)													
DIBUTYLTIN	NA		NA	NA		NA	NA	NA		NA	NA	NA	NA
MONOBUTYLTIN	NA		NA	NA		NA	NA	NA		NA	NA	NA	NA
TETRABUTYLTIN	NA		NA	NA		NA	NA	NA		NA	NA	NA	NA
TRIBUTYLTIN	NA		NA	NA		NA	NA	NA		NA	NA	NA	NA
Total Organic Carbon Analysis (MG/KG)													
CARBON	4.63	22000		1.51	4100		1.53	6.17	16000		5.33	0.64	1.01

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-15	DSY-16	DSY-17	DSY-18	DSY-19	DSY-20		DSY-21	DSY-22	DSY-23
Sample Number	DSY-15	DSY-16	DSY-17	DSY-18	DSY-19	DSY-20	DSY-SD-20-082604	DSY-21	DSY-22	DSY-23
Date Sampled	6/13/1994	6/13/1994	6/13/1994	6/13/1994	6/13/1994	6/13/1994	8/26/2004	6/13/1994	6/13/1994	6/13/1994
QC Identifier										
Semivolatile Organic Analysis (UG/KG)										
1,1-BIPHENYL	0.00	1.5	0.00	9.37	0.00	0.00	NA	5.62	9.36	10.93
1-METHYLNAPHTHALENE	0.00	2.36	0.00	0.00	0.00	0.00	NA	14.95	78.68	35.72
1-METHYLPHENANTHRENE	176.54	21.19	82.13	228.33	311.12	421.18	NA	15.41	28.68	107.59
2,3,5-TRIMETHYLNAPHTHALENE	0.00	1.82	0.00	1.01	0.00	4.3	NA	4.19	7.06	9.73
2,6-DIMETHYLNAPHTHALENE	0.00	0.67	0.00	0.00	0.00	0.00	NA	3.04	1.18	5.39
2-METHYLNAPHTHALENE	0.00	1.46	0.00	0.00	0.00	0.00	NA	20.1	35.18	53.4
ACENAPHTHENE	0.00	1.05	0.00	14.84	0.00	17.13	NA	7.12	10.79	21.57
ACENAPHTHYLENE	0.00	2.78	32.21	167	0.00	64.6	NA	30.23	42.38	65.31
ANTHRACENE	257	7.83	212.67	753.36	799.35	922.14	NA	99.9	129.74	165.52
BENZO(A)ANTHRACENE	134.35	14.48	187.99	897.91	399.2	1420	NA	196.33	271.7	414.03
BENZO(A)PYRENE	245.08	11.76	310.59	1190	496.21	880.34	NA	109.63	182.008	239.46
BENZO(B)FLUORANTHENE	324.38	20.17	476.63	1890	1050	1500	NA	158.84	252.21	317.95
BENZO(B+K)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(E)PYRENE	220.86	11.44	264.91	1020	576.42	742.72	NA	88.94	145.57	186.89
BENZO(G,H,I)PERYLENE	164.98	13.71	163.01	562.52	259.74	279.72	NA	133.61	215.38	310.4
BENZO(K)FLUORANTHENE	229.83	32.56	242.86	899.04	791.3	2299.84	NA	47.04	75.13	117.63
CHRYSENE	444.14	13.57	386.62	1460	1170	1580	NA	121.62	193.46	234.29
DIBENZO(A,H)ANTHRACENE	20.5	3.62	64.18	243.3	39.28	56.8	NA	43.99	63.36	117
FLUORANTHENE	464.3	34.36	477.49	1590	1830	5850	NA	324.6	549.89	827.01
FLUORENE	0.00	4.96	24.42	92.44	0.00	215.62	NA	29.36	78.14	63.94
HIGH MOLECULAR WEIGHT PAHS	3129.21	237.28	3417.68	12859.78	9211.87	20405.51	NA	1923.4	3270.568	4408.67
INDENO(1,2,3-CD)PYRENE	142.96	9.44	142.51	529.48	255.29	276.16	NA	99.71	164.16	225.8
LOW MOLECULAR WEIGHT PAHS	433.54	48.21	351.43	1266.35	1110.47	1654.1	NA	232.9	437.18	551.02
NAPHTHALENE	0.00	2.59	0.00	0.00	0.00	9.13	NA	2.98	15.99	11.92
PERYLENE	129.95	12.63	90.7	310.78	244.35	299.93	NA	54.42	95.61	118
PHENANTHRENE	112	18.25	201.41	626.75	550.08	1400	NA	171.29	547.73	477.64
PYRENE	495.88	41.29	408.78	1640	1550	3820	NA	373.38	514.36	822.57
TOTAL PAHS	3562.75	285.49	3769.11	14126.13	10322.34	22059.61	NA	2156.3	3707.748	4959.69
Low Concentration PAH (SIM) Analysis (UG/KG)										
2-METHYLNAPHTHALENE	NA	NA	NA	NA	NA	NA	9.1 UJ	NA	NA	NA
ACENAPHTHENE	NA	NA	NA	NA	NA	NA	11 J	NA	NA	NA
ACENAPHTHYLENE	NA	NA	NA	NA	NA	NA	34 J	NA	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-15	DSY-16	DSY-17	DSY-18	DSY-19	DSY-20		DSY-21	DSY-22	DSY-23
Sample Number	DSY-15	DSY-16	DSY-17	DSY-18	DSY-19	DSY-20	DSY-SD-20-082604	DSY-21	DSY-22	DSY-23
Date Sampled	6/13/1994	6/13/1994	6/13/1994	6/13/1994	6/13/1994	6/13/1994	8/26/2004	6/13/1994	6/13/1994	6/13/1994
QC Identifier										
ANTHRACENE	NA	NA	NA	NA	NA	NA	54 J	NA	NA	NA
BENZO(A)ANTHRACENE	NA	NA	NA	NA	NA	NA	200 J	NA	NA	NA
BENZO(A)PYRENE	NA	NA	NA	NA	NA	NA	230 J	NA	NA	NA
BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	NA	410 J	NA	NA	NA
BENZO(G,H,I)PERYLENE	NA	NA	NA	NA	NA	NA	93 J	NA	NA	NA
BENZO(K)FLUORANTHENE	NA	NA	NA	NA	NA	NA	140 J	NA	NA	NA
CHRYSENE	NA	NA	NA	NA	NA	NA	260 J	NA	NA	NA
DIBENZO(A,H)ANTHRACENE	NA	NA	NA	NA	NA	NA	29 J	NA	NA	NA
FLUORANTHENE	NA	NA	NA	NA	NA	NA	250 J	NA	NA	NA
FLUORENE	NA	NA	NA	NA	NA	NA	19 J	NA	NA	NA
HIGH MOLECULAR WEIGHT PAHS	NA	NA	NA	NA	NA	NA	2048	NA	NA	NA
INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA	NA	NA	86 J	NA	NA	NA
LOW MOLECULAR WEIGHT PAHS	NA	NA	NA	NA	NA	NA	268	NA	NA	NA
NAPHTHALENE	NA	NA	NA	NA	NA	NA	9.1 UJ	NA	NA	NA
PHENANTHRENE	NA	NA	NA	NA	NA	NA	150 J	NA	NA	NA
PYRENE	NA	NA	NA	NA	NA	NA	350 J	NA	NA	NA
TOTAL PAH	NA	NA	NA	NA	NA	NA	2316	NA	NA	NA
Pesticide/PCB Analysis (UG/KG)										
2,4'-DDE	1.5749	0.00	0.6533	4.3373	2.3874	6.2639	NA	1.1765	2.5337	1.5831
4,4'-DDE	1.1955	0.3584	0.4383	0.00	1.7878	0.00	NA	0.7568	2.0208	3.7097
ALDRIN	0.00	0.00	0.00	0.087	0.00	0.1782	NA	0.00	0.00	0.00
HEXACHLOROBENZENE	0.0634	0.00	0.071	0.1049	0.1034	0.1183	NA	0.2434	0.0826	1.4655
MIREX	0.00	0.00	0.1688	0.3908	0.2284	0.3245	NA	0.0866	0.28	0.2163
PCB Analysis (UG/KG)										
2,2',5-TRICHLOROBIPHENYL	NA	NA	NA	NA	NA	NA	0.437 JEB	NA	NA	NA
2,4'-DICHLOROBIPHENYL	NA	NA	NA	NA	NA	NA	0.696 EB	NA	NA	NA
PCB-101	NA	NA	NA	NA	NA	NA	15 J	NA	NA	NA
PCB-104	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-105	NA	NA	NA	NA	NA	NA	4.38	NA	NA	NA
PCB-118	NA	NA	NA	NA	NA	NA	12.8	NA	NA	NA
PCB-126	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-128	NA	NA	NA	NA	NA	NA	2.84 J	NA	NA	NA
PCB-138	NA	NA	NA	NA	NA	NA	17.6 J	NA	NA	NA
PCB-153	NA	NA	NA	NA	NA	NA	14.3 J	NA	NA	NA
PCB-170	NA	NA	NA	NA	NA	NA	2.26	NA	NA	NA
PCB-18	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-15	DSY-16	DSY-17	DSY-18	DSY-19	DSY-20		DSY-21	DSY-22	DSY-23
Sample Number	DSY-15	DSY-16	DSY-17	DSY-18	DSY-19	DSY-20	DSY-SD-20-082604	DSY-21	DSY-22	DSY-23
Date Sampled	6/13/1994	6/13/1994	6/13/1994	6/13/1994	6/13/1994	6/13/1994	8/26/2004	6/13/1994	6/13/1994	6/13/1994
QC Identifier										
PCB-180	NA	NA	NA	NA	NA	NA	4.88 J	NA	NA	NA
PCB-187	NA	NA	NA	NA	NA	NA	4.3	NA	NA	NA
PCB-188	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-195	NA	NA	NA	NA	NA	NA	0.661	NA	NA	NA
PCB-201	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-206	NA	NA	NA	NA	NA	NA	1.41	NA	NA	NA
PCB-209	NA	NA	NA	NA	NA	NA	2.15	NA	NA	NA
PCB-28	NA	NA	NA	NA	NA	NA	1.69 J	NA	NA	NA
PCB-29	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-44	NA	NA	NA	NA	NA	NA	3.47 JEB	NA	NA	NA
PCB-50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-52	NA	NA	NA	NA	NA	NA	7.67 EB	NA	NA	NA
PCB-66	NA	NA	NA	NA	NA	NA	4.27	NA	NA	NA
PCB-8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-87	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SUM OF PCB CONGENERS X 2	54.835	9.4	243.7826	292.7514	216.559	366.9521	202	92.3076	178.2045	150.1339
TAL Metal Analysis (MG/KG)										
ALUMINUM	NA	NA	NA	NA	NA	NA	12500	NA	NA	NA
ANTIMONY	NA	NA	NA	NA	NA	NA	0.37 UJ	NA	NA	NA
ARSENIC	NA	NA	NA	NA	NA	NA	11.0 J	NA	NA	NA
BARIUM	NA	NA	NA	NA	NA	NA	40.6	NA	NA	NA
BERYLLIUM	NA	NA	NA	NA	NA	NA	1.1	NA	NA	NA
CADMIUM	0.0536	0.0285	0.0405	0.2227	0.1723	0.2536	0.54 J	0.1892	0.2089	0.2091
CALCIUM	NA	NA	NA	NA	NA	NA	8300 J	NA	NA	NA
CHROMIUM	72.28	55.45	57.342	106.538	105.124	99.231	43.2	142.34	106.25	98.852
COBALT	NA	NA	NA	NA	NA	NA	7.5 J	NA	NA	NA
COPPER	18.606	6.41	17.233	81.666	66.912	79.683	58.7 J	29.659	51.264	49.438
IRON	NA	NA	NA	NA	NA	NA	24400	NA	NA	NA
LEAD	42.025	31.5291	32.9018	60.2299	57.8157	76.9119	47.9 J	41.8304	52.5276	54.1921
MAGNESIUM	NA	NA	NA	NA	NA	NA	8150	NA	NA	NA
MANGANESE	NA	NA	NA	NA	NA	NA	253	NA	NA	NA
MERCURY	NA	NA	NA	NA	NA	NA	0.23	NA	NA	NA
NICKEL	10.127	4.438	5.902	25.361	22.794	23.066	18.4 J	7.909	25.281	23.196
POTASSIUM	NA	NA	NA	NA	NA	NA	3920	NA	NA	NA
SELENIUM	NA	NA	NA	NA	NA	NA	0.49 U	NA	NA	NA
SILVER	0.0533	0.0473	0.0534	0.1591	0.4008	0.8837	0.24 UJ	0.0822	0.1222	0.1223
SODIUM	NA	NA	NA	NA	NA	NA	18800	NA	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-15	DSY-16	DSY-17	DSY-18	DSY-19	DSY-20			DSY-21	DSY-22	DSY-23
Sample Number	DSY-15	DSY-16	DSY-17	DSY-18	DSY-19	DSY-20	DSY-SD-20-082604		DSY-21	DSY-22	DSY-23
Date Sampled	6/13/1994	6/13/1994	6/13/1994	6/13/1994	6/13/1994	6/13/1994	8/26/2004		6/13/1994	6/13/1994	6/13/1994
QC Identifier											
THALLIUM	NA	NA	NA	NA	NA	NA	1.8	UJ	NA	NA	NA
VANADIUM	NA	NA	NA	NA	NA	NA	42.0		NA	NA	NA
ZINC	83.129	48.315	71.286	163.324	139.453	157.727	158	J	174.732	142.782	140.573
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (MG/KG)											
CADMIUM	NA	NA	NA	NA	NA	NA	0.2300	B	NA	NA	NA
CHROMIUM	NA	NA	NA	NA	NA	NA	11.90		NA	NA	NA
COPPER	NA	NA	NA	NA	NA	NA	32.90	N*	NA	NA	NA
LEAD	NA	NA	NA	NA	NA	NA	43.10		NA	NA	NA
MERCURY	NA	NA	NA	NA	NA	NA	0.001300	UN	NA	NA	NA
NICKEL	NA	NA	NA	NA	NA	NA	51.40	N*	NA	NA	NA
SULFIDE	NA	NA	NA	NA	NA	NA	80.00		NA	NA	NA
ZINC	NA	NA	NA	NA	NA	NA	88.00		NA	NA	NA
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (UMOLE/G)											
CADMIUM	NA	NA	NA	NA	NA	NA	0.002860	U	NA	NA	NA
CHROMIUM	NA	NA	NA	NA	NA	NA	0.2286	U	NA	NA	NA
COPPER	NA	NA	NA	NA	NA	NA	0.5176	J	NA	NA	NA
LEAD	NA	NA	NA	NA	NA	NA	0.2081		NA	NA	NA
MERCURY	NA	NA	NA	NA	NA	NA	0.00006400	UJ	NA	NA	NA
NICKEL	NA	NA	NA	NA	NA	NA	0.8757	UJ	NA	NA	NA
SEM/AVS RATIO	NA	NA	NA	NA	NA	NA	0.8330		NA	NA	NA
SULFIDE	NA	NA	NA	NA	NA	NA	2.4862	J	NA	NA	NA
TOTAL SIMULTANEOUSLY EXTRACTED METALS	NA	NA	NA	NA	NA	NA	2.0709		NA	NA	NA
ZINC	NA	NA	NA	NA	NA	NA	1.3452	J	NA	NA	NA
Miscellaneous Analysis (UG/KG)											
DIBUTYLTIN	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA
MONOBUTYLTIN	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA
TETRABUTYLTIN	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA
TRIBUTYLTIN	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA
Total Organic Carbon Analysis (MG/KG)											
CARBON	2.06	0.26	1.01	2.95	4.21	3.29	18000		1.15	2.94	2.86

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-24	DSY-25			DSY-26			
Sample Number	DSY-24	DSY-25-SUR	DSY-25-SURb	DSY-25-SURc	DSY-26-SUR	DSY-26-SURb	DSY-26-SURc	DSY-SD-26-082604
Date Sampled	6/13/1994	9/28/1995	9/28/1995	9/28/1995	10/19/1995	10/19/1995	10/19/1995	8/26/2004
QC Identifier								
Semivolatile Organic Analysis (UG/KG)								
1,1-BIPHENYL	2.67	6.8913	NA	NA	6.6637	NA	NA	NA
1-METHYLNAPHTHALENE	10.82	10.9328	NA	NA	7.8339	NA	NA	NA
1-METHYLPHENANTHRENE	9.02	52.5604	NA	NA	43.5391	NA	NA	NA
2,3,5-TRIMETHYLNAPHTHALENE	3.28	6.1887	NA	NA	4.343	NA	NA	NA
2,6-DIMETHYLNAPHTHALENE	3.48	27.1956	NA	NA	18.6451	NA	NA	NA
2-METHYLNAPHTHALENE	14.56	11.2173	NA	NA	13.8635	NA	NA	NA
ACENAPHTHENE	2.2	41.7442	NA	NA	12.2124	NA	NA	NA
ACENAPHTHYLENE	31.85	75.6525	NA	NA	93.8391	NA	NA	NA
ANTHRACENE	38.28	302.1497	NA	NA	268.4	NA	NA	NA
BENZO(A)ANTHRACENE	86.15	328.1891	NA	NA	517.9409	NA	NA	NA
BENZO(A)PYRENE	54.52	395.8064	NA	NA	434.2685	NA	NA	NA
BENZO(B)FLUORANTHENE	69.42	NA	NA	NA	NA	NA	NA	NA
BENZO(B+K)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(E)PYRENE	38.08	345.3157	NA	NA	365.0057	NA	NA	NA
BENZO(G,H,I)PERYLENE	61.29	199.7091	NA	NA	201.169	NA	NA	NA
BENZO(K)FLUORANTHENE	105.67	876.604	NA	NA	998.7657	NA	NA	NA
CHRYSENE	57.66	484.8087	NA	NA	591.6976	NA	NA	NA
DIBENZO(A,H)ANTHRACENE	16.11	60.8598	NA	NA	61.3426	NA	NA	NA
FLUORANTHENE	223.98	490.4041	NA	NA	686.4765	NA	NA	NA
FLUORENE	18.21	44.1331	NA	NA	53.8912	NA	NA	NA
HIGH MOLECULAR WEIGHT PAHS	1162.21	2343.5877	NA	NA	3031.3942	NA	NA	NA
INDENO(1,2,3-CD)PYRENE	45.89	195.3932	NA	NA	209.3156	NA	NA	NA
LOW MOLECULAR WEIGHT PAHS	136.02	776.1088	NA	NA	775.2631	NA	NA	NA
NAPHTHALENE	1.65	17.9795	NA	NA	16.1573	NA	NA	NA
PERYLENE	26.2	103.96	NA	NA	133.3047	NA	NA	NA
PHENANTHRENE	179.64	283.2325	NA	NA	316.8996	NA	NA	NA
PYRENE	197.6	583.5197	NA	NA	739.6682	NA	NA	NA
TOTAL PAHS	1298.23	4940	NA	NA	5800	NA	NA	NA
Low Concentration PAH (SIM) Analysis (UG/KG)								
2-METHYLNAPHTHALENE	NA	NA	NA	NA	NA	NA	NA	4.8 U
ACENAPHTHENE	NA	NA	NA	NA	NA	NA	NA	4.8 U
ACENAPHTHYLENE	NA	NA	NA	NA	NA	NA	NA	5.2

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-24	DSY-25			DSY-26			
Sample Number	DSY-24	DSY-25-SUR	DSY-25-SURb	DSY-25-SURc	DSY-26-SUR	DSY-26-SURb	DSY-26-SURc	DSY-SD-26-082604
Date Sampled	6/13/1994	9/28/1995	9/28/1995	9/28/1995	10/19/1995	10/19/1995	10/19/1995	8/26/2004
QC Identifier								
ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	21
BENZO(A)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	77
BENZO(A)PYRENE	NA	NA	NA	NA	NA	NA	NA	89 J
BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	170 J
BENZO(G,H,I)PERYLENE	NA	NA	NA	NA	NA	NA	NA	27 J
BENZO(K)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	71 J
CHRYSENE	NA	NA	NA	NA	NA	NA	NA	110
DIBENZO(A,H)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	8.0 J
FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	120
FLUORENE	NA	NA	NA	NA	NA	NA	NA	8.2
HIGH MOLECULAR WEIGHT PAHS	NA	NA	NA	NA	NA	NA	NA	816
INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA	NA	NA	NA	24 J
LOW MOLECULAR WEIGHT PAHS	NA	NA	NA	NA	NA	NA	NA	74.4
NAPHTHALENE	NA	NA	NA	NA	NA	NA	NA	4.8 U
PHENANTHRENE	NA	NA	NA	NA	NA	NA	NA	40
PYRENE	NA	NA	NA	NA	NA	NA	NA	120
TOTAL PAH	NA	NA	NA	NA	NA	NA	NA	890.4
Pesticide/PCB Analysis (UG/KG)								
2,4'-DDE	0.2954	0.10	NA	NA	1.5221	NA	NA	NA
4,4'-DDE	0.4708	0.8747	NA	NA	0.6077	NA	NA	NA
ALDRIN	0.00	0.10	NA	NA	0.10	NA	NA	NA
HEXACHLOROBENZENE	0.00	0.080	NA	NA	0.1185 J	NA	NA	NA
MIREX	0.00	0.10	NA	NA	0.1872 J	NA	NA	NA
PCB Analysis (UG/KG)								
2,2',5-TRICHLOROBIPHENYL	NA	NA	NA	NA	NA	NA	NA	0.135 JEB
2,4'-DICHLOROBIPHENYL	NA	NA	NA	NA	NA	NA	NA	0.192 EB
PCB-101	NA	6.481	NA	NA	5.724	NA	NA	6.46 J
PCB-104	NA	NA	NA	NA	NA	NA	NA	NA
PCB-105	NA	1.7527	NA	NA	1.8208	NA	NA	2.46
PCB-118	NA	5.0247	NA	NA	6.2007	NA	NA	5.95
PCB-126	NA	NA	NA	NA	NA	NA	NA	NA
PCB-128	NA	1.3681	NA	NA	1.3364	NA	NA	1.29 J
PCB-138	NA	5.9192	NA	NA	7.2131	NA	NA	7.21 J
PCB-153	NA	4.3733	NA	NA	6.1611	NA	NA	4.88 J
PCB-170	NA	0.8938	NA	NA	1.5347	NA	NA	0.717
PCB-18	NA	0.6655	NA	NA	0.7851	NA	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-24	DSY-25			DSY-26			
Sample Number	DSY-24	DSY-25-SUR	DSY-25-SURb	DSY-25-SURc	DSY-26-SUR	DSY-26-SURb	DSY-26-SURc	DSY-SD-26-082604
Date Sampled	6/13/1994	9/28/1995	9/28/1995	9/28/1995	10/19/1995	10/19/1995	10/19/1995	8/26/2004
QC Identifier								
PCB-180	NA	1.8609	NA	NA	2.7359	NA	NA	1.38 J
PCB-187	NA	1.8067	NA	NA	1.9215	NA	NA	0.912
PCB-188	NA	NA	NA	NA	NA	NA	NA	NA
PCB-195	NA	0.1638	NA	NA	0.5054	NA	NA	0.123 J
PCB-201	NA	NA	NA	NA	NA	NA	NA	NA
PCB-206	NA	1.5175	NA	NA	2.1269	NA	NA	0.321
PCB-209	NA	0.914	NA	NA	2.037	NA	NA	0.44
PCB-28	NA	2.0575	NA	NA	1.262	NA	NA	0.38 JEB
PCB-29	NA	NA	NA	NA	NA	NA	NA	NA
PCB-44	NA	2.0422	NA	NA	1.9768	NA	NA	1.65 JEB
PCB-50	NA	NA	NA	NA	NA	NA	NA	NA
PCB-52	NA	3.2134	NA	NA	3.618	NA	NA	4.36 EB
PCB-66	NA	6.1573	NA	NA	1.6273	NA	NA	1.21
PCB-8	NA	0.5945	NA	NA	0.5337	NA	NA	NA
PCB-87	NA	NA	NA	NA	NA	NA	NA	NA
SUM OF PCB CONGENERS X 2	25.869	93.6121	NA	NA	98.2409	NA	NA	80.1
TAL Metal Analysis (MG/KG)								
ALUMINUM	NA	21201.25	NA	NA	23628.5	NA	NA	7400
ANTIMONY	NA	NA	NA	NA	NA	NA	NA	R
ARSENIC	NA	6.36	NA	NA	9.43	NA	NA	7.0 J
BARIUM	NA	NA	NA	NA	NA	NA	NA	16.8 J
BERYLLIUM	NA	NA	NA	NA	NA	NA	NA	0.56
CADMIUM	0.0149	0.34 J	NA	NA	0.18 J	NA	NA	0.013 UJ
CALCIUM	NA	NA	NA	NA	NA	NA	NA	3150
CHROMIUM	71.895	55.0	NA	NA	53.5	NA	NA	22.2 J
COBALT	NA	NA	NA	NA	NA	NA	NA	5.7 J
COPPER	14.432	23.5	NA	NA	39.25	NA	NA	35.2 J
IRON	NA	23830.75	NA	NA	23353.5	NA	NA	17600
LEAD	39.1522	35.9	NA	NA	40.4	NA	NA	27.0 J
MAGNESIUM	NA	NA	NA	NA	NA	NA	NA	4030
MANGANESE	NA	268.5	NA	NA	148.5	NA	NA	161
MERCURY	NA	0.134	NA	NA	0.137	NA	NA	0.060
NICKEL	11.742	21.0	NA	NA	20.5	NA	NA	15.3 J
POTASSIUM	NA	NA	NA	NA	NA	NA	NA	1530
SELENIUM	NA	NA	NA	NA	NA	NA	NA	0.25 U
SILVER	0.0553	0.2625	NA	NA	0.1875	NA	NA	0.13 U
SODIUM	NA	NA	NA	NA	NA	NA	NA	6500

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Location	DSY-24	DSY-25			DSY-26			
Sample Number	DSY-24	DSY-25-SUR	DSY-25-SURb	DSY-25-SURc	DSY-26-SUR	DSY-26-SURb	DSY-26-SURc	DSY-SD-26-082604
Date Sampled	6/13/1994	9/28/1995	9/28/1995	9/28/1995	10/19/1995	10/19/1995	10/19/1995	8/26/2004
QC Identifier								
THALLIUM	NA	NA	NA	NA	NA	NA	NA	1.2 J
VANADIUM	NA	NA	NA	NA	NA	NA	NA	24.7
ZINC	98.084	110	NA	NA	101.5	NA	NA	74.1 J
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (MG/KG)								
CADMIUM	NA	NA	NA	NA	NA	NA	NA	0.1600 B
CHROMIUM	NA	NA	NA	NA	NA	NA	NA	4.500
COPPER	NA	NA	NA	NA	NA	NA	NA	16.20 *
LEAD	NA	NA	NA	NA	NA	NA	NA	19.70
MERCURY	NA	NA	NA	NA	NA	NA	NA	0.002300 B
NICKEL	NA	NA	NA	NA	NA	NA	NA	4.400 E
SULFIDE	NA	NA	NA	NA	NA	NA	NA	NA
ZINC	NA	NA	NA	NA	NA	NA	NA	39.50
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (UMOLE/G)								
CADMIUM	NA	NA	NA	NA	NA	NA	NA	0.001610 U
CHROMIUM	NA	NA	NA	NA	NA	NA	NA	0.08620
COPPER	NA	NA	NA	NA	NA	NA	NA	0.2553 J
LEAD	NA	NA	NA	NA	NA	NA	NA	0.09500
MERCURY	NA	NA	NA	NA	NA	NA	NA	0.00003600 U
NICKEL	NA	NA	NA	NA	NA	NA	NA	0.07530 J
SEM/AVS RATIO	NA	-21.7015	0.1171	2.8785	-2.8926	0.2902	1.1824	7.3725
SULFIDE	NA	NA	NA	NA	NA	NA	NA	0.1514 J
TOTAL SIMULTANEOUSLY EXTRACTED METALS	NA	NA	NA	NA	NA	NA	NA	1.1162
ZINC	NA	NA	NA	NA	NA	NA	NA	0.6044 J
Miscellaneous Analysis (UG/KG)								
DIBUTYLTIN	NA	0.82 J	NA	NA	2.58	NA	NA	NA
MONOBUTYLTIN	NA	0.50	NA	NA	1.05	NA	NA	NA
TETRABUTYLTIN	NA	0.50	NA	NA	0.29 J	NA	NA	NA
TRIBUTYLTIN	NA	0.73 J	NA	NA	2.27	NA	NA	NA
Total Organic Carbon Analysis (MG/KG)								
CARBON	1.4	NA	NA	NA	NA	NA	NA	2900

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-27					
Sample Number	DSY-27-SUR	DSY-27-SURb	DSY-27-SURc	DSY-V9-BOT	DSY-V9-MID	DSY-SD-27-082604
Date Sampled	10/12/1995	10/12/1995	10/12/1995	1/11/1996	1/11/1996	8/26/2004
QC Identifier						
Semivolatile Organic Analysis (UG/KG)						
1,1-BIPHENYL	15.0649	NA	NA	0.64	18.1083	NA
1-METHYLNAPHTHALENE	20.4658	NA	NA	5.5608	42.6734	NA
1-METHYLPHENANTHRENE	61.4409	NA	NA	14.215	148.3877	NA
2,3,5-TRIMETHYLNAPHTHALENE	7.8727	NA	NA	1.8923	15.7056	NA
2,6-DIMETHYLNAPHTHALENE	38.4551	NA	NA	0.5525 J	56.9563	NA
2-METHYLNAPHTHALENE	32.7246	NA	NA	3.5003	31.7189	NA
ACENAPHTHENE	23.8942	NA	NA	0.44	27.3134	NA
ACENAPHTHYLENE	142.327	NA	NA	26.6369	326.7656	NA
ANTHRACENE	382.6193	NA	NA	91.18	987.9747	NA
BENZO(A)ANTHRACENE	808.5664	NA	NA	358.6432	3740	NA
BENZO(A)PYRENE	923.9997	NA	NA	235.6422	2380	NA
BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	NA
BENZO(B+K)FLUORANTHENE	NA	NA	NA	NA	NA	NA
BENZO(E)PYRENE	829.1939	NA	NA	197.2686	2070	NA
BENZO(G,H,I)PERYLENE	499.8266	NA	NA	49.2665	846.942	NA
BENZO(K)FLUORANTHENE	2240	NA	NA	573.8013	6100	NA
CHRYSENE	911.5175	NA	NA	243.0485	2690	NA
DIBENZO(A,H)ANTHRACENE	131.2298	NA	NA	22.7131	257.2799	NA
FLUORANTHENE	801.425	NA	NA	274.7406	2560	NA
FLUORENE	61.6292	NA	NA	13.2458	150.9851	NA
HIGH MOLECULAR WEIGHT PAHS	5526.7383	NA	NA	2075.2226	21497.2799	NA
INDENO(1,2,3-CD)PYRENE	473.0522	NA	NA	80.3212	871.5971	NA
LOW MOLECULAR WEIGHT PAHS	1020.2172	NA	NA	226.099	2438.7464	NA
NAPHTHALENE	41.7458	NA	NA	5.259	51.6201	NA
PERYLENE	248.7351	NA	NA	66.6729	617.5347	NA
PHENANTHRENE	335.2771	NA	NA	85.8369	862.3687	NA
PYRENE	1950	NA	NA	940.4349	9870	NA
TOTAL PAHS	11000	NA	NA	3300	34723.9	NA
Low Concentration PAH (SIM) Analysis (UG/KG)						
2-METHYLNAPHTHALENE	NA	NA	NA	NA	NA	8.1
ACENAPHTHENE	NA	NA	NA	NA	NA	15
ACENAPHTHYLENE	NA	NA	NA	NA	NA	61

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-27					
Sample Number	DSY-27-SUR	DSY-27-SURb	DSY-27-SURc	DSY-V9-BOT	DSY-V9-MID	DSY-SD-27-082604
Date Sampled	10/12/1995	10/12/1995	10/12/1995	1/11/1996	1/11/1996	8/26/2004
QC Identifier						
ANTHRACENE	NA	NA	NA	NA	NA	130
BENZO(A)ANTHRACENE	NA	NA	NA	NA	NA	410
BENZO(A)PYRENE	NA	NA	NA	NA	NA	530
BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	740 *
BENZO(G,H,I)PERYLENE	NA	NA	NA	NA	NA	160
BENZO(K)FLUORANTHENE	NA	NA	NA	NA	NA	320
CHRYSENE	NA	NA	NA	NA	NA	560
DIBENZO(A,H)ANTHRACENE	NA	NA	NA	NA	NA	56 J
FLUORANTHENE	NA	NA	NA	NA	NA	380
FLUORENE	NA	NA	NA	NA	NA	31
HIGH MOLECULAR WEIGHT PAHS	NA	NA	NA	NA	NA	3796
INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA	NA	160
LOW MOLECULAR WEIGHT PAHS	NA	NA	NA	NA	NA	445.1
NAPHTHALENE	NA	NA	NA	NA	NA	10
PHENANTHRENE	NA	NA	NA	NA	NA	190 J
PYRENE	NA	NA	NA	NA	NA	480
TOTAL PAH	NA	NA	NA	NA	NA	4241.1
Pesticide/PCB Analysis (UG/KG)						
2,4'-DDE	65.2185	NA	NA	1.7655	23.2318	NA
4,4'-DDE	7.0026	NA	NA	0.5041	9.6092	NA
ALDRIN	0.10	NA	NA	0.10	0.10	NA
HEXACHLOROBENZENE	0.123 J	NA	NA	0.080	0.3846	NA
MIREX	2.5938	NA	NA	0.4285	8.585	NA
PCB Analysis (UG/KG)						
2,2',5-TRICHLOROBIPHENYL	NA	NA	NA	NA	NA	1.39 JEB
2,4'-DICHLOROBIPHENYL	NA	NA	NA	NA	NA	1.85 JEB
PCB-101	220.22	NA	NA	5.307	76.223	227 J
PCB-104	NA	NA	NA	NA	NA	NA
PCB-105	137.4368	NA	NA	2.4691	42.7546	110
PCB-118	242.4092	NA	NA	5.4943	81.9763	293
PCB-126	NA	NA	NA	NA	NA	NA
PCB-128	72.9992	NA	NA	1.2688	25.1776	65.4 J
PCB-138	265.3538	NA	NA	5.8137	94.9642	370 J
PCB-153	173.9958	NA	NA	4.09	65.4074	226 J
PCB-170	44.1602	NA	NA	0.9654	20.3958	32.3
PCB-18	8.362	NA	NA	2.135	27.5421	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-27					
Sample Number	DSY-27-SUR	DSY-27-SURb	DSY-27-SURc	DSY-V9-BOT	DSY-V9-MID	DSY-SD-27-082604
Date Sampled	10/12/1995	10/12/1995	10/12/1995	1/11/1996	1/11/1996	8/26/2004
QC Identifier						
PCB-180	53.1671	NA	NA	1.5326	29.2051	43.5 J
PCB-187	25.8152	NA	NA	0.8777	14.6916	20.3
PCB-188	NA	NA	NA	NA	NA	NA
PCB-195	2.9292	NA	NA	0.2558	3.5626	1.62 J
PCB-201	NA	NA	NA	NA	NA	NA
PCB-206	7.4458	NA	NA	0.5977	9.7235	1.72 J
PCB-209	5.045	NA	NA	0.6182	9.6201	1.77 J
PCB-28	12.9159	NA	NA	2.0613	28.3429	3.46 J
PCB-29	NA	NA	NA	NA	NA	NA
PCB-44	65.0467	NA	NA	1.7735	25.5459	15.6 JEB
PCB-50	NA	NA	NA	NA	NA	NA
PCB-52	130.4981	NA	NA	3.8796	46.2482	38.2 EB
PCB-66	179.5804	NA	NA	1.2291	21.8878	25.2
PCB-8	5.6403	NA	NA	5.2581	65.9511	NA
PCB-87	NA	NA	NA	NA	NA	NA
SUM OF PCB CONGENERS X 2	3310	NA	NA	91.254	1380	2960
TAL Metal Analysis (MG/KG)						
ALUMINUM	43767.5	NA	NA	18200.25	18218	10800
ANTIMONY	NA	NA	NA	NA	NA	2.8 UJ
ARSENIC	11.6	NA	NA	11.38	10.32	13.2 J
BARIUM	NA	NA	NA	NA	NA	31.2 J
BERYLLIUM	NA	NA	NA	NA	NA	0.71
CADMIUM	1.03 J	NA	NA	0.10 J	1.24 J	0.92 J
CALCIUM	NA	NA	NA	NA	NA	137000 J
CHROMIUM	103	NA	NA	29.75	50.75	49.2 J
COBALT	NA	NA	NA	NA	NA	4.8 J
COPPER	166.25	NA	NA	2.5 J	1.5 J	442
IRON	34532.5	NA	NA	17196	15478.25	23400
LEAD	150.7	NA	NA	15.5	182	138 J
MAGNESIUM	NA	NA	NA	NA	NA	5040
MANGANESE	346.5	NA	NA	189	193.5	209
MERCURY	0.5875	NA	NA	0.015 U	0.015 U	0.31
NICKEL	43.5	NA	NA	15.5	13.0	14.0 J
POTASSIUM	NA	NA	NA	NA	NA	2370 J
SELENIUM	NA	NA	NA	NA	NA	0.37 U
SILVER	0.6875	NA	NA	0.17	1.82	0.18 UJ
SODIUM	NA	NA	NA	NA	NA	13000

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Location	DSY-27						
Sample Number	DSY-27-SUR	DSY-27-SURb	DSY-27-SURc	DSY-V9-BOT	DSY-V9-MID	DSY-SD-27-082604	
Date Sampled	10/12/1995	10/12/1995	10/12/1995	1/11/1996	1/11/1996	8/26/2004	
QC Identifier							
THALLIUM	NA	NA	NA	NA	NA		R
VANADIUM	NA	NA	NA	NA	NA	36.8	
ZINC	547.25	NA	NA	36.0	29.75	546	J
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (MG/KG)							
CADMIUM	NA	NA	NA	NA	NA	0.3700	
CHROMIUM	NA	NA	NA	NA	NA	24.50	
COPPER	NA	NA	NA	NA	NA	60.70	N*
LEAD	NA	NA	NA	NA	NA	93.90	
MERCURY	NA	NA	NA	NA	NA	0.001000	UN
NICKEL	NA	NA	NA	NA	NA	5.700	N*
SULFIDE	NA	NA	NA	NA	NA	710.0	
ZINC	NA	NA	NA	NA	NA	598.0	
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (UMOLE/G)							
CADMIUM	NA	NA	NA	NA	NA	0.003300	
CHROMIUM	NA	NA	NA	NA	NA	0.4708	
COPPER	NA	NA	NA	NA	NA	0.9555	J
LEAD	NA	NA	NA	NA	NA	0.4534	
MERCURY	NA	NA	NA	NA	NA	0.00005100	UJ
NICKEL	NA	NA	NA	NA	NA	0.09680	UJ
SEM/AVS RATIO	-164.3531	0.06840	12.0719	NA	NA	0.5015	
SULFIDE	NA	NA	NA	NA	NA	21.9848	J
TOTAL SIMULTANEOUSLY EXTRACTED METALS	NA	NA	NA	NA	NA	11.0261	
ZINC	NA	NA	NA	NA	NA	9.1431	J
Miscellaneous Analysis (UG/KG)							
DIBUTYLTIN	5.56	NA	NA	0.50	5.25		NA
MONOBUTYLTIN	4.8	NA	NA	0.50	3.38		NA
TETRABUTYLTIN	0.50	NA	NA	0.50	0.50		NA
TRIBUTYLTIN	8.52	NA	NA	0.50	7.27		NA
Total Organic Carbon Analysis (MG/KG)							
CARBON	NA	NA	NA	NA	NA	15000	

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Location	DSY-28							
Sample Number	DSY-28-SUR	DSY-28-SURb	DSY-28-SURc	DSY-28-BOT	DSY-28-MID	DSY-V4-BOT	DSY-V4-MID	DSY-SD-28-082504
Date Sampled	10/19/1995	10/19/1995	10/19/1995	11/16/1995	11/16/1995	1/11/1996	1/11/1996	8/25/2004
QC Identifier								
Semivolatile Organic Analysis (UG/KG)								
1,1-BIPHENYL	12.6086	NA	NA	55.4158	12.6874	0.64	0.64	NA
1-METHYLNAPHTHALENE	19.8486	NA	NA	155.9459	27.7092	3.255	3.255	NA
1-METHYLPHENANTHRENE	38.5723	NA	NA	576.9192	49.9757	2.715	2.2056 J	NA
2,3,5-TRIMETHYLNAPHTHALENE	8.4092	NA	NA	59.0593	8.8952	0.54	0.54	NA
2,6-DIMETHYLNAPHTHALENE	34.2342	NA	NA	105.3072	39.1718	1.78	1.78	NA
2-METHYLNAPHTHALENE	43.8733	NA	NA	145.247	35.1052	5.3	0.00	NA
ACENAPHTHENE	17.2749	NA	NA	820.099	20.7905	0.44	0.44	NA
ACENAPHTHYLENE	74.6342	NA	NA	210.611	108.8023	0.77	1.0017	NA
ANTHRACENE	183.4293	NA	NA	2040	323.3137	2.0557 J	1.085	NA
BENZO(A)ANTHRACENE	294.0186	NA	NA	4490	513.224	9.7087	0.00	NA
BENZO(A)PYRENE	377.4684	NA	NA	4130	697.5214	6.2333	0.00	NA
BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(B+K)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(E)PYRENE	362.449	NA	NA	3000	602.8268	4.6899	1.5897 J	NA
BENZO(G,H,I)PERYLENE	247.1024	NA	NA	1780	372.9967	1.9684 J	25	NA
BENZO(K)FLUORANTHENE	911.3454	NA	NA	8490	1550.3108	13.2157	1.9057 J	NA
CHRYSENE	363.6943	NA	NA	4670	646.4287	8.1253	3.76	NA
DIBENZO(A,H)ANTHRACENE	66.5977	NA	NA	570.7401	99.6221	0.3007 J	1.0738 J	NA
FLUORANTHENE	458.7699	NA	NA	11000	649.2962	7.3992 J	14.3696	NA
FLUORENE	31.4468	NA	NA	1020	42.1807	1.34	2.0815 J	NA
HIGH MOLECULAR WEIGHT PAHS	2210.2406	NA	NA	34320.7401	4116.0924	64.6812	19.2034	NA
INDENO(1,2,3-CD)PYRENE	222.5593	NA	NA	1840	332.0114	2.1646 J	1.645	NA
LOW MOLECULAR WEIGHT PAHS	608.693	NA	NA	12822.4259	880.6856	14.021	5.8125	NA
NAPHTHALENE	37.5376	NA	NA	126.4689	47.646	2.6	0.00	NA
PERYLENE	133.3961	NA	NA	928.7011	176.1805	5.7463	0.445	NA
PHENANTHRENE	220.497	NA	NA	8460	302.8472	1.5153 J	1.2043 J	NA
PYRENE	649.6917	NA	NA	9460	1510	32.914	0.00	NA
TOTAL PAHS	4810	NA	NA	64100	8170	96	25.432	NA
Low Concentration PAH (SIM) Analysis (UG/KG)								
2-METHYLNAPHTHALENE	NA	NA	NA	NA	NA	NA	NA	11 U
ACENAPHTHENE	NA	NA	NA	NA	NA	NA	NA	11 U
ACENAPHTHYLENE	NA	NA	NA	NA	NA	NA	NA	27

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-28							
Sample Number	DSY-28-SUR	DSY-28-SURb	DSY-28-SURc	DSY-28-BOT	DSY-28-MID	DSY-V4-BOT	DSY-V4-MID	DSY-SD-28-082504
Date Sampled	10/19/1995	10/19/1995	10/19/1995	11/16/1995	11/16/1995	1/11/1996	1/11/1996	8/25/2004
QC Identifier								
ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	38
BENZO(A)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	140
BENZO(A)PYRENE	NA	NA	NA	NA	NA	NA	NA	220 J
BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	290 J
BENZO(G,H,I)PERYLENE	NA	NA	NA	NA	NA	NA	NA	97 J
BENZO(K)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	110 J
CHRYSENE	NA	NA	NA	NA	NA	NA	NA	180
DIBENZO(A,H)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	24 J
FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	160
FLUORENE	NA	NA	NA	NA	NA	NA	NA	18
HIGH MOLECULAR WEIGHT PAHS	NA	NA	NA	NA	NA	NA	NA	1656
INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA	NA	NA	NA	85 J
LOW MOLECULAR WEIGHT PAHS	NA	NA	NA	NA	NA	NA	NA	182
NAPHTHALENE	NA	NA	NA	NA	NA	NA	NA	12
PHENANTHRENE	NA	NA	NA	NA	NA	NA	NA	87
PYRENE	NA	NA	NA	NA	NA	NA	NA	350
TOTAL PAH	NA	NA	NA	NA	NA	NA	NA	1838
Pesticide/PCB Analysis (UG/KG)								
2,4'-DDE	1.6726	NA	NA	3.027	6.3366	0.3287	0.4694	NA
4,4'-DDE	2.0345	NA	NA	17.057	5.0083	0.025	0.1952	NA
ALDRIN	0.10	NA	NA	0.10	0.10	0.10	0.10	NA
HEXACHLOROBENZENE	0.0554 J	NA	NA	0.1034 J	0.0881 J	0.080	0.080	NA
MIREX	0.1694 J	NA	NA	0.3859	1.6626	0.1262 J	0.0696 J	NA
PCB Analysis (UG/KG)								
2,2',5-TRICHLOROBIPHENYL	NA	NA	NA	NA	NA	NA	NA	0.231 JEB
2,4'-DICHLOROBIPHENYL	NA	NA	NA	NA	NA	NA	NA	0.228 EB
PCB-101	5.509	NA	NA	10.109	21.293	0.568	1.134	3.63 J
PCB-104	NA	NA	NA	NA	NA	NA	NA	NA
PCB-105	2.0427	NA	NA	3.7277	6.4038	0.1016	0.1817	1.25
PCB-118	7.0903	NA	NA	12.382	22.6231	0.2509 J	0.6896	4.22
PCB-126	NA	NA	NA	NA	NA	NA	NA	NA
PCB-128	1.8865	NA	NA	2.7907	6.9928	0.0633 J	0.15	1.01 J
PCB-138	10.857	NA	NA	15.803	33.3266	0.3076	0.8547	6.86 J
PCB-153	9.974	NA	NA	14.7091	27.5092	0.2316	0.6955	7.25 J
PCB-170	3.1251	NA	NA	3.9981	12.8635	0.035	0.1345	0.844
PCB-18	0.4502	NA	NA	0.9586	3.0462	0.4674	0.4542	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-28							
Sample Number	DSY-28-SUR	DSY-28-SURb	DSY-28-SURc	DSY-28-BOT	DSY-28-MID	DSY-V4-BOT	DSY-V4-MID	DSY-SD-28-082504
Date Sampled	10/19/1995	10/19/1995	10/19/1995	11/16/1995	11/16/1995	1/11/1996	1/11/1996	8/25/2004
QC Identifier								
PCB-180	5.7721	NA	NA	7.3233	21.9454	0.2138	0.59	2.11 J
PCB-187	3.9393	NA	NA	5.855	11.4878	0.0554	0.3042	2.4
PCB-188	NA	NA	NA	NA	NA	NA	NA	NA
PCB-195	0.9648	NA	NA	0.8377	2.1603	0.0588	0.1482	0.228
PCB-201	NA	NA	NA	NA	NA	NA	NA	NA
PCB-206	3.1163	NA	NA	5.3297	6.8891	0.2296	0.3894	1.33
PCB-209	3.9938	NA	NA	5.2007	4.4421	0.2509	0.8203	1.66
PCB-28	1.4968	NA	NA	2.1122	6.2505	0.149	0.1789	1.47 J
PCB-29	NA	NA	NA	NA	NA	NA	NA	NA
PCB-44	1.467	NA	NA	2.5902	6.7862	0.2257	0.494	1.8 JEB
PCB-50	NA	NA	NA	NA	NA	NA	NA	NA
PCB-52	2.8518	NA	NA	4.5068	12.8159	0.2433	0.875	1.76 EB
PCB-66	1.6536	NA	NA	2.9492	5.874	0.1075	0.2229	1.64
PCB-8	0.6636	NA	NA	0.7466	2.519	0.1925	0.0699 J	NA
PCB-87	NA	NA	NA	NA	NA	NA	NA	NA
SUM OF PCB CONGENERS X 2	133.7077	NA	NA	203.8593	430.457	7.4336	16.7737	79.8
TAL Metal Analysis (MG/KG)								
ALUMINUM	41307.5	NA	NA	38435	30315	17497.75	29658.75	13400
ANTIMONY	NA	NA	NA	NA	NA	NA	NA	0.48 UJ
ARSENIC	8.68	NA	NA	9.66	9.5	8.59	4.85	11.8 J
BARIUM	NA	NA	NA	NA	NA	NA	NA	39.0
BERYLLIUM	NA	NA	NA	NA	NA	NA	NA	1.2
CADMIUM	0.55 J	NA	NA	0.90 J	0.91 J	0.11 J	0.070 J	0.48 J
CALCIUM	NA	NA	NA	NA	NA	NA	NA	9170 J
CHROMIUM	80.5	NA	NA	107.75	112.75	44.0	108	46.0
COBALT	NA	NA	NA	NA	NA	NA	NA	8.1 J
COPPER	71.75	NA	NA	132.5	179.5	18.25	168	60.1 J
IRON	29155	NA	NA	35297.5	32305	33277.75	30379.25	26700
LEAD	77.7	NA	NA	192.6	148.4	12.8	16.1	51.3 J
MAGNESIUM	NA	NA	NA	NA	NA	NA	NA	9310
MANGANESE	302.5	NA	NA	338	331.5	343.25	268.25	278
MERCURY	0.315	NA	NA	1.0775	0.4075	0.015 U	0.86	0.17
NICKEL	24.25	NA	NA	45.5	77.75	30.75	37.25	19.9 J
POTASSIUM	NA	NA	NA	NA	NA	NA	NA	4360
SELENIUM	NA	NA	NA	NA	NA	NA	NA	R
SILVER	0.5125	NA	NA	1.0	0.96	0.16	0.15	0.32 UJ
SODIUM	NA	NA	NA	NA	NA	NA	NA	24300

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Location	DSY-28								
Sample Number	DSY-28-SUR	DSY-28-SURb	DSY-28-SURc	DSY-28-BOT	DSY-28-MID	DSY-V4-BOT	DSY-V4-MID	DSY-SD-28-082504	
Date Sampled	10/19/1995	10/19/1995	10/19/1995	11/16/1995	11/16/1995	1/11/1996	1/11/1996	8/25/2004	
QC Identifier									
THALLIUM	NA	NA	NA	NA	NA	NA	NA	1.7	UJ
VANADIUM	NA	NA	NA	NA	NA	NA	NA	45.6	
ZINC	169.25	NA	NA	327.75	455	71.25	466.5	142	J
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (MG/KG)									
CADMIUM	NA	NA	NA	NA	NA	NA	NA	0.2300	B
CHROMIUM	NA	NA	NA	NA	NA	NA	NA	9.900	
COPPER	NA	NA	NA	NA	NA	NA	NA	31.00	N*
LEAD	NA	NA	NA	NA	NA	NA	NA	45.50	
MERCURY	NA	NA	NA	NA	NA	NA	NA	0.001600	UN
NICKEL	NA	NA	NA	NA	NA	NA	NA	4.200	BN*
SULFIDE	NA	NA	NA	NA	NA	NA	NA	3.600	
ZINC	NA	NA	NA	NA	NA	NA	NA	83.00	
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (UMOLE/G)									
CADMIUM	NA	NA	NA	NA	NA	NA	NA	0.003660	U
CHROMIUM	NA	NA	NA	NA	NA	NA	NA	0.1897	
COPPER	NA	NA	NA	NA	NA	NA	NA	0.4884	J
LEAD	NA	NA	NA	NA	NA	NA	NA	0.2198	
MERCURY	NA	NA	NA	NA	NA	NA	NA	0.00008200	UJ
NICKEL	NA	NA	NA	NA	NA	NA	NA	0.07220	UJ
SEM/AVS RATIO	-55.482	0.1186	7.468	NA	NA	NA	NA	19.4047	
SULFIDE	NA	NA	NA	NA	NA	NA	NA	0.1117	J
TOTAL SIMULTANEOUSLY EXTRACTED METALS	NA	NA	NA	NA	NA	NA	NA	2.1675	
ZINC	NA	NA	NA	NA	NA	NA	NA	1.2696	J
Miscellaneous Analysis (UG/KG)									
DIBUTYLTIN	21.0	NA	NA	43.4	5.03	0.50	0.50	NA	
MONOBUTYLTIN	8.88	NA	NA	14.99	2.9	0.50	0.50	NA	
TETRABUTYLTIN	0.60	J	NA	NA	0.50	0.50	0.50	0.50	NA	
TRIBUTYLTIN	65.36	NA	NA	140.54	12.87	0.50	0.50	NA	
Total Organic Carbon Analysis (MG/KG)									
CARBON	NA	NA	NA	NA	NA	NA	NA	24000	

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Location	DSY-29						
Sample Number	DSY-29-SUR	DSY-29-SURb	DSY-29-SURc	DSY-29-SUR-D	DSY-29-BOT	DSY-29-MID	DSY-SD-29-082604
Date Sampled	10/19/1995	10/19/1995	10/19/1995	10/19/1995	11/16/1995	11/16/1995	8/26/2004
QC Identifier							
Semivolatile Organic Analysis (UG/KG)							
1,1-BIPHENYL	29.9113	NA	NA	30.1792	0.64	12.5828	NA
1-METHYLNAPHTHALENE	50.0709	NA	NA	45.4347	3.255	52.95	NA
1-METHYLPHENANTHRENE	266.5573	NA	NA	241.0912	2.2382 J	194.9058	NA
2,3,5-TRIMETHYLNAPHTHALENE	27.9395	NA	NA	28.7557	0.54	17.6121	NA
2,6-DIMETHYLNAPHTHALENE	112.3151	NA	NA	123.8987	1.78	23.9274	NA
2-METHYLNAPHTHALENE	73.4692	NA	NA	61.8418	5.3	26.7152	NA
ACENAPHTHENE	188.5882	NA	NA	197.1768	0.44	158.0626	NA
ACENAPHTHYLENE	300.1476	NA	NA	460.8249	0.77	119.6388	NA
ANTHRACENE	1220	NA	NA	1750	4.5195	541.4797	NA
BENZO(A)ANTHRACENE	2700	NA	NA	4310	6.773	1640	NA
BENZO(A)PYRENE	2380	NA	NA	3200	9.529	1550.0409	NA
BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA
BENZO(B+K)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA
BENZO(E)PYRENE	1950	NA	NA	2510	11.8765	1140	NA
BENZO(G,H,I)PERYLENE	1110	NA	NA	1360	7.0974	700.7949	NA
BENZO(K)FLUORANTHENE	5350	NA	NA	7050	34.6377	2750	NA
CHRYSENE	2800	NA	NA	3740	15.3196	1590	NA
DIBENZO(A,H)ANTHRACENE	317.4257	NA	NA	392.8234	1.8584 J	223.3704	NA
FLUORANTHENE	4970	NA	NA	8290	20.367	2860	NA
FLUORENE	293.6357	NA	NA	333.2252	1.34	137.6665	NA
HIGH MOLECULAR WEIGHT PAHS	18467.4257	NA	NA	28222.8234	82.1203	11413.4112	NA
INDENO(1,2,3-CD)PYRENE	1020	NA	NA	1310	5.9139	673.0268	NA
LOW MOLECULAR WEIGHT PAHS	3761.4565	NA	NA	4643.5637	19.0347	2278.709	NA
NAPHTHALENE	76.0754	NA	NA	90.9503	2.6	55.1463	NA
PERYLENE	610.9469	NA	NA	844.1755	4.9633	367.9719	NA
PHENANTHRENE	1609.5404	NA	NA	1749.5448	4.0652 J	1240	NA
PYRENE	5300	NA	NA	8290	28.2732	3550	NA
TOTAL PAHS	32800	NA	NA	46400	157	19600	NA
Low Concentration PAH (SIM) Analysis (UG/KG)							
2-METHYLNAPHTHALENE	NA	NA	NA	NA	NA	NA	39 U
ACENAPHTHENE	NA	NA	NA	NA	NA	NA	120
ACENAPHTHYLENE	NA	NA	NA	NA	NA	NA	73

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-29						
Sample Number	DSY-29-SUR	DSY-29-SURb	DSY-29-SURc	DSY-29-SUR-D	DSY-29-BOT	DSY-29-MID	DSY-SD-29-082604
Date Sampled	10/19/1995	10/19/1995	10/19/1995	10/19/1995	11/16/1995	11/16/1995	8/26/2004
QC Identifier							
ANTHRACENE	NA	NA	NA	NA	NA	NA	320
BENZO(A)ANTHRACENE	NA	NA	NA	NA	NA	NA	1200
BENZO(A)PYRENE	NA	NA	NA	NA	NA	NA	1200
BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	NA	1400
BENZO(G,H,I)PERYLENE	NA	NA	NA	NA	NA	NA	510
BENZO(K)FLUORANTHENE	NA	NA	NA	NA	NA	NA	630
CHRYSENE	NA	NA	NA	NA	NA	NA	1300
DIBENZO(A,H)ANTHRACENE	NA	NA	NA	NA	NA	NA	160 J
FLUORANTHENE	NA	NA	NA	NA	NA	NA	2000
FLUORENE	NA	NA	NA	NA	NA	NA	130
HIGH MOLECULAR WEIGHT PAHS	NA	NA	NA	NA	NA	NA	10970
INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA	NA	NA	470
LOW MOLECULAR WEIGHT PAHS	NA	NA	NA	NA	NA	NA	1643
NAPHTHALENE	NA	NA	NA	NA	NA	NA	39 U
PHENANTHRENE	NA	NA	NA	NA	NA	NA	1000 J
PYRENE	NA	NA	NA	NA	NA	NA	2100
TOTAL PAH	NA	NA	NA	NA	NA	NA	12613
Pesticide/PCB Analysis (UG/KG)							
2,4'-DDE	4.9571	NA	NA	4.7577	0.10	1.1214	NA
4,4'-DDE	6.2869	NA	NA	6.4334	0.1156	9.2481	NA
ALDRIN	0.10	NA	NA	0.2152	0.10	0.10	NA
HEXACHLOROBENZENE	0.1562 J	NA	NA	0.080	0.080	0.080	NA
MIREX	0.10	NA	NA	0.3101	0.10	0.10	NA
PCB Analysis (UG/KG)							
2,2',5-TRICHLOROBIPHENYL	NA	NA	NA	NA	NA	NA	0.233 JEB
2,4'-DICHLOROBIPHENYL	NA	NA	NA	NA	NA	NA	0.424 JEB
PCB-101	16.696	NA	NA	15.662	0.255	4.324	9.6 J
PCB-104	NA	NA	NA	NA	NA	NA	NA
PCB-105	6.6132	NA	NA	6.5112	0.035	1.3988	3.66
PCB-118	18.3807	NA	NA	17.5629	0.135	4.5103	9.71
PCB-126	NA	NA	NA	NA	NA	NA	NA
PCB-128	5.1411	NA	NA	4.8757	0.035	0.9992	3.16 J
PCB-138	27.041	NA	NA	26.1257	0.0926 J	5.9912	21.9 J
PCB-153	22.7965	NA	NA	22.6695	0.0957 J	5.2303	19.8 J
PCB-170	7.2459	NA	NA	7.5795	0.035	1.6568	4.15
PCB-18	0.6827	NA	NA	0.7411	0.015	0.2304	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-29						
Sample Number	DSY-29-SUR	DSY-29-SURb	DSY-29-SURc	DSY-29-SUR-D	DSY-29-BOT	DSY-29-MID	DSY-SD-29-082604
Date Sampled	10/19/1995	10/19/1995	10/19/1995	10/19/1995	11/16/1995	11/16/1995	8/26/2004
QC Identifier							
PCB-180	13.7914	NA	NA	14.7384	0.0819 J	3.6683	10.2 J
PCB-187	8.5443	NA	NA	9.783	0.1186	2.6938	9.28
PCB-188	NA	NA	NA	NA	NA	NA	NA
PCB-195	3.8324	NA	NA	5.9233	0.020	0.5814	1.43
PCB-201	NA	NA	NA	NA	NA	NA	NA
PCB-206	17.3943	NA	NA	39.0153	0.2506	2.5762	7.85
PCB-209	105.269	NA	NA	279.6978	0.2277	2.4618	94.3
PCB-28	1.6609	NA	NA	1.7241	0.0645	0.513	1.16 J
PCB-29	NA	NA	NA	NA	NA	NA	NA
PCB-44	3.9443	NA	NA	3.7456	0.0924	0.9777	1.74 JEB
PCB-50	NA	NA	NA	NA	NA	NA	NA
PCB-52	9.6936	NA	NA	8.1678	0.0516 J	1.7773	3.34 EB
PCB-66	3.8666	NA	NA	2.7804	0.0964	0.9991	2.9
PCB-8	0.5965	NA	NA	0.6921	0.055	0.1507	NA
PCB-87	NA	NA	NA	NA	NA	NA	NA
SUM OF PCB CONGENERS X 2	546.3809	NA	NA	935.9907	2.854	81.4807	410
TAL Metal Analysis (MG/KG)							
ALUMINUM	37147.5	NA	NA	38107.5	18495.25	17663	13000
ANTIMONY	NA	NA	NA	NA	NA	NA	0.41 UJ
ARSENIC	12.46	NA	NA	12.32	3.0	5.57	12.3 J
BARIUM	NA	NA	NA	NA	NA	NA	48.2
BERYLLIUM	NA	NA	NA	NA	NA	NA	1.0
CADMIUM	1.45	NA	NA	2.18	0.14 J	0.78 J	1.1 J
CALCIUM	NA	NA	NA	NA	NA	NA	11000 J
CHROMIUM	86.5	NA	NA	88.0	31.25	56.0	46.1 J
COBALT	NA	NA	NA	NA	NA	NA	8.4 J
COPPER	157.75	NA	NA	165	1.875 U	60.0	93.5 J
IRON	35452.5	NA	NA	36347.5	16445.75	22018.5	30500
LEAD	185.9	NA	NA	172.5	19.0	87.1	113 J
MAGNESIUM	NA	NA	NA	NA	NA	NA	7820
MANGANESE	282.25	NA	NA	289.75	113	137	251
MERCURY	0.5025	NA	NA	0.51	0.015 U	0.565	0.27
NICKEL	34.75	NA	NA	36.0	15.25	23.25	24.2 J
POTASSIUM	NA	NA	NA	NA	NA	NA	3420 J
SELENIUM	NA	NA	NA	NA	NA	NA	0.54 U
SILVER	0.7875	NA	NA	0.9875	0.065 U	0.61	0.27 UJ
SODIUM	NA	NA	NA	NA	NA	NA	20800

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Location	DSY-29							
Sample Number	DSY-29-SUR	DSY-29-SURb	DSY-29-SURc	DSY-29-SUR-D	DSY-29-BOT	DSY-29-MID	DSY-SD-29-082604	
Date Sampled	10/19/1995	10/19/1995	10/19/1995	10/19/1995	11/16/1995	11/16/1995	8/26/2004	
QC Identifier								
THALLIUM	NA	NA	NA	NA	NA	NA	1.9	UJ
VANADIUM	NA	NA	NA	NA	NA	NA	49.4	
ZINC	392.75	NA	NA	403.25	34.5	130.5	252	
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (MG/KG)								
CADMIUM	NA	NA	NA	NA	NA	NA	0.7200	
CHROMIUM	NA	NA	NA	NA	NA	NA	10.90	
COPPER	NA	NA	NA	NA	NA	NA	42.30	N*
LEAD	NA	NA	NA	NA	NA	NA	88.70	
MERCURY	NA	NA	NA	NA	NA	NA	0.001500	UN
NICKEL	NA	NA	NA	NA	NA	NA	84.50	N*
SULFIDE	NA	NA	NA	NA	NA	NA	2300	
ZINC	NA	NA	NA	NA	NA	NA	169.0	
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (UMOLE/G)								
CADMIUM	NA	NA	NA	NA	NA	NA	0.006400	
CHROMIUM	NA	NA	NA	NA	NA	NA	0.2102	U
COPPER	NA	NA	NA	NA	NA	NA	0.6664	J
LEAD	NA	NA	NA	NA	NA	NA	0.4281	
MERCURY	NA	NA	NA	NA	NA	NA	0.00007300	UJ
NICKEL	NA	NA	NA	NA	NA	NA	1.4396	UJ
SEM/AVS RATIO	-175.5936	0.04130	7.5664	NA	NA	NA	0.05250	
SULFIDE	NA	NA	NA	NA	NA	NA	70.1675	J
TOTAL SIMULTANEOUSLY EXTRACTED METALS	NA	NA	NA	NA	NA	NA	3.6869	
ZINC	NA	NA	NA	NA	NA	NA	2.586	J
Miscellaneous Analysis (UG/KG)								
DIBUTYLTIN	20.58	NA	NA	30.04	0.50	0.50	NA	
MONOBUTYLTIN	8.65	NA	NA	18.06	0.50	0.50	NA	
TETRABUTYLTIN	0.50	NA	NA	0.54 J	0.50	0.50	NA	
TRIBUTYLTIN	60.89	NA	NA	66.17	0.50	0.50	NA	
Total Organic Carbon Analysis (MG/KG)								
CARBON	NA	NA	NA	NA	NA	NA	32000	

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-30					DSY-31		
Sample Number	DSY-30-SUR	DSY-30-SURb	DSY-30-SURc	DSY-30-BOT	DSY-30-MID	DSY-31-SUR	DSY-31-SURb	DSY-31-SURc
Date Sampled	10/12/1995	10/12/1995	10/12/1995	11/16/1995	11/16/1995	10/12/1995	10/12/1995	10/12/1995
QC Identifier								
Semivolatile Organic Analysis (UG/KG)								
1,1-BIPHENYL	23.7612	NA	NA	0.64	2.8461	14.4062	NA	NA
1-METHYLNAPHTHALENE	55.1059	NA	NA	3.255	10.8544	20.4157	NA	NA
1-METHYLPHENANTHRENE	114.1619	NA	NA	2.715	18.5915	32.5298	NA	NA
2,3,5-TRIMETHYLNAPHTHALENE	19.247	NA	NA	0.54	3.7367	7.8987	NA	NA
2,6-DIMETHYLNAPHTHALENE	70.705	NA	NA	4.3851	6.8306	34.6414	NA	NA
2-METHYLNAPHTHALENE	88.1922	NA	NA	5.3	12.1748	36.8598	NA	NA
ACENAPHTHENE	196.9635	NA	NA	0.44	9.4373	17.1397	NA	NA
ACENAPHTHYLENE	91.9431	NA	NA	0.77	19.2568	71.0036	NA	NA
ANTHRACENE	455.8496	NA	NA	0.9119 J	49.8583	200.3	NA	NA
BENZO(A)ANTHRACENE	696.6908	NA	NA	0.8496 J	105.1753	280.585	NA	NA
BENZO(A)PYRENE	811.8407	NA	NA	2.415	137.7264	420.8157	NA	NA
BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(B+K)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(E)PYRENE	772.6699	NA	NA	2.04	103.9351	401.4211	NA	NA
BENZO(G,H,I)PERYLENE	451.5919	NA	NA	1.472 J	74.5695	214.7073	NA	NA
BENZO(K)FLUORANTHENE	1640	NA	NA	4.0093 J	266.7754	1040	NA	NA
CHRYSENE	715.6919	NA	NA	1.3263 J	109.9579	398.9704	NA	NA
DIBENZO(A,H)ANTHRACENE	130.1156	NA	NA	0.844 J	17.6947	62.9278	NA	NA
FLUORANTHENE	1490	NA	NA	1.8671 J	239.1575	399.3288	NA	NA
FLUORENE	176.6084	NA	NA	1.34	15.7432	28.1165	NA	NA
HIGH MOLECULAR WEIGHT PAHS	5594.3696	NA	NA	9.0553	846.8089	2408.6018	NA	NA
INDENO(1,2,3-CD)PYRENE	398.2413	NA	NA	1.2933 J	70.6037	217.9902	NA	NA
LOW MOLECULAR WEIGHT PAHS	2415.6703	NA	NA	13.0357	261.5475	614.8201	NA	NA
NAPHTHALENE	136.1136	NA	NA	2.6	13.64	45.3043	NA	NA
PERYLENE	207.3981	NA	NA	17.4748	38.4788	141.5225	NA	NA
PHENANTHRENE	1270	NA	NA	1.6737 J	141.4371	216.0962	NA	NA
PYRENE	1750.0305	NA	NA	1.7533 J	237.097	845.9742	NA	NA
TOTAL PAHS	11800	NA	NA	37.9	1710	5150	NA	NA
Low Concentration PAH (SIM) Analysis (UG/KG)								
2-METHYLNAPHTHALENE	NA	NA	NA	NA	NA	NA	NA	NA
ACENAPHTHENE	NA	NA	NA	NA	NA	NA	NA	NA
ACENAPHTHYLENE	NA	NA	NA	NA	NA	NA	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Location	DSY-30					DSY-31		
Sample Number	DSY-30-SUR	DSY-30-SURb	DSY-30-SURc	DSY-30-BOT	DSY-30-MID	DSY-31-SUR	DSY-31-SURb	DSY-31-SURc
Date Sampled	10/12/1995	10/12/1995	10/12/1995	11/16/1995	11/16/1995	10/12/1995	10/12/1995	10/12/1995
QC Identifier								
ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(A)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(A)PYRENE	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(G,H,I)PERYLENE	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(K)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA
CHRYSENE	NA	NA	NA	NA	NA	NA	NA	NA
DIBENZO(A,H)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	NA
FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA
FLUORENE	NA	NA	NA	NA	NA	NA	NA	NA
HIGH MOLECULAR WEIGHT PAHS	NA	NA	NA	NA	NA	NA	NA	NA
INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA	NA	NA	NA	NA
LOW MOLECULAR WEIGHT PAHS	NA	NA	NA	NA	NA	NA	NA	NA
NAPHTHALENE	NA	NA	NA	NA	NA	NA	NA	NA
PHENANTHRENE	NA	NA	NA	NA	NA	NA	NA	NA
PYRENE	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL PAH	NA	NA	NA	NA	NA	NA	NA	NA
Pesticide/PCB Analysis (UG/KG)								
2,4'-DDE	5.6635	NA	NA	0.10	0.4163	3.629	NA	NA
4,4'-DDE	4.4378	NA	NA	0.2349	0.5865	1.9497	NA	NA
ALDRIN	0.10	NA	NA	0.10	0.10	0.10	NA	NA
HEXACHLOROBENZENE	0.080	NA	NA	0.080	0.080	0.080	NA	NA
MIREX	5.0321	NA	NA	0.10	0.1278 J	0.3274	NA	NA
PCB Analysis (UG/KG)								
2,2',5-TRICHLOROBIPHENYL	NA	NA	NA	NA	NA	NA	NA	NA
2,4'-DICHLOROBIPHENYL	NA	NA	NA	NA	NA	NA	NA	NA
PCB-101	19.003	NA	NA	0.277	0.293	12.746	NA	NA
PCB-104	NA	NA	NA	NA	NA	NA	NA	NA
PCB-105	7.0445	NA	NA	0.035	0.1018	4.3904	NA	NA
PCB-118	19.5558	NA	NA	0.135	0.349	13.7448	NA	NA
PCB-126	NA	NA	NA	NA	NA	NA	NA	NA
PCB-128	6.2479	NA	NA	0.0971	0.035	3.0669	NA	NA
PCB-138	26.5724	NA	NA	0.1271 J	0.2396 J	16.1059	NA	NA
PCB-153	20.5378	NA	NA	0.075	0.1476 J	14.4279	NA	NA
PCB-170	6.289	NA	NA	0.035	0.2207	3.8268	NA	NA
PCB-18	1.2973	NA	NA	0.0906	0.2045	1.3428	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-30					DSY-31		
Sample Number	DSY-30-SUR	DSY-30-SURb	DSY-30-SURc	DSY-30-BOT	DSY-30-MID	DSY-31-SUR	DSY-31-SURb	DSY-31-SURc
Date Sampled	10/12/1995	10/12/1995	10/12/1995	11/16/1995	11/16/1995	10/12/1995	10/12/1995	10/12/1995
QC Identifier								
PCB-180	11.5742	NA	NA	0.2419	0.0631 J	6.7996	NA	NA
PCB-187	7.0216	NA	NA	0.0518	0.1921	4.6643	NA	NA
PCB-188	NA	NA	NA	NA	NA	NA	NA	NA
PCB-195	1.0068	NA	NA	0.020	0.020	1.7964	NA	NA
PCB-201	NA	NA	NA	NA	NA	NA	NA	NA
PCB-206	6.2653	NA	NA	0.015	1.1309	4.3287	NA	NA
PCB-209	6.8161	NA	NA	1.1315	1.7857	4.5038	NA	NA
PCB-28	2.5442	NA	NA	0.0902	0.5919	3.6719	NA	NA
PCB-29	NA	NA	NA	NA	NA	NA	NA	NA
PCB-44	4.4891	NA	NA	0.1411	0.2011	3.6906	NA	NA
PCB-50	NA	NA	NA	NA	NA	NA	NA	NA
PCB-52	9.22	NA	NA	0.2759	0.4602	7.2303	NA	NA
PCB-66	0.9377	NA	NA	0.144	0.3939	2.7227	NA	NA
PCB-8	1.2214	NA	NA	0.055	0.1058	1.4339	NA	NA
PCB-87	NA	NA	NA	NA	NA	NA	NA	NA
SUM OF PCB CONGENERS X 2	315.2884	NA	NA	5.3362	12.9621	220.9876	NA	NA
TAL Metal Analysis (MG/KG)								
ALUMINUM	37525	NA	NA	23276.5	26627.5	38455	NA	NA
ANTIMONY	NA	NA	NA	NA	NA	NA	NA	NA
ARSENIC	10.3	NA	NA	6.07	5.45	10.22	NA	NA
BARIUM	NA	NA	NA	NA	NA	NA	NA	NA
BERYLLIUM	NA	NA	NA	NA	NA	NA	NA	NA
CADMIUM	1.2 J	NA	NA	0.27 J	0.16 J	0.76 J	NA	NA
CALCIUM	NA	NA	NA	NA	NA	NA	NA	NA
CHROMIUM	79.25	NA	NA	42.0	49.75	76.75	NA	NA
COBALT	NA	NA	NA	NA	NA	NA	NA	NA
COPPER	81.25	NA	NA	1.875 U	9.75	80.75	NA	NA
IRON	27417.5	NA	NA	21068.75	21970.25	28335	NA	NA
LEAD	80.0	NA	NA	21.7	34.9	81.0	NA	NA
MAGNESIUM	NA	NA	NA	NA	NA	NA	NA	NA
MANGANESE	276.5	NA	NA	214	140.75	307.5	NA	NA
MERCURY	0.47	NA	NA	0.015 B	0.1398	0.395	NA	NA
NICKEL	27.25	NA	NA	13.5	16.75	24.75	NA	NA
POTASSIUM	NA	NA	NA	NA	NA	NA	NA	NA
SELENIUM	NA	NA	NA	NA	NA	NA	NA	NA
SILVER	0.7375	NA	NA	0.065 U	0.14	0.5125	NA	NA
SODIUM	NA	NA	NA	NA	NA	NA	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-30					DSY-31		
Sample Number	DSY-30-SUR	DSY-30-SURb	DSY-30-SURc	DSY-30-BOT	DSY-30-MID	DSY-31-SUR	DSY-31-SURb	DSY-31-SURc
Date Sampled	10/12/1995	10/12/1995	10/12/1995	11/16/1995	11/16/1995	10/12/1995	10/12/1995	10/12/1995
QC Identifier								
THALLIUM	NA	NA	NA	NA	NA	NA	NA	NA
VANADIUM	NA	NA	NA	NA	NA	NA	NA	NA
ZINC	192.75	NA	NA	48.5	64.5	167	NA	NA
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (MG/KG)								
CADMIUM	NA	NA	NA	NA	NA	NA	NA	NA
CHROMIUM	NA	NA	NA	NA	NA	NA	NA	NA
COPPER	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	NA	NA	NA	NA	NA	NA	NA	NA
MERCURY	NA	NA	NA	NA	NA	NA	NA	NA
NICKEL	NA	NA	NA	NA	NA	NA	NA	NA
SULFIDE	NA	NA	NA	NA	NA	NA	NA	NA
ZINC	NA	NA	NA	NA	NA	NA	NA	NA
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (UMOLE/G)								
CADMIUM	NA	NA	NA	NA	NA	NA	NA	NA
CHROMIUM	NA	NA	NA	NA	NA	NA	NA	NA
COPPER	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	NA	NA	NA	NA	NA	NA	NA	NA
MERCURY	NA	NA	NA	NA	NA	NA	NA	NA
NICKEL	NA	NA	NA	NA	NA	NA	NA	NA
SEM/AVS RATIO	-19.5035	0.2202	5.5065	NA	NA	-47.2728	0.05570	2.7872
SULFIDE	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL SIMULTANEOUSLY EXTRACTED METALS	NA	NA	NA	NA	NA	NA	NA	NA
ZINC	NA	NA	NA	NA	NA	NA	NA	NA
Miscellaneous Analysis (UG/KG)								
DIBUTYLTIN	4.06	NA	NA	0.50	0.50	86.93	NA	NA
MONOBUTYLTIN	2.45	NA	NA	0.50	0.50	45.5	NA	NA
TETRABUTYLTIN	0.50	NA	NA	0.50	0.50	0.45 J	NA	NA
TRIBUTYLTIN	6.86	NA	NA	0.50	0.50	228.12	NA	NA
Total Organic Carbon Analysis (MG/KG)								
CARBON	NA	NA	NA	NA	NA	NA	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Location	DSY-31 cont.			DSY-32				DSY-33		
Sample Number	DSY-31-BOT	DSY-31-MID	DSY-SD-31-082604	DSY-32-SUR	DSY-32-SURb	DSY-32-SURc	DSY-SD-32-082604	DSY-33-SUR	DSY-33-SURb	DSY-33-SURc
Date Sampled	11/16/1995	11/16/1995	8/26/2004	9/28/1995	9/28/1995	9/28/1995	8/26/2004	9/28/1995	9/28/1995	9/28/1995
QC Identifier										
Semivolatile Organic Analysis (UG/KG)										
1,1-BIPHENYL	0.64	6.5419	NA	15.369	NA	NA	NA	3.1795	NA	NA
1-METHYLNAPHTHALENE	3.255	10.3431	NA	17.5691	NA	NA	NA	5.1117 J	NA	NA
1-METHYLPHENANTHRENE	2.715	14.126	NA	51.5744	NA	NA	NA	8.8757	NA	NA
2,3,5-TRIMETHYLNAPHTHALENE	0.54	4.089	NA	7.8906	NA	NA	NA	2.0425	NA	NA
2,6-DIMETHYLNAPHTHALENE	2.4912 J	17.0688	NA	43.5907	NA	NA	NA	9.9094	NA	NA
2-METHYLNAPHTHALENE	5.3	15.075	NA	32.0827	NA	NA	NA	9.6587 J	NA	NA
ACENAPHTHENE	0.44	4.1809	NA	14.2886	NA	NA	NA	3.3124	NA	NA
ACENAPHTHYLENE	0.77	22.4076	NA	131.2997	NA	NA	NA	11.8505	NA	NA
ANTHRACENE	1.085	51.0713	NA	298.0573	NA	NA	NA	31.4882	NA	NA
BENZO(A)ANTHRACENE	1.802 J	66.8864	NA	387.6965	NA	NA	NA	50.0309	NA	NA
BENZO(A)PYRENE	2.0163 J	147.0902	NA	494.6919	NA	NA	NA	67.8487	NA	NA
BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(B+K)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(E)PYRENE	1.5001 J	155.7333	NA	417.1659	NA	NA	NA	63.4532	NA	NA
BENZO(G,H,I)PERYLENE	1.5481 J	92.946	NA	286.709	NA	NA	NA	50.3306	NA	NA
BENZO(K)FLUORANTHENE	5.9001 J	295.1911	NA	1100	NA	NA	NA	155.341	NA	NA
CHRYSENE	2.5637 J	100.0411	NA	491.2839	NA	NA	NA	58.7768	NA	NA
DIBENZO(A,H)ANTHRACENE	0.767 J	25.8549	NA	72.2172	NA	NA	NA	12.4056	NA	NA
FLUORANTHENE	2.5785 J	104.247	NA	535.2793	NA	NA	NA	95.2291	NA	NA
FLUORENE	1.34	9.1526	NA	25.7327	NA	NA	NA	6.5724	NA	NA
HIGH MOLECULAR WEIGHT PAHS	13.3997	743.8501	NA	2897.783	NA	NA	NA	391.2466	NA	NA
INDENO(1,2,3-CD)PYRENE	1.3166 J	74.786	NA	263.6159	NA	NA	NA	45.3127	NA	NA
LOW MOLECULAR WEIGHT PAHS	13.2199	180.0346	NA	725.9518	NA	NA	NA	119.9073	NA	NA
NAPHTHALENE	2.6	17.9095	NA	42.6678	NA	NA	NA	10.8658	NA	NA
PERYLENE	11.5841	45.3489	NA	150.4787	NA	NA	NA	23.9158	NA	NA
PHENANTHRENE	1.6849 J	60.2378	NA	181.823	NA	NA	NA	46.1594	NA	NA
PYRENE	3.6722 J	299.7304	NA	916.6143	NA	NA	NA	106.9554	NA	NA
TOTAL PAHS	39	1640	NA	5980	NA	NA	NA	879	NA	NA
Low Concentration PAH (SIM) Analysis (UG/KG)										
2-METHYLNAPHTHALENE	NA	NA	8.8 U	NA	NA	NA	9.4 U	NA	NA	NA
ACENAPHTHENE	NA	NA	8.8 U	NA	NA	NA	10	NA	NA	NA
ACENAPHTHYLENE	NA	NA	19	NA	NA	NA	24	NA	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Location	DSY-31 cont.			DSY-32				DSY-33		
Sample Number	DSY-31-BOT	DSY-31-MID	DSY-SD-31-082604	DSY-32-SUR	DSY-32-SURb	DSY-32-SURc	DSY-SD-32-082604	DSY-33-SUR	DSY-33-SURb	DSY-33-SURc
Date Sampled	11/16/1995	11/16/1995	8/26/2004	9/28/1995	9/28/1995	9/28/1995	8/26/2004	9/28/1995	9/28/1995	9/28/1995
QC Identifier										
ANTHRACENE	NA	NA	27	NA	NA	NA	53	NA	NA	NA
BENZO(A)ANTHRACENE	NA	NA	91	NA	NA	NA	200	NA	NA	NA
BENZO(A)PYRENE	NA	NA	120	NA	NA	NA	250 J	NA	NA	NA
BENZO(B)FLUORANTHENE	NA	NA	200	NA	NA	NA	530 J	NA	NA	NA
BENZO(G,H,I)PERYLENE	NA	NA	55	NA	NA	NA	100 J	NA	NA	NA
BENZO(K)FLUORANTHENE	NA	NA	63	NA	NA	NA	190 J	NA	NA	NA
CHRYSENE	NA	NA	150	NA	NA	NA	270	NA	NA	NA
DIBENZO(A,H)ANTHRACENE	NA	NA	14 J	NA	NA	NA	22 J	NA	NA	NA
FLUORANTHENE	NA	NA	130	NA	NA	NA	280	NA	NA	NA
FLUORENE	NA	NA	10	NA	NA	NA	22	NA	NA	NA
HIGH MOLECULAR WEIGHT PAHS	NA	NA	1055	NA	NA	NA	2334	NA	NA	NA
INDENO(1,2,3-CD)PYRENE	NA	NA	52	NA	NA	NA	82 J	NA	NA	NA
LOW MOLECULAR WEIGHT PAHS	NA	NA	110	NA	NA	NA	232	NA	NA	NA
NAPHTHALENE	NA	NA	8.8 U	NA	NA	NA	13	NA	NA	NA
PHENANTHRENE	NA	NA	54 J	NA	NA	NA	110	NA	NA	NA
PYRENE	NA	NA	180	NA	NA	NA	410	NA	NA	NA
TOTAL PAH	NA	NA	1165	NA	NA	NA	2566	NA	NA	NA
Pesticide/PCB Analysis (UG/KG)										
2,4'-DDE	0.284	2.4482	NA	0.26	NA	NA	NA	0.6334	NA	NA
4,4'-DDE	0.1597	4.8822	NA	2.3816	NA	NA	NA	0.4185	NA	NA
ALDRIN	0.1247 J	0.1285 J	NA	0.10	NA	NA	NA	0.10	NA	NA
HEXACHLOROBENZENE	0.080	0.080	NA	0.080	NA	NA	NA	0.080	NA	NA
MIREX	0.10	0.1636 J	NA	0.7081	NA	NA	NA	0.10	NA	NA
PCB Analysis (UG/KG)										
2,2',5-TRICHLOROBIPHENYL	NA	NA	0.346 JEB	NA	NA	NA	0.165 JEB	NA	NA	NA
2,4'-DICHLOROBIPHENYL	NA	NA	0.582 EB	NA	NA	NA	0.483 JEB	NA	NA	NA
PCB-101	0.313	7.483	7.43 J	14.32	NA	NA	4.8 J	1.74	NA	NA
PCB-104	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-105	0.035	3.3525	2.69	2.6336	NA	NA	1.7	0.5626	NA	NA
PCB-118	0.135	7.8191	8.29	11.282	NA	NA	5.71	2.3403	NA	NA
PCB-126	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-128	0.035	2.4545	1.83 J	3.1408	NA	NA	1.45 J	0.5496	NA	NA
PCB-138	0.0696 J	10.3747	11.2 J	15.1649	NA	NA	8.66 J	2.8904	NA	NA
PCB-153	0.075	7.9894	9.84 J	12.2329	NA	NA	8.18 J	2.7247	NA	NA
PCB-170	0.035	2.5928	1.75	2.3014	NA	NA	1.56	0.7962	NA	NA
PCB-18	0.015	1.1913	NA	0.907	NA	NA	NA	0.2639	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Location	DSY-31 cont.			DSY-32				DSY-33		
Sample Number	DSY-31-BOT	DSY-31-MID	DSY-SD-31-082604	DSY-32-SUR	DSY-32-SURb	DSY-32-SURc	DSY-SD-32-082604	DSY-33-SUR	DSY-33-SURb	DSY-33-SURc
Date Sampled	11/16/1995	11/16/1995	8/26/2004	9/28/1995	9/28/1995	9/28/1995	8/26/2004	9/28/1995	9/28/1995	9/28/1995
QC Identifier										
PCB-180	0.045	6.4264	3.81 J	4.5228	NA	NA	3.53 J	1.5035	NA	NA
PCB-187	0.010	4.1432	3.32	4.2601	NA	NA	3.39	1.1935	NA	NA
PCB-188	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-195	0.020	1.1069	0.486	0.5338	NA	NA	0.409 J	0.1868	NA	NA
PCB-201	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-206	0.1998	2.6919	1.27	2.6839	NA	NA	1.32	1.1163	NA	NA
PCB-209	0.2124	2.1184	2.17	4.3385	NA	NA	1.99	1.2885	NA	NA
PCB-28	0.1528	2.1743	1.48 J	2.6096	NA	NA	1.21 JEB	0.5686	NA	NA
PCB-29	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-44	0.1902	3.0588	1.93 JEB	2.5857	NA	NA	1.4 JEB	0.5355	NA	NA
PCB-50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-52	0.3002	5.4226	3.67 EB	4.4274	NA	NA	2.19 EB	0.9627	NA	NA
PCB-66	0.1078	2.4358	3.11	11.2788	NA	NA	2.7	0.4552	NA	NA
PCB-8	0.055	0.5095	NA	1.2327	NA	NA	NA	0.2865	NA	NA
PCB-87	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SUM OF PCB CONGENERS X 2	3.1993	146.6901	130	200.912	NA	NA	102	39.9302	NA	NA
TAL Metal Analysis (MG/KG)										
ALUMINUM	34225	27677.5	12800	34225	NA	NA	12700	23359.5	NA	NA
ANTIMONY	NA	NA	0.37 UJ	NA	NA	NA	R	NA	NA	NA
ARSENIC	5.49	9.04	10.9 J	10.93	NA	NA	11.3 J	7.39	NA	NA
BARIUM	NA	NA	35.2	NA	NA	NA	35.5 J	NA	NA	NA
BERYLLIUM	NA	NA	1.2	NA	NA	NA	1.1	NA	NA	NA
CADMIUM	0.12 J	0.53 J	0.53 J	0.72 J	NA	NA	0.028 UJ	0.19 J	NA	NA
CALCIUM	NA	NA	8330 J	NA	NA	NA	23500	NA	NA	NA
CHROMIUM	38.75	56.5	44.3	84.75	NA	NA	42.4 J	46.5	NA	NA
COBALT	NA	NA	7.5 J	NA	NA	NA	7.4 J	NA	NA	NA
COPPER	1.875 U	36.75	58.9 J	66.75	NA	NA	57.3 J	17.25	NA	NA
IRON	17771.75	24123	24800	26545	NA	NA	23400	21405.75	NA	NA
LEAD	29.9	52.7	47.9 J	124.8	NA	NA	43.6 J	40.0	NA	NA
MAGNESIUM	NA	NA	8250	NA	NA	NA	7970	NA	NA	NA
MANGANESE	253.5	219.75	264	293.5	NA	NA	233	133.5	NA	NA
MERCURY	0.0712	0.275	0.23	0.3725	NA	NA	0.27	0.1278	NA	NA
NICKEL	12.5	21.75	18.3 J	25.75	NA	NA	17.7 J	18.25	NA	NA
POTASSIUM	NA	NA	4000	NA	NA	NA	4140	NA	NA	NA
SELENIUM	NA	NA	1.4 R	NA	NA	NA	0.56 U	NA	NA	NA
SILVER	0.065 U	0.57	0.25 UJ	0.8125	NA	NA	0.28 U	0.2375	NA	NA
SODIUM	NA	NA	18600	NA	NA	NA	20000	NA	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Location	DSY-31 cont.				DSY-32				DSY-33		
Sample Number	DSY-31-BOT	DSY-31-MID	DSY-SD-31-082604		DSY-32-SUR	DSY-32-SURb	DSY-32-SURc	DSY-SD-32-082604		DSY-33-SUR	DSY-33-SURb	DSY-33-SURc
Date Sampled	11/16/1995	11/16/1995	8/26/2004		9/28/1995	9/28/1995	9/28/1995	8/26/2004		9/28/1995	9/28/1995	9/28/1995
QC Identifier												
THALLIUM	NA	NA	2.0	UJ	NA	NA	NA	2.0	J	NA	NA	NA
VANADIUM	NA	NA	42.9		NA	NA	NA	41.5		NA	NA	NA
ZINC	36.0	122.75	140	J	201.25	NA	NA	111	J	72.25	NA	NA
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (MG/KG)												
CADMIUM	NA	NA	0.1700	B	NA	NA	NA	0.2000	B	NA	NA	NA
CHROMIUM	NA	NA	8.900		NA	NA	NA	11.50		NA	NA	NA
COPPER	NA	NA	3.400	N*	NA	NA	NA	140.0	*	NA	NA	NA
LEAD	NA	NA	33.00		NA	NA	NA	40.20		NA	NA	NA
MERCURY	NA	NA	0.001300	UN	NA	NA	NA	0.006400	B	NA	NA	NA
NICKEL	NA	NA	3.100	BN*	NA	NA	NA	402.0	E	NA	NA	NA
SULFIDE	NA	NA	16.00		NA	NA	NA	0.08500	U	NA	NA	NA
ZINC	NA	NA	76.30		NA	NA	NA	70.20		NA	NA	NA
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (UMOLE/G)												
CADMIUM	NA	NA	0.002890	U	NA	NA	NA	0.003150	U	NA	NA	NA
CHROMIUM	NA	NA	0.1718	U	NA	NA	NA	0.2221		NA	NA	NA
COPPER	NA	NA	0.05350	UJ	NA	NA	NA	2.2047	J	NA	NA	NA
LEAD	NA	NA	0.1593		NA	NA	NA	0.1938		NA	NA	NA
MERCURY	NA	NA	0.00006500	UJ	NA	NA	NA	0.00007100	U	NA	NA	NA
NICKEL	NA	NA		R	NA	NA	NA	6.856	J	NA	NA	NA
SEM/AVS RATIO	NA	NA	2.6391		-14.5054	0.1569	2.6996	399.0		1.0704	2.3636	1.8554
SULFIDE	NA	NA	0.5027	J	NA	NA	NA	0.02644	UJ	NA	NA	NA
TOTAL SIMULTANEOUSLY EXTRACTED METALS	NA	NA	1.3267		NA	NA	NA	10.5504		NA	NA	NA
ZINC	NA	NA	1.1674	J	NA	NA	NA	1.0738	J	NA	NA	NA
Miscellaneous Analysis (UG/KG)												
DIBUTYLTIN	0.50	0.50		NA	2.71	NA	NA		NA	0.50	NA	NA
MONOBUTYLTIN	0.50	0.50		NA	1.12	NA	NA		NA	0.50	NA	NA
TETRABUTYLTIN	0.50	0.50		NA	0.38	J NA	NA		NA	0.50	NA	NA
TRIBUTYLTIN	0.50	0.50		NA	4.26	NA	NA		NA	0.50	NA	NA
Total Organic Carbon Analysis (MG/KG)												
CARBON	NA	NA	28000		NA	NA	NA	130		NA	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Location	DSY-34			
Sample Number	DSY-34-SUR	DSY-34-SURb	DSY-34-SURc	DSY-34-MID
Date Sampled	10/12/1995	10/12/1995	10/12/1995	11/16/1995
QC Identifier				
Semivolatile Organic Analysis (UG/KG)				
1,1-BIPHENYL	6.4185	NA	NA	0.9763 J
1-METHYLNAPHTHALENE	12.7025	NA	NA	1.6283 J
1-METHYLPHENANTHRENE	18.3086	NA	NA	2.5267 J
2,3,5-TRIMETHYLNAPHTHALENE	4.4278	NA	NA	0.7724 J
2,6-DIMETHYLNAPHTHALENE	9.5563	NA	NA	4.9645
2-METHYLNAPHTHALENE	24.215	NA	NA	2.9815 J
ACENAPHTHENE	8.5513	NA	NA	0.7796 J
ACENAPHTHYLENE	28.6848	NA	NA	5.2068
ANTHRACENE	64.347	NA	NA	10.0042
BENZO(A)ANTHRACENE	100.9039	NA	NA	19.3733
BENZO(A)PYRENE	147.6253	NA	NA	21.0301
BENZO(B)FLUORANTHENE	NA	NA	NA	NA
BENZO(B+K)FLUORANTHENE	NA	NA	NA	NA
BENZO(E)PYRENE	141.0881	NA	NA	21.2535
BENZO(G,H,I)PERYLENE	97.5955	NA	NA	15.9454
BENZO(K)FLUORANTHENE	348.2932	NA	NA	49.2962
CHRYSENE	127.7599	NA	NA	15.0412
DIBENZO(A,H)ANTHRACENE	26.4518	NA	NA	4.6995
FLUORANTHENE	207.8392	NA	NA	23.813
FLUORENE	13.9193	NA	NA	1.7725 J
HIGH MOLECULAR WEIGHT PAHS	860.3718	NA	NA	126.7275
INDENO(1,2,3-CD)PYRENE	93.2662	NA	NA	16.6419
LOW MOLECULAR WEIGHT PAHS	272.2083	NA	NA	35.2644
NAPHTHALENE	22.2664	NA	NA	3.0524 J
PERYLENE	61.0289	NA	NA	22.6897
PHENANTHRENE	110.2245	NA	NA	11.4673
PYRENE	249.7918	NA	NA	42.7705
TOTAL PAHS	1930	NA	NA	299
Low Concentration PAH (SIM) Analysis (UG/KG)				
2-METHYLNAPHTHALENE	NA	NA	NA	NA
ACENAPHTHENE	NA	NA	NA	NA
ACENAPHTHYLENE	NA	NA	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Location	DSY-34			
Sample Number	DSY-34-SUR	DSY-34-SURb	DSY-34-SURc	DSY-34-MID
Date Sampled	10/12/1995	10/12/1995	10/12/1995	11/16/1995
QC Identifier				
ANTHRACENE	NA	NA	NA	NA
BENZO(A)ANTHRACENE	NA	NA	NA	NA
BENZO(A)PYRENE	NA	NA	NA	NA
BENZO(B)FLUORANTHENE	NA	NA	NA	NA
BENZO(G,H,I)PERYLENE	NA	NA	NA	NA
BENZO(K)FLUORANTHENE	NA	NA	NA	NA
CHRYSENE	NA	NA	NA	NA
DIBENZO(A,H)ANTHRACENE	NA	NA	NA	NA
FLUORANTHENE	NA	NA	NA	NA
FLUORENE	NA	NA	NA	NA
HIGH MOLECULAR WEIGHT PAHS	NA	NA	NA	NA
INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA
LOW MOLECULAR WEIGHT PAHS	NA	NA	NA	NA
NAPHTHALENE	NA	NA	NA	NA
PHENANTHRENE	NA	NA	NA	NA
PYRENE	NA	NA	NA	NA
TOTAL PAH	NA	NA	NA	NA
Pesticide/PCB Analysis (UG/KG)				
2,4'-DDE	0.8958	NA	NA	0.6482
4,4'-DDE	0.959	NA	NA	0.1788
ALDRIN	0.10	NA	NA	0.10
HEXACHLOROBENZENE	0.080	NA	NA	0.080
MIREX	0.2942	NA	NA	0.078 J
PCB Analysis (UG/KG)				
2,2',5-TRICHLOROBIPHENYL	NA	NA	NA	NA
2,4'-DICHLOROBIPHENYL	NA	NA	NA	NA
PCB-101	2.874	NA	NA	1.347
PCB-104	NA	NA	NA	NA
PCB-105	0.7937	NA	NA	0.3111
PCB-118	3.514	NA	NA	1.1045
PCB-126	NA	NA	NA	NA
PCB-128	0.8718	NA	NA	0.4057
PCB-138	4.8626	NA	NA	1.2991
PCB-153	4.8068	NA	NA	1.1181
PCB-170	1.3913	NA	NA	0.3311
PCB-18	0.2355	NA	NA	0.015

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-34			
Sample Number	DSY-34-SUR	DSY-34-SURb	DSY-34-SURc	DSY-34-MID
Date Sampled	10/12/1995	10/12/1995	10/12/1995	11/16/1995
QC Identifier				
PCB-180	2.4644	NA	NA	0.8127
PCB-187	1.8859	NA	NA	0.4827
PCB-188	NA	NA	NA	NA
PCB-195	0.4939	NA	NA	0.4887
PCB-201	NA	NA	NA	NA
PCB-206	1.8105	NA	NA	0.579
PCB-209	1.9815	NA	NA	0.7045
PCB-28	0.875	NA	NA	0.2344
PCB-29	NA	NA	NA	NA
PCB-44	0.8472	NA	NA	0.2994
PCB-50	NA	NA	NA	NA
PCB-52	1.3713	NA	NA	0.5421
PCB-66	0.8843	NA	NA	0.3447
PCB-8	0.3271	NA	NA	0.0616 J
PCB-87	NA	NA	NA	NA
SUM OF PCB CONGENERS X 2	64.5813	NA	NA	20.9327
TAL Metal Analysis (MG/KG)				
ALUMINUM	32957.5	NA	NA	32772.5
ANTIMONY	NA	NA	NA	NA
ARSENIC	9.66	NA	NA	6.79
BARIUM	NA	NA	NA	NA
BERYLLIUM	NA	NA	NA	NA
CADMIUM	0.32 J	NA	NA	0.16 J
CALCIUM	NA	NA	NA	NA
CHROMIUM	64.25	NA	NA	48.0
COBALT	NA	NA	NA	NA
COPPER	33.5	NA	NA	1.875 U
IRON	25630	NA	NA	21319.75
LEAD	47.6	NA	NA	24.5
MAGNESIUM	NA	NA	NA	NA
MANGANESE	280	NA	NA	294.25
MERCURY	0.1533	NA	NA	0.015 B
NICKEL	20.5	NA	NA	17.0
POTASSIUM	NA	NA	NA	NA
SELENIUM	NA	NA	NA	NA
SILVER	0.2875	NA	NA	0.065 U
SODIUM	NA	NA	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1A
SUMMARY OF HISTORICAL SEDIMENT ANALYTICAL RESULTS (1993-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-34			
Sample Number	DSY-34-SUR	DSY-34-SURb	DSY-34-SURc	DSY-34-MID
Date Sampled	10/12/1995	10/12/1995	10/12/1995	11/16/1995
QC Identifier				
THALLIUM	NA	NA	NA	NA
VANADIUM	NA	NA	NA	NA
ZINC	105.5	NA	NA	47.0
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (MG/KG)				
CADMIUM	NA	NA	NA	NA
CHROMIUM	NA	NA	NA	NA
COPPER	NA	NA	NA	NA
LEAD	NA	NA	NA	NA
MERCURY	NA	NA	NA	NA
NICKEL	NA	NA	NA	NA
SULFIDE	NA	NA	NA	NA
ZINC	NA	NA	NA	NA
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (UMOLE/G)				
CADMIUM	NA	NA	NA	NA
CHROMIUM	NA	NA	NA	NA
COPPER	NA	NA	NA	NA
LEAD	NA	NA	NA	NA
MERCURY	NA	NA	NA	NA
NICKEL	NA	NA	NA	NA
SEM/AVS RATIO	-28.0893	0.04850	1.4307	NA
SULFIDE	NA	NA	NA	NA
TOTAL SIMULTANEOUSLY EXTRACTED METALS	NA	NA	NA	NA
ZINC	NA	NA	NA	NA
Miscellaneous Analysis (UG/KG)				
DIBUTYLTIN	3.38	NA	NA	0.50
MONOBUTYLTIN	1.85	NA	NA	0.50
TETRABUTYLTIN	0.50	NA	NA	0.50
TRIBUTYLTIN	4.13	NA	NA	0.50
Total Organic Carbon Analysis (MG/KG)				
CARBON	NA	NA	NA	NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

APPENDIX C-1B
ANALYTICAL RESULTS (1995-2004)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

Sample Location	DSY-34				DSY-35						DSY-36						
Sample Number	DSY-34-BOT		DSY-34-MID-D		DSY-35-SUR		DSY-35-SURb		DSY-35-SURc		DSY-36-SUR		DSY-36-SURb		DSY-36-SURc		DSY-36-BOT
Date Sampled	11/16/1995		11/16/1995		10/12/1995		10/12/1995		10/12/1995		9/28/1995		9/28/1995		9/28/1995		11/16/1995
QC Identifier	NM		NM		NM		NM		NM		NM		NM		NM		NM
Semivolatile Organic Analysis (UG/KG)																	
1,1-BIPHENYL	0.64			NA	0.4236	J		NA		NA	10.5031			NA		NA	0.64
1-METHYLNAPHTHALENE	3.255			NA	0.367	J		NA		NA	16.7074			NA		NA	3.255
1-METHYLPHENANTHRENE	2.715			NA	0.5025	J		NA		NA	33.9206			NA		NA	2.0268
2,3,5-TRIMETHYLNAPHTHALENE	0.54			NA	0.1619	J		NA		NA	6.4102			NA		NA	0.54
2,6-DIMETHYLNAPHTHALENE	1.78			NA	1.6908	J		NA		NA	46.6015			NA		NA	1.78
2-METHYLNAPHTHALENE	5.3			NA	0.6455	J		NA		NA	23.0027			NA		NA	5.3
ACENAPHTHENE	0.44			NA	0.2281	J		NA		NA	10.9969			NA		NA	0.44
ACENAPHTHYLENE	0.77			NA	0.6101	J		NA		NA	74.941			NA		NA	1.307
ANTHRACENE	1.085			NA	1.597	J		NA		NA	157.5701			NA		NA	2.5738
BENZO(A)ANTHRACENE	0.7508	J		NA	2.7642	J		NA		NA	221.588			NA		NA	6.8198
BENZO(A)PYRENE	2.415			NA	4.1449	J		NA		NA	319.4442			NA		NA	10.3104
BENZO(B)FLUORANTHENE		NA		NA		NA		NA		NA		NA		NA		NA	
BENZO(B+K)FLUORANTHENE		NA		NA		NA		NA		NA		NA		NA		NA	
BENZO(E)PYRENE	2.04			NA	5.023			NA		NA	274.8794			NA		NA	9.1145
BENZO(G,H,I)PERYLENE	1.1	J		NA	4.1154			NA		NA	195.1419			NA		NA	8.0936
BENZO(K)FLUORANTHENE	3.0432	J		NA	10.9534	J		NA		NA	699.6676			NA		NA	22.0431
CHRYSENE	0.6638	J		NA	3.6345	J		NA		NA	287.3551			NA		NA	7.4692
DIBENZO(A,H)ANTHRACENE	1.39			NA	0.9219	J		NA		NA	48.2962			NA		NA	1.8792
FLUORANTHENE	1.344	J		NA	7.2165	J		NA		NA	345.0788			NA		NA	11.8507
FLUORENE	1.34			NA	0.5791	J		NA		NA	18.0226			NA		NA	1.34
HIGH MOLECULAR WEIGHT PAHS	7.3587			NA	25.1363			NA		NA	1703.2945			NA		NA	53.1417
INDENO(1,2,3-CD)PYRENE	0.935	J		NA	3.1529	J		NA		NA	177.6413			NA		NA	7.1575
LOW MOLECULAR WEIGHT PAHS	12.5909			NA	8.0078			NA		NA	456.2084			NA		NA	19.3377
NAPHTHALENE	2.6			NA	0.6588	J		NA		NA	34.0638			NA		NA	2.6
PERYLENE	27.4437			NA	2.1146			NA		NA	97.6371			NA		NA	7.1512
PHENANTHRENE	1.0559	J		NA	3.6892	J		NA		NA	137.6113			NA		NA	5.7769
PYRENE	0.7951	J		NA	6.4543	J		NA		NA	481.5321			NA		NA	14.8124
TOTAL PAHS	41			NA	61.7			NA		NA	3720			NA		NA	118
Low Concentration PAH (SIM) Analysis (UG/KG)																	

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Number	DSY-34-BOT		DSY-34-MID-D		DSY-35-SUR		DSY-35-SURb		DSY-35-SURc		DSY-36-SUR		DSY-36-SURb		DSY-36-SURc		DSY-36-BOT
Date Sampled	11/16/1995		11/16/1995		10/12/1995		10/12/1995		10/12/1995		9/28/1995		9/28/1995		9/28/1995		11/16/1995
QC Identifier	NM		NM		NM		NM		NM		NM		NM		NM		NM
2-METHYLNAPHTHALENE		NA		NA		NA		NA		NA		NA		NA		NA	
ACENAPHTHENE		NA		NA		NA		NA		NA		NA		NA		NA	
ACENAPHTHYLENE		NA		NA		NA		NA		NA		NA		NA		NA	
ANTHRACENE		NA		NA		NA		NA		NA		NA		NA		NA	
BENZO(A)ANTHRACENE		NA		NA		NA		NA		NA		NA		NA		NA	
BENZO(A)PYRENE		NA		NA		NA		NA		NA		NA		NA		NA	
BENZO(B)FLUORANTHENE		NA		NA		NA		NA		NA		NA		NA		NA	
BENZO(G,H,I)PERYLENE		NA		NA		NA		NA		NA		NA		NA		NA	
BENZO(K)FLUORANTHENE		NA		NA		NA		NA		NA		NA		NA		NA	
CHRYSENE		NA		NA		NA		NA		NA		NA		NA		NA	
DIBENZO(A,H)ANTHRACENE		NA		NA		NA		NA		NA		NA		NA		NA	
FLUORANTHENE		NA		NA		NA		NA		NA		NA		NA		NA	
FLUORENE		NA		NA		NA		NA		NA		NA		NA		NA	
HIGH MOLECULAR WEIGHT PAHS		NA		NA		NA		NA		NA		NA		NA		NA	
INDENO(1,2,3-CD)PYRENE		NA		NA		NA		NA		NA		NA		NA		NA	
LOW MOLECULAR WEIGHT PAHS		NA		NA		NA		NA		NA		NA		NA		NA	
NAPHTHALENE		NA		NA		NA		NA		NA		NA		NA		NA	
PHENANTHRENE		NA		NA		NA		NA		NA		NA		NA		NA	
PYRENE		NA		NA		NA		NA		NA		NA		NA		NA	
TOTAL PAH		NA		NA		NA		NA		NA		NA		NA		NA	
Pesticide/PCB Analysis (UG/KG)																	
2,4'-DDE	0.2723			NA	0.2583			NA		NA	0.2477			NA		NA	0.338
4,4'-DDE	0.1947			NA	0.025			NA		NA	2.6			NA		NA	0.1056
ALDRIN	0.10			NA	0.10			NA		NA	0.10			NA		NA	0.10
HEXACHLOROBENZENE	0.080			NA	0.080			NA		NA	0.080			NA		NA	0.080
MIREX	0.10			NA	0.10			NA		NA	0.368			NA		NA	0.10
PCB Analysis (UG/KG)																	
2,2',5-TRICHLOROBIPHENYL		NA		NA		NA		NA		NA		NA		NA		NA	
2,4'-DICHLOROBIPHENYL		NA		NA		NA		NA		NA		NA		NA		NA	
PCB-101	0.275			NA	0.513			NA		NA	6.729			NA		NA	0.308
PCB-104		NA		NA		NA		NA		NA		NA		NA		NA	
PCB-105	0.035			NA	0.035			NA		NA	1.3672			NA		NA	0.035
PCB-118	0.135			NA	0.135			NA		NA	6.1134			NA		NA	0.135

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Number	DSY-34-BOT		DSY-34-MID-D		DSY-35-SUR		DSY-35-SURb		DSY-35-SURc		DSY-36-SUR		DSY-36-SURb		DSY-36-SURc		DSY-36-BOT
Date Sampled	11/16/1995		11/16/1995		10/12/1995		10/12/1995		10/12/1995		9/28/1995		9/28/1995		9/28/1995		11/16/1995
QC Identifier	NM		NM		NM		NM		NM		NM		NM		NM		NM
PCB-126		NA		NA		NA		NA		NA		NA		NA		NA	
PCB-128	0.1038			NA	0.035			NA		NA	1.8556			NA		NA	0.035
PCB-138	0.2009	J		NA	0.14			NA		NA	9.0808			NA		NA	0.14
PCB-153	0.1088	J		NA	0.2065			NA		NA	7.9963			NA		NA	0.056
PCB-170	0.035			NA	0.1291			NA		NA	1.7487			NA		NA	0.0515
PCB-18	0.1452			NA	0.015			NA		NA	0.4918			NA		NA	0.015
PCB-180	0.045			NA	0.2786			NA		NA	3.1973			NA		NA	0.045
PCB-187	0.0776			NA	0.078			NA		NA	3.3983			NA		NA	0.0624
PCB-188		NA		NA		NA		NA		NA		NA		NA		NA	
PCB-195	0.1085			NA	0.0916			NA		NA	0.324			NA		NA	0.020
PCB-201		NA		NA		NA		NA		NA		NA		NA		NA	
PCB-206	0.2119			NA	0.4362			NA		NA	2.2298			NA		NA	0.4071
PCB-209	0.1962			NA	0.3811			NA		NA	2.3967			NA		NA	0.3936
PCB-28	0.1822			NA	0.2379			NA		NA	1.2711			NA		NA	0.1653
PCB-29		NA		NA		NA		NA		NA		NA		NA		NA	
PCB-44	0.2289			NA	0.3633			NA		NA	1.1167			NA		NA	0.2844
PCB-50		NA		NA		NA		NA		NA		NA		NA		NA	
PCB-52	0.3112			NA	0.5105			NA		NA	1.3674			NA		NA	0.2423
PCB-66	0.1358			NA	0.1228			NA		NA	5.3557			NA		NA	0.084
PCB-8	0.055			NA	0.055			NA		NA	0.5962			NA		NA	0.055
PCB-87		NA		NA		NA		NA		NA		NA		NA		NA	
SUM OF PCB CONGENERS X 2	4.9628			NA	6.6972			NA		NA	113.2718			NA		NA	4.1091
TAL Metal Analysis (MG/KG)																	
ALUMINUM	24773		25610		19687.25			NA		NA	38025			NA		NA	16196.25
ANTIMONY		NA		NA		NA		NA		NA		NA		NA		NA	
ARSENIC	7.41		8.92		3.39			NA		NA	11.21			NA		NA	4.11
BARIUM		NA		NA		NA		NA		NA		NA		NA		NA	
BERYLLIUM		NA		NA		NA		NA		NA		NA		NA		NA	
CADMIUM	0.14	J	0.13	J	0.090	J		NA		NA	0.40	J		NA		NA	0.10
CALCIUM		NA		NA		NA		NA		NA		NA		NA		NA	
CHROMIUM	54.5		44.5		24.25			NA		NA	83.25			NA		NA	30.5
COBALT		NA		NA		NA		NA		NA		NA		NA		NA	
COPPER	4.25		7.75		1.875	U		NA		NA	54.0			NA		NA	1.875

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Number	DSY-34-BOT		DSY-34-MID-D		DSY-35-SUR		DSY-35-SURb		DSY-35-SURc		DSY-36-SUR		DSY-36-SURb		DSY-36-SURc		DSY-36-BOT
Date Sampled	11/16/1995		11/16/1995		10/12/1995		10/12/1995		10/12/1995		9/28/1995		9/28/1995		9/28/1995		11/16/1995
QC Identifier	NM		NM		NM		NM		NM		NM		NM		NM		NM
IRON	23519.75		23879		12660			NA		NA	28620			NA		NA	13836
LEAD	25.7		23.2		14.0			NA		NA	78.8			NA		NA	33.5
MAGNESIUM		NA		NA		NA		NA		NA		NA		NA		NA	
MANGANESE	312		274.25		90.25			NA		NA	312.75			NA		NA	132.25
MERCURY	0.015	B	0.13		0.0675			NA		NA	0.375			NA		NA	0.015
NICKEL	21.5		18.75		5.0	B		NA		NA	25.75			NA		NA	5.0
POTASSIUM		NA		NA		NA		NA		NA		NA		NA		NA	
SELENIUM		NA		NA		NA		NA		NA		NA		NA		NA	
SILVER	0.065	U	0.065	U	0.065	U		NA		NA	0.5625			NA		NA	0.065
SODIUM		NA		NA		NA		NA		NA		NA		NA		NA	
THALLIUM		NA		NA		NA		NA		NA		NA		NA		NA	
VANADIUM		NA		NA		NA		NA		NA		NA		NA		NA	
ZINC	55.5		38.25		28.5			NA		NA	144.25			NA		NA	35.5
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (MG/KG)																	
CADMIUM		NA		NA		NA		NA		NA		NA		NA		NA	
CHROMIUM		NA		NA		NA		NA		NA		NA		NA		NA	
COPPER		NA		NA		NA		NA		NA		NA		NA		NA	
LEAD		NA		NA		NA		NA		NA		NA		NA		NA	
MERCURY		NA		NA		NA		NA		NA		NA		NA		NA	
NICKEL		NA		NA		NA		NA		NA		NA		NA		NA	
SULFIDE		NA		NA		NA		NA		NA		NA		NA		NA	
ZINC		NA		NA		NA		NA		NA		NA		NA		NA	
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (UMOLE/G)																	
CADMIUM		NA		NA		NA		NA		NA		NA		NA		NA	
CHROMIUM		NA		NA		NA		NA		NA		NA		NA		NA	
COPPER		NA		NA		NA		NA		NA		NA		NA		NA	
LEAD		NA		NA		NA		NA		NA		NA		NA		NA	
MERCURY		NA		NA		NA		NA		NA		NA		NA		NA	
NICKEL		NA		NA		NA		NA		NA		NA		NA		NA	

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Number	DSY-34-BOT		DSY-34-MID-D		DSY-35-SUR		DSY-35-SURb		DSY-35-SURc		DSY-36-SUR		DSY-36-SURb		DSY-36-SURc		DSY-36-BOT
Date Sampled	11/16/1995		11/16/1995		10/12/1995		10/12/1995		10/12/1995		9/28/1995		9/28/1995		9/28/1995		11/16/1995
QC Identifier	NM		NM		NM		NM		NM		NM		NM		NM		NM
SEM/AVS RATIO		NA		NA	-0.3243		0.7589		1.0207		-35.5012		0.03910		1.4438		
SULFIDE		NA		NA		NA		NA		NA		NA		NA		NA	
TOTAL SIMULTANEOUSLY EXTRACTED METALS		NA		NA		NA		NA		NA		NA		NA		NA	
ZINC		NA		NA		NA		NA		NA		NA		NA		NA	
Miscellaneous Analysis (UG/KG)																	
DIBUTYLTIN	0.50			NA	0.50			NA		NA	3.22			NA		NA	0.50
MONOBUTYLTIN	0.50			NA	0.50			NA		NA	2.32			NA		NA	0.50
TETRABUTYLTIN	0.50			NA	0.50			NA		NA	0.50			NA		NA	0.50
TRIBUTYLTIN	0.50			NA	0.50			NA		NA	5.01			NA		NA	0.50
Total Organic Carbon Analysis (MG/KG)																	
CARBON		NA		NA		NA		NA		NA		NA		NA		NA	

Sample Location						DSY-37						DSY-38						
Sample Number		DSY-36-MID		DSY-36-BOT-D		DSY-37-SUR		DSY-37-SURb		DSY-37-SURc		DSY-38-SUR		DSY-38-SURb		DSY-38-SURc		DSY-39-SUR
Date Sampled		11/16/1995		11/16/1995		9/28/1995		9/28/1995		9/28/1995		9/28/1995		9/28/1995		9/28/1995		10/12/1995
QC Identifier		NM		NM		NM		NM		NM		NM		NM		NM		NM
Semivolatile Organic Analysis (UG/KG)																		
1,1-BIPHENYL		17.1115			NA	5.7901			NA		NA	5.7017			NA		NA	5.6367
1-METHYLNAPHTHALENE		26.3586			NA	12.6333			NA		NA	9.1653			NA		NA	9.2729
1-METHYLPHENANTHRENE	J	41.5989			NA	39.7996			NA		NA	30.9269			NA		NA	20.2223
2,3,5-TRIMETHYLNAPHTHALENE		11.5575			NA	4.741			NA		NA	4.0373			NA		NA	4.565
2,6-DIMETHYLNAPHTHALENE		82.6702			NA	18.8187			NA		NA	18.3099			NA		NA	14.309
2-METHYLNAPHTHALENE		49.5465			NA	17.6354			NA		NA	13.9583			NA		NA	15.1678
ACENAPHTHENE		27.3787			NA	7.4117			NA		NA	6.5343			NA		NA	10.1533
ACENAPHTHYLENE	J	76.23			NA	34.5103			NA		NA	25.0591			NA		NA	22.5213
ANTHRACENE		144.0166			NA	140.8196			NA		NA	94.0249			NA		NA	77.1908
BENZO(A)ANTHRACENE		263.8047			NA	144.4228			NA		NA	111.562			NA		NA	97.7044
BENZO(A)PYRENE		432.4069			NA	163.8001			NA		NA	119.8243			NA		NA	142.9988
BENZO(B)FLUORANTHENE	NA		NA		NA		NA		NA		NA		NA		NA		NA	
BENZO(B+K)FLUORANTHENE	NA		NA		NA		NA		NA		NA		NA		NA		NA	
BENZO(E)PYRENE		449.4213			NA	139.5178			NA		NA	111.8547			NA		NA	125.9047
BENZO(G,H,I)PERYLENE		300.7021			NA	125.852			NA		NA	94.6462			NA		NA	96.6666
BENZO(K)FLUORANTHENE		865.1706			NA	308.4101			NA		NA	259.8451			NA		NA	302.3467
CHRYSENE	J	271.5133			NA	154.2679			NA		NA	107.1053			NA		NA	119.8757
DIBENZO(A,H)ANTHRACENE	J	96.4263			NA	28.797			NA		NA	21.0294			NA		NA	27.3463
FLUORANTHENE		398.7873			NA	262.1371			NA		NA	229.9813			NA		NA	215.9599
FLUORENE		36.6652			NA	9.7356			NA		NA	6.4167			NA		NA	14.7325
HIGH MOLECULAR WEIGHT PAHS		2129.0725			NA	1115.872			NA		NA	843.8954			NA		NA	830.6092
INDENO(1,2,3-CD)PYRENE		303.8668			NA	100.4461			NA		NA	80.2293			NA		NA	91.2782
LOW MOLECULAR WEIGHT PAHS		635.4366			NA	320.0889			NA		NA	236.3492			NA		NA	279.4344
NAPHTHALENE		66.6058			NA	26.8803			NA		NA	23.2175			NA		NA	23.682
PERYLENE		144.0299			NA	53.2935			NA		NA	51.0892			NA		NA	51.9245
PHENANTHRENE		234.9938			NA	83.0961			NA		NA	67.1385			NA		NA	115.9867
PYRENE		666.134			NA	362.4472			NA		NA	254.393			NA		NA	226.7241
TOTAL PAHS		5010			NA	2250			NA		NA	1750			NA		NA	1830
Low Concentration PAH (SIM) Analysis (UG/KG)																		

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Number		DSY-36-MID		DSY-36-BOT-D		DSY-37-SUR		DSY-37-SURb		DSY-37-SURc		DSY-38-SUR		DSY-38-SURb		DSY-38-SURc		DSY-39-SUR
Date Sampled		11/16/1995		11/16/1995		9/28/1995		9/28/1995		9/28/1995		9/28/1995		9/28/1995		9/28/1995		10/12/1995
QC Identifier		NM		NM		NM		NM		NM		NM		NM		NM		NM
2-METHYLNAPHTHALENE	NA		NA		NA		NA		NA		NA		NA		NA		NA	
ACENAPHTHENE	NA		NA		NA		NA		NA		NA		NA		NA		NA	
ACENAPHTHYLENE	NA		NA		NA		NA		NA		NA		NA		NA		NA	
ANTHRACENE	NA		NA		NA		NA		NA		NA		NA		NA		NA	
BENZO(A)ANTHRACENE	NA		NA		NA		NA		NA		NA		NA		NA		NA	
BENZO(A)PYRENE	NA		NA		NA		NA		NA		NA		NA		NA		NA	
BENZO(B)FLUORANTHENE	NA		NA		NA		NA		NA		NA		NA		NA		NA	
BENZO(G,H,I)PERYLENE	NA		NA		NA		NA		NA		NA		NA		NA		NA	
BENZO(K)FLUORANTHENE	NA		NA		NA		NA		NA		NA		NA		NA		NA	
CHRYSENE	NA		NA		NA		NA		NA		NA		NA		NA		NA	
DIBENZO(A,H)ANTHRACENE	NA		NA		NA		NA		NA		NA		NA		NA		NA	
FLUORANTHENE	NA		NA		NA		NA		NA		NA		NA		NA		NA	
FLUORENE	NA		NA		NA		NA		NA		NA		NA		NA		NA	
HIGH MOLECULAR WEIGHT PAHS	NA		NA		NA		NA		NA		NA		NA		NA		NA	
INDENO(1,2,3-CD)PYRENE	NA		NA		NA		NA		NA		NA		NA		NA		NA	
LOW MOLECULAR WEIGHT PAHS	NA		NA		NA		NA		NA		NA		NA		NA		NA	
NAPHTHALENE	NA		NA		NA		NA		NA		NA		NA		NA		NA	
PHENANTHRENE	NA		NA		NA		NA		NA		NA		NA		NA		NA	
PYRENE	NA		NA		NA		NA		NA		NA		NA		NA		NA	
TOTAL PAH	NA		NA		NA		NA		NA		NA		NA		NA		NA	
Pesticide/PCB Analysis (UG/KG)																		
2,4'-DDE		7.8661			NA	0.10			NA		NA	0.10			NA		NA	0.7129
4,4'-DDE		14.2656			NA	1.3518			NA		NA	1.2931			NA		NA	0.732
ALDRIN		0.10			NA	0.10			NA		NA	0.10			NA		NA	0.10
HEXACHLOROBENZENE		0.080			NA	0.080			NA		NA	0.080			NA		NA	0.080
MIREX		2.2239			NA	0.3619			NA		NA	0.3448			NA		NA	0.10
PCB Analysis (UG/KG)																		
2,2',5-TRICHLOROBIPHENYL	NA		NA		NA		NA		NA		NA		NA		NA		NA	
2,4'-DICHLOROBIPHENYL	NA		NA		NA		NA		NA		NA		NA		NA		NA	
PCB-101		21.172			NA	6.356			NA		NA	2.8			NA		NA	2.087
PCB-104	NA		NA		NA		NA		NA		NA		NA		NA		NA	
PCB-105		9.6886			NA	1.4095			NA		NA	0.5768			NA		NA	0.5358
PCB-118		22.9353			NA	5.2959			NA		NA	2.4862			NA		NA	2.2526

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Number		DSY-36-MID		DSY-36-BOT-D		DSY-37-SUR		DSY-37-SURb		DSY-37-SURc		DSY-38-SUR		DSY-38-SURb		DSY-38-SURc		DSY-39-SUR
Date Sampled		11/16/1995		11/16/1995		9/28/1995		9/28/1995		9/28/1995		9/28/1995		9/28/1995		9/28/1995		10/12/1995
QC Identifier		NM		NM		NM		NM		NM		NM		NM		NM		NM
PCB-126	NA		NA		NA		NA		NA		NA		NA		NA		NA	
PCB-128		8.1933			NA	1.7673			NA		NA	0.8325			NA		NA	0.6028
PCB-138		34.7309			NA	7.3905			NA		NA	5.1287			NA		NA	4.1426
PCB-153	J	25.8305			NA	5.8466			NA		NA	4.4583			NA		NA	4.4188
PCB-170	J	8.5214			NA	1.4043			NA		NA	1.3398			NA		NA	1.5161
PCB-18		2.0864			NA	0.3356			NA		NA	0.6802			NA		NA	0.2468
PCB-180		13.6693			NA	2.5359			NA		NA	2.5176			NA		NA	2.7745
PCB-187		9.0519			NA	2.3954			NA		NA	1.909			NA		NA	1.8472
PCB-188	NA		NA		NA		NA		NA		NA		NA		NA		NA	
PCB-195		1.0191			NA	0.1839			NA		NA	0.27			NA		NA	0.5727
PCB-201	NA		NA		NA		NA		NA		NA		NA		NA		NA	
PCB-206		7.4894			NA	2.7861			NA		NA	1.1182			NA		NA	1.9276
PCB-209		5.4607			NA	3.1046			NA		NA	1.5548			NA		NA	2.072
PCB-28		3.1201			NA	0.7645			NA		NA	0.5629			NA		NA	0.7922
PCB-29	NA		NA		NA		NA		NA		NA		NA		NA		NA	
PCB-44		6.026			NA	1.051			NA		NA	0.4708			NA		NA	0.9304
PCB-50	NA		NA		NA		NA		NA		NA		NA		NA		NA	
PCB-52		10.5182			NA	2.0985			NA		NA	0.7066			NA		NA	1.2025
PCB-66		5.5719			NA	4.7669			NA		NA	2.0839			NA		NA	0.8999
PCB-8		1.6442			NA	0.4582			NA		NA	0.1693			NA		NA	0.2574
PCB-87	NA		NA		NA		NA		NA		NA		NA		NA		NA	
SUM OF PCB CONGENERS X 2		393.4579			NA	99.9017			NA		NA	59.3308			NA		NA	58.1578
TAL Metal Analysis (MG/KG)																		
ALUMINUM		31102.5		19920.75		27560			NA		NA	37845			NA		NA	34007.5
ANTIMONY	NA		NA		NA		NA		NA		NA		NA		NA		NA	
ARSENIC		7.79		4.56		7.41			NA		NA	8.94			NA		NA	7.58
BARIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA	
BERYLLIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA	
CADMIUM	J	0.93	J	0.050	J	0.32	J		NA		NA	0.25	J		NA		NA	0.18
CALCIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA	
CHROMIUM		110.5		27.75		56.5			NA		NA	66.0			NA		NA	56.5
COBALT	NA		NA		NA		NA		NA		NA		NA		NA		NA	
COPPER	U	104.5		4.0		27.0			NA		NA	28.0			NA		NA	20.0

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Number		DSY-36-MID		DSY-36-BOT-D		DSY-37-SUR		DSY-37-SURb		DSY-37-SURc		DSY-38-SUR		DSY-38-SURb		DSY-38-SURc		DSY-39-SUR
Date Sampled		11/16/1995		11/16/1995		9/28/1995		9/28/1995		9/28/1995		9/28/1995		9/28/1995		9/28/1995		10/12/1995
QC Identifier		NM		NM		NM		NM		NM		NM		NM		NM		NM
IRON		28667.5		14162.75		20071.5			NA		NA	26180			NA		NA	21417.75
LEAD		112.5		20.9		56.9			NA		NA	62.2			NA		NA	54.0
MAGNESIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA	
MANGANESE		317.25		134.25		265			NA		NA	333.75			NA		NA	285.25
MERCURY	B	0.75		0.050		0.2775			NA		NA	0.2625			NA		NA	0.1498
NICKEL	B	30.75		5.0	B	16.75			NA		NA	22.0			NA		NA	17.75
POTASSIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA	
SELENIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA	
SILVER	U	1.54		0.065	U	0.3875			NA		NA	0.1625			NA		NA	0.2625
SODIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA	
THALLIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA	
VANADIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA	
ZINC		213.75		20.25		93.5			NA		NA	109			NA		NA	97.25
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (MG/KG)																		
CADMIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA	
CHROMIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA	
COPPER	NA		NA		NA		NA		NA		NA		NA		NA		NA	
LEAD	NA		NA		NA		NA		NA		NA		NA		NA		NA	
MERCURY	NA		NA		NA		NA		NA		NA		NA		NA		NA	
NICKEL	NA		NA		NA		NA		NA		NA		NA		NA		NA	
SULFIDE	NA		NA		NA		NA		NA		NA		NA		NA		NA	
ZINC	NA		NA		NA		NA		NA		NA		NA		NA		NA	
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (UMOLE/G)																		
CADMIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA	
CHROMIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA	
COPPER	NA		NA		NA		NA		NA		NA		NA		NA		NA	
LEAD	NA		NA		NA		NA		NA		NA		NA		NA		NA	
MERCURY	NA		NA		NA		NA		NA		NA		NA		NA		NA	
NICKEL	NA		NA		NA		NA		NA		NA		NA		NA		NA	

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Number		DSY-36-MID		DSY-36-BOT-D		DSY-37-SUR		DSY-37-SURb		DSY-37-SURc		DSY-38-SUR		DSY-38-SURb		DSY-38-SURc		DSY-39-SUR
Date Sampled		11/16/1995		11/16/1995		9/28/1995		9/28/1995		9/28/1995		9/28/1995		9/28/1995		9/28/1995		10/12/1995
QC Identifier		NM		NM		NM		NM		NM		NM		NM		NM		NM
SEM/AVS RATIO	NA		NA		NA	0.3814		1.1599		2.7664		-27.8734		0.06420		1.9116		-19.241
SULFIDE	NA		NA		NA		NA		NA		NA		NA		NA		NA	
TOTAL SIMULTANEOUSLY EXTRACTED METALS	NA		NA		NA		NA		NA		NA		NA		NA		NA	
ZINC	NA		NA		NA		NA		NA		NA		NA		NA		NA	
Miscellaneous Analysis (UG/KG)																		
DIBUTYLTIN		0.50			NA	0.50			NA		NA	0.50			NA		NA	0.50
MONOBUTYLTIN		0.50			NA	0.50			NA		NA	0.50			NA		NA	0.50
TETRABUTYLTIN		0.50			NA	0.50			NA		NA	0.50			NA		NA	0.50
TRIBUTYLTIN		0.50			NA	0.50			NA		NA	0.50			NA		NA	0.50
Total Organic Carbon Analysis (MG/KG)																		
CARBON	NA		NA		NA		NA		NA		NA		NA		NA		NA	

Sample Location	DSY-39					DSY-40						DSY-41					
Sample Number		DSY-39-SURb		DSY-39-SURc		DSY-40-SUR		DSY-40-SURb		DSY-40-SURc		DSY-41-SUR		DSY-41-SURb		DSY-41-SURc	
Date Sampled		10/12/1995		10/12/1995		10/12/1995		10/12/1995		10/12/1995		10/12/1995		10/12/1995		10/12/1995	
QC Identifier		NM		NM		NM		NM		NM		NM		NM		NM	
Semivolatile Organic Analysis (UG/KG)																	
1,1-BIPHENYL			NA		NA	6.0243			NA		NA	0.6608	J		NA		NA
1-METHYLNAPHTHALENE			NA		NA	9.4141			NA		NA	1.274	J		NA		NA
1-METHYLPHENANTHRENE			NA		NA	38.2603			NA		NA	2.2161	J		NA		NA
2,3,5-TRIMETHYLNAPHTHALENE			NA		NA	4.6604			NA		NA	0.45	J		NA		NA
2,6-DIMETHYLNAPHTHALENE			NA		NA	17.328			NA		NA	2.36	J		NA		NA
2-METHYLNAPHTHALENE			NA		NA	16.3906			NA		NA	2.0144	J		NA		NA
ACENAPHTHENE			NA		NA	16.2043			NA		NA	1.7107			NA		NA
ACENAPHTHYLENE			NA		NA	95.6494			NA		NA	0.77			NA		NA
ANTHRACENE			NA		NA	233.9226			NA		NA	11.0984			NA		NA
BENZO(A)ANTHRACENE			NA		NA	233.5916			NA		NA	13.7614			NA		NA
BENZO(A)PYRENE			NA		NA	316.6461			NA		NA	18.5537			NA		NA
BENZO(B)FLUORANTHENE	NA		NA		NA		NA		NA		NA		NA		NA		NA
BENZO(B+K)FLUORANTHENE	NA		NA		NA		NA		NA		NA		NA		NA		NA
BENZO(E)PYRENE			NA		NA	333.0076			NA		NA	19.4418			NA		NA
BENZO(G,H,I)PERYLENE			NA		NA	183.6859			NA		NA	12.178			NA		NA
BENZO(K)FLUORANTHENE			NA		NA	835.598			NA		NA	47.2615			NA		NA
CHRYSENE			NA		NA	444.3335			NA		NA	20.6496			NA		NA
DIBENZO(A,H)ANTHRACENE			NA		NA	52.7742			NA		NA	3.1757			NA		NA
FLUORANTHENE			NA		NA	779.3467			NA		NA	37.8307			NA		NA
FLUORENE			NA		NA	19.0906			NA		NA	2.0935	J		NA		NA
HIGH MOLECULAR WEIGHT PAHS			NA		NA	3016.6921			NA		NA	143.5151			NA		NA
INDENO(1,2,3-CD)PYRENE			NA		NA	165.5701			NA		NA	11.4375			NA		NA
LOW MOLECULAR WEIGHT PAHS			NA		NA	705.8468			NA		NA	39.6856			NA		NA
NAPHTHALENE			NA		NA	20.9993			NA		NA	1.8391	J		NA		NA
PERYLENE			NA		NA	78.6964			NA		NA	7.3112			NA		NA
PHENANTHRENE			NA		NA	303.59			NA		NA	20.1595			NA		NA
PYRENE			NA		NA	1190			NA		NA	49.544			NA		NA
TOTAL PAHS			NA		NA	5390			NA		NA	291			NA		NA
Low Concentration PAH (SIM) Analysis (UG/KG)																	

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Number		DSY-39-SURb		DSY-39-SURc		DSY-40-SUR		DSY-40-SURb		DSY-40-SURc		DSY-41-SUR		DSY-41-SURb		DSY-41-SURc	
Date Sampled		10/12/1995		10/12/1995		10/12/1995		10/12/1995		10/12/1995		10/12/1995		10/12/1995		10/12/1995	
QC Identifier		NM		NM		NM		NM		NM		NM		NM		NM	
2-METHYLNAPHTHALENE	NA		NA		NA		NA		NA		NA		NA		NA		NA
ACENAPHTHENE	NA		NA		NA		NA		NA		NA		NA		NA		NA
ACENAPHTHYLENE	NA		NA		NA		NA		NA		NA		NA		NA		NA
ANTHRACENE	NA		NA		NA		NA		NA		NA		NA		NA		NA
BENZO(A)ANTHRACENE	NA		NA		NA		NA		NA		NA		NA		NA		NA
BENZO(A)PYRENE	NA		NA		NA		NA		NA		NA		NA		NA		NA
BENZO(B)FLUORANTHENE	NA		NA		NA		NA		NA		NA		NA		NA		NA
BENZO(G,H,I)PERYLENE	NA		NA		NA		NA		NA		NA		NA		NA		NA
BENZO(K)FLUORANTHENE	NA		NA		NA		NA		NA		NA		NA		NA		NA
CHRYSENE	NA		NA		NA		NA		NA		NA		NA		NA		NA
DIBENZO(A,H)ANTHRACENE	NA		NA		NA		NA		NA		NA		NA		NA		NA
FLUORANTHENE	NA		NA		NA		NA		NA		NA		NA		NA		NA
FLUORENE	NA		NA		NA		NA		NA		NA		NA		NA		NA
HIGH MOLECULAR WEIGHT PAHS	NA		NA		NA		NA		NA		NA		NA		NA		NA
INDENO(1,2,3-CD)PYRENE	NA		NA		NA		NA		NA		NA		NA		NA		NA
LOW MOLECULAR WEIGHT PAHS	NA		NA		NA		NA		NA		NA		NA		NA		NA
NAPHTHALENE	NA		NA		NA		NA		NA		NA		NA		NA		NA
PHENANTHRENE	NA		NA		NA		NA		NA		NA		NA		NA		NA
PYRENE	NA		NA		NA		NA		NA		NA		NA		NA		NA
TOTAL PAH	NA		NA		NA		NA		NA		NA		NA		NA		NA
Pesticide/PCB Analysis (UG/KG)																	
2,4'-DDE			NA		NA	1.0651			NA		NA	0.3972			NA		NA
4,4'-DDE			NA		NA	1.1393			NA		NA	0.0771			NA		NA
ALDRIN			NA		NA	0.10			NA		NA	0.10			NA		NA
HEXACHLOROBENZENE			NA		NA	0.080			NA		NA	0.080			NA		NA
MIREX			NA		NA	0.2276			NA		NA	0.10			NA		NA
PCB Analysis (UG/KG)																	
2,2',5-TRICHLOROBIPHENYL	NA		NA		NA		NA		NA		NA		NA		NA		NA
2,4'-DICHLOROBIPHENYL	NA		NA		NA		NA		NA		NA		NA		NA		NA
PCB-101			NA		NA	3.933			NA		NA	0.515			NA		NA
PCB-104	NA		NA		NA		NA		NA		NA		NA		NA		NA
PCB-105			NA		NA	1.5466			NA		NA	0.107			NA		NA
PCB-118			NA		NA	4.8452			NA		NA	0.362			NA		NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Number		DSY-39-SURb		DSY-39-SURc		DSY-40-SUR		DSY-40-SURb		DSY-40-SURc		DSY-41-SUR		DSY-41-SURb		DSY-41-SURc	
Date Sampled		10/12/1995		10/12/1995		10/12/1995		10/12/1995		10/12/1995		10/12/1995		10/12/1995		10/12/1995	
QC Identifier		NM		NM		NM		NM		NM		NM		NM		NM	
PCB-126	NA		NA		NA		NA		NA		NA		NA		NA		NA
PCB-128			NA		NA	1.4168			NA		NA	0.2303			NA		NA
PCB-138			NA		NA	7.0954			NA		NA	0.5885			NA		NA
PCB-153			NA		NA	5.8684			NA		NA	0.5212			NA		NA
PCB-170			NA		NA	1.7081			NA		NA	0.1686			NA		NA
PCB-18			NA		NA	0.3392			NA		NA	0.2655			NA		NA
PCB-180			NA		NA	3.4588			NA		NA	0.3314			NA		NA
PCB-187			NA		NA	2.2572			NA		NA	0.2927			NA		NA
PCB-188	NA		NA		NA		NA		NA		NA		NA		NA		NA
PCB-195			NA		NA	0.5608			NA		NA	0.1661			NA		NA
PCB-201	NA		NA		NA		NA		NA		NA		NA		NA		NA
PCB-206			NA		NA	2.3933			NA		NA	0.6884			NA		NA
PCB-209			NA		NA	2.8384			NA		NA	0.7888			NA		NA
PCB-28			NA		NA	0.6664			NA		NA	0.2029			NA		NA
PCB-29	NA		NA		NA		NA		NA		NA		NA		NA		NA
PCB-44			NA		NA	0.8039			NA		NA	0.5151			NA		NA
PCB-50	NA		NA		NA		NA		NA		NA		NA		NA		NA
PCB-52			NA		NA	1.4743			NA		NA	0.7292			NA		NA
PCB-66			NA		NA	0.7126			NA		NA	0.2372			NA		NA
PCB-8			NA		NA	0.1474			NA		NA	0.1667			NA		NA
PCB-87	NA		NA		NA		NA		NA		NA		NA		NA		NA
SUM OF PCB CONGENERS X 2			NA		NA	84.1312			NA		NA	13.7532			NA		NA
TAL Metal Analysis (MG/KG)																	
ALUMINUM			NA		NA	25730			NA		NA	26762.5			NA		NA
ANTIMONY	NA		NA		NA		NA		NA		NA		NA		NA		NA
ARSENIC			NA		NA	6.79			NA		NA	11.43			NA		NA
BARIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA
BERYLLIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA
CADMIUM	J		NA		NA	0.50	J		NA		NA	0.18	J		NA		NA
CALCIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA
CHROMIUM			NA		NA	44.5			NA		NA	36.75			NA		NA
COBALT	NA		NA		NA		NA		NA		NA		NA		NA		NA
COPPER			NA		NA	29.75			NA		NA	9.25			NA		NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Number		DSY-39-SURb		DSY-39-SURc		DSY-40-SUR		DSY-40-SURb		DSY-40-SURc		DSY-41-SUR		DSY-41-SURb		DSY-41-SURc	
Date Sampled		10/12/1995		10/12/1995		10/12/1995		10/12/1995		10/12/1995		10/12/1995		10/12/1995		10/12/1995	
QC Identifier		NM		NM		NM		NM		NM		NM		NM		NM	
IRON			NA		NA	20511			NA		NA	17739.25			NA		NA
LEAD			NA		NA	42.1			NA		NA	17.0			NA		NA
MAGNESIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA
MANGANESE			NA		NA	116.5			NA		NA	106			NA		NA
MERCURY			NA		NA	0.1943			NA		NA	0.015	B		NA		NA
NICKEL			NA		NA	17.25			NA		NA	14.5			NA		NA
POTASSIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA
SELENIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA
SILVER			NA		NA	0.2125			NA		NA	0.065	U		NA		NA
SODIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA
THALLIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA
VANADIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA
ZINC			NA		NA	100.25			NA		NA	47.25			NA		NA
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (MG/KG)																	
CADMIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA
CHROMIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA
COPPER	NA		NA		NA		NA		NA		NA		NA		NA		NA
LEAD	NA		NA		NA		NA		NA		NA		NA		NA		NA
MERCURY	NA		NA		NA		NA		NA		NA		NA		NA		NA
NICKEL	NA		NA		NA		NA		NA		NA		NA		NA		NA
SULFIDE	NA		NA		NA		NA		NA		NA		NA		NA		NA
ZINC	NA		NA		NA		NA		NA		NA		NA		NA		NA
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (UMOLE/G)																	
CADMIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA
CHROMIUM	NA		NA		NA		NA		NA		NA		NA		NA		NA
COPPER	NA		NA		NA		NA		NA		NA		NA		NA		NA
LEAD	NA		NA		NA		NA		NA		NA		NA		NA		NA
MERCURY	NA		NA		NA		NA		NA		NA		NA		NA		NA
NICKEL	NA		NA		NA		NA		NA		NA		NA		NA		NA

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Number		DSY-39-SURb		DSY-39-SURc		DSY-40-SUR		DSY-40-SURb		DSY-40-SURc		DSY-41-SUR		DSY-41-SURb		DSY-41-SURc	
Date Sampled		10/12/1995		10/12/1995		10/12/1995		10/12/1995		10/12/1995		10/12/1995		10/12/1995		10/12/1995	
QC Identifier		NM		NM		NM		NM		NM		NM		NM		NM	
SEM/AVS RATIO		0.1121		2.429		-16.6219		0.1152		2.1631		-3.2097		0.2899		1.3103	
SULFIDE	NA		NA		NA		NA		NA		NA		NA		NA		NA
TOTAL SIMULTANEOUSLY EXTRACTED METALS	NA		NA		NA		NA		NA		NA		NA		NA		NA
ZINC	NA		NA		NA		NA		NA		NA		NA		NA		NA
Miscellaneous Analysis (UG/KG)																	
DIBUTYLTIN			NA		NA	4.9			NA		NA	0.50			NA		NA
MONOBUTYLTIN			NA		NA	3.32			NA		NA	0.50			NA		NA
TETRABUTYLTIN			NA		NA	0.50			NA		NA	0.50			NA		NA
TRIBUTYLTIN			NA		NA	4.21			NA		NA	0.50			NA		NA
Total Organic Carbon Analysis (MG/KG)																	
CARBON	NA		NA		NA		NA		NA		NA		NA		NA		NA

Sample Location	DSY-SD-101				DSY-SD-103				DSY-SD-104			
Sample Number	DSY-SD-101-0006		DSY-SD-101-0612		DSY-SD-103-0006		DSY-SD-103-0612		DSY-SD-104-0006		DSY-SD-104-0612	
Date Sampled	8/25/2004		8/25/2004		8/25/2004		8/25/2004		8/25/2004		8/25/2004	
QC Identifier	NM		NM		NM		NM		NM		NM	
Semivolatile Organic Analysis (UG/KG)												
1,1-BIPHENYL		NA		NA		NA		NA		NA		NA
1-METHYLNAPHTHALENE		NA		NA		NA		NA		NA		NA
1-METHYLPHENANTHRENE		NA		NA		NA		NA		NA		NA
2,3,5-TRIMETHYLNAPHTHALENE		NA		NA		NA		NA		NA		NA
2,6-DIMETHYLNAPHTHALENE		NA		NA		NA		NA		NA		NA
2-METHYLNAPHTHALENE		NA		NA		NA		NA		NA		NA
ACENAPHTHENE		NA		NA		NA		NA		NA		NA
ACENAPHTHYLENE		NA		NA		NA		NA		NA		NA
ANTHRACENE		NA		NA		NA		NA		NA		NA
BENZO(A)ANTHRACENE		NA		NA		NA		NA		NA		NA
BENZO(A)PYRENE		NA		NA		NA		NA		NA		NA
BENZO(B)FLUORANTHENE		NA		NA		NA		NA		NA		NA
BENZO(B+K)FLUORANTHENE		NA		NA		NA		NA		NA		NA
BENZO(E)PYRENE		NA		NA		NA		NA		NA		NA
BENZO(G,H,I)PERYLENE		NA		NA		NA		NA		NA		NA
BENZO(K)FLUORANTHENE		NA		NA		NA		NA		NA		NA
CHRYSENE		NA		NA		NA		NA		NA		NA
DIBENZO(A,H)ANTHRACENE		NA		NA		NA		NA		NA		NA
FLUORANTHENE		NA		NA		NA		NA		NA		NA
FLUORENE		NA		NA		NA		NA		NA		NA
HIGH MOLECULAR WEIGHT PAHS		NA		NA		NA		NA		NA		NA
INDENO(1,2,3-CD)PYRENE		NA		NA		NA		NA		NA		NA
LOW MOLECULAR WEIGHT PAHS		NA		NA		NA		NA		NA		NA
NAPHTHALENE		NA		NA		NA		NA		NA		NA
PERYLENE		NA		NA		NA		NA		NA		NA
PHENANTHRENE		NA		NA		NA		NA		NA		NA
PYRENE		NA		NA		NA		NA		NA		NA
TOTAL PAHS		NA		NA		NA		NA		NA		NA
Low Concentration PAH (SIM) Analysis (UG/KG)												

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Number	DSY-SD-101-0006		DSY-SD-101-0612		DSY-SD-103-0006		DSY-SD-103-0612		DSY-SD-104-0006		DSY-SD-104-0612	
Date Sampled	8/25/2004		8/25/2004		8/25/2004		8/25/2004		8/25/2004		8/25/2004	
QC Identifier	NM		NM		NM		NM		NM		NM	
2-METHYLNAPHTHALENE	9.6		9.5		8.5	U	28		11	U	10	UJ
ACENAPHTHENE	8.0		9.8		10		170		11	U	14	J
ACENAPHTHYLENE	44		63		33		89		18		45	J
ANTHRACENE	54		93		82		470		30		98	J
BENZO(A)ANTHRACENE	230		340		500		2000	*	140		290	J
BENZO(A)PYRENE	270		420		360		1400	*	140		320	J
BENZO(B)FLUORANTHENE	420		740	*	560		2200	*	250		530	J
BENZO(G,H,I)PERYLENE	110		150		130		420		78		140	J
BENZO(K)FLUORANTHENE	160		230		210		850	*	64		200	J
CHRYSENE	240		380		330		2100	*	140		330	J
DIBENZO(A,H)ANTHRACENE	31		43		43		120		20		36	J
FLUORANTHENE	300		290		460		7300	*	130		380	J
FLUORENE	15		21		16		110		11	U	23	J
HIGH MOLECULAR WEIGHT PAHS	2541		4743		4223		23070		1316		2966	
INDENO(1,2,3-CD)PYRENE	110		150		130		380		64		120	J
LOW MOLECULAR WEIGHT PAHS	240.6		358.3		225		1415		111		392	
NAPHTHALENE	10		12		8.5	U	48		11	U	12	J
PHENANTHRENE	100		150		84		500		63		200	J
PYRENE	670	*	2000	*	1500	*	6300	*	290		620	J
TOTAL PAH	2781.6		5101.3		4448		24485		1427		3358	
Pesticide/PCB Analysis (UG/KG)												
2,4'-DDE		NA		NA		NA		NA		NA		NA
4,4'-DDE		NA		NA		NA		NA		NA		NA
ALDRIN		NA		NA		NA		NA		NA		NA
HEXACHLOROBENZENE		NA		NA		NA		NA		NA		NA
MIREX		NA		NA		NA		NA		NA		NA
PCB Analysis (UG/KG)												
2,2',5-TRICHLOROBIPHENYL	5.86	JEB	4.65	JEB	7.39	JEB	5.15	JEB	0.244	JEB	0.81	JEB
2,4'-DICHLOROBIPHENYL	3.48	EB	2.48	EB	7.91	JEB	11.8	JEB	0.431	JEB	0.885	EB
PCB-101	13.1	J	24.6	J	55.8	J	52.9	J	7.38	J	12.5	J
PCB-104		NA		NA		NA		NA		NA		NA
PCB-105	3.76		7.29		20.9		20.1		2.37		3.41	
PCB-118	10.4		19.2		50.9		46.9		7.07		9.76	

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Number	DSY-SD-101-0006		DSY-SD-101-0612		DSY-SD-103-0006		DSY-SD-103-0612		DSY-SD-104-0006		DSY-SD-104-0612	
Date Sampled	8/25/2004		8/25/2004		8/25/2004		8/25/2004		8/25/2004		8/25/2004	
QC Identifier	NM		NM		NM		NM		NM		NM	
PCB-126		NA		NA		NA		NA		NA		NA
PCB-128	2.41	J	4.32	J	9.27	J	9.81	J	1.84	J	2.51	J
PCB-138	16.4	J	28.6	J	54.1	J	57.7	J	12.4	J	17.1	J
PCB-153	15.1	J	23.5	J	40.4	J	43.1	J	11.1	J	15.8	J
PCB-170	2.85		4.43		6.94		7.08		2.3		3.15	
PCB-18		NA		NA		NA		NA		NA		NA
PCB-180	7.78	J	11.1	J	16.3	J	18.3	J	5.5	J	7.25	J
PCB-187	7.34		8.55		11.8		13.1		4.6		6.18	
PCB-188		NA		NA		NA		NA		NA		NA
PCB-195	0.947	J	1.42		1.72	J	2.28		0.603		0.857	
PCB-201		NA		NA		NA		NA		NA		NA
PCB-206	1.28		1.86		2.74		3.94		1.58		1.56	
PCB-209	1.69		3.36		3.03		3.49		6.05		3.03	
PCB-28	15.1	J	12	J	12.8	J	11.2	J	1.25	J	1.92	J
PCB-29		NA		NA		NA		NA		NA		NA
PCB-44	14.2	JEB	13.6	JEB	21.2	JEB	17.9	JEB	1.67	JEB	4.0	JEB
PCB-50		NA		NA		NA		NA		NA		NA
PCB-52	13.9	EB	19	EB	40.3	EB	32	EB	3.09	EB	6.62	EB
PCB-66	17.9		15		18.6		17.6		2.68		4.22	
PCB-8		NA		NA		NA		NA		NA		NA
PCB-87		NA		NA		NA		NA		NA		NA
SUM OF PCB CONGENERS X 2	307		410		764		749		144		203	
TAL Metal Analysis (MG/KG)												
ALUMINUM	11500		10400		10200		10400		13700		15500	
ANTIMONY	0.58	UJ	1.9	UJ	0.48	UJ	0.85	UJ	0.42	UJ	0.43	UJ
ARSENIC	9.4	J	8.2	J	9.1	J	9.1	J	10.1	J	11.1	J
BARIUM	36.9		34.5		36.2		22.5	J	41.2		48.1	
BERYLLIUM	0.98		0.85		0.93		0.75		1.2		1.4	
CADMIUM	0.87	J	1.2	J	0.57	J	0.93	J	0.55	J	0.68	J
CALCIUM	6690	J	9570	J	27500	J	7550	J	14100	J	9130	J
CHROMIUM	41.4		47.3		40.1		56.1		50.1		58.1	
COBALT	8.4	J	7.8	J	6.8	J	7.8	J	8.2	J	9.2	J
COPPER	55.9	J	66.8	J	85.9	J	218		77.7	J	107	J

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Number	DSY-SD-101-0006		DSY-SD-101-0612		DSY-SD-103-0006		DSY-SD-103-0612		DSY-SD-104-0006		DSY-SD-104-0612	
Date Sampled	8/25/2004		8/25/2004		8/25/2004		8/25/2004		8/25/2004		8/25/2004	
QC Identifier	NM		NM		NM		NM		NM		NM	
IRON	21100		19600		22900		24400		27600		30600	
LEAD	40.7	J	49.0	J	71.6	J	168	J	58.4	J	75.6	J
MAGNESIUM	6600		6220		6840		5170		9120		9670	
MANGANESE	313		299		225		206		289		325	
MERCURY	0.21		0.62		0.28		0.55		0.27		0.39	
NICKEL	20.3	J	24.3	J	20.8	J	24.5	J	21.8	J	24.2	J
POTASSIUM	3250	J	2810	J	2910	J	2070	J	4430		4730	J
SELENIUM		R	0.35	U	0.43	U	0.41	R	0.57	U		R
SILVER	0.42	J	0.50	J	0.22	UJ	0.64	J	0.28	UJ	0.29	UJ
SODIUM	9470		9890		13200		3480	J	22400		20900	
THALLIUM	1.9	UJ	1.5	UJ	1.6	UJ	1.8	UJ	2.1	UJ	2.1	UJ
VANADIUM	35.9		36.3		40.6		39.3		48.6		54.6	
ZINC	144	J	178		200		401		166	J	205	J
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (MG/KG)												
CADMIUM	0.6700		0.5000		0.3900		1.100		5.700		0.3800	B
CHROMIUM	9.500		14.60		11.20		14.80		13.60		12.40	
COPPER	25.50	N*	11.20	N*	26.20	N*	12.50	N*	189.0	N*	32.20	N*
LEAD	34.00		53.50		70.30		104.0		49.50		64.40	
MERCURY	0.005500	BN	0.0009300	UN	0.001200	UN	0.001000	UN	0.004700	BN	0.001500	UN
NICKEL	4.400	N*	3.700	N*	6.500	N*	26.30	N*	193.0	N*	7.300	N*
SULFIDE	280.0		550.0		1800		1700		2300		1700	
ZINC	82.90		123.0		137.0		619.0		284.0		128.0	
Acid Volatile Sulfides/Simultaneously Extracted Metals Analysis (UMOLE/G)												
CADMIUM	0.006000		0.004500		0.003400		0.009600		0.05110		0.003350	U
CHROMIUM	0.1832		0.2811		0.2149		0.2838		0.2624		0.2376	
COPPER	0.4020	J	0.1769	J	0.4125	J	0.1964	J	2.9733	J	0.5068	J
LEAD	0.1641		0.2582		0.3391		0.5016		0.2389		0.3107	
MERCURY	0.00004500	UJ	0.00004700	UJ	0.00006200	UJ	0.00005200	UJ	0.00007900	UJ	0.00007500	UJ
NICKEL	0.07460	J	0.06220	UJ	0.1099	J	0.4483	J	3.2936	J	0.1248	J

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

Sample Number	DSY-SD-101-0006		DSY-SD-101-0612		DSY-SD-103-0006		DSY-SD-103-0612		DSY-SD-104-0006		DSY-SD-104-0612	
Date Sampled	8/25/2004		8/25/2004		8/25/2004		8/25/2004		8/25/2004		8/25/2004	
QC Identifier	NM		NM		NM		NM		NM		NM	
SEM/AVS RATIO	0.2405		0.1533		0.05760		0.2097		0.1546		0.06050	
SULFIDE	8.7213	J	17.0062	J	55.1061	J	52.0081	J	72.1943	J	51.907	J
TOTAL SIMULTANEOUSLY EXTRACTED METALS	2.0973		2.6064		3.1732		10.9058		11.1596		3.1429	
ZINC	1.2674	J	1.8857	J	2.0934	J	9.4661	J	4.3403	J	1.963	J
Miscellaneous Analysis (UG/KG)												
DIBUTYLTIN		NA		NA		NA		NA		NA		NA
MONOBUTYLTIN		NA		NA		NA		NA		NA		NA
TETRABUTYLTIN		NA		NA		NA		NA		NA		NA
TRIBUTYLTIN		NA		NA		NA		NA		NA		NA
Total Organic Carbon Analysis (MG/KG)												
CARBON	18000		17000		32000		22000		26000		23000	

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
R - Rejected; NA - Not Analyzed; * - From dilution analysis

C-2 SEDIMENT DATA FROM 2011

APPENDIX C-2A
ANALYTICAL RESULTS FOR 0 TO 1 FOOT INTERVAL SEDIMENT SAMPLES (2011)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
FEASIBILITY STUDY
NAVSTA NEWPORT, NEWPORT RI

SAMPLE ID	Comparison Criteria	DSY-SD-18-0012	DSY-SD-AA01-0012	DSY-SD-AA05-0012	DSY-SD-AA09-0012	DSY-SD-AA13-0012	DSY-SD-AA17-0012	DSY-SD-AA21-0012	DSY-SD-AA24-0012	DSY-SD-AA26-0012	DSY-SD-AA28-0016-AVG	DSY-SD-AA30-0012	DSY-SD-AB11-0012	DSY-SD-AB15-0012	DSY-SD-AC24-0012	DSY-SD-AC26-0012	DSY-SD-AC28-0012-AVG	DSY-SD-AC30-0012	DSY-SD-AD01-0012	DSY-SD-AD05-0012	DSY-SD-AD09-0012
LOCATION ID		DSY-SD-18	DSY-SD-AA01	DSY-SD-AA05	DSY-SD-AA09	DSY-SD-AA13	DSY-SD-AA17	DSY-SD-AA21	DSY-SD-AA24	DSY-SD-AA26	DSY-SD-AA28	DSY-SD-AA30	DSY-SD-AB11	DSY-SD-AB15	DSY-SD-AC24	DSY-SD-AC26	DSY-SD-AC28	DSY-SD-AC30	DSY-SD-AD01	DSY-SD-AD05	DSY-SD-AD09
SAMPLE DATE		10/07/11	10/12/11	10/12/11	10/13/11	10/13/11	10/13/11	10/13/11	10/13/11	10/13/11	10/13/11	10/13/11	09/29/11	09/29/11	09/26/11	09/28/11	09/28/11	09/28/11	09/29/11	09/29/11	09/29/11
TOP DEPTH		0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT
BOTTOM DEPTH		1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1.33 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT
SEMIVOLATILES (UG/KG)																					
BENZO(A)ANTHRACENE		310 U	730 U	720 U	840 UJ	800 U	730 U	800 U	580 U	320 J	375 J	360 J	330 J	470 J	690 U	680 U	400 J	710 U	190 J	590 U	530 U
BENZO(A)PYRENE	539	45	140	170	120 J	71	120	73	54	170	300	290	160	220	180 J	180	230 J	80 J	150	88	56
BENZO(B)FLUORANTHENE		310 U	730 U	720 U	840 UJ	800 U	730 U	800 U	580 U	330 J	460 J	570 J	570 U	340 J	690 UJ	680 UJ	365 J	710 U	430 UJ	590 UJ	530 UJ
BENZO(G,H,I)PERYLENE		310 U	730 U	720 U	840 UJ	800 U	730 U	800 U	580 U	480 U	410 U	170 J	570 U	610 U	690 UJ	680 UJ	655 UJ	710 UJ	430 U	590 UJ	530 UJ
BENZO(K)FLUORANTHENE		310 U	730 U	720 U	840 UJ	800 U	730 U	800 U	580 U	180 J	195 J	260 J	230 J	430 J	690 UJ	270 J	445 J	710 U	200 J	590 UJ	530 UJ
CHRYSENE		310 U	290 J	280 U	840 UJ	800 U	730 U	800 U	580 U	380 J	450 J	440	520 J	580 J	300 J	300 J	425 J	710 U	390 J	590 U	530 U
DIBENZO(A,H)ANTHRACENE		310 U	730 U	720 U	840 UJ	800 U	730 U	800 U	580 U	480 U	410 U	320 UJ	570 U	610 U	690 UJ	680 UJ	655 UJ	710 UJ	430 UJ	590 UJ	530 UJ
FLUORANTHENE		310 U	590 J	560 J	840 UJ	800 U	730 U	800 U	580 U	670	555 J	660	740 J	620 J	690 U	350 J	435 J	710 U	230 J	590 U	530 U
HIGH MOLECULAR WEIGHT PAHS	13903	45 J	1640 J	1340 J	540 J	71 J	560 J	73 J	54 J	2820 J	3540 J	5220 J	2960 J	3960 J	1280 J	1740 J	2790 J	80 J	1770 J	418 J	296 J
INDENO(1,2,3-CD)PYRENE		310 UJ	730 U	720 U	840 UJ	800 U	730 U	800 U	580 UJ	480 UJ	410 U	170 J	570 U	610 U	690 UJ	680 UJ	655 UJ	710 UJ	430 UJ	590 UJ	530 UJ
PYRENE		310 U	620 J	610 J	420 J	800 UJ	440 J	800 UJ	580 U	770	1200	2300	980	1300	800 J	640 J	1320 J	710 UJ	610 J	330 J	240 J
PCBS (UG/KG)																					
AROCLOR-1016		10 U	25 UJ	25 UJ	27 UJ	28 U	23 U	26 U	19 UJ	16 U	13.5 UJ	10 UJ	18 U	19 UJ	24 UJ	23 U	21 U	24 U	15 UJ	23 U	20 U
AROCLOR-1221		10 U	25 UJ	25 UJ	27 UJ	28 U	23 U	26 U	19 UJ	16 U	13.5 U	10 U	18 U	19 UJ	24 UJ	23 U	21 U	24 U	15 UJ	23 U	20 U
AROCLOR-1232		12 U	30 UJ	30 UJ	32 UJ	33 U	28 U	31 U	22 UJ	19 U	15.5 U	12 U	21 U	23 UJ	28 UJ	27 U	25 U	28 U	18 UJ	27 U	24 U
AROCLOR-1242		10 U	25 UJ	25 UJ	27 UJ	28 U	23 U	26 U	19 UJ	16 U	13.5 U	10 U	18 U	19 UJ	24 UJ	23 U	21 U	24 U	15 UJ	23 U	20 U
AROCLOR-1248		10 U	25 UJ	25 UJ	27 UJ	28 U	23 U	26 U	19 UJ	16 U	13.5 U	10 U	18 U	19 UJ	24 UJ	23 U	21 U	24 U	15 UJ	23 U	20 U
AROCLOR-1254		10 U	25 UJ	25 UJ	27 UJ	28 U	240 J	26 U	19 UJ	97 J	410	1100	18 U	19 UJ	24 UJ	170	65.2 J	24 U	15 UJ	23 U	20 U
AROCLOR-1260		10 U	25 UJ	25 UJ	27 UJ	28 U	330	26 U	19 UJ	16 U	225	780 J	18 U	19 UJ	24 UJ	23 U	21 U	24 U	15 UJ	23 U	20 U
TOTAL AROCLOR	1060	10.3 U	25.7 UJ	25.7 UJ	27.7 UJ	28.7 U	570 J	26.7 U	19.4 UJ	97 J	635 J	1880 J	18.4 U	19.6 UJ	24.6 UJ	170	65.4 J	24.6 U	15.4 UJ	23.6 U	20.6 U
METALS (MG/KG)																					
COPPER	74	NA	36.9	49.4	63 J	62	77.8	61.3	24.5	48.8	72.6	37.5	35.7 J	109 J	119	NA	NA	NA	NA	70.5 J	81.1 J
LEAD	168	14.1 J	45	55.7	66.3 J	58.5	76.8	57.4	25.2	44.9	82	59.8	58.3 J	166 J	90.8	114	75.3	63.4 J	107 J	43.7 J	35.7 J
ZINC	118	NA	114	152	156 J	162 J	397 J	167 J	66.8 J	158 J	230 J	206 J	82.5 J	137 J	320	NA	NA	NA	NA	138 J	119 J
MISCELLANEOUS PARAMETERS (MG/KG)																					
TOTAL ORGANIC CARBON		19000 J	53000	52000	52000 J	49000	48000	48000	52000	49000	30500	17000	42000	50000	42000	35000	41000	42000	21000	38000	31000
MISCELLANEOUS PARAMETERS (%)																					
AMOSITE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ASBESTOS	1	NA	ND	<1	<1	<1	<1	ND	<1	<1	<1	<1	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHRYSOTILE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL SOLIDS		78	33	34	30	30	33	31	42	52	59.5	74	NA	NA	34	36	37.5	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (UG/KG)																					
TRIBUTYLTIN (AS TIN)	228	0.67 U	0.69 U	1.7	1.8	1.5 J	7.9	3.5	0.8 J	7.9	1.9 J	5.7	1.3 J	0.7 U	14	8.3	38.9 J	5.9	1.5	3.4	0.73 U

DARK SHADING-EXCEEDS RPRG; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

APPENDIX C-2A
ANALYTICAL RESULTS FOR 0 TO 1 FOOT INTERVAL SEDIMENT SAMPLES (2011)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
FEASIBILITY STUDY
NAVSTA NEWPORT, NEWPORT RI

SAMPLE ID	Comparison Criteria	DSY-SD-AD13-0012	DSY-SD-AD17-0012	DSY-SD-AD21-0012	DSY-SD-AE24-0012	DSY-SD-AE26-0012	DSY-SD-AE28-0012	DSY-SD-AE30-0012	DSY-SD-AG24-0012	DSY-SD-AG26-0012-AVG	DSY-SD-AG28-0012	DSY-SD-AG30-0012	DSY-SD-AI24-0012	DSY-SD-AI26-0012	DSY-SD-AI28-0012	DSY-SD-AI30-0012	DSY-SD-AK24-0012	DSY-SD-AK26-0012	DSY-SD-AK28-0012	DSY-SD-AK30-0012	DSY-SD-AO30-0012
LOCATION ID		DSY-SD-AD13	DSY-SD-AD17	DSY-SD-AD21	DSY-SD-AE24	DSY-SD-AE26	DSY-SD-AE28	DSY-SD-AE30	DSY-SD-AG24	DSY-SD-AG26	DSY-SD-AG28	DSY-SD-AG30	DSY-SD-AI24	DSY-SD-AI26	DSY-SD-AI28	DSY-SD-AI30	DSY-SD-AK24	DSY-SD-AK26	DSY-SD-AK28	DSY-SD-AK30	DSY-SD-AO30
SAMPLE DATE		09/29/11	09/29/11	09/29/11	09/26/11	09/28/11	09/28/11	09/28/11	09/26/11	09/26/11	09/26/11	09/28/11	09/26/11	09/26/11	09/23/11	09/26/11	09/23/11	09/23/11	09/23/11	09/23/11	09/23/11
TOP DEPTH		0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT
BOTTOM DEPTH		1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT
SEMIVOLATILES (UG/KG)																					
BENZO(A)ANTHRACENE		1700	680 U	330 J	630 U	720 U	760 U	220 J	210 J	275 J	650 U	300 U	440 J	630 U	640 U	270 U	320 U	310 U	290 U	310 U	310 U
BENZO(A)PYRENE	539	1300	98	250	270 J	100	130	240	250	225 J	150	35	400	240 J	140	75	22 J	66	12 U	110 J	59
BENZO(B)FLUORANTHENE		1000	680 U	580 U	630 U	720 UJ	760 U	260 J	400 J	395 J	650 UJ	300 U	780 J	380 J	640 U	270 UJ	320 U	310 U	290 U	310 U	310 U
BENZO(G,H,I)PERYLENE		890	680 U	580 U	630 U	720 UJ	760 U	330 UJ	290 J	625 UJ	650 UJ	300 U	630 UJ	630 UJ	640 U	270 UJ	320 U	310 U	290 U	310 U	310 U
BENZO(K)FLUORANTHENE		1300	680 U	580 U	630 U	720 UJ	760 U	400 J	230 J	285 J	650 UJ	300 U	350 J	630 UJ	640 U	270 UJ	320 U	310 U	290 U	310 U	310 U
CHRYSENE		1700	680 U	430 J	330 J	720 U	760 U	380 J	360 J	315 J	650 U	300 U	660 J	630 U	640 U	110 J	320 U	310 U	290 U	130 J	310 U
DIBENZO(A,H)ANTHRACENE		470 U	680 U	580 U	630 U	720 UJ	760 U	330 UJ	500 U	625 UJ	650 UJ	300 U	630 UJ	630 UJ	640 U	270 UJ	320 U	310 U	290 U	310 U	310 U
FLUORANTHENE		2500	680 U	580 U	630 U	720 U	760 U	350 J	280 J	310 J	650 U	150 J	360 J	440 J	640 U	160 J	320 U	310 U	290 U	180 J	310 U
HIGH MOLECULAR WEIGHT PAHS	13903	17300	408 J	2310 J	1360 J	430 J	130	2670 J	3010 J	1920 J	650 J	315 J	5090 J	1860 J	510 J	675 J	22 J	66	262 U	840 J	269 J
INDENO(1,2,3-CD)PYRENE		1100	680 U	580 U	630 UJ	720 UJ	760 U	330 UJ	500 U	625 UJ	650 UJ	300 U	630 UJ	630 UJ	640 U	270 UJ	320 U	310 U	290 U	310 U	310 U
PYRENE		5800	310 J	1300 J	760 J	330 J	760 U	820	990	740 J	500 J	130 J	2100	800 J	370 J	330 J	320 U	310 U	290 U	420 J	210 J
PCBS (UG/KG)																					
AROCLOR-1016		19 U	24 U	21 U	23 UJ	25 U	26 U	11 U	17 U	22.5 UJ	22 U	10 U	22 U	22 UJ	20 UJ	10 U	11 UJ	10 U	10 UJ	11 UJ	11 UJ
AROCLOR-1221		19 U	24 U	21 U	23 UJ	25 U	26 U	11 U	17 U	22.5 UJ	22 U	10 U	22 U	22 UJ	20 UJ	10 U	11 U	10 U	10 UJ	11 UJ	11 U
AROCLOR-1232		22 U	28 U	24 U	27 UJ	29 U	30 U	13 U	20 U	26.5 UJ	26 U	12 U	25 U	25 UJ	23 UJ	12 U	13 U	12 U	12 UJ	13 UJ	13 U
AROCLOR-1242		19 U	24 U	21 U	23 UJ	25 U	26 U	11 U	17 U	22.5 UJ	22 U	10 U	22 U	22 UJ	20 UJ	10 U	11 U	10 U	10 UJ	11 UJ	11 U
AROCLOR-1248		19 U	24 U	21 U	23 UJ	25 U	26 U	11 U	17 U	22.5 UJ	22 U	10 U	22 U	22 UJ	20 UJ	10 U	11 U	10 U	10 UJ	11 UJ	11 U
AROCLOR-1254		120	83 J	110 J	290 J	25 U	26 U	60	180	22.5 UJ	22 U	10 U	360 J	22 UJ	20 UJ	10 U	11 U	10 U	10 UJ	65 J	11 U
AROCLOR-1260		19 U	24 U	21 U	23 UJ	25 U	26 U	11 U	17 U	22.5 UJ	22 U	10 U	22 U	22 UJ	20 UJ	10 U	11 UJ	10 U	10 UJ	11 UJ	11 UJ
TOTAL AROCLOR	1060	120	83 J	110 J	290 J	25.6 U	26.6 U	60	180	23.1 UJ	22.6 U	10.3 U	360 J	22.4 UJ	20.4 UJ	10.3 U	11.3 UJ	10.3 U	10.3 UJ	65 J	11.3 UJ
METALS (MG/KG)																					
COPPER	74	208 J	65.6 J	185 J	NA	NA	45.3 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	168	109 J	59.7 J	200 J	1020	48.4	48.8	51.3	69.9	68.9	66.1	8.7	91.5	54.6	56.1	20.9	9.5	8.2	2.3	80.1	13
ZINC	118	413 J	159 J	294 J	NA	NA	138 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/KG)																					
TOTAL ORGANIC CARBON		36000	44000	37000	53000	36000	36000	12000	28000	39000	38000	1600	44000	35000	36000	2200	8200	7000	1200	8200	3800
MISCELLANEOUS PARAMETERS (%)																					
AMOSITE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ASBESTOS	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHRYSOTILE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL SOLIDS		NA	NA	NA	36	34	32	74	NA	36.5	NA	83	NA	38	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (UG/KG)																					
TRIBUTYLTIN (AS TIN)	228	410	0.72 U	9.3	9.3	1.8	0.95 J	0.64 U	3.9	14	7.4	1.9	9.8	4.6	12	16	0.68 U	0.66 U	0.64 U	13	0.65 U

DARK SHADING-EXCEEDS RPRG; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

APPENDIX C-2A
ANALYTICAL RESULTS FOR 0 TO 1 FOOT INTERVAL SEDIMENT SAMPLES (2011)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
FEASIBILITY STUDY
NAVSTA NEWPORT, NEWPORT RI

SAMPLE ID	Comparison Criteria	DSY-SD-AP20-0012	DSY-SD-AT16-0012	DSY-SD-AT20-0012	DSY-SD-AT24-0012-AVG	DSY-SD-AT30-0012	DSY-SD-AX06-0012	DSY-SD-AX20-0012	DSY-SD-AY30-0012	DSY-SD-BB02-0012	DSY-SD-BB06-0012	DSY-SD-BB10-0012	DSY-SD-BB26-0012	DSY-SD-BC28-0012	DSY-SD-BC30-0012	DSY-SD-BD26-0012-AVG	DSY-SD-BE28-0012	DSY-SD-BE30-0012	DSY-SD-BF06-0012	DSY-SD-BF23-0012	DSY-SD-BG26-0012
LOCATION ID		DSY-SD-AP20	DSY-SD-AT16	DSY-SD-AT20	DSY-SD-AT24	DSY-SD-AT30	DSY-SD-AX06	DSY-SD-AX20	DSY-SD-AY30	DSY-SD-BB02	DSY-SD-BB06	DSY-SD-BB10	DSY-SD-BB26	DSY-SD-BC28	DSY-SD-BC30	DSY-SD-BD26	DSY-SD-BE28	DSY-SD-BE30	DSY-SD-BF06	DSY-SD-BF23	DSY-SD-BG26
SAMPLE DATE		09/22/11	09/22/11	09/22/11	09/22/11	09/23/11	09/22/11	09/22/11	09/23/11	09/22/11	09/22/11	09/22/11	09/21/11	09/21/11	09/21/11	09/21/11	09/22/11	09/21/11	09/22/11	09/22/11	09/21/11
TOP DEPTH		0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT
BOTTOM DEPTH		1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT
SEMIVOLATILES (UG/KG)																					
BENZO(A)ANTHRACENE		360 UJ	460 U	340 U	180 J	1100	470 U	370 UJ	300 U	420 U	390 U	350 U	1300 J	940 J	1300 J	1650 J	710 J	10000	310 U	290 U	640 J
BENZO(A)PYRENE	539	91	160	100	144 J	890	160	140	12 U	140	64	100	930 J	790 J	1200 J	1260 J	610	9000	87	79	490
BENZO(B)FLUORANTHENE		360 U	460 U	340 U	265 J	1400	470 U	370 U	300 U	420 UJ	390 U	350 U	1600 J	1000 J	1900 J	2050 J	950 J	10000	310 U	290 U	1000
BENZO(G,H,I)PERYLENE		360 U	460 U	340 U	340 UJ	420	470 U	370 U	300 U	420 UJ	390 U	350 U	560 J	430 J	520 J	695 J	640 UJ	6300 J	310 U	290 U	310 J
BENZO(K)FLUORANTHENE		360 U	460 U	340 U	340 UJ	620	470 U	370 U	300 U	190 J	390 U	350 U	670 J	400 J	840 J	950 J	580 J	4400 J	310 U	290 U	430 J
CHRYSENE		360 U	220 J	340 U	230 J	1400	470 U	170 J	300 U	170 J	390 U	350 U	1500 J	1200 J	1700 J	2000 J	990	12000	310 U	290 U	770
DIBENZO(A,H)ANTHRACENE		360 U	460 U	340 U	340 UJ	290 U	470 U	370 U	300 U	420 UJ	390 U	350 U	480 UJ	400 UJ	580 UJ	535 UJ	640 UJ	1300 J	310 U	290 U	540 U
FLUORANTHENE		180 J	250 J	170 J	335 J	3000	230 J	290 J	300 U	240 J	390 U	170 J	1700	1000	1700	1850 J	1200	24000	180 J	180 J	860
HIGH MOLECULAR WEIGHT PAHS	13903	461 J	1140 J	550 J	1260 J	12300	780 J	1040 J	271 U	1180 J	234 J	530 J	16400 J	9660 J	14100 J	16600 J	7640 J	117000 J	487 J	539 J	6700 J
INDENO(1,2,3-CD)PYRENE		360 U	460 U	340 U	340 UJ	440	470 U	370 U	300 U	420 UJ	390 U	350 U	500 J	300 J	330 J	542 J	640 UJ	6400 J	310 UJ	290 UJ	540 UJ
PYRENE		190 J	510 J	280 J	375 J	3000	390 J	440 J	300 U	440 J	170 J	260 J	7600 J	3600 J	4600 J	5750 J	2600	34000	220 J	280 J	2200
PCBS (UG/KG)																					
AROCLOR-1016		12 UJ	16 U	11 U	12.5 UJ	10 UJ	16 U	12 UJ	10 UJ	15 UJ	12 U	12 U	16 UJ	13 UJ	19 UJ	18 UJ	22 UJ	14 UJ	12 UJ	11 UJ	19 UJ
AROCLOR-1221		12 UJ	16 U	11 U	12.5 UJ	10 U	16 U	12 UJ	10 U	15 UJ	12 U	12 U	16 UJ	13 UJ	19 UJ	18 UJ	22 U	14 U	12 U	11 UJ	19 UJ
AROCLOR-1232		15 UJ	19 U	13 U	14.5 UJ	12 U	19 U	14 UJ	12 U	18 UJ	15 U	14 U	19 UJ	15 UJ	22 UJ	21 UJ	25 U	17 U	14 U	13 UJ	22 UJ
AROCLOR-1242		12 UJ	16 U	11 U	12.5 UJ	10 U	16 U	12 UJ	10 U	15 UJ	12 U	12 U	16 UJ	13 UJ	19 UJ	18 UJ	22 U	14 U	12 U	11 UJ	19 UJ
AROCLOR-1248		12 UJ	16 U	11 U	12.5 UJ	10 U	16 U	12 UJ	10 U	15 UJ	12 U	12 U	16 UJ	13 UJ	19 UJ	18 UJ	22 U	14 U	12 U	11 UJ	19 UJ
AROCLOR-1254		58 J	130	11 U	12.5 UJ	10 U	100 J	12 UJ	10 U	15 UJ	12 U	12 U	16 UJ	13 UJ	19 UJ	18 UJ	22 U	14 U	12 U	11 UJ	19 UJ
AROCLOR-1260		12 UJ	16 U	11 U	12.5 UJ	10 UJ	16 U	12 UJ	10 UJ	15 UJ	12 U	12 U	16 UJ	13 UJ	19 UJ	18 UJ	22 U	14 U	12 U	11 UJ	19 UJ
TOTAL AROCLOR	1060	58 J	130	11.3 U	12.8 UJ	10.3 UJ	100 J	12.3 UJ	10.3 UJ	15.4 UJ	12.4 U	12.3 U	16.4 UJ	13.3 UJ	19.4 UJ	18.4 UJ	22.4 UJ	14.4 UJ	12.3 UJ	11.3 UJ	19.4 UJ
METALS (MG/KG)																					
COPPER	74	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	110 J	69.3 J	159 J	136 J	91.8 J	113 J	NA	13.4 J	111 J
LEAD	168	20 J	65.7	32.2	20.7 J	35	51.7	41.6 J	5.1	45 J	26.1	30.2	143	67.5	94.6	134	80.4 J	173 J	14.9 J	14.5 J	91.4
ZINC	118	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	799	168	422	312	246 J	354 J	NA	55.9 J	250
MISCELLANEOUS PARAMETERS (MG/KG)																					
TOTAL ORGANIC CARBON		16000	30000	19000	16000	3000	27000	20000	1700 J	30000	22000	18000	51000	40000	45000	55000	50000	36000	18000	9400 J	45000
MISCELLANEOUS PARAMETERS (%)																					
AMOSITE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ASBESTOS	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHRYSOTILE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL SOLIDS		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (UG/KG)																					
TRIBUTYLTIN (AS TIN)	228	0.68 U	3.2	0.65 U	0.69 U	0.65 U	0.72 U	0.66 U	0.62 U	0.69 U	0.69 U	0.65 U	3.2	14	20	8.75	13	15	0.66 U	1.9	12

DARK SHADING-EXCEEDS RPRG; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

APPENDIX C-2A
ANALYTICAL RESULTS FOR 0 TO 1 FOOT INTERVAL SEDIMENT SAMPLES (2011)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
FEASIBILITY STUDY
NAVSTA NEWPORT, NEWPORT RI

SAMPLE ID	Comparison Criteria	DSY-SD-BG28-0012	DSY-SD-BI26-0012	DSY-SD-BJ23-0012	DSY-SD-C09-0012	DSY-SD-C13-0012	DSY-SD-C17-0012	DSY-SD-C21-0012	DSY-SD-C25-0012	DSY-SD-C29-0012	DSY-SD-G01-0012	DSY-SD-G05-0012	DSY-SD-G09-0012	DSY-SD-G13-0012	DSY-SD-G17-0012	DSY-SD-G21-0012	DSY-SD-G25-0012	DSY-SD-G29-0018	DSY-SD-J24-0012	DSY-SD-J26-0012	DSY-SD-J28-0012	DSY-SD-J30-0012	DSY-SD-K05-0012
LOCATION ID		DSY-SD-BG28	DSY-SD-BI26	DSY-SD-BJ23	DSY-SD-C09	DSY-SD-C13	DSY-SD-C17	DSY-SD-C21	DSY-SD-C25	DSY-SD-C29	DSY-SD-G01	DSY-SD-G05	DSY-SD-G09	DSY-SD-G13	DSY-SD-G17	DSY-SD-G21	DSY-SD-G25	DSY-SD-G29	DSY-SD-J24	DSY-SD-J26	DSY-SD-J28	DSY-SD-J30	DSY-SD-K05
SAMPLE DATE		09/21/11	09/21/11	09/21/11	10/07/11	10/07/11	10/07/11	10/07/11	10/07/11	10/07/11	10/12/11	10/12/11	10/12/11	10/12/11	10/12/11	10/12/11	10/12/11	10/13/11	10/04/11	10/04/11	10/04/11	10/04/11	10/03/11
TOP DEPTH		0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT
BOTTOM DEPTH		1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1.5 FT	1 FT	1 FT	1 FT	1 FT	1 FT
SEMIVOLATILES (UG/KG)																							
BENZO(A)ANTHRACENE		850 J	650	150 J	310 U	140 J	330 U	160 J	780	620 J	450 J	290 J	310 J	300 J	630 U	490 J	2100	1600	170 J	380 J	560 J	21000 J	410 UJ
BENZO(A)PYRENE	539	810 J	580	12 U	37	110 J	44	160	840	620 J	210	160	190	160	130	250	1200	1600 J	100	230	350 J	8800 J	97 J
BENZO(B)FLUORANTHENE		1300 J	830	210 J	310 U	350 U	330 U	240 J	1200	670 J	400 J	330 J	400 J	590 U	630 U	590 J	1900	2700 J	390 UJ	410 J	500 J	11000 J	410 UJ
BENZO(G,H,I)PERYLENE		380 J	300 J	310 U	310 U	350 U	330 U	370 U	340 J	590 UJ	620 U	550 U	670 U	590 U	630 U	730 U	410 J	650 J	390 UJ	640 UJ	550 U	3000 J	410 UJ
BENZO(K)FLUORANTHENE		560	370 J	310 U	310 U	350 U	330 U	200 J	940	660 J	210 U	550 U	670 U	590 U	630 U	300 J	830 J	1200 J	390 UJ	450 J	520 J	7900 J	410 UJ
CHRYSENE		1100 J	690	210 J	310 U	170 J	330 U	210 J	1200	850	520 J	330 J	430 J	410 J	240 J	720 J	2000	2200	320 J	550 J	620 J	21000 J	410 UJ
DIBENZO(A,H)ANTHRACENE		340 U	380 U	310 U	310 U	350 UJ	330 UJ	370 U	570 U	590 UJ	620 U	550 U	670 U	590 U	630 U	730 U	640 U	480 UJ	390 UJ	640 UJ	550 UJ	1100 J	410 UJ
FLUORANTHENE		1300 J	1000 J	250 J	310 U	350 U	330 U	180 J	620 J	510 J	1500	660 J	690 J	470 J	470 J	1000 J	2700	2000	230 J	640 U	720 J	53000 J	410 UJ
HIGH MOLECULAR WEIGHT PAHS	13903	9760 J	6450 J	1190 J	37 J	680 J	44 J	1670 J	9250 J	6430 J	4280 J	2560 J	2820 J	1920 J	1260 J	4450 J	15000 J	17300 J	1680 J	3320 J	6270 J	186000 J	507 J
INDENO(1,2,3-CD)PYRENE		460 J	330 J	310 UJ	310 UJ	350 UJ	330 UJ	370 UJ	430 J	590 UJ	620 U	550 U	670 U	590 U	630 U	730 U	510 J	780 J	390 UJ	640 UJ	550 UJ	3700 J	410 UJ
PYRENE		3000 J	1700	370 J	310 U	260 J	330 U	520	2900	2500	1200	790	800 J	580 J	420 J	1100	3400	4600	860 J	1300	3000 J	55000 J	410 J
PCBS (UG/KG)																							
AROCLOR-1016		12 U	13 UJ	10 UJ	11 U	12 UJ	12 UJ	14 U	20 UJ	20 UJ	22 U	19 U	23 UJ	21 U	23 U	27 U	22 UJ	17 UJ	12 U	23 UJ	19 UJ	24 UJ	13 U
AROCLOR-1221		12 U	13 U	10 U	11 U	12 UJ	12 UJ	14 U	20 UJ	20 UJ	22 U	19 U	23 UJ	21 U	23 U	27 U	22 U	17 U	12 U	23 UJ	19 UJ	24 UJ	13 U
AROCLOR-1232		14 U	16 U	12 U	13 U	15 UJ	14 UJ	16 U	24 UJ	24 UJ	26 U	23 U	28 UJ	24 U	27 U	32 U	26 U	20 U	14 U	27 UJ	22 UJ	28 UJ	16 U
AROCLOR-1242		12 U	13 U	10 U	11 U	12 UJ	12 UJ	14 U	20 UJ	20 UJ	22 U	19 U	23 UJ	21 U	23 U	27 U	22 U	17 U	12 U	23 UJ	19 UJ	24 UJ	13 U
AROCLOR-1248		12 U	13 U	10 U	11 U	12 UJ	12 UJ	14 U	20 UJ	20 UJ	22 U	19 U	23 UJ	21 U	23 U	27 U	22 U	17 U	12 U	23 UJ	19 UJ	24 UJ	13 U
AROCLOR-1254		12 U	13 U	10 U	11 U	120 J	12 UJ	190 J	140 J	470 J	22 U	19 U	23 UJ	21 U	23 U	27 U	22 U	260 J	1200	180 J	180 J	24 UJ	240
AROCLOR-1260		12 U	13 U	10 U	11 U	12 UJ	12 UJ	14 U	20 UJ	20 UJ	22 U	19 U	23 UJ	21 U	23 U	27 U	22 U	220	12 U	23 UJ	19 UJ	24 UJ	13 U
TOTAL AROCLOR	1060	12.3 U	13.4 UJ	10.3 UJ	11.3 U	120 J	12.3 UJ	190 J	140 J	470 J	22.6 U	19.6 U	23.7 UJ	21.4 U	23.6 U	27.7 U	22.6 UJ	480 J	1200	180 J	180 J	24.6 UJ	240
METALS (MG/KG)																							
COPPER	74	29.6 J	41.1 J	12.4 J	NA	NA	NA	NA	NA	NA	36.4	40.1	51.3	56.1	45.6	56.5	69.2	107	NA	NA	NA	NA	42.2
LEAD	168	28.8 J	39.7 J	13.3	15.9 J	19.2 J	22.5 J	320 J	198 J	209 J	368 J	43.8 J	61.7 J	54.4 J	48.6 J	53.1 J	49.7 J	98.2	1100 J	57.9 J	52.2 J	58.6 J	1410
ZINC	118	108 J	139 J	48.7	NA	NA	NA	NA	NA	NA	111	124	166	152	137	159	162	243 J	NA	NA	NA	NA	678
MISCELLANEOUS PARAMETERS (MG/KG)																							
TOTAL ORGANIC CARBON		16000 J	21000	8000 J	13000 J	14000	10000	24000 J	38000 J	36000	43000 J	38000 J	44000 J	34000 J	54000 J	53000 J	46000 J	44000	28000 J	38000 J	28000 J	36000 J	22000 J
MISCELLANEOUS PARAMETERS (%)																							
AMOSITE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ASBESTOS	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHRYSOTILE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL SOLIDS		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (UG/KG)																							
TRIBUTYLTIN (AS TIN)	228	2.5	4.6	13	0.68 U	0.69 U	0.67 U	0.66 U	10	0.85 J	0.71 U	0.71 U	0.73 U	0.73 U	0.73 U	0.72 U	2.7	6.6	0.7 U	0.71 U	5.2	0.77 J	0.69 U

DARK SHADING-EXCEEDS RPRG; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

APPENDIX C-2A
ANALYTICAL RESULTS FOR 0 TO 1 FOOT INTERVAL SEDIMENT SAMPLES (2011)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
FEASIBILITY STUDY
NAVSTA NEWPORT, NEWPORT RI

SAMPLE ID	Comparison Criteria	DSY-SD-K09-0012-AVG	DSY-SD-K13-0012	DSY-SD-K17-0012	DSY-SD-K21-0012	DSY-SD-L24-0012	DSY-SD-L26-0012	DSY-SD-L28-0012	DSY-SD-L30-0012	DSY-SD-N24-0012	DSY-SD-N26-0012	DSY-SD-N28-0012	DSY-SD-N30-0012	DSY-SD-O09-0012	DSY-SD-O13-0012-AVG	DSY-SD-O17-0012	DSY-SD-O21-0012	DSY-SD-Q25-0012	DSY-SD-Q29-0012	DSY-SD-S09-0012	DSY-SD-S13-0012	DSY-SD-S17-0012	DSY-SD-S21-0012
LOCATION ID		DSY-SD-K09	DSY-SD-K13	DSY-SD-K17	DSY-SD-K21	DSY-SD-L24	DSY-SD-L26	DSY-SD-L28	DSY-SD-L30	DSY-SD-N24	DSY-SD-N26	DSY-SD-N28	DSY-SD-N30	DSY-SD-O09	DSY-SD-O13	DSY-SD-O17	DSY-SD-O21	DSY-SD-Q25	DSY-SD-Q29	DSY-SD-S09	DSY-SD-S13	DSY-SD-S17	DSY-SD-S21
SAMPLE DATE		10/03/11	10/03/11	10/03/11	10/03/11	10/04/11	10/04/11	10/04/11	10/04/11	10/05/11	10/05/11	10/05/11	10/05/11	09/30/11	09/30/11	09/30/11	09/30/11	10/05/11	10/06/11	09/30/11	09/30/11	09/30/11	09/30/11
TOP DEPTH		0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT
BOTTOM DEPTH		1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT
SEMIVOLATILES (UG/KG)																							
BENZO(A)ANTHRACENE		340 UJ	270 J	680 UJ	620 UJ	570 U	890 J	560 J	1000 J	230 J	400 J	620 UR	290 J	240 J	325 U	560 U	590 UJ	320 J	630 U	190 J	250 J	410 U	290 J
BENZO(A)PYRENE	539	28.5 J	160 J	160 J	140 J	580 J	670 J	420	930 J	290 J	450 J	68 J	310 J	160	20 J	79	130 J	300 J	190	170	180	61	240
BENZO(B)FLUORANTHENE		340 UJ	440 UJ	680 UJ	620 UJ	570 U	590 J	550 J	930 J	590 U	570 J	620 UR	470 J	260 J	325 U	560 U	590 UJ	530 UJ	630 U	450 U	530 U	410 U	350 J
BENZO(G,H,I)PERYLENE		340 UJ	440 UJ	680 UJ	620 UJ	570 U	300 J	500 UJ	490 UJ	590 U	640 U	620 UR	560 UJ	460 U	325 U	560 U	590 UJ	530 UJ	630 U	450 U	530 U	410 U	480 UJ
BENZO(K)FLUORANTHENE		340 UJ	440 UJ	680 UJ	210 J	570 U	650 J	660 J	1100 J	400 J	560 J	620 UR	300 J	230 J	325 U	560 U	210 J	530 UJ	630 U	240 J	320 J	410 U	340 J
CHRYSENE		340 UJ	360 J	260 UJ	620 UJ	570 U	970 J	860 J	1000 J	380 J	530 J	620 UR	400 J	300 J	325 U	560 U	590 UJ	440 J	270 J	250 J	340 J	410 U	390 J
DIBENZO(A,H)ANTHRACENE		340 UJ	440 UJ	680 UJ	620 UJ	570 U	460 UJ	500 UJ	490 UJ	590 U	640 U	620 UR	560 UJ	460 U	325 U	560 U	590 UJ	530 UJ	630 U	450 U	530 U	410 U	480 UJ
FLUORANTHENE		340 UJ	350 J	680 UJ	620 UJ	570 U	990	290 J	980 J	300 J	450 J	620 UR	350 J	280 J	325 U	560 U	270 J	320 J	630 U	250 J	250 J	410 U	260 J
HIGH MOLECULAR WEIGHT PAHS	13903	28.5 J	2940 J	720 J	1310 J	580 J	8580 J	5640 J	11500 J	2310 J	4360 J	748 J	3070 J	1970 J	20 J	79	1160 J	2980 J	1090 J	1650 J	1890 J	61	3370 J
INDENO(1,2,3-CD)PYRENE		340 UJ	440 UJ	680 UJ	620 UJ	570 U	420 J	500 UJ	430 J	590 U	640 U	620 UR	560 UJ	460 U	325 U	560 U	590 UJ	530 UJ	630 U	450 U	530 U	410 U	480 UJ
PYRENE		340 UJ	1800 J	560 J	960 J	570 U	3100 J	2300 J	5100 J	710 J	1400	680 J	950	500 J	325 U	560 U	550 J	1600	630 J	550 J	550 J	410 U	1500 J
PCBS (UG/KG)																							
AROCLOR-1016		9.85 U	310 U	22 U	19 U	18 UJ	16 U	17 U	16 U	19 UJ	21 UJ	20 U	20 UJ	16 U	11.5 U	20 U	19 UJ	18 UJ	21 U	17 U	19 U	14 UJ	16 UJ
AROCLOR-1221		9.85 U	310 U	22 U	19 U	18 UJ	16 U	17 U	16 U	19 UJ	21 UJ	20 U	20 UJ	16 U	11.5 U	20 U	19 UJ	18 UJ	21 U	17 U	19 U	14 UJ	16 UJ
AROCLOR-1232		12 U	360 U	26 U	22 U	21 UJ	19 U	20 U	20 U	23 UJ	25 UJ	23 U	24 UJ	18 U	13.5 U	24 U	22 UJ	21 UJ	25 U	20 U	22 U	16 UJ	19 UJ
AROCLOR-1242		9.85 U	310 U	22 U	19 U	18 UJ	16 U	17 U	16 U	19 UJ	21 UJ	20 U	20 UJ	16 U	11.5 U	20 U	19 UJ	18 UJ	21 U	17 U	19 U	14 UJ	16 UJ
AROCLOR-1248		9.85 U	310 U	22 U	19 U	18 UJ	16 U	17 U	16 U	19 UJ	21 UJ	20 U	20 UJ	16 U	11.5 U	20 U	19 UJ	18 UJ	21 U	17 U	19 U	14 UJ	16 UJ
AROCLOR-1254		46.5	17000	110 J	140	1200 J	1800 J	3600	270	100 J	110 J	100	74 J	160 J	40 J	96 J	19 UJ	260 J	21 U	120	19 U	14 UJ	430 J
AROCLOR-1260		9.85 U	310 U	22 U	19 U	510 J	16 U	17 U	16 U	92 J	21 UJ	20 U	20 UJ	16 U	11.5 U	20 U	19 UJ	150 J	21 U	17 U	19 U	14 UJ	16 UJ
TOTAL AROCLOR	1060	46.5	17000	110 J	140	1710 J	1800 J	3600	270	192 J	110 J	100	74 J	160 J	40.1 J	96 J	19.4 UJ	410 J	21.6 U	120	19.4 U	14.3 UJ	430 J
METALS (MG/KG)																							
COPPER	74	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	168	13.9	598	55.1	57.4	884 J	324 J	878 J	65.2 J	53.2 J	110 J	70.6 J	51.1 J	63.5 J	27.6 J	45.4 J	51.5 J	60.6 J	56.5	51.1 J	48.6 J	18 J	64.6 J
ZINC	118	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/KG)																							
TOTAL ORGANIC CARBON		10100 J	34000 J	33000 J	37000 J	64000	36000 J	39000 J	27000 J	33000	37000	38000	38000	23000	9150	28000	36000 J	34000	34000 J	28000	31000	21000 J	36000 J
MISCELLANEOUS PARAMETERS (%)																							
AMOSITE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ASBESTOS	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHRYSOTILE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL SOLIDS		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (UG/KG)																							
TRIBUTYLTIN (AS TIN)	228	0.68 U	3.4 U	0.69 U	0.7 U	2.6	7.5	0.77 J	3.5	3.3	7.7	2.9	1.5	1.8	0.715 U	1.8	1.1 J	3.8	1.1 J	1.6	3	0.71 U	3.3

DARK SHADING-EXCEEDS RPRG; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

APPENDIX C-2A
ANALYTICAL RESULTS FOR 0 TO 1 FOOT INTERVAL SEDIMENT SAMPLES (2011)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
FEASIBILITY STUDY
NAVSTA NEWPORT, NEWPORT RI

SAMPLE ID	Comparison Criteria	DSY-SD-T25-0012	DSY-SD-T29-0012	DSY-SD-W09-0012	DSY-SD-W13-0012	DSY-SD-W17-0012	DSY-SD-W21-0012-AVG	DSY-SD-W24-0012-AVG	DSY-SD-W26-0012	DSY-SD-W28-0012	DSY-SD-W30-0012	DSY-SD-Y03-0012	DSY-SD-Y25-0012	DSY-SD-Y26-0012	DSY-SD-Y28-0012	DSY-SD-Y30-0012
LOCATION ID		DSY-SD-T25	DSY-SD-T29	DSY-SD-W09	DSY-SD-W13	DSY-SD-W17	DSY-SD-W21	DSY-SD-W24	DSY-SD-W26	DSY-SD-W28	DSY-SD-W30	DSY-SD-Y03	DSY-SD-Y25	DSY-SD-Y26	DSY-SD-Y28	DSY-SD-Y30
SAMPLE DATE		10/05/11	10/06/11	09/30/11	09/30/11	09/30/11	09/30/11	10/06/11	10/05/11	10/06/11	10/06/11	10/03/11	10/03/11	10/03/11	10/03/11	10/03/11
TOP DEPTH		0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT	0 FT
BOTTOM DEPTH		1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT
SEMIVOLATILES (UG/KG)																
BENZO(A)ANTHRACENE		220 J	210 J	210 J	160 J	260 J	665 UJ	460 J	420 J	220 U	750	410 UJ	1000	1300	320 J	1300
BENZO(A)PYRENE	539	250	190	230	150	240 J	200 J	355	320	230	500	38 J	520	900 J	220	1100 J
BENZO(B)FLUORANTHENE		470 J	310 J	290 J	400 U	350 J	665 UJ	680 J	640 J	630 U	610	410 UJ	650 J	1200 J	740 UJ	1100 J
BENZO(G,H,I)PERYLENE		620 U	310 U	500 U	400 U	640 UJ	665 UJ	595 UJ	600 UJ	630 U	360 U	410 UJ	320 J	600 UJ	740 UJ	450 J
BENZO(K)FLUORANTHENE		620 U	130 J	360 J	210 J	400 J	300 J	295 J	300 J	630 U	520	410 UJ	700 J	1200 J	740 UJ	1400 J
CHRYSENE		290 J	270 J	290 J	220 J	340 J	665 UJ	620 J	500 J	280 J	780	410 UJ	1200	1600	400 J	1600
DIBENZO(A,H)ANTHRACENE		620 U	310 U	500 U	400 U	640 UJ	665 UJ	595 UJ	600 U	630 U	360 UJ	410 UJ	640 UJ	600 UJ	740 UJ	440 UJ
FLUORANTHENE		620 U	190 J	250 J	180 J	640 UJ	665 UJ	785 J	350 J	630 U	1400	410 UJ	1500	1200	740 U	2000
HIGH MOLECULAR WEIGHT PAHS	13903	2070 J	1870 J	2200 J	1500 J	2690 J	855 J	4900 J	3830 J	1150 J	6560 J	38 J	10200 J	10800 J	1840 J	18900 J
INDENO(1,2,3-CD)PYRENE		620 U	310 U	500 U	400 U	640 UJ	665 UJ	595 UJ	600 U	630 UJ	360 UJ	410 UJ	350 J	380 J	740 UJ	530 J
PYRENE		840	570	570 J	580	1100 J	520 J	1700	1300 J	640 J	2000	410 UJ	4000 J	3000	900 J	9400 J
PCBS (UG/KG)																
AROCLOR-1016		22 U	11 U	17 UJ	14 U	21 UJ	21.5 UJ	21.5 U	22 UJ	22 U	12 U	13 U	20 UJ	22 UJ	23 UJ	14 U
AROCLOR-1221		22 U	11 U	17 UJ	14 U	21 UJ	21.5 UJ	21.5 U	22 UJ	22 U	12 U	13 U	20 UJ	22 UJ	23 UJ	14 U
AROCLOR-1232		26 U	13 U	20 UJ	16 U	25 UJ	25.5 UJ	25.5 U	26 UJ	26 U	15 U	15 U	24 UJ	25 UJ	27 UJ	17 U
AROCLOR-1242		22 U	11 U	17 UJ	14 U	21 UJ	21.5 UJ	21.5 U	22 UJ	22 U	12 U	13 U	20 UJ	22 UJ	23 UJ	14 U
AROCLOR-1248		22 U	11 U	17 UJ	14 U	21 UJ	21.5 UJ	21.5 U	22 UJ	22 U	12 U	13 U	20 UJ	22 UJ	23 UJ	14 U
AROCLOR-1254		1500	110	17 UJ	260	21 UJ	65 J	1500	150 J	280	89	13 U	190 J	200 J	190 J	530
AROCLOR-1260		22 U	11 U	17 UJ	14 U	21 UJ	21.5 UJ	550	22 UJ	22 U	12 U	13 U	20 UJ	22 UJ	23 UJ	14 U
TOTAL AROCLOR	1060	1500	110	17.4 UJ	260	21.6 UJ	65.2 J	2050	150 J	280	89	13.3 U	190 J	200 J	190 J	530
METALS (MG/KG)																
COPPER	74	NA	NA	75.4	90.8	167	133	NA	NA	NA	NA	9.3	NA	NA	NA	NA
LEAD	168	64.2	20.1	64.7 J	58.2 J	118 J	67.4 J	904 J	68	66.2 J	36.8 J	11.1	165	69.5	69.4	256
ZINC	118	NA	NA	148	172	823	196	NA	NA	NA	NA	48.4	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/KG)																
TOTAL ORGANIC CARBON		37000 J	13000 J	31000 J	24000	35000 J	39500 J	47500 J	32000 J	38000 J	20000 J	17000 J	45000	48000	40000	26000
MISCELLANEOUS PARAMETERS (%)																
AMOSITE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ASBESTOS	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHRYSOTILE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL SOLIDS		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (UG/KG)																
TRIBUTYLTIN (AS TIN)	228	8.2	0.69 U	9.3	5.1	43	25.5 J	15	16	15	27	0.73 U	14	6.5	2.9	32

DARK SHADING-EXCEEDS RPRG; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

APPENDIX C-2B
ANALYTICAL RESULTS FOR 1 TO 2 FOOT INTERVAL SEDIMENT SAMPLES (2011)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
FEASIBILITY STUDY
NAVSTA NEWPORT, NEWPORT RI

SAMPLE ID	Comparison Criteria	DSY-SD-18-1224	DSY-SD-AA01-1224	DSY-SD-AA05-1224	DSY-SD-AA09-1224	DSY-SD-AA13-1224	DSY-SD-AA17-1224	DSY-SD-AA21-1224	DSY-SD-AA24-1224	DSY-SD-AA26-1224	DSY-SD-AA30-1224	DSY-SD-AB11-1224	DSY-SD-AB15-1224	DSY-SD-AC24-1224	DSY-SD-AC26-1224	DSY-SD-AC28-1224	DSY-SD-AC30-1224	DSY-SD-AD01-1224	DSY-SD-AD05-1224	DSY-SD-AD09-1224	DSY-SD-AD13-1224	DSY-SD-AD17-1224
LOCATION ID		DSY-SD-18	DSY-SD-AA01	DSY-SD-AA05	DSY-SD-AA09	DSY-SD-AA13	DSY-SD-AA17	DSY-SD-AA21	DSY-SD-AA24	DSY-SD-AA26	DSY-SD-AA30	DSY-SD-AB11	DSY-SD-AB15	DSY-SD-AC24	DSY-SD-AC26	DSY-SD-AC28	DSY-SD-AC30	DSY-SD-AD01	DSY-SD-AD05	DSY-SD-AD09	DSY-SD-AD13	DSY-SD-AD17
SAMPLE DATE		10/07/11	10/12/11	10/12/11	10/13/11	10/13/11	10/13/11	10/13/11	10/13/11	10/13/11	10/13/11	09/29/11	09/29/11	09/26/11	09/28/11	09/28/11	09/28/11	09/29/11	09/29/11	09/29/11	09/29/11	09/29/11
TOP DEPTH		1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT
BOTTOM DEPTH		2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT
SACODE		NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
SEMIVOLATILES (UG/KG)																						
BENZO(A)ANTHRACENE		290 U	720 U	470 J	280 J	760 U	270 J	720 U	720 U	880	280 J	470 J	290 J	340 UJ	550 J	740 J	820 J	350 U	270 J	560 U	380 U	350 J
BENZO(A)PYRENE	539	9.4 J	140	310	180	150	160	100	80	420	200	260	200 J	100	370	310	520	19 J	160	110	6.4 J	220
BENZO(B)FLUORANTHENE		290 U	720 U	530 J	690 U	760 U	760 U	720 U	720 U	880 J	410 J	330 J	600 U	340 UJ	550 UJ	410 J	650 J	350 U	560 UJ	560 U	380 U	320 J
BENZO(G,H,I)PERYLENE		290 U	720 U	630 U	690 U	760 U	760 U	720 U	720 U	230 J	160 J	600 U	600 U	340 UJ	550 UJ	600 UJ	330 J	350 U	560 UJ	560 U	380 U	560 UJ
BENZO(K)FLUORANTHENE		290 U	720 U	280 J	690 U	760 U	760 U	720 U	720 U	370 J	200 J	600 U	270 J	340 UJ	500 J	550 J	870 J	350 U	320 J	560 U	380 U	360 J
CHRYSENE		290 U	720 U	620 J	380 J	760 U	310 J	720 U	720 U	1000	310 J	560 J	460 J	340 UJ	700 J	690 J	900	350 U	330 J	220 J	380 U	420 J
DIBENZO(A,H)ANTHRACENE		290 U	720 U	630 U	690 U	760 U	760 U	720 U	720 U	500 UJ	310 U	600 U	600 U	340 UJ	550 UJ	600 UJ	620 UJ	350 U	560 UJ	560 U	380 U	560 UJ
FLUORANTHENE		290 U	520 J	1000	470 J	390 J	630 J	720 U	720 U	2200	370 J	1400	590 J	340 U	410 J	1700	700 J	350 U	560 U	560 U	380 U	300 J
HIGH MOLECULAR WEIGHT PAHS	13903	9.4 J	1260 J	4210 J	1860 J	990 J	2120 J	420 J	80 J	9740 J	3390 J	5120 J	2810 J	880 J	4730 J	8600 J	7910 J	19 J	2020 J	690 J	6.4 J	3570 J
INDENO(1,2,3-CD)PYRENE		290 UJ	720 U	630 U	690 U	760 U	760 U	720 UJ	720 UJ	260 J	160 J	600 U	600 U	340 UJ	550 UJ	600 UJ	420 J	350 U	560 UJ	560 U	380 U	560 UJ
PYRENE		290 U	600 J	1000	550 J	450 J	750 J	320 J	720 U	3500	1300	2100	1000	780 J	2200 J	4200 J	2700 J	350 U	940 J	360 J	380 U	1600 J
PCBS (UG/KG)																						
AROCLOR-1016		10 U	25 UJ	22 UJ	23 U	24 U	22 U	25 U	25 U	17 U	9.2 UJ	21 U	20 UJ	12 UJ	18 UJ	20 UJ	22 U	13 UJ	20 U	20 U	13 UJ	20 UJ
AROCLOR-1221		10 U	25 UJ	22 UJ	23 U	24 U	22 U	25 U	25 U	17 U	9.2 U	21 U	20 UJ	12 UJ	18 UJ	20 UJ	22 U	13 UJ	20 U	20 U	13 UJ	20 UJ
AROCLOR-1232		12 U	29 UJ	25 UJ	27 U	28 U	26 U	30 U	29 U	20 U	11 U	25 U	24 UJ	14 UJ	21 UJ	24 UJ	25 U	15 UJ	23 U	24 U	16 UJ	24 UJ
AROCLOR-1242		10 U	25 UJ	22 UJ	23 U	24 U	22 U	25 U	25 U	17 U	9.2 U	21 U	20 UJ	12 UJ	18 UJ	20 UJ	22 U	13 UJ	20 U	20 U	13 UJ	20 UJ
AROCLOR-1248		10 U	25 UJ	22 UJ	23 U	24 U	22 U	25 U	25 U	17 U	9.2 U	21 U	20 UJ	12 UJ	18 UJ	20 UJ	22 U	13 UJ	20 U	20 U	13 UJ	20 UJ
AROCLOR-1254		10 U	25 UJ	22 UJ	23 U	24 U	22 U	25 U	25 U	960	160	21 U	20 UJ	170 J	1100 J	460 J	170	13 UJ	20 U	20 U	13 UJ	430 J
AROCLOR-1260		10 U	25 UJ	22 UJ	23 U	24 U	22 U	25 U	25 U	320	9.2 U	21 U	20 UJ	12 UJ	18 UJ	20 UJ	22 U	13 UJ	20 U	20 U	13 UJ	20 UJ
TOTAL AROCLOR	1060	10.3 U	25.6 UJ	22.4 UJ	23.6 U	24.6 U	22.6 U	25.7 U	25.6 U	1280	160 J	21.6 U	20.6 UJ	170 J	1100 J	460 J	170	13.3 UJ	20.4 U	20.6 U	13.4 UJ	430 J
METALS (MG/KG)																						
COPPER	74	NA	41.3	60.9	116	89.7	90.5	75.1	93.5	154	32.4	74.6 J	54.7 J	6	NA	NA	NA	NA	84.2 J	95.3 J	8.4 J	282 J
LEAD	168	10 J	49.9	55.2	96	80.7	74.8	67.4	70.6	180	48.9	88.4 J	89.8 J	4.6	473	103	104 J	11.6 J	60.5 J	60 J	8.2 J	190 J
ZINC	118	NA	122	153	210 J	242 J	237 J	155 J	229 J	583 J	129 J	111 J	124 J	424	NA	NA	NA	NA	179 J	186 J	48.9 J	577 J
MISCELLANEOUS PARAMETERS (MG/KG)																						
TOTAL ORGANIC CARBON		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (%)																						
AMOSITE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ASBESTOS	1	NA	ND	<1	<1	<1	<1	<1	<1	2	<1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHRYSOTILE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL SOLIDS		82	34	39	35	32	32	33	34	49	79	NA	NA	70	44	40	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (UG/KG)																						
TRIBUTYLTIN (AS TIN)	228	0.62 U	0.71 U	4.4	75	8.4	7.6	11	1 J	43	0.67 U	1.6	4.3	0.67 J	0.68 U	16	23	0.69 U	18	2.5	0.73 U	15
MISCELLANEOUS PARAMETERS (%)																						
TOTAL SOLIDS		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

DARK SHADING-EXCEEDS RPRG; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

APPENDIX C-2B
ANALYTICAL RESULTS FOR 1 TO 2 FOOT INTERVAL SEDIMENT SAMPLES (2011)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
FEASIBILITY STUDY
NAVSTA NEWPORT, NEWPORT RI

SAMPLE ID	Comparison Criteria	DSY-SD-AD21-1224	DSY-SD-AE24-1224	DSY-SD-AE26-1224	DSY-SD-AE28-1224	DSY-SD-AE30-1224	DSY-SD-AG24-1224	DSY-SD-AG26-1224	DSY-SD-AG28-1224	DSY-SD-AG30-1224	DSY-SD-AI24-1224	DSY-SD-AI26-1224	DSY-SD-AI28-1224	DSY-SD-AI30-1224	DSY-SD-AK24-1224	DSY-SD-AK26-1224	DSY-SD-AK28-1224	DSY-SD-AK30-1224	DSY-SD-AO30-1224	DSY-SD-AP20-1224	DSY-SD-AT16-1224	DSY-SD-AT20-1224
LOCATION ID		DSY-SD-AD21	DSY-SD-AE24	DSY-SD-AE26	DSY-SD-AE28	DSY-SD-AE30	DSY-SD-AG24	DSY-SD-AG26	DSY-SD-AG28	DSY-SD-AG30	DSY-SD-AI24	DSY-SD-AI26	DSY-SD-AI28	DSY-SD-AI30	DSY-SD-AK24	DSY-SD-AK26	DSY-SD-AK28	DSY-SD-AK30	DSY-SD-AO30	DSY-SD-AP20	DSY-SD-AT16	DSY-SD-AT20
SAMPLE DATE		09/29/11	09/26/11	09/28/11	09/28/11	09/28/11	09/26/11	09/26/11	09/26/11	09/28/11	09/26/11	09/26/11	09/23/11	09/26/11	09/23/11	09/23/11	09/23/11	09/23/11	09/23/11	09/22/11	09/22/11	09/22/11
TOP DEPTH		1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT
BOTTOM DEPTH		2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT
SACODE		NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
SEMIVOLATILES (UG/KG)																						
BENZO(A)ANTHRACENE		390 UJ	200 J	270 J	650 U	280 U	380 U	550 UJ	260 J	290 U	330 U	620 U	300 J	200 J	300 U	280 U	290 U	300 U	300 U	380 UJ	370 U	330 UJ
BENZO(A)PYRENE	539	100	190	240	200	5.6 J	35	200	210	27	89	170 J	310	180	57	11 U	12 U	59	12 U	16 U	6.1 J	13 UJ
BENZO(B)FLUORANTHENE		390 UJ	490 UJ	620 UJ	650 U	280 U	380 UJ	550 UJ	400 J	290 U	330 U	620 U	530 J	300 J	300 U	280 U	290 U	300 U	300 U	380 U	370 U	330 UJ
BENZO(G,H,I)PERYLENE		390 UJ	490 UJ	620 UJ	650 U	280 U	380 UJ	550 UJ	620 U	290 U	330 U	620 U	610 U	290 U	300 U	280 U	290 U	300 U	300 U	380 U	370 U	330 UJ
BENZO(K)FLUORANTHENE		390 UJ	490 UJ	350 J	350 J	280 U	380 UJ	550 UJ	620 U	290 U	330 U	620 U	270 J	290 U	300 U	280 U	290 U	300 U	300 U	380 U	370 U	330 UJ
CHRYSENE		390 UJ	290 J	400 J	320 J	280 U	380 U	550 UJ	330 J	290 U	330 U	240 J	480 J	270 J	300 U	280 U	290 U	300 U	300 U	380 U	370 U	330 UJ
DIBENZO(A,H)ANTHRACENE		390 UJ	490 UJ	620 UJ	650 U	280 U	380 UJ	550 UJ	620 U	290 U	330 U	620 U	610 U	290 U	300 U	280 U	290 U	300 U	300 U	380 U	370 U	330 UJ
FLUORANTHENE		390 U	490 U	620 U	650 U	280 U	380 U	550 U	320 J	290 U	330 U	620 U	500 J	370 J	300 U	280 U	290 U	300 U	300 U	380 UJ	370 U	330 UJ
HIGH MOLECULAR WEIGHT PAHS	13903	680 J	1660 J	2130 J	1550 J	5.6 J	245 J	1300 J	2290 J	27 J	489 J	1030 J	3370 J	2280 J	197 J	253 U	262 U	279 J	271 U	344 UJ	6.1 J	298 UJ
INDENO(1,2,3-CD)PYRENE		390 UJ	490 UJ	620 UJ	650 U	280 U	380 UJ	550 UJ	620 U	290 U	330 U	620 UJ	610 U	290 U	300 U	280 U	290 U	300 U	300 U	380 U	370 U	330 UJ
PYRENE		580 J	980	870 J	680 J	280 UJ	210 J	1100 J	770 J	290 UJ	400 J	620 J	980	960	140 J	280 U	290 U	220 J	300 U	380 U	370 U	330 UJ
PCBS (UG/KG)																						
AROCLOR-1016		13 U	16 UJ	21 U	22 U	9.5 U	13 U	19 UJ	21 U	8.9 U	12 U	20 UJ	21 UJ	10 U	11 UJ	10 UJ	10 UJ	10 U	10 U	13 UJ	11 UJ	12 U
AROCLOR-1221		13 U	16 UJ	21 U	22 U	9.5 U	13 U	19 UJ	21 U	8.9 U	12 U	20 UJ	21 UJ	10 U	11 U	10 U	10 U	10 U	10 U	13 UJ	11 UJ	12 U
AROCLOR-1232		16 U	19 UJ	25 U	26 U	11 U	15 U	22 UJ	25 U	10 U	14 U	24 UJ	24 UJ	12 U	13 U	12 U	12 U	12 U	12 U	15 UJ	12 UJ	14 U
AROCLOR-1242		13 U	16 UJ	21 U	22 U	9.5 U	13 U	19 UJ	21 U	8.9 U	12 U	20 UJ	21 UJ	10 U	11 U	10 U	10 U	10 U	10 U	13 UJ	11 UJ	12 U
AROCLOR-1248		13 U	16 UJ	21 U	22 U	9.5 U	13 U	19 UJ	21 U	8.9 U	12 U	20 UJ	21 UJ	10 U	11 U	10 U	10 U	10 U	10 U	13 UJ	11 UJ	12 U
AROCLOR-1254		49 J	160 J	21 U	22 U	9.5 U	13 U	130 J	140	8.9 U	250 J	63 J	21 UJ	10 U	11 U	10 U	10 U	10 U	10 U	13 UJ	11 UJ	12 U
AROCLOR-1260		13 U	16 UJ	21 U	22 U	9.5 U	13 U	19 UJ	21 U	8.9 U	12 U	20 UJ	21 UJ	10 U	11 UJ	10 UJ	10 UJ	10 U	10 U	13 UJ	11 UJ	12 U
TOTAL AROCLOR	1060	49 J	160 J	21.6 U	22.6 U	9.71 U	13.3 U	130 J	140	9.06 U	250 J	63 J	21.4 UJ	10.3 U	11.3 UJ	10.3 UJ	10.3 UJ	10.3 U	10.3 U	13.3 UJ	11.1 UJ	12.3 U
METALS (MG/KG)																						
COPPER	74	38.1 J	NA	NA	86.8 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	168	36.6 J	198	68.2	88.4	8.3	7.2	113	106	191	78.3	98.2	95	24.9	22.6	6.1	2	12.1	2.6	6.9 J	8.8	5.8
ZINC	118	619 J	NA	NA	209 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/KG)																						
TOTAL ORGANIC CARBON		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (%)																						
AMOSITE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ASBESTOS	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHRYSOTILE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL SOLIDS		NA	49	39	38	88	NA	43	NA	84	NA	40	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (UG/KG)																						
TRIBUTYLTIN (AS TIN)	228	0.79 J	0.65 U	160	49	0.64 U	0.63 U	1.4 J	3.8	17	0.72 U	9.3	24	0.96 J	0.69 U	0.66 U	0.66 U	0.64 U	0.67 U	0.72 U	0.68 U	0.66 U
MISCELLANEOUS PARAMETERS (%)																						
TOTAL SOLIDS		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

DARK SHADING-EXCEEDS RPRG; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

APPENDIX C-2B
ANALYTICAL RESULTS FOR 1 TO 2 FOOT INTERVAL SEDIMENT SAMPLES (2011)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
FEASIBILITY STUDY
NAVSTA NEWPORT, NEWPORT RI

SAMPLE ID	Comparison Criteria	DSY-SD-AT24-1224	DSY-SD-AT30-1224-AVG	DSY-SD-AX06-1224	DSY-SD-AX20-1224	DSY-SD-AY30-1224	DSY-SD-BB02-1224	DSY-SD-BB06-1224	DSY-SD-BB10-1224	DSY-SD-BB26-1224	DSY-SD-BC28-1224	DSY-SD-BC30-1224	DSY-SD-BD26-1224	DSY-SD-BE28-1224	DSY-SD-BE30-1224	DSY-SD-BF06-1224	DSY-SD-BF23-1224	DSY-SD-BG26-1224	DSY-SD-BG28-1224	DSY-SD-BI26-1224-AVG	DSY-SD-BJ23-1224	DSY-SD-C09-1224	DSY-SD-C13-1224
LOCATION ID		DSY-SD-AT24	DSY-SD-AT30	DSY-SD-AX06	DSY-SD-AX20	DSY-SD-AY30	DSY-SD-BB02	DSY-SD-BB06	DSY-SD-BB10	DSY-SD-BB26	DSY-SD-BC28	DSY-SD-BC30	DSY-SD-BD26	DSY-SD-BE28	DSY-SD-BE30	DSY-SD-BF06	DSY-SD-BF23	DSY-SD-BG26	DSY-SD-BG28	DSY-SD-BI26	DSY-SD-BJ23	DSY-SD-C09	DSY-SD-C13
SAMPLE DATE		09/22/11	09/23/11	09/22/11	09/22/11	09/23/11	09/22/11	09/22/11	09/22/11	09/21/11	09/21/11	09/21/11	09/21/11	09/22/11	09/21/11	09/22/11	09/22/11	09/21/11	09/21/11	09/21/11	09/21/11	10/07/11	10/07/11
TOP DEPTH		1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT
BOTTOM DEPTH		2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT
SACODE		NORMAL	AVG	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	AVG	NORMAL	NORMAL	NORMAL
SEMIVOLATILES (UG/KG)																							
BENZO(A)ANTHRACENE		330 UJ	290 U	380 U	330 UJ	300 U	340 U	360 U	400 U	930 J	420 J	420 UJ	1300 J	1200	1800	340 U	310 U	340 J	300 U	470 J	320 UJ	310 U	310 U
BENZO(A)PYRENE	539	4.6 J	11.5 U	15 J	13 U	12 U	4.7 J	15 U	16 U	940 J	340	2100 J	1100 J	940 J	1600	14 U	7.6 J	240	42	465	11 J	12 U	8.2 J
BENZO(B)FLUORANTHENE		330 U	290 U	380 U	330 U	300 U	340 U	360 U	400 U	1100 J	550 J	1900 J	1600 J	1400 J	2300	340 U	310 U	570 J	300 U	730	320 U	310 U	310 U
BENZO(G,H,I)PERYLENE		330 U	290 U	380 U	330 U	300 U	340 U	360 U	400 U	720 J	180 J	1800 J	660 J	370 UJ	690	340 U	310 U	240 J	300 U	225 J	320 U	310 U	310 U
BENZO(K)FLUORANTHENE		330 U	290 U	380 U	330 U	300 U	340 U	360 U	400 U	420 J	230 J	690 J	700 J	660 J	950	340 U	310 U	260 J	300 U	295 J	320 U	310 U	310 U
CHRYSENE		330 U	290 U	380 U	330 U	300 U	340 U	360 U	400 U	1300 J	510 J	420 UJ	1400	1400	1800	340 U	310 U	480 J	300 U	545	320 U	310 U	310 U
DIBENZO(A,H)ANTHRACENE		330 U	290 U	380 U	330 U	300 U	340 U	360 U	400 U	360 UJ	350 UJ	420 UJ	410 UJ	370 UJ	250 J	340 U	310 U	370 UJ	300 U	280 U	320 U	310 U	310 UJ
FLUORANTHENE		330 UJ	290 U	380 U	330 UJ	300 U	340 U	360 U	400 U	1100	510	1400	1800	1500	3100 J	340 U	310 U	570	160 J	695 J	320 U	310 U	310 U
HIGH MOLECULAR WEIGHT PAHS	13903	4.6 J	262 U	15 J	298 UJ	271 U	4.7 J	326 U	362 U	10900 J	4240 J	19700 J	13300 J	11600 J	20600 J	307 U	7.6 J	4100 J	352 J	5210 J	11 J	280 UJ	8.2 J
INDENO(1,2,3-CD)PYRENE		330 U	290 U	380 U	330 U	300 U	340 UJ	360 U	400 U	470 J	350 UJ	850 J	560 J	370 UJ	880 J	340 U	310 UJ	370 UJ	300 UJ	235 J	320 UJ	310 UJ	310 UJ
PYRENE		330 U	290 U	380 U	330 U	300 U	340 U	360 U	400 U	3900 J	1500 J	11000 J	4200	4500	7200 J	340 U	310 U	1400	150 J	1550	320 U	310 U	310 U
PCBS (UG/KG)																							
AROCLOR-1016		11 UJ	10 UJ	12 U	12 UJ	10 UJ	12 UJ	12 U	15 U	13 UJ	12 UJ	14 UJ	14 UJ	12 UJ	11 UJ	12 U	11 UJ	12 UJ	11 UJ	10.5 UJ	11 UJ	11 U	10 UJ
AROCLOR-1221		11 UJ	10 U	12 U	12 UJ	10 U	12 UJ	12 U	15 U	13 UJ	12 UJ	14 UJ	14 UJ	12 U	11 UJ	12 U	11 UJ	12 U	11 UJ	10.5 UJ	11 U	11 U	10 UJ
AROCLOR-1232		12 UJ	12 U	15 U	14 UJ	12 U	14 UJ	14 U	17 U	15 UJ	15 UJ	17 UJ	16 UJ	14 U	13 UJ	14 U	13 UJ	14 U	13 UJ	12.5 UJ	13 U	12 U	12 UJ
AROCLOR-1242		11 UJ	10 U	12 U	12 UJ	10 U	12 UJ	12 U	15 U	13 UJ	12 UJ	14 UJ	14 UJ	12 U	11 UJ	12 U	11 UJ	12 U	11 UJ	10.5 UJ	11 U	11 U	10 UJ
AROCLOR-1248		11 UJ	10 U	12 U	12 UJ	10 U	12 UJ	12 U	15 U	13 UJ	12 UJ	14 UJ	14 UJ	12 U	11 UJ	12 U	11 UJ	12 U	11 UJ	10.5 UJ	11 U	11 U	10 UJ
AROCLOR-1254		11 UJ	10 U	12 U	12 UJ	10 U	12 UJ	12 U	15 U	13 UJ	12 UJ	14 UJ	14 UJ	12 U	11 UJ	12 U	11 UJ	12 U	11 UJ	10.5 UJ	11 U	11 U	10 UJ
AROCLOR-1260		11 UJ	10 UJ	12 U	12 UJ	10 UJ	12 UJ	12 U	15 U	13 UJ	12 UJ	14 UJ	14 UJ	12 U	11 UJ	12 U	11 UJ	12 U	11 UJ	10.5 UJ	11 U	11 U	10 UJ
TOTAL AROCLOR	1060	11.1 UJ	10.3 UJ	12.4 U	12.3 UJ	10.3 UJ	12.3 UJ	12.3 U	15.3 U	13.3 UJ	12.4 UJ	14.4 UJ	14.3 UJ	12.3 UJ	11.3 UJ	12.3 U	11.3 UJ	12.3 UJ	11.3 UJ	10.8 UJ	11.3 UJ	11.1 U	10.3 UJ
METALS (MG/KG)																							
COPPER	74	NA	NA	NA	NA	NA	NA	NA	NA	108 J	35.8 J	67 J	43.8 J	63.9 J	25.2 J	NA	4.2 J	28 J	6.5 J	22.6 J	6.8 J	3.2	NA
LEAD	168	6.1 J	2.9	13	5.2 J	2.2	28.5 J	6.5	7.9	149	44.3	62.6	50.9	50.6 J	61.7 J	5.1	4 J	32	7.3 J	30.6 J	6.7	4 J	4.5 J
ZINC	118	NA	NA	NA	NA	NA	NA	NA	NA	432	98.2	147	122	136 J	82.9 J	NA	29.4 J	78.7	42.2 J	74.5 J	38.4	20.8	NA
MISCELLANEOUS PARAMETERS (MG/KG)																							
TOTAL ORGANIC CARBON		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (%)																							
AMOSITE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ASBESTOS	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHRYSOTILE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL SOLIDS		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (UG/KG)																							
TRIBUTYLTIN (AS TIN)	228	0.7 U	0.7 U	0.71 U	0.7 U	0.62 U	0.64 U	0.71 U	0.7 U	0.7 U	0.65 U	3.8 J	0.69 U	7.6	0.72 U	0.66 U	0.68 U	0.66 U	0.66 U	0.715 U	0.67 U	0.66 U	0.64 U
MISCELLANEOUS PARAMETERS (%)																							
TOTAL SOLIDS		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	78	79

DARK SHADING-EXCEEDS RPRG; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

APPENDIX C-2B
ANALYTICAL RESULTS FOR 1 TO 2 FOOT INTERVAL SEDIMENT SAMPLES (2011)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
FEASIBILITY STUDY
NAVSTA NEWPORT, NEWPORT RI

SAMPLE ID	Comparison Criteria	DSY-SD-C17-1224	DSY-SD-C21-1224	DSY-SD-C25-1224-AVG	DSY-SD-C29-1224	DSY-SD-G01-1224	DSY-SD-G05-1224	DSY-SD-G09-1224	DSY-SD-G13-1224	DSY-SD-G17-1224	DSY-SD-G21-1224	DSY-SD-G25-1224	DSY-SD-J24-0012	DSY-SD-J26-1224	DSY-SD-J28-1224	DSY-SD-J30-1224	DSY-SD-K05-1224	DSY-SD-K09-1224	DSY-SD-K13-1224	DSY-SD-K17-1224	DSY-SD-K21-1224	DSY-SD-L24-1224	DSY-SD-L26-1224	DSY-SD-L28-1224-AVG	DSY-SD-L30-1224
LOCATION ID		DSY-SD-C17	DSY-SD-C21	DSY-SD-C25	DSY-SD-C29	DSY-SD-G01	DSY-SD-G05	DSY-SD-G09	DSY-SD-G13	DSY-SD-G17	DSY-SD-G21	DSY-SD-G25	DSY-SD-J24	DSY-SD-J26	DSY-SD-J28	DSY-SD-J30	DSY-SD-K05	DSY-SD-K09	DSY-SD-K13	DSY-SD-K17	DSY-SD-K21	DSY-SD-L24	DSY-SD-L26	DSY-SD-L28	DSY-SD-L30
SAMPLE DATE		10/07/11	10/07/11	10/07/11	10/07/11	10/12/11	10/12/11	10/12/11	10/12/11	10/12/11	10/12/11	10/12/11	10/04/11	10/04/11	10/04/11	10/04/11	10/03/11	10/03/11	10/03/11	10/03/11	10/03/11	10/04/11	10/04/11	10/04/11	10/04/11
TOP DEPTH		1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	0 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT
BOTTOM DEPTH		2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	1 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT
SACODE		NORMAL	NORMAL	AVG	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	AVG	NORMAL
SEMIVOLATILES (UG/KG)																									
BENZO(A)ANTHRACENE		300 U	140 J	135 J	520 J	400 J	440 J	700 J	390 J	340 J	290 J	3900	170 J	1500	740 J	960 J	310 UJ	340 UJ	320 UJ	350 UJ	150 J	480 J	300 U	340 U	130 UJ
BENZO(A)PYRENE	539	5.6 J	170	97.5 J	550	200	210	320	210	240	270	2200	100	1000 J	400 J	580 J	12 UJ	14 UJ	37 J	24 J	110 J	20 UJ	13 J	73.5	140 J
BENZO(B)FLUORANTHENE		300 U	220 J	195 J	480 UJ	390 J	510 J	720 J	750 U	470 J	720 UR	3500	390 UJ	1500 J	570 J	910 J	310 UJ	340 UJ	320 UJ	350 UJ	400 UJ	410 J	300 U	340 UJ	340 UJ
BENZO(G,H,I)PERYLENE		300 U	340 U	300 U	480 UJ	660 U	670 U	740 U	750 U	690 U	720 UR	700 J	390 UJ	590 UJ	580 UJ	650 UJ	310 UJ	340 UJ	320 UJ	350 UJ	400 UJ	500 UJ	300 U	340 UJ	340 UJ
BENZO(K)FLUORANTHENE		300 U	220 J	145 J	480 UJ	660 U	670 U	360 J	750 U	230 J	720 UR	1500	390 UJ	1800 J	570 J	730 J	310 UJ	340 UJ	320 UJ	350 UJ	140 J	430 J	300 U	340 UJ	340 UJ
CHRYSENE		300 U	210 J	160 J	730 J	480 J	660 J	1000	480 J	500 J	330 J	3900	320 J	2000	820 J	1100 J	310 UJ	340 UJ	320 UJ	350 UJ	180 J	620 J	300 U	155 J	140 J
DIBENZO(A,H)ANTHRACENE		300 UJ	340 U	300 U	480 UJ	660 U	670 U	740 U	750 U	690 U	720 UR	680 U	390 UJ	590 UJ	580 UJ	650 UJ	310 UJ	340 UJ	320 UJ	350 UJ	400 UJ	500 UJ	300 U	340 UJ	340 UJ
FLUORANTHENE		300 U	340 U	300 U	430 J	2300	1100	1000	960 J	1200 J	530 J	1600	230 J	450 J	1100 J	2700 J	310 UJ	340 UJ	320 UJ	350 UJ	210 J	760	300 U	340 U	340 UJ
HIGH MOLECULAR WEIGHT PAHS	13903	5.6 J	1810 J	909 J	5330 J	5570 J	4020 J	5200 J	2880 J	3880 J	2140 J	26800 J	1680 J	13000 J	8700 J	12400 J	280 UJ	307 UJ	337 J	24 J	1370 J	5300 J	13 J	458 J	1120 J
INDENO(1,2,3-CD)PYRENE		300 UJ	340 UJ	300 UJ	480 UJ	660 U	670 U	740 U	750 U	690 U	720 UR	810 J	390 UJ	590 UJ	580 UJ	650 UJ	310 UJ	340 UJ	320 UJ	350 UJ	400 UJ	500 UJ	300 U	340 UJ	340 UJ
PYRENE		300 U	850	445	3100 J	1800	1100	1100	840 J	900 J	720 J	8700 J	860 J	4800	4500 J	5400 J	310 UJ	340 UJ	300 J	350 UJ	580 J	2600 J	300 U	315 J	840 J
PCBS (UG/KG)																									
AROCLOR-1016		10 U	12 U	10.6 U	17 UJ	23 U	25 U	26 U	24 U	28 U	24 U	23 UJ	12 U	21 UJ	20 UJ	21 UJ	11 U	11 U	10 U	11 U	13 U	16 U	10 U	12 U	11 U
AROCLOR-1221		10 U	12 U	10.6 U	17 UJ	23 U	25 U	26 U	24 U	28 U	24 U	23 U	12 U	21 UJ	20 UJ	21 UJ	11 U	11 U	10 U	11 U	13 U	16 U	10 U	12 U	11 U
AROCLOR-1232		12 U	14 U	12.5 U	20 UJ	27 U	30 U	30 U	29 U	33 U	29 U	27 U	14 U	25 UJ	23 UJ	25 UJ	13 U	13 U	12 U	13 U	16 U	19 U	12 U	14 U	13 U
AROCLOR-1242		10 U	12 U	10.6 U	17 UJ	23 U	25 U	26 U	24 U	28 U	24 U	23 U	12 U	21 UJ	20 UJ	21 UJ	11 U	11 U	10 U	11 U	13 U	16 U	10 U	12 U	11 U
AROCLOR-1248		10 U	12 U	10.6 U	17 UJ	23 U	25 U	26 U	24 U	28 U	24 U	23 U	12 U	21 UJ	20 UJ	21 UJ	11 U	11 U	10 U	11 U	13 U	16 U	10 U	12 U	11 U
AROCLOR-1254		10 U	180	192 J	550 J	23 U	25 U	26 U	24 U	28 U	24 U	170 J	1200	160 J	380 J	130 J	11 U	11 U	66 J	54	550	2000	10 U	115	220
AROCLOR-1260		10 U	180	10.6 U	17 UJ	23 U	25 U	26 U	24 U	28 U	24 U	23 U	12 U	21 UJ	20 UJ	21 UJ	11 U	11 U	10 U	11 U	13 U	760	10 U	12 U	11 U
TOTAL AROCLOR	1060	10.3 U	360	192 J	550 J	23.6 U	25.7 U	26.6 U	24.7 U	28.7 U	24.7 U	170 J	1200	160 J	380 J	130 J	11.3 U	11.3 U	66 J	54	550	2760	10.3 U	115	220
METALS (MG/KG)																									
COPPER	74	NA	NA	NA	NA	37.1	46.6	53	55	54.7	49	260	NA	NA	NA	NA	4.2	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	168	3.6 J	88.4 J	68.4 J	759 J	47.7 J	62.8 J	63.4 J	56.5 J	60.6 J	49.3 J	199 J	1100 J	54.9 J	315 J	81 J	5.3	4.9	168	13	135	543 J	4.3 J	85.5 J	9.5 J
ZINC	118	NA	NA	NA	NA	110	145	161	144	154	135	675	NA	NA	NA	NA	24.9	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/KG)																									
TOTAL ORGANIC CARBON		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	28000 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (%)																									
AMOSITE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ASBESTOS	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHRYSOTILE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL SOLIDS		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (UG/KG)																									
TRIBUTYLTIN (AS TIN)	228	0.62 U	0.72 U	1.3 J	0.7 U	0.69 U	0.7 U	0.73 U	0.73 U	0.7 U	0.72 U	44	0.7 U	6.9	1.2 J	2.3	0.65 U	0.69 U	0.71 U	0.7 U	0.67 U	0.68 U	0.64 U	0.675 U	0.71 U
MISCELLANEOUS PARAMETERS (%)																									
TOTAL SOLIDS		82	66	78.5	49	36	33	32	31	30	34	36	NA	NA	NA	NA	NA	NA	NA	NA	NA	48	80	NA	NA

DARK SHADING-EXCEEDS RPRG; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

APPENDIX C-2B
ANALYTICAL RESULTS FOR 1 TO 2 FOOT INTERVAL SEDIMENT SAMPLES (2011)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
FEASIBILITY STUDY
NAVSTA NEWPORT, NEWPORT RI

SAMPLE ID	Comparison Criteria	DSY-SD-N24-1224	DSY-SD-N26-1224	DSY-SD-N28-1224	DSY-SD-N30-1224	DSY-SD-O09-1224	DSY-SD-O13-1224	DSY-SD-O17-1224	DSY-SD-O21-1224	DSY-SD-Q25-1224	DSY-SD-Q29-1224	DSY-SD-S09-1224	DSY-SD-S13-1224	DSY-SD-S17-1224	DSY-SD-S21-1224	DSY-SD-T25-1224	DSY-SD-T29-1224	DSY-SD-W09-1224	DSY-SD-W13-1224-AVG	DSY-SD-W17-1224	DSY-SD-W21-1224	DSY-SD-W24-1224	DSY-SD-W26-1224	DSY-SD-W28-1224
LOCATION ID		DSY-SD-N24	DSY-SD-N26	DSY-SD-N28	DSY-SD-N30	DSY-SD-O09	DSY-SD-O13	DSY-SD-O17	DSY-SD-O21	DSY-SD-Q25	DSY-SD-Q29	DSY-SD-S09	DSY-SD-S13	DSY-SD-S17	DSY-SD-S21	DSY-SD-T25	DSY-SD-T29	DSY-SD-W09	DSY-SD-W13	DSY-SD-W17	DSY-SD-W21	DSY-SD-W24	DSY-SD-W26	DSY-SD-W28
SAMPLE DATE		10/05/11	10/05/11	10/05/11	10/05/11	09/30/11	09/30/11	09/30/11	09/30/11	10/05/11	10/06/11	09/30/11	09/30/11	09/30/11	09/30/11	10/05/11	10/06/11	09/30/11	09/30/11	09/30/11	09/30/11	10/06/11	10/05/11	10/06/11
TOP DEPTH		1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT
BOTTOM DEPTH		2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT
SACODE		NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	AVG	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
SEMIVOLATILES (UG/KG)																								
BENZO(A)ANTHRACENE		500 J	390 J	760 J	600 J	350 U	320 U	380 J	270 J	340 U	840	380 U	280 J	340 U	380 UJ	380 J	300 U	410 U	360 U	160 J	420 U	220 J	330 J	1000 J
BENZO(A)PYRENE	539	500	300 J	710 J	580 J	14 U	13 U	390	200	36	560	21 J	220	14 U	70	490	56	31 J	40.5	150	97	150	300	930 J
BENZO(B)FLUORANTHENE		700 J	430 UJ	760 J	670 J	350 U	320 U	550 J	340 J	340 U	970	380 U	350 J	340 UJ	380 UJ	560 U	300 U	410 U	360 U	440 UJ	420 UJ	360 UJ	610 J	920 J
BENZO(G,H,I)PERYLENE		550 UJ	430 UJ	580 U	580 UJ	350 U	320 U	560 UJ	510 UJ	340 UJ	280 J	380 U	520 U	340 UJ	380 UJ	560 U	300 U	410 U	360 U	440 UJ	420 UJ	360 UJ	600 U	520 J
BENZO(K)FLUORANTHENE		580 J	430 UJ	780	620 J	350 U	320 U	520 J	300 J	340 U	500 J	380 U	350 J	340 UJ	380 UJ	560 U	300 U	410 U	360 U	440 UJ	170 J	360 UJ	250 J	1000 J
CHRYSENE		700 J	460 J	900	680 J	350 U	320 U	520 J	340 J	340 U	1200	380 U	420 J	340 U	380 UJ	560 J	300 U	410 U	360 U	280 J	420 U	270 J	470 J	1400 J
DIBENZO(A,H)ANTHRACENE		550 UJ	430 UJ	580 U	580 UJ	350 U	320 U	560 UJ	510 UJ	340 U	520 U	380 U	520 U	340 UJ	380 UJ	560 U	300 U	410 U	360 U	440 UJ	420 UJ	360 UJ	600 U	440 UJ
FLUORANTHENE		400 J	750 J	680 J	560 J	350 U	320 U	270 J	280 J	340 U	810	380 U	230 J	340 U	380 U	300 J	300 U	410 U	360 U	440 U	420 U	430 J	300 J	510 J
HIGH MOLECULAR WEIGHT PAHS	13903	6880 J	3900 J	7790 J	5910 J	316 U	289 U	4030 J	3030 J	36 J	7860 J	21 J	2730 J	307 UJ	510 J	3830 J	246 J	31 J	40.5	1690 J	817 J	1870 J	3460 J	10300 J
INDENO(1,2,3-CD)PYRENE		550 UJ	430 UJ	580 U	580 UJ	350 U	320 U	560 UJ	510 UJ	340 U	300 J	380 U	520 U	340 UJ	380 UJ	560 U	300 U	410 U	360 U	440 UJ	420 UJ	360 UJ	600 U	380 J
PYRENE		3500 J	2000 J	3200	2200	350 U	320 U	1400	1300 J	140 UJ	2400	380 U	880	340 U	440 J	2100	190 J	410 U	360 U	1100 J	550 J	800	1200	3600 J
PCBS (UG/KG)																								
AROCLOR-1016		19 U	14 U	20 U	20 UJ	12 U	11 U	19 U	18 UJ	11 U	18 U	13 U	18 UJ	12 UJ	13 J	19 U	10 U	15 UJ	13 UJ	15 U	14 UJ	13 U	21 U	16 U
AROCLOR-1221		19 U	14 U	20 U	20 UJ	12 U	11 U	19 U	18 UJ	11 U	18 U	13 U	18 UJ	12 UJ	13 J	19 U	10 U	15 UJ	13 UJ	15 U	14 UJ	13 U	21 U	16 U
AROCLOR-1232		22 U	17 U	23 U	24 UJ	14 U	13 U	22 U	21 UJ	13 U	21 U	16 U	21 UJ	14 UJ	16 J	22 U	12 U	18 UJ	15 UJ	18 U	16 UJ	15 U	24 U	18 U
AROCLOR-1242		19 U	14 U	20 U	20 UJ	12 U	11 U	19 U	18 UJ	11 U	18 U	13 U	18 UJ	12 UJ	13 J	19 U	57	15 UJ	13 UJ	15 U	14 UJ	13 U	21 U	16 U
AROCLOR-1248		19 U	14 U	20 U	20 UJ	12 U	11 U	19 U	18 UJ	11 U	18 U	13 U	18 UJ	12 UJ	13 J	19 U	10 U	15 UJ	13 UJ	15 U	14 UJ	13 U	21 U	16 U
AROCLOR-1254		710	580	740	86 J	12 U	11 U	250	18 UJ	89	260	13 U	140 J	12 UJ	230 J	92	10 U	15 UJ	13 UJ	450	80 J	630	240	1400
AROCLOR-1260		280	250	220	20 UJ	12 U	11 U	19 U	18 UJ	11 U	18 U	13 U	18 UJ	12 UJ	13 J	19 U	10 U	15 UJ	13 UJ	450	14 UJ	500	21 U	16 U
TOTAL AROCLOR	1060	990	830	960	86 J	12.3 U	11.3 U	250	18.4 UJ	89	260	13.4 U	140 J	12.3 UJ	311 J	92	57	15.4 UJ	13.3 UJ	900	80 J	1130	240	1400
METALS (MG/KG)																								
COPPER	74	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	17	17.3	239	47	NA	NA	NA
LEAD	168	66.6 J	68.8 J	246 J	213 J	6.2 J	3.7 J	79.8 J	56.4 J	23.3	63.3	12.6 J	97 J	11.5 J	80.4 J	236	16	46.4 J	25.6 J	210 J	133 J	577	109	94.8 J
ZINC	118	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	84	68.3	590	122	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/KG)																								
TOTAL ORGANIC CARBON		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (%)																								
AMOSITE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ASBESTOS	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHRYSOTILE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL SOLIDS		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (UG/KG)																								
TRIBUTYLTIN (AS TIN)	228	3	0.66 U	10	8.6	0.67 U	0.65 U	20	5.3	0.62 U	1.7	0.71 U	1.7	0.65 U	0.71 U	0.67 U	0.71 U	0.71 U	0.695 U	0.66 U	78	0.69 U	8.8	9.7
MISCELLANEOUS PARAMETERS (%)																								
TOTAL SOLIDS		44	56	41	42	NA	NA	NA	NA	71	47	NA	NA	NA	NA	44	81	NA	NA	NA	NA	64	40	53

DARK SHADING-EXCEEDS RPRG; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

SAMPLE ID	Comparison Criteria	DSY-SD-W30-1224	DSY-SD-Y03-1224	DSY-SD-Y25-1224	DSY-SD-Y26-1224	DSY-SD-Y28-1224	DSY-SD-Y30-1224
LOCATION ID		DSY-SD-W30	DSY-SD-Y03	DSY-SD-Y25	DSY-SD-Y26	DSY-SD-Y28	DSY-SD-Y30
SAMPLE DATE		10/06/11	10/03/11	10/03/11	10/03/11	10/03/11	10/03/11
TOP DEPTH		1 FT	1 FT	1 FT	1 FT	1 FT	1 FT
BOTTOM DEPTH		2 FT	2 FT	2 FT	2 FT	2 FT	2 FT
SACODE		NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
SEMIVOLATILES (UG/KG)							
BENZO(A)ANTHRACENE		300 U	380 UJ	3000 J	1900 J	4700 J	1100 J
BENZO(A)PYRENE	539	34	15 UJ	1600 J	1200 J	2300 J	650 J
BENZO(B)FLUORANTHENE		300 U	380 UJ	1800 J	1500 J	2600 J	640 J
BENZO(G,H,I)PERYLENE		300 U	380 UJ	690 J	370 J	640 J	320 UJ
BENZO(K)FLUORANTHENE		300 U	380 UJ	1800 J	1300 J	2900 J	800 J
CHRYSENE		300 U	380 UJ	2900 J	2200 J	6100 J	1400 J
DIBENZO(A,H)ANTHRACENE		300 UJ	380 UJ	580 UJ	560 UJ	580 UJ	320 UJ
FLUORANTHENE		300 U	380 UJ	4500	1800 J	4900	2300 J
HIGH MOLECULAR WEIGHT PAHS	13903	274 J	344 UJ	31100 J	17200 J	39000 J	15000 J
INDENO(1,2,3-CD)PYRENE		300 UJ	380 UJ	810 J	500 J	840 J	370 J
PYRENE		240 J	380 UJ	14000	6400 J	14000	7700 J
PCBS (UG/KG)							
AROCLOR-1016		8.6 U	13 U	20 UJ	21 U	19 UJ	12 UJ
AROCLOR-1221		8.6 U	13 U	20 UJ	21 U	19 UJ	12 UJ
AROCLOR-1232		10 U	15 U	23 UJ	25 U	23 UJ	14 UJ
AROCLOR-1242		8.6 U	13 U	20 UJ	21 U	19 UJ	12 UJ
AROCLOR-1248		8.6 U	13 U	20 UJ	21 U	19 UJ	12 UJ
AROCLOR-1254		420	13 U	1000 J	1000 J	680 J	12 UJ
AROCLOR-1260		8.6 U	13 U	20 UJ	21 U	19 UJ	12 UJ
TOTAL AROCLOR	1060	420	13.3 U	1000 J	1000 J	680 J	12.3 UJ
METALS (MG/KG)							
COPPER	74	NA	6.2	NA	NA	NA	NA
LEAD	168	21.7 J	7.3	918	160	199	41
ZINC	118	NA	41.2	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/KG)							
TOTAL ORGANIC CARBON		NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (%)							
AMOSITE	1	NA	NA	NA	NA	NA	NA
ASBESTOS	1	NA	NA	NA	NA	NA	NA
CHRYSOTILE	1	NA	NA	NA	NA	NA	NA
TOTAL SOLIDS		NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (UG/KG)							
TRIBUTYLTIN (AS TIN)	228	0.72 U	0.66 U	10	24	39	3.4 U
MISCELLANEOUS PARAMETERS (%)							
TOTAL SOLIDS		83	NA	NA	NA	NA	NA

APPENDIX C-2C
ANALYTICAL RESULTS FOR 2 TO 4 FOOT INTERVAL SEDIMENT SAMPLES (2011)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
FEASIBILITY STUDY
NAVSTA NEWPORT, NEWPORT RI

SAMPLE ID	Comparison Criteria	DSY-SD-18-2448	DSY-SD-AA01-2448-AVG	DSY-SD-AA05-2448	DSY-SD-AA09-2448	DSY-SD-AA13-2448	DSY-SD-AA17-2448	DSY-SD-AA21-2448-AVG	DSY-SD-AA24-2448	DSY-SD-AA26-2448	DSY-SD-AB11-2448	DSY-SD-AB15-2448	DSY-SD-AC24-2448	DSY-SD-AC26-2448-AVG	DSY-SD-AC28-2448	DSY-SD-AC30-2448	DSY-SD-AD01-2448	DSY-SD-AD05-2448	DSY-SD-AD09-2448	DSY-SD-AD13-2448-AVG	DSY-SD-AD17-2448	DSY-SD-AD21-2448
LOCATION ID		DSY-SD-18	DSY-SD-AA01	DSY-SD-AA05	DSY-SD-AA09	DSY-SD-AA13	DSY-SD-AA17	DSY-SD-AA21	DSY-SD-AA24	DSY-SD-AA26	DSY-SD-AB11	DSY-SD-AB15	DSY-SD-AC24	DSY-SD-AC26	DSY-SD-AC28	DSY-SD-AC30	DSY-SD-AD01	DSY-SD-AD05	DSY-SD-AD09	DSY-SD-AD13	DSY-SD-AD17	DSY-SD-AD21
SAMPLE DATE		10/07/11	10/12/11	10/12/11	10/13/11	10/13/11	10/13/11	10/13/11	10/13/11	10/13/11	09/29/11	09/29/11	09/26/11	09/28/11	09/28/11	09/28/11	09/29/11	09/29/11	09/29/11	09/29/11	09/29/11	09/29/11
TOP DEPTH		2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT
BOTTOM DEPTH		4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT
SACODE		NORMAL	AVG	NORMAL	NORMAL	NORMAL	NORMAL	AVG	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	AVG	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	AVG	NORMAL	NORMAL
SEMIVOLATILES (UG/KG)																						
BENZO(A)ANTHRACENE		260 U	260 J	3000	1100	530 J	1400	555 J	540 J	370 J	3200 J	880	300 U	320 U	2700 J	870 J	340 U	820 J	240 J	355 U	360 U	340 U
BENZO(A)PYRENE	539	10 U	195	1600	580	320	820	183 J	280	200	1300 J	450	11 J	52 J	1600 J	470	14 U	400	140	14.5 U	14 J	22 J
BENZO(B)FLUORANTHENE		260 U	665 U	2600	870	560 J	1200	500 J	640 J	470 UJ	1300 J	510 J	300 UJ	320 UJ	1500 J	460 UJ	340 U	550 J	410 U	355 UJ	360 U	340 U
BENZO(G,H,I)PERYLENE		260 U	665 U	570 J	620 U	710 U	370 J	695 U	690 U	470 UJ	680 J	460 J	300 UJ	320 UJ	820 J	360 J	340 U	210 UJ	410 U	355 UJ	360 U	340 U
BENZO(K)FLUORANTHENE		260 U	665 U	1100	440 J	260 J	620 J	275 J	300 J	470 UJ	1300 J	600 J	300 UJ	320 UJ	1600 J	460 UJ	340 U	720 J	210 J	355 UJ	360 U	340 U
CHRYSENE		260 U	350 J	3200	1200	640 J	1600	715 J	760 J	520 J	3400 J	1100	300 U	145 J	2800 J	980 J	340 U	900 J	370 J	355 U	360 U	340 U
DIBENZO(A,H)ANTHRACENE		260 U	665 U	560 U	620 U	710 U	720 U	695 U	690 U	470 UJ	370 UJ	560 U	300 UJ	320 UJ	550 UJ	460 UJ	340 U	500 UJ	410 U	355 UJ	360 U	340 U
FLUORANTHENE		260 U	740 J	9900	2700	930 J	2700	1350	1100	800	16000	1900	300 U	230 U	3200	1200	340 U	800	210 J	355 U	360 U	340 U
HIGH MOLECULAR WEIGHT PAHS	13903	235 UJ	2300 J	31600 J	9690 J	4340 J	12100 J	4980 J	5420 J	3390 J	41000 J	8970 J	11 J	317 J	23200 J	7480 J	307 U	7750 J	2050 J	320 UJ	14 J	22 J
INDENO(1,2,3-CD)PYRENE		260 UJ	665 U	680 J	620 U	710 U	400 J	695 UJ	690 UJ	470 UJ	830 J	470 J	300 UJ	320 UJ	880 J	460 UJ	340 U	260 J	410 U	355 UJ	360 U	340 U
PYRENE		260 U	755 J	8900	2800 J	1100 J	3000	1400	1800	1500	13000	2600	300 U	280 J	8100 J	3600 J	340 U	3300 J	880	355 U	360 U	340 U
PCBS (UG/KG)																						
AROCLOR-1016		9.3 U	23 UJ	19 UJ	21 U	24 U	24 U	24 U	23 U	16 U	13 U	20 U	11 UJ	11 UJ	18 U	17 U	13 UJ	18 U	15 U	13 U	13 U	12 UJ
AROCLOR-1221		9.3 U	23 UJ	19 UJ	21 U	24 U	24 U	24 U	23 U	16 U	13 U	20 U	11 UJ	11 UJ	18 U	17 U	13 UJ	18 U	15 U	13 U	13 U	12 UJ
AROCLOR-1232		11 U	27 UJ	22 UJ	25 U	28 U	28 U	28 U	27 U	18 U	15 U	23 U	13 UJ	13 UJ	120 J	20 U	15 UJ	21 U	17 U	15 U	15 U	14 UJ
AROCLOR-1242		9.3 U	23 UJ	19 UJ	21 U	24 U	24 U	24 U	23 U	16 U	13 U	20 U	11 UJ	11 UJ	18 U	17 U	13 UJ	18 U	15 U	13 U	13 U	12 UJ
AROCLOR-1248		9.3 U	23 UJ	19 UJ	21 U	24 U	24 U	24 U	23 U	16 U	13 U	20 U	11 UJ	11 UJ	18 U	17 U	13 UJ	18 U	15 U	13 U	13 U	12 UJ
AROCLOR-1254		9.3 U	23 UJ	170 J	1300	24 U	24 U	220 J	190 J	730	13 U	97	11 UJ	122 J	690	2600	13 UJ	340	310	13 U	120	12 UJ
AROCLOR-1260		9.3 U	23 UJ	19 UJ	21 U	24 U	24 U	24 U	23 U	540	13 U	20 U	11 UJ	11 UJ	18 U	17 U	13 UJ	18 U	15 U	13 U	13 U	12 UJ
TOTAL AROCLOR	1060	9.54 U	23.6 UJ	170 J	1300	24.6 U	24.6 U	220 J	190 J	1270	13.3 U	97	11.3 UJ	122 J	810 J	2600	13.3 UJ	340	310	13.3 U	120	12.3 UJ
METALS (MG/KG)																						
COPPER	74	NA	39.5	155	123	126	226	151	87.8	183	66.9 J	154 J	59.1	NA	NA	NA	NA	131 J	295 J	6.6 J	16.1 J	8 J
LEAD	168	8.1 J	57.2	111	111	115	138	139	81	148	139 J	281 J	42.9	90.9	276	788 J	7 J	252 J	437 J	8.75 J	66 J	10.3 J
ZINC	118	NA	126	373	275 J	289 J	309 J	330 J	197 J	570 J	163 J	466 J	126	NA	NA	NA	NA	320 J	782 J	43.2 J	196 J	142 J
MISCELLANEOUS PARAMETERS (MG/KG)																						
TOTAL ORGANIC CARBON		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (%)																						
AMOSITE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ASBESTOS	1	NA	ND	<1	<1	<1	<1	<1	<1	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHRYSOTILE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL SOLIDS		88	37	42	40	34	34	35.5	36	52	NA	NA	77	76	44	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (UG/KG)																						
TRIBUTYLTIN (AS TIN)	228	0.67 U	0.705 U	16	42	240	100	21.5 J	23	1.2 J	34	160	0.65 U	0.64 U	6.8 U	0.72 U	0.7 U	32	1.3 J	0.705 U	0.71 U	0.69 U
MISCELLANEOUS PARAMETERS (%)																						
TOTAL SOLIDS		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

DARK SHADING-EXCEEDS RPRG; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

APPENDIX C-2C
ANALYTICAL RESULTS FOR 2 TO 4 FOOT INTERVAL SEDIMENT SAMPLES (2011)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
FEASIBILITY STUDY
NAVSTA NEWPORT, NEWPORT RI

SAMPLE ID	Comparison Criteria	DSY-SD-AE24-2448	DSY-SD-AE26-2448	DSY-SD-AE28-2448	DSY-SD-AG24-2448	DSY-SD-AG26-2448	DSY-SD-AG28-2448-AVG	DSY-SD-AG30-2436	DSY-SD-AI24-2448	DSY-SD-AI26-2448	DSY-SD-AI28-2448	DSY-SD-AI30-2448	DSY-SD-AK24-2448-AVG	DSY-SD-AK26-2448	DSY-SD-AK28-2448	DSY-SD-AK30-2448	DSY-SD-AO30-2448	DSY-SD-AP20-2448	DSY-SD-AT16-2448-AVG	DSY-SD-AT20-2448	DSY-SD-AT24-2448	DSY-SD-AT30-2448	DSY-SD-AX06-2448
LOCATION ID		DSY-SD-AE24	DSY-SD-AE26	DSY-SD-AE28	DSY-SD-AG24	DSY-SD-AG26	DSY-SD-AG28	DSY-SD-AG30	DSY-SD-AI24	DSY-SD-AI26	DSY-SD-AI28	DSY-SD-AI30	DSY-SD-AK24	DSY-SD-AK26	DSY-SD-AK28	DSY-SD-AK30	DSY-SD-AO30	DSY-SD-AP20	DSY-SD-AT16	DSY-SD-AT20	DSY-SD-AT24	DSY-SD-AT30	DSY-SD-AX06
SAMPLE DATE		09/26/11	09/28/11	09/28/11	09/26/11	09/26/11	09/26/11	09/28/11	09/26/11	09/26/11	09/23/11	09/26/11	09/23/11	09/23/11	09/23/11	09/23/11	09/23/11	09/22/11	09/22/11	09/22/11	09/22/11	09/23/11	09/22/11
TOP DEPTH		2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT
BOTTOM DEPTH		4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	3 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT
SACODE		NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	AVG	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	AVG	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	AVG	NORMAL	NORMAL	NORMAL	NORMAL
SEMIVOLATILES (UG/KG)																							
BENZO(A)ANTHRACENE		320 U	740 J	360 U	340 U	340 U	175 J	290 U	310 U	440 U	410 J	290 U	305 U	290 U	280 U	280 U	290 U	370 UJ	380 U	370 U	300 UJ	300 U	360 U
BENZO(A)PYRENE	539	16 J	730 J	77	22 J	67	145	12 U	5.5 J	120	260	19 J	6.85 J	12 U	11 U	12 U	12 U	15 U	15 U	15 U	12 U	12 U	14 U
BENZO(B)FLUORANTHENE		320 U	670 J	360 UJ	340 U	340 U	232 J	290 U	310 U	440 UJ	530 UJ	290 UJ	305 U	290 U	280 U	280 UJ	290 U	370 U	380 UJ	370 U	300 U	300 U	360 U
BENZO(G,H,I)PERYLENE		320 U	500 UJ	360 UJ	340 U	340 U	400 U	290 U	310 U	440 UJ	530 UJ	290 UJ	305 U	290 U	280 U	280 UJ	290 U	370 U	380 UJ	370 U	300 U	300 U	360 U
BENZO(K)FLUORANTHENE		320 U	760 J	360 UJ	340 U	340 U	400 U	290 U	310 U	440 UJ	530 UJ	290 UJ	305 U	290 U	280 U	280 UJ	290 U	370 U	380 UJ	370 U	300 U	300 U	360 U
CHRYSENE		320 U	1100 J	360 U	340 U	340 U	248 J	290 U	310 U	440 U	610 J	290 U	305 U	290 U	280 U	280 U	290 U	370 U	380 U	370 U	300 U	300 U	360 U
DIBENZO(A,H)ANTHRACENE		320 U	500 UJ	360 UJ	340 U	340 U	400 U	290 U	310 U	440 UJ	530 UJ	290 UJ	305 U	290 U	280 U	280 UJ	290 U	370 U	380 UJ	370 U	300 U	300 U	360 U
FLUORANTHENE		320 U	620 J	360 U	340 U	340 U	202 J	290 U	310 U	440 U	660 J	290 U	305 U	290 U	280 U	280 U	290 U	370 UJ	380 U	370 U	300 UJ	300 U	360 U
HIGH MOLECULAR WEIGHT PAHS	13903	16 J	8020 J	437 J	22 J	337 J	1440 J	262 UJ	5.5 J	740 J	3340 J	139 J	75.8 J	262 U	253 U	253 UJ	262 U	334 UJ	344 UJ	334 U	271 UJ	271 U	325 U
INDENO(1,2,3-CD)PYRENE		320 UJ	500 UJ	360 UJ	340 U	340 UJ	400 U	290 U	310 U	440 UJ	530 UJ	290 UJ	305 U	290 U	280 U	280 UJ	290 U	370 U	380 UJ	370 U	300 U	300 U	360 U
PYRENE		320 U	3400 J	360 J	340 U	270 J	725	290 UJ	310 U	620	1400 J	120 J	305 U	290 U	280 U	280 U	290 U	370 U	380 U	370 U	300 U	300 U	360 U
PCBS (UG/KG)																							
AROCLOR-1016		11 UJ	17 UJ	12 U	12 U	13 UJ	13.5 U	8.8 U	10 U	15 UJ	19 UJ	9.6 U	11 UJ	10 UJ	9.6 UJ	10 U	9.6 U	13 UJ	13 U	12 U	11 UJ	9.9 UJ	12 U
AROCLOR-1221		11 UJ	17 UJ	12 U	12 U	13 UJ	13.5 U	8.8 U	10 U	15 UJ	19 UJ	9.6 U	11 U	10 U	9.6 U	10 U	9.6 U	13 UJ	13 U	12 U	11 UJ	9.9 U	12 U
AROCLOR-1232		13 UJ	20 UJ	14 U	14 U	15 UJ	15.5 U	10 U	12 U	17 UJ	22 UJ	11 U	13.5 U	12 U	11 U	12 U	11 U	16 UJ	15 U	14 U	12 UJ	12 U	15 U
AROCLOR-1242		11 UJ	17 UJ	12 U	12 U	13 UJ	13.5 U	8.8 U	10 U	15 UJ	19 UJ	9.6 U	11 U	10 U	9.6 U	10 U	9.6 U	13 UJ	13 U	12 U	11 UJ	9.9 U	12 U
AROCLOR-1248		11 UJ	17 UJ	12 U	12 U	13 UJ	13.5 U	8.8 U	10 U	15 UJ	19 UJ	9.6 U	11 U	10 U	9.6 U	10 U	9.6 U	13 UJ	13 U	12 U	11 UJ	9.9 U	12 U
AROCLOR-1254		11 UJ	860 J	130	12 U	55 J	240	8.8 U	10 U	86 J	230 J	9.6 U	11 U	10 U	9.6 U	10 U	9.6 U	13 UJ	13 U	12 U	11 UJ	9.9 U	12 U
AROCLOR-1260		11 UJ	530 J	12 U	12 U	13 UJ	13.5 U	8.8 U	10 U	15 UJ	19 UJ	9.6 U	11 UJ	10 UJ	9.6 UJ	10 U	9.6 U	13 UJ	13 U	12 U	11 UJ	9.9 UJ	12 U
TOTAL AROCLOR	1060	11.3 UJ	1390 J	130	12.3 U	55 J	240	8.97 U	10.3 U	86 J	230 J	9.8 U	11.4 UJ	10.3 UJ	9.8 UJ	10.3 U	9.8 U	13.4 UJ	13.3 U	12.3 U	11.1 UJ	10.2 UJ	12.4 U
METALS (MG/KG)																							
COPPER	74	NA	NA	72.1 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	168	4.8	296	98.6	10.2	25.7	64.2	22.1	5.7	62.1	114	8.7	7.8	2.3	1.8	3.2	2.1	6.5 J	6.1	5.2	4.4 J	4.6	6
ZINC	118	NA	NA	931 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/KG)																							
TOTAL ORGANIC CARBON		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (%)																							
AMOSITE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ASBESTOS	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHRYSOTILE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL SOLIDS		75	48	68	NA	66	NA	86	NA	56	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (UG/KG)																							
TRIBUTYLTIN (AS TIN)	228	0.68 U	7.8	22	0.67 U	0.71 U	0.8 J	1.2 J	0.64 U	0.69 U	0.97 J	0.7 U	0.68 U	0.65 U	0.64 U	0.61 U	0.64 U	0.65 U	0.655 U	0.68 U	0.69 U	0.61 U	0.66 U
MISCELLANEOUS PARAMETERS (%)																							
TOTAL SOLIDS		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

DARK SHADING-EXCEEDS RPRG; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

APPENDIX C-2C
ANALYTICAL RESULTS FOR 2 TO 4 FOOT INTERVAL SEDIMENT SAMPLES (2011)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
FEASIBILITY STUDY
NAVSTA NEWPORT, NEWPORT RI

SAMPLE ID	Comparison Criteria	DSY-SD-AX20-2448	DSY-SD-AY30-2448-AVG	DSY-SD-BB02-2448-AVG	DSY-SD-BB06-2448	DSY-SD-BB10-2448-AVG	DSY-SD-BB26-2448	DSY-SD-BC28-2448	DSY-SD-BC30-2448	DSY-SD-BD26-2448	DSY-SD-BE28-2448	DSY-SD-BE30-2448	DSY-SD-BF06-2448	DSY-SD-BF23-2448	DSY-SD-BG26-2448	DSY-SD-BG28-2448	DSY-SD-BI26-2448	DSY-SD-BJ23-2448-AVG	DSY-SD-C09-2448-AVG	DSY-SD-C13-2448	DSY-SD-C17-2448	DSY-SD-C21-2448	DSY-SD-C25-2448
LOCATION ID		DSY-SD-AX20	DSY-SD-AY30	DSY-SD-BB02	DSY-SD-BB06	DSY-SD-BB10	DSY-SD-BB26	DSY-SD-BC28	DSY-SD-BC30	DSY-SD-BD26	DSY-SD-BE28	DSY-SD-BE30	DSY-SD-BF06	DSY-SD-BF23	DSY-SD-BG26	DSY-SD-BG28	DSY-SD-BI26	DSY-SD-BJ23	DSY-SD-C09	DSY-SD-C13	DSY-SD-C17	DSY-SD-C21	DSY-SD-C25
SAMPLE DATE		09/22/11	09/23/11	09/22/11	09/22/11	09/22/11	09/21/11	09/21/11	09/21/11	09/21/11	09/22/11	09/21/11	09/22/11	09/22/11	09/21/11	09/21/11	09/21/11	09/21/11	10/07/11	10/07/11	10/07/11	10/07/11	10/07/11
TOP DEPTH		2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT
BOTTOM DEPTH		4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT
SACODE		NORMAL	AVG	AVG	NORMAL	AVG	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	AVG	AVG	NORMAL	NORMAL	NORMAL	NORMAL
SEMIVOLATILES (UG/KG)																							
BENZO(A)ANTHRACENE		350 UJ	260 U	385 U	370 U	380 U	350 J	320 UJ	830 J	170 J	280 U	290 J	350 U	290 U	290 UJ	270 U	260 U	295 UJ	310 U	320 U	300 U	270 U	280 U
BENZO(A)PYRENE	539	14 U	10 U	15.5 U	15 U	63.5 J	300	13 U	690 J	120	5.2 J	250	14 U	12 U	12 U	58	10 U	12 U	12.5 UJ	13 UJ	12 U	11 U	11 U
BENZO(B)FLUORANTHENE		350 U	260 U	385 U	370 U	380 U	570	320 U	340 UJ	240 J	280 U	380 J	350 U	290 U	290 U	270 U	260 U	295 U	310 U	320 U	300 U	270 U	280 U
BENZO(G,H,I)PERYLENE		350 U	260 U	385 U	370 U	380 U	190 J	320 U	440 J	340 U	280 U	140 J	350 U	290 UJ	290 U	270 U	260 U	295 U	310 UJ	320 UJ	300 U	270 U	280 U
BENZO(K)FLUORANTHENE		350 U	260 U	385 U	370 U	380 U	220 J	320 U	340 UJ	340 U	280 U	190 J	350 U	290 U	290 U	97 J	260 U	295 U	310 U	320 U	300 U	270 U	280 U
CHRYSENE		350 U	260 U	385 U	370 U	380 U	440 J	320 U	1200 J	210 J	280 U	350 J	350 U	290 U	290 U	120 J	260 U	295 U	310 U	320 U	300 U	270 U	280 U
DIBENZO(A,H)ANTHRACENE		350 U	260 U	385 U	370 U	380 U	400 U	320 U	340 UJ	340 U	280 U	300 U	350 U	290 UJ	290 U	270 U	260 U	295 U	310 U	320 U	300 UJ	270 U	280 U
FLUORANTHENE		350 UJ	260 U	385 U	370 U	192 J	760	320 U	1000	300 J	280 U	720 J	350 U	290 U	290 U	250 J	260 U	295 U	310 U	320 U	300 U	270 U	280 U
HIGH MOLECULAR WEIGHT PAHS	13903	316 UJ	235 U	348 UJ	334 U	424 J	4030 J	289 UJ	8760 J	1530 J	5.2 J	3620 J	316 U	262 UJ	262 UJ	765 J	235 UJ	266 UJ	280 UJ	289 UJ	271 UJ	244 UJ	253 UJ
INDENO(1,2,3-CD)PYRENE		350 U	260 U	385 UJ	370 U	380 U	400 UJ	320 UJ	340 UJ	340 UJ	280 UJ	300 UJ	350 U	290 UJ	290 UJ	270 UJ	260 UJ	295 UJ	310 UJ	320 U	300 UJ	270 UJ	280 UJ
PYRENE		350 U	260 U	385 U	370 U	268 J	1200	320 U	4600 J	490	280 U	1300	350 U	290 U	290 U	240 J	260 U	295 U	310 U	320 U	300 U	270 U	280 U
PCBS (UG/KG)																							
AROCLOR-1016		12 U	10 UJ	13 UJ	12 UJ	13.5 U	13 UJ	10 UJ	11 UJ	11 UJ	10 UJ	11 UJ	12 U	10 UJ	9.7 UJ	9.8 U	9.2 UJ	9.9 UJ	10.2 UJ	11 UJ	10 U	9.8 U	10 U
AROCLOR-1221		12 U	10 U	13 UJ	12 UJ	13.5 U	13 UJ	10 UJ	11 UJ	11 UJ	10 UJ	11 UJ	12 U	10 UJ	9.7 U	9.8 U	9.2 UJ	9.9 U	10.2 UJ	11 UJ	10 U	9.8 U	10 U
AROCLOR-1232		14 U	12 U	16 UJ	14 UJ	16 U	15 UJ	12 UJ	14 UJ	13 UJ	12 UJ	13 UJ	14 U	12 UJ	11 U	11 U	11 UJ	12 U	12 UJ	13 UJ	12 U	12 U	12 U
AROCLOR-1242		12 U	10 U	13 UJ	12 UJ	13.5 U	13 UJ	10 UJ	11 UJ	11 UJ	10 UJ	11 UJ	12 U	10 UJ	9.7 U	9.8 U	9.2 UJ	9.9 U	10.2 UJ	11 UJ	10 U	9.8 U	10 U
AROCLOR-1248		12 U	10 U	13 UJ	12 UJ	13.5 U	13 UJ	10 UJ	11 UJ	11 UJ	10 UJ	11 UJ	12 U	10 UJ	9.7 U	9.8 U	9.2 UJ	9.9 U	10.2 UJ	11 UJ	10 U	9.8 U	10 U
AROCLOR-1254		12 U	10 U	13 UJ	12 UJ	13.5 U	13 UJ	10 UJ	11 UJ	11 UJ	10 UJ	11 UJ	12 U	10 UJ	9.7 U	9.8 U	9.2 UJ	9.9 U	10.2 UJ	11 UJ	10 U	9.8 U	10 U
AROCLOR-1260		12 U	10 UJ	13 UJ	12 UJ	13.5 U	13 UJ	10 UJ	11 UJ	11 UJ	10 UJ	11 UJ	12 U	10 UJ	9.7 U	9.8 U	9.2 UJ	9.9 UJ	10.2 UJ	11 UJ	10 U	9.8 U	10 U
TOTAL AROCLOR	1060	12.3 U	10.3 UJ	13.4 UJ	12.3 UJ	13.8 U	13.3 UJ	10.3 UJ	11.4 UJ	11.3 UJ	10.3 UJ	11.3 UJ	12.3 U	10.3 UJ	9.89 UJ	9.97 U	9.46 UJ	10.2 UJ	10.5 UJ	11.3 UJ	10.3 U	10.1 U	10.3 U
METALS (MG/KG)																							
COPPER	74	NA	NA	NA	NA	NA	92.4 J	2.5 J	24.4 J	8 J	3 J	8.3 J	NA	3 J	2.6 J	4.8 J	8.5 J	4.5 J	39.2 J	NA	NA	NA	NA
LEAD	168	5 J	3.6	6.05 J	5.7	5.65	75.3	1.8	25.4	11.2	2 J	9.5 J	5.5	2.6 J	1.8	4.3 J	4.6 J	2.2	44.8 J	4.7 J	3.7 J	12 J	3.6 J
ZINC	118	NA	NA	NA	NA	NA	168	18.7	69.6	40	20.5 J	46.6 J	NA	26.1 J	17.7	32.6 J	32.8 J	29	245 J	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/KG)																							
TOTAL ORGANIC CARBON		NA	NA	NA	NA	22000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (%)																							
AMOSITE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ASBESTOS	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHRYSOTILE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL SOLIDS		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (UG/KG)																							
TRIBUTYLTIN (AS TIN)	228	0.72 U	0.71 U	0.65 U	0.65 U	0.68 U	0.68 U	0.61 U	0.66 U	0.69 U	0.64 U	0.69 U	0.64 U	0.66 U	0.61 U	0.62 U	0.68 U	0.69 U	0.68 U	0.66 U	0.72 U	0.72 U	0.67 U
MISCELLANEOUS PARAMETERS (%)																							
TOTAL SOLIDS		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	78	78	80	86	82

DARK SHADING-EXCEEDS RPRG; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

APPENDIX C-2C
ANALYTICAL RESULTS FOR 2 TO 4 FOOT INTERVAL SEDIMENT SAMPLES (2011)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
FEASIBILITY STUDY
NAVSTA NEWPORT, NEWPORT RI

SAMPLE ID	Comparison Criteria	DSY-SD-C29-2448	DSY-SD-G01-2448	DSY-SD-G05-2448-AVG	DSY-SD-G09-2448	DSY-SD-G13-2448	DSY-SD-G17-2448-AVG	DSY-SD-G21-2448	DSY-SD-G25-2448	DSY-SD-J26-2448-AVG	DSY-SD-J28-2448	DSY-SD-J30-2448	DSY-SD-K05-2448	DSY-SD-K09-2448	DSY-SD-K13-2448	DSY-SD-K17-2448	DSY-SD-K21-2448	DSY-SD-L24-2448	DSY-SD-L26-2448	DSY-SD-L28-2448	DSY-SD-L30-2448	DSY-SD-N24-2448-AVG	DSY-SD-N26-2448	DSY-SD-N28-2448	DSY-SD-N30-2448
LOCATION ID		DSY-SD-C29	DSY-SD-G01	DSY-SD-G05	DSY-SD-G09	DSY-SD-G13	DSY-SD-G17	DSY-SD-G21	DSY-SD-G25	DSY-SD-J26	DSY-SD-J28	DSY-SD-J30	DSY-SD-K05	DSY-SD-K09	DSY-SD-K13	DSY-SD-K17	DSY-SD-K21	DSY-SD-L24	DSY-SD-L26	DSY-SD-L28	DSY-SD-L30	DSY-SD-N24	DSY-SD-N26	DSY-SD-N28	DSY-SD-N30
SAMPLE DATE		10/07/11	10/12/11	10/12/11	10/12/11	10/12/11	10/12/11	10/12/11	10/12/11	10/04/11	10/04/11	10/04/11	10/03/11	10/03/11	10/03/11	10/03/11	10/03/11	10/04/11	10/04/11	10/04/11	10/04/11	10/05/11	10/05/11	10/05/11	10/05/11
TOP DEPTH		2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT
BOTTOM DEPTH		4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT
SACODE		NORMAL	NORMAL	AVG	NORMAL	NORMAL	AVG	NORMAL	NORMAL	AVG	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	AVG	NORMAL	NORMAL	NORMAL
SEMIVOLATILES (UG/KG)																									
BENZO(A)ANTHRACENE		340 U	970	1000	480 J	340 J	670 J	870	3900	330 J	220 J	350 J	320 UJ	320 UJ	320 UJ	320 UJ	270 UJ	460 J	320 U	310 U	300 U	305 U	340 U	380 U	200 J
BENZO(A)PYRENE	539	84 J	400	455	240 J	190	350	430	2100	162 J	170 J	240 J	13 UJ	13 UJ	13 UJ	13 UJ	22 J	41	57	18 J	12 U	29.5 J	20 J	64 J	140 J
BENZO(B)FLUORANTHENE		340 U	840 J	925 J	470 J	770 U	610 J	890	3300	390 UJ	440 UJ	420 J	320 UJ	320 UJ	320 UJ	320 UJ	270 UJ	380 J	320 U	310 UJ	300 UJ	305 U	340 U	380 UJ	340 U
BENZO(G,H,I)PERYLENE		340 U	700 U	655 U	730 UJ	770 U	735 U	630 U	750 J	390 UJ	440 UJ	400 UJ	320 UJ	320 UJ	320 UJ	320 UJ	270 UJ	350 UJ	320 U	310 UJ	300 UJ	305 U	340 U	380 UJ	340 UJ
BENZO(K)FLUORANTHENE		340 U	380 J	445 J	730 UJ	770 U	350 J	380 J	1500	390 UJ	170 J	280 J	320 UJ	320 UJ	320 UJ	320 UJ	270 UJ	340 J	320 U	310 UJ	300 UJ	305 U	340 U	380 UJ	180 J
CHRYSENE		340 U	1100	1250	560 J	430 J	755 J	940	4600	370 J	340 J	340 J	320 UJ	320 UJ	320 UJ	320 UJ	270 UJ	540 J	320 U	310 U	300 U	305 U	340 U	380 U	190 J
DIBENZO(A,H)ANTHRACENE		340 UJ	700 U	655 U	730 UJ	770 U	735 U	630 U	700 U	390 UJ	440 UJ	400 UJ	320 UJ	320 UJ	320 UJ	320 UJ	270 UJ	350 UJ	320 U	310 UJ	300 UJ	305 U	340 U	380 UJ	340 U
FLUORANTHENE		340 U	4300	3250	1300 J	720 J	1650 J	2300	1500	305 J	220 J	320 J	320 UJ	320 UJ	320 UJ	320 UJ	270 UJ	820	320 U	310 U	300 U	305 U	340 U	380 U	330 J
HIGH MOLECULAR WEIGHT PAHS	13903	414 J	11800 J	10200 J	4150 J	2650 J	5700 J	7910 J	26400 J	2250 J	1770 J	4250 J	289 UJ	289 UJ	289 UJ	289 UJ	22 J	4580 J	217 J	18 J	271 UJ	124 J	20 J	484 J	1820 J
INDENO(1,2,3-CD)PYRENE		340 UJ	700 U	655 U	730 UJ	770 U	735 U	630 U	910 J	390 UJ	440 UJ	400 UJ	320 UJ	320 UJ	320 UJ	320 UJ	270 UJ	350 UJ	320 U	310 UJ	300 UJ	305 U	340 U	380 UJ	340 U
PYRENE		330 J	3800	2850	1100 J	970 J	1500	2100	7800 J	1360 J	650 J	2300 J	320 UJ	320 UJ	320 UJ	320 UJ	270 UJ	2000 J	160 J	310 U	300 U	170 J	340 U	420 J	780
PCBS (UG/KG)																									
AROCLOR-1016		12 UJ	24 U	23.5 U	26 U	27 U	26 U	22 U	22 UJ	12.5 UJ	14 UJ	13 U	9.6 U	10 U	9 U	9.5 U	11 U	11 U	9.5 U	11 U	10 U	9.6 UJ	12 U	13 U	12 U
AROCLOR-1221		12 UJ	24 U	23.5 U	26 U	27 U	26 U	22 U	22 U	12.5 UJ	14 UJ	13 U	9.6 U	10 U	9 U	9.5 U	11 U	11 U	9.5 U	11 U	10 U	9.6 UJ	12 U	13 U	12 U
AROCLOR-1232		14 UJ	28 U	27.5 U	31 U	32 U	31 U	26 U	26 U	15 UJ	17 UJ	16 U	11 U	12 U	11 U	11 U	13 U	13 U	11 U	13 U	12 U	11.5 UJ	14 U	16 U	14 U
AROCLOR-1242		12 UJ	24 U	23.5 U	26 U	27 U	26 U	22 U	22 U	12.5 UJ	14 UJ	13 U	9.6 U	10 U	9 U	9.5 U	11 U	11 U	9.5 U	32	10 U	9.6 UJ	12 U	13 U	12 U
AROCLOR-1248		12 UJ	24 U	23.5 U	26 U	27 U	26 U	22 U	22 U	12.5 UJ	14 UJ	13 U	9.6 U	10 U	9 U	9.5 U	11 U	11 U	9.5 U	11 U	10 U	9.6 UJ	12 U	13 U	12 U
AROCLOR-1254		59 J	24 U	195 J	26 U	130 J	26 U	22 U	190 J	690 J	400 J	160	9.6 UJ	10 U	9 UJ	9.5 U	11 U	11 U	46	11 U	10 U	86.5 J	12 U	520 J	76
AROCLOR-1260		12 UJ	24 U	23.5 U	26 U	27 U	26 U	22 U	22 U	12.5 UJ	14 UJ	13 U	9.6 U	10 U	9 U	9.5 U	11 U	11 U	9.5 U	11 U	10 U	46.5 J	12 U	250	12 U
TOTAL AROCLOR	1060	59 J	24.6 U	195 J	26.7 U	130 J	26.7 U	22.6 U	190 J	690 J	400 J	160	9.8 UJ	10.3 U	9.29 UJ	9.71 U	11.3 U	11.3 U	46	32	10.3 U	130 J	12.3 U	770 J	76
METALS (MG/KG)																									
COPPER	74	NA	102	94.2	79.6	57.7	83.6	89.8	284	NA	NA	NA	4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	168	11.7 J	74.5 J	77.9 J	82.2 J	68.3 J	78.2 J	75.3 J	212 J	44 J	51.9 J	94.1 J	4.4	4.7	5.2	3.4	7.2	20.8 J	9.2 J	10.3 J	5.7 J	842 J	45.2 J	390 J	38.5 J
ZINC	118	NA	172	248 J	183	167	171	183	738	NA	NA	NA	25.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/KG)																									
TOTAL ORGANIC CARBON		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (%)																									
AMOSITE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ASBESTOS	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHRYSOTILE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL SOLIDS		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (UG/KG)																									
TRIBUTYLTIN (AS TIN)	228	0.69 U	1.2 J	2.95	0.8 J	0.75 J	2.1	6.4	1.9	0.72 U	0.69 U	0.66 U	0.7 U	0.68 U	0.68 U	0.68 U	0.69 U	0.65 U	0.68 U	0.68 U	0.65 U	0.685 U	0.71 U	0.72 U	0.61 U
MISCELLANEOUS PARAMETERS (%)																									
TOTAL SOLIDS		71	35	35	33	30	32	37	35	NA	NA	NA	NA	NA	NA	NA	NA	70	75	NA	NA	79	72	63	72

DARK SHADING-EXCEEDS RPRG; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

APPENDIX C-2C
ANALYTICAL RESULTS FOR 2 TO 4 FOOT INTERVAL SEDIMENT SAMPLES (2011)
SITE 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
FEASIBILITY STUDY
NAVSTA NEWPORT, NEWPORT RI

SAMPLE ID	Comparison Criteria	DSY-SD-O09-2448	DSY-SD-O13-2448	DSY-SD-O17-2448	DSY-SD-O21-2448	DSY-SD-Q25-2448	DSY-SD-Q29-2448	DSY-SD-S09-2448-AVG	DSY-SD-S13-2448	DSY-SD-S17-2448	DSY-SD-S21-2448-AVG	DSY-SD-T25-2448	DSY-SD-T29-2448	DSY-SD-W09-2448	DSY-SD-W13-2448	DSY-SD-W17-2448	DSY-SD-W21-2448	DSY-SD-W24-2448	DSY-SD-W26-2448-AVG	DSY-SD-W28-2448	DSY-SD-W30-2448	DSY-SD-Y03-2448-AVG	DSY-SD-Y25-2448-AVG	DSY-SD-Y26-2448
LOCATION ID		DSY-SD-O09	DSY-SD-O13	DSY-SD-O17	DSY-SD-O21	DSY-SD-Q25	DSY-SD-Q29	DSY-SD-S09	DSY-SD-S13	DSY-SD-S17	DSY-SD-S21	DSY-SD-T25	DSY-SD-T29	DSY-SD-W09	DSY-SD-W13	DSY-SD-W17	DSY-SD-W21	DSY-SD-W24	DSY-SD-W26	DSY-SD-W28	DSY-SD-W30	DSY-SD-Y03	DSY-SD-Y25	DSY-SD-Y26
SAMPLE DATE		09/30/11	09/30/11	09/30/11	09/30/11	10/05/11	10/06/11	09/30/11	09/30/11	09/30/11	09/30/11	10/05/11	10/06/11	09/30/11	09/30/11	09/30/11	09/30/11	10/06/11	10/05/11	10/06/11	10/06/11	10/03/11	10/03/11	10/03/11
TOP DEPTH		2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT	2 FT
BOTTOM DEPTH		4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT	4 FT
SACODE		NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	AVG	NORMAL	NORMAL	AVG	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	AVG	NORMAL	NORMAL	AVG	AVG	NORMAL
SEMIVOLATILES (UG/KG)																								
BENZO(A)ANTHRACENE		330 U	320 U	390 U	200 J	300 U	330 U	345 U	410 U	340 U	345 U	300 U	280 U	390 U	360 U	350 U	340 U	310 U	220 J	300 U	290 U	375 UJ	200 J	580 J
BENZO(A)PYRENE	539	26 J	13 U	42	140	12 U	120	14 UJ	43	13 U	16.2 J	68	22 J	9.2 J	14 U	5.2 J	14 U	13 J	150	11 J	55	7.35 J	126	370
BENZO(B)FLUORANTHENE		330 U	320 U	390 U	370 UJ	300 U	330 U	345 U	410 U	340 U	345 U	300 U	280 U	390 U	360 U	350 U	340 U	310 U	355 U	300 U	290 U	375 UJ	202 J	380 J
BENZO(G,H,I)PERYLENE		330 U	320 U	390 UJ	370 UJ	300 UJ	330 U	345 U	410 U	340 U	345 U	300 U	280 U	390 U	360 U	350 U	340 U	310 U	355 U	300 U	290 U	375 UJ	360 UJ	390 UJ
BENZO(K)FLUORANTHENE		330 U	320 U	390 U	370 UJ	300 U	330 U	345 U	410 U	340 U	345 U	300 U	280 U	390 U	360 U	350 U	340 U	310 U	355 U	300 U	290 U	375 UJ	192 J	420 J
CHRYSENE		330 U	320 U	390 U	220 J	300 U	140 J	345 U	410 U	340 U	345 U	300 U	280 U	390 U	360 U	350 U	340 U	310 U	245 J	300 U	290 U	375 UJ	270 J	730 J
DIBENZO(A,H)ANTHRACENE		330 U	320 U	390 UJ	370 UJ	300 U	330 U	345 U	410 U	340 U	345 U	300 U	280 U	390 U	360 U	350 U	340 U	310 U	355 U	300 U	290 U	375 UJ	360 UJ	390 UJ
FLUORANTHENE		330 U	320 U	390 U	170 J	300 U	330 U	345 U	410 U	340 U	345 U	300 U	280 U	390 U	360 U	350 U	340 U	310 U	168 J	300 U	290 U	375 UJ	220 J	720
HIGH MOLECULAR WEIGHT PAHS	13903	26 J	289 U	42 J	1830 J	271 UJ	810 J	312 UJ	43	307 U	16.2 J	338 J	22 J	9.2 J	325 U	5.2 J	307 U	13 J	1500 J	11 J	295 J	87.1 J	2110 J	5500 J
INDENO(1,2,3-CD)PYRENE		330 U	320 U	390 UJ	370 UJ	300 U	330 U	345 U	410 U	340 U	345 U	300 U	280 U	390 U	360 U	350 U	340 U	310 U	355 U	300 UJ	290 UJ	375 UJ	360 UJ	390 UJ
PYRENE		330 U	320 U	390 U	1100 J	300 UJ	550	345 U	410 U	340 U	345 U	270 J	280 U	390 U	360 U	350 U	340 U	310 U	795	300 U	240 J	375 UJ	1080 J	2300 J
PCBS (UG/KG)																								
AROCLOR-1016		11 U	11 U	13 U	13 UJ	10 U	11 U	13 U	14 U	11 UJ	12 U	11 U	10 UJ	14 UJ	12 UJ	13 UJ	13 UJ	11 UJ	13 U	11 U	10 U	11 U	12 UJ	13 U
AROCLOR-1221		11 U	11 U	13 U	13 UJ	10 U	11 U	13 U	14 U	11 UJ	12 U	11 U	10 U	14 UJ	12 UJ	13 UJ	13 UJ	11 UJ	13 U	11 U	10 U	11 U	12 UJ	13 U
AROCLOR-1232		13 U	13 U	16 U	15 UJ	12 U	13 U	15 U	16 U	14 UJ	14 U	12 U	12 U	16 UJ	15 UJ	15 UJ	15 UJ	13 UJ	15 U	13 U	12 U	12.5 U	15 UJ	16 U
AROCLOR-1242		11 U	11 U	13 U	13 UJ	10 U	11 U	13 U	14 U	11 UJ	12 U	11 U	120 J	14 UJ	12 UJ	13 UJ	13 UJ	11 UJ	13 U	11 U	10 U	11 U	12 UJ	13 U
AROCLOR-1248		11 U	11 U	13 U	13 UJ	10 U	11 U	13 U	14 U	11 UJ	12 U	11 U	10 U	14 UJ	12 UJ	13 UJ	13 UJ	11 UJ	13 U	11 U	10 U	11 U	12 UJ	13 U
AROCLOR-1254		11 U	11 U	130	170 J	10 U	98	13 U	14 U	11 UJ	12 U	110	10 U	14 UJ	12 UJ	13 UJ	13 UJ	11 UJ	440 J	11 U	67	11 U	100 J	800
AROCLOR-1260		11 U	11 U	13 U	13 UJ	10 U	11 U	13 U	14 U	11 UJ	12 U	11 U	10 U	14 UJ	12 UJ	13 UJ	13 UJ	11 UJ	13 U	11 U	10 U	11 U	12 UJ	13 U
TOTAL AROCLOR	1060	11.3 U	11.3 U	130	170 J	10.3 U	98	13.3 U	14.3 U	11.4 UJ	12.3 U	110	120 J	14.3 UJ	12.4 UJ	13.3 UJ	13.3 UJ	11.3 UJ	440 J	11.3 U	67	11.2 U	100 J	800
METALS (MG/KG)																								
COPPER	74	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.9	6.4	5.2	6.6	NA	NA	NA	NA	6.8	NA	NA
LEAD	168	5.6 J	4.5 J	37.2 J	51.7 J	2.4	22.5	7.35 J	19.4 J	6.4 J	12.7 J	36.3	6.6	12.3 J	7 J	6.6 J	7.8 J	5	102	28 J	9.7 J	7.5	48.8	125
ZINC	118	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	49.8	46.3	42.5	44.5	NA	NA	NA	NA	42.8	NA	NA
MISCELLANEOUS PARAMETERS (MG/KG)																								
TOTAL ORGANIC CARBON		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (%)																								
AMOSITE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ASBESTOS	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHRYSOTILE	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL SOLIDS		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (UG/KG)																								
TRIBUTYLTIN (AS TIN)	228	0.7 U	0.69 U	0.69 U	0.7 U	0.66 U	5.7	0.695 U	0.66 U	0.66 U	0.69 U	0.69 U	0.62 U	0.7 U	0.67 U	0.71 U	0.68 U	0.65 U	5.15 J	0.63 U	0.72 U	0.69 U	0.69 U	3.4 U
MISCELLANEOUS PARAMETERS (%)																								
TOTAL SOLIDS		NA	NA	NA	NA	80	74	NA	NA	NA	NA	75	83	NA	NA	NA	NA	76	66	78	80	NA	NA	NA

DARK SHADING-EXCEEDS RPRG; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

SAMPLE ID	Comparison Criteria	DSY-SD-Y28-2448
LOCATION ID		DSY-SD-Y28
SAMPLE DATE		10/03/11
TOP DEPTH		2 FT
BOTTOM DEPTH		4 FT
SACODE		NORMAL
SEMIVOLATILES (UG/KG)		
BENZO(A)ANTHRACENE		220 J
BENZO(A)PYRENE	539	230
BENZO(B)FLUORANTHENE		250 J
BENZO(G,H,I)PERYLENE		350 UJ
BENZO(K)FLUORANTHENE		330 J
CHRYSENE		440 J
DIBENZO(A,H)ANTHRACENE		350 UJ
FLUORANTHENE		280 J
HIGH MOLECULAR WEIGHT PAHS	13903	3850 J
INDENO(1,2,3-CD)PYRENE		350 UJ
PYRENE		2100 J
PCBS (UG/KG)		
AROCLOR-1016		12 UJ
AROCLOR-1221		12 UJ
AROCLOR-1232		14 UJ
AROCLOR-1242		12 UJ
AROCLOR-1248		12 UJ
AROCLOR-1254		260 J
AROCLOR-1260		12 UJ
TOTAL AROCLOR	1060	260 J
METALS (MG/KG)		
COPPER	74	NA
LEAD	168	52.4
ZINC	118	NA
MISCELLANEOUS PARAMETERS (MG/KG)		
TOTAL ORGANIC CARBON		NA
MISCELLANEOUS PARAMETERS (%)		
AMOSITE	1	NA
ASBESTOS	1	NA
CHRYSOTILE	1	NA
TOTAL SOLIDS		NA
MISCELLANEOUS PARAMETERS (UG/KG)		
TRIBUTYLTIN (AS TIN)	228	0.66 U
MISCELLANEOUS PARAMETERS (%)		
TOTAL SOLIDS		NA

C-3 GRAIN SIZE DATA 2011

TETRA TECH NUS, INC. **RECORD OF REVIEW**

1. TITLE AS IT APPEARS ON THE DOCUMENT – (See instruction #1 on reverse for definition of Documents):

DV Memo to S. Parker, CTOWE61 Data Gaps Investigation at Naval Station Newport (NAVSTA), off-shore portions of Derecktor Shipyard, Site 19

Tier I **Data Validation, SDG** DSY-10 (grain size only)

2. DATE OF DOCUMENT: 12/1/11 DOCUMENT CONTROL No.: C-Navy-12-11-4903W

AUTHORS: **L. Guzman** TtNUS JOB CHARGE No.: **112G02747 SA.DV**

TYPE (DRAFT, DRAFT FINAL, FINAL): **Final** SUBMITTAL DATE:

3. REVIEWER AND STATUS REVIEWERS ASSIGNED BY: Date

Assigned Reviewer (See Instruction #3)	Disapproval		Approved with Suggestions		Reviewer Requires Final Verification		Approved By	
	Initials	(Date)	Initials	(Date)	Initials	(Date)	Initials	(Date)
a) Ann Fraake							AF	11/30/11
b)								
c)								
d)								

4. COMMENTS (Explain conditions and comments, or state where comments and edits are provided. Attach additional pages as needed):

5. AUTHOR COMMENTS/RESOLUTION:

6. APPROVAL FOR TRANSMITTAL:

_____ DATE: _____

See #7 on Reverse for Authority to Approve Transmittals

TETRA TECH NUS, INC **INTERNAL CORRESPONDENCE**

C-NAVY-12-11-4903W

Date: December 01, 2011 c: File G02747-4.10 (w/enc.-original)

To: Steve Parker (w/o enc.)

From: Lucy Guzman (no copy)

Subject: Tier I Data Validation, SDG DYS-10
Katahdin Analytical Services
CTO WE61, Former Derecktor Shipyard Marine Sediment, Data Gaps Investigation, NAVSTA Newport, Newport, Rhode Island

Grain Size:
11/Sediments/ DSY-SD-GP01-0012 DSY-SD-GP02-0012 DSY-SD-GP03-0012
DSY-SD-GP04-0012 DSY-SD-GP05-0012 DSY-SD-GP06-0012
DSY-SD-GP07-0012 DSY-SD-GP08-0012 DSY-SD-GP09-0012
DSY-SD-GP10-0012 DSY-SD-DUP12-092711

Field Duplicate Pair: DSY-SD-GP03-0012/DSY-SD-DUP12-092711

Tetra Tech NUS, Inc. (TtNUS) performed a Tier I data validation on grain size analytical data for the sediment samples in this SDG. These samples were collected as part of the marine sediment data gaps investigation on September 27, 2011. The sample collection and analysis were performed according to the Sampling and Analysis Plan for the Former Derecktor Shipyard Marine Sediment Data Gaps Investigation, NAVSTA Newport, Newport, Rhode Island; dated August 2011.

The grain size analysis was performed according to the ASTM D422 procedure. The analysis was subcontracted by Katahdin to Test America, Burlington, VT. Only data completeness is evaluated for Tier I data validation.

The sample results are presented in the enclosed data summary tables and graphs.

Laboratory Data Completeness

The grain size data for all the samples sent to the laboratory are complete.

Tables: Data Summary Tables
Grain Size Graphs and Tabulated Data

Enclosures: Data Completeness Worksheets

PROJ_NO: 02747	NSAMPLE	DSY-SD-DUP12-092711			DSY-SD-GP01-0012			DSY-SD-GP02-0012			DSY-SD-GP03-0012		
SDG: DSY-10	LAB_ID	200-7324-11			200-7324-1			200-7324-2			200-7324-3		
FRACTION: MISC	SAMP_DATE	9/27/2011			9/27/2011			9/27/2011			9/27/2011		
MEDIA: SEDIMENT	QC_TYPE	FD			NM			NM			NM		
	UNITS	%			%			%			%		
	PCT_SOLIDS	100.0			100.0			100.0			100.0		
	DUP_OF	DSY-SD-GP03-0012											
PARAMETER		RESULT	VQL	QLCD	RESULT	VQL	QLCD	RESULT	VQL	QLCD	RESULT	VQL	QLCD
HYDROMETER-0.0019MM		9.8			9.7			19.3			11.1		
HYDROMETER-0.001MM		8.4			8.3			16.6			9.7		
HYDROMETER-0.002MM		11.3			11.2			23.5			12.7		
HYDROMETER-0.0043MM		12.7			12.5			30.3			15.4		
HYDROMETER-0.0052MM		18.1			15.1			37			19.7		
HYDROMETER-0.006MM		45.4			34.9			42.4			48.2		
HYDROMETER-0.0074MM		57.8			42.8			47.8			59.1		
PERCENT CLAY		11.3			11.2			23.5			12.7		
PERCENT COARSE SAND		1			2.9			3.3			1.9		
PERCENT FINE SAND		19.2			37.6			16.5			19.6		
PERCENT GRAVEL		2.4			0.9			4.2			0.3		
PERCENT MEDIUM SAND		6.4			12.3			17.5			6.6		
PERCENT SAND		26.6			52.8			37.3			28.1		
PERCENT SILT		59.7			35.1			35			58.9		
SIEVE 1"		100			100			100			100		
SIEVE 1-1/2"		100			100			100			100		
SIEVE 2"		100			100			100			100		
SIEVE 3"		100			100			100			100		
SIEVE 3/4"		100			100			100			100		
SIEVE 3/8"		100			100			100			100		
SIEVE NO. 004		97.6			99.1			95.8			99.7		
SIEVE NO. 010		96.6			96.2			92.5			97.8		
SIEVE NO. 020		95.2			93.8			86.2			96.3		
SIEVE NO. 040		90.2			83.9			75			91.2		
SIEVE NO. 060		81.7			61.2			67.4			82.4		
SIEVE NO. 080		78.8			52.8			65.5			79.4		
SIEVE NO. 100		77.4			50.3			64.5			78		
SIEVE NO. 200		71			46.3			58.5			71.6		

PROJ_NO: 02747	NSAMPLE	DSY-SD-GP04-0012			DSY-SD-GP05-0012			DSY-SD-GP06-0012			DSY-SD-GP07-0012		
SDG: DSY-10	LAB_ID	200-7324-4			200-7324-5			200-7324-6			200-7324-7		
FRACTION: MISC	SAMP_DATE	9/27/2011			9/27/2011			9/27/2011			9/27/2011		
MEDIA: SEDIMENT	QC_TYPE	NM			NM			NM			NM		
	UNITS	%			%			%			%		
	PCT_SOLIDS	100.0			100.0			100.0			100.0		
	DUP_OF												
PARAMETER		RESULT	VQL	QLCD	RESULT	VQL	QLCD	RESULT	VQL	QLCD	RESULT	VQL	QLCD
HYDROMETER-0.0019MM		13			15.3			7.6			12.1		
HYDROMETER-0.001MM		11.4			12.6			6.1			10.4		
HYDROMETER-0.002MM		14.9			21			9.3			12.4		
HYDROMETER-0.0043MM		14.9			25.1			11.1			14.4		
HYDROMETER-0.0052MM		21.5			30.6			12.5			24.6		
HYDROMETER-0.006MM		59.7			40.4			36.1			70.3		
HYDROMETER-0.0074MM		78.9			47.3			52.3			83.9		
PERCENT CLAY		14.9			21			9.3			12.4		
PERCENT COARSE SAND		0			0			2.1			1.4		
PERCENT FINE SAND		8.4			25.2			30.2			3.3		
PERCENT GRAVEL		0			0			2.4			3.3		
PERCENT MEDIUM SAND		3.1			2.5			4.2			3.3		
PERCENT SAND		11.5			27.7			36.5			8		
PERCENT SILT		73.6			51.3			51.8			76.3		
SIEVE 1"		100			100			100			100		
SIEVE 1-1/2"		100			100			100			100		
SIEVE 2"		100			100			100			100		
SIEVE 3"		100			100			100			100		
SIEVE 3/4"		100			100			100			100		
SIEVE 3/8"		100			100			98.6			98		
SIEVE NO. 004		100			100			97.6			96.7		
SIEVE NO. 010		100			100			95.5			95.3		
SIEVE NO. 020		99.3			99.2			93.8			93.1		
SIEVE NO. 040		96.9			97.5			91.3			92		
SIEVE NO. 060		94.4			90.5			82.1			91.2		
SIEVE NO. 080		93			85.7			73.7			90.7		
SIEVE NO. 100		92			83			69.4			90.3		
SIEVE NO. 200		88.5			72.3			61.1			88.7		

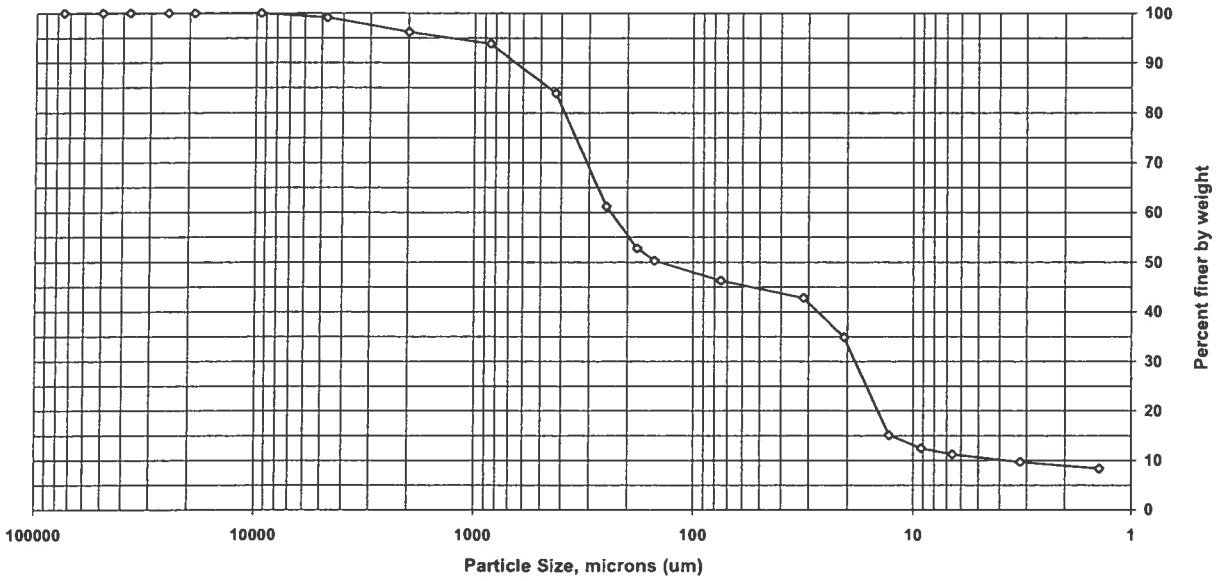
PROJ_NO: 02747	NSAMPLE	DSY-SD-GP08-0012			DSY-SD-GP09-0012			DSY-SD-GP10-0012		
SDG: DSY-10	LAB_ID	200-7324-8			200-7324-9			200-7324-10		
FRACTION: MISC	SAMP_DATE	9/27/2011			9/27/2011			9/27/2011		
MEDIA: SEDIMENT	QC_TYPE	NM			NM			NM		
	UNITS	%			%			%		
	PCT_SOLIDS	100.0			100.0			100.0		
	DUP_OF									
PARAMETER		RESULT	VQL	QLCD	RESULT	VQL	QLCD	RESULT	VQL	QLCD
HYDROMETER-0.0019MM		13			11			7.5		
HYDROMETER-0.001MM		11.4			9.8			6.4		
HYDROMETER-0.002MM		14.9			16			8.7		
HYDROMETER-0.0043MM		14.9			18.4			10.8		
HYDROMETER-0.0052MM		19.9			23.2			15		
HYDROMETER-0.006MM		66.1			30.6			21.4		
HYDROMETER-0.0074MM		82.1			36.6			25.6		
PERCENT CLAY		14.9			16			8.7		
PERCENT COARSE SAND		0			0.6			2.6		
PERCENT FINE SAND		4.5			34.2			54.1		
PERCENT GRAVEL		0			0.3			0.4		
PERCENT MEDIUM SAND		1.7			0.9			6.8		
PERCENT SAND		6.2			35.7			63.5		
PERCENT SILT		78.9			48			27.4		
SIEVE 1"		100			100			100		
SIEVE 1-1/2"		100			100			100		
SIEVE 2"		100			100			100		
SIEVE 3"		100			100			100		
SIEVE 3/4"		100			100			100		
SIEVE 3/8"		100			100			100		
SIEVE NO. 004		100			99.7			99.6		
SIEVE NO. 010		100			99.1			97		
SIEVE NO. 020		99.3			98.8			94.2		
SIEVE NO. 040		98.3			98.2			90.2		
SIEVE NO. 060		97.3			97.3			72.6		
SIEVE NO. 080		96.6			95.4			61.5		
SIEVE NO. 100		96.1			91.7			53		
SIEVE NO. 200		93.8			64			36.1		

Particle Size of Soils by ASTM D422

				Date Received:	10/04/11
Sample ID:	DSY-SD-GP01-0012	Percent Solids:	52.5%	Start Date:	10/06/11
Lab ID:	200-7324-A-1	Specific Gravity:	2.650	End Date:	10/11/11

Shape (> #10): subangular

Non-soil material: shell, plant
Hardness (> #10): hard



Sieve size	Particle size, um	Percent finer	Incremental percent
3 inch	75000	100.0	0.0
2 inch	50000	100.0	0.0
1.5 inch	37500	100.0	0.0
1 inch	25000	100.0	0.0
3/4 inch	19000	100.0	0.0
3/8 inch	9500	100.0	0.0
#4	4750	99.1	0.9
#10	2000	96.2	2.9
#20	850	93.8	2.4
#40	425	83.9	9.9
#60	250	61.2	22.7
#80	180	52.8	8.4
#100	150	50.3	2.5
#200	75	46.3	4.0
Hyd1	31.6	42.8	3.5
Hyd2	20.7	34.9	7.9
Hyd3	12.9	15.1	19.8
Hyd4	9.2	12.5	2.6
Hyd5	6.6	11.2	1.3
Hyd6	3.2	9.7	1.6
Hyd7	1.4	8.3	1.3

Soil Classification	Percent of sample
Gravel	0.9
Sand	52.8
Coarse Sand	2.9
Medium Sand	12.3
Fine Sand	37.6
Silt	35.1
Clay	11.2

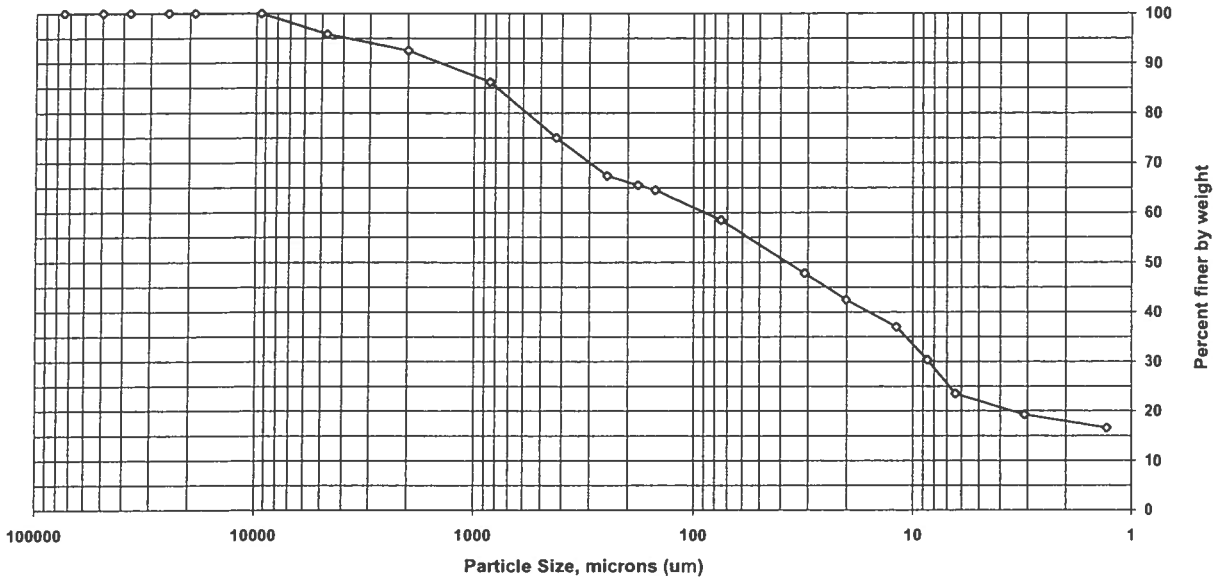
Particle Size of Soils by ASTM D422

				Date Received:	10/04/11
Sample ID:	DSY-SD-GP02-0012	Percent Solids:	57.1%	Start Date:	10/06/11
Lab ID:	200-7324-A-2	Specific Gravity:	2.650	End Date:	10/11/11

Shape (> #10): subangular

Non-soil material: shell

Hardness (> #10): hard



Sieve size	Particle size, um	Percent finer	Incremental percent
3 inch	75000	100.0	0.0
2 inch	50000	100.0	0.0
1.5 inch	37500	100.0	0.0
1 inch	25000	100.0	0.0
3/4 inch	19000	100.0	0.0
3/8 inch	9500	100.0	0.0
#4	4750	95.8	4.2
#10	2000	92.5	3.3
#20	850	86.2	6.3
#40	425	75.0	11.2
#60	250	67.4	7.6
#80	180	65.5	1.9
#100	150	64.5	1.0
#200	75	58.5	6.0
Hyd1	31.1	47.8	10.7
Hyd2	20.1	42.4	5.4
Hyd3	11.9	37.0	5.4
Hyd4	8.6	30.3	6.7
Hyd5	6.4	23.5	6.8
Hyd6	3.1	19.3	4.2
Hyd7	1.3	16.6	2.7

Soil Classification	Percent of sample
Gravel	4.2
Sand	37.3
Coarse Sand	3.3
Medium Sand	17.5
Fine Sand	16.5
Silt	35.0
Clay	23.5

Particle Size of Soils by ASTM D422

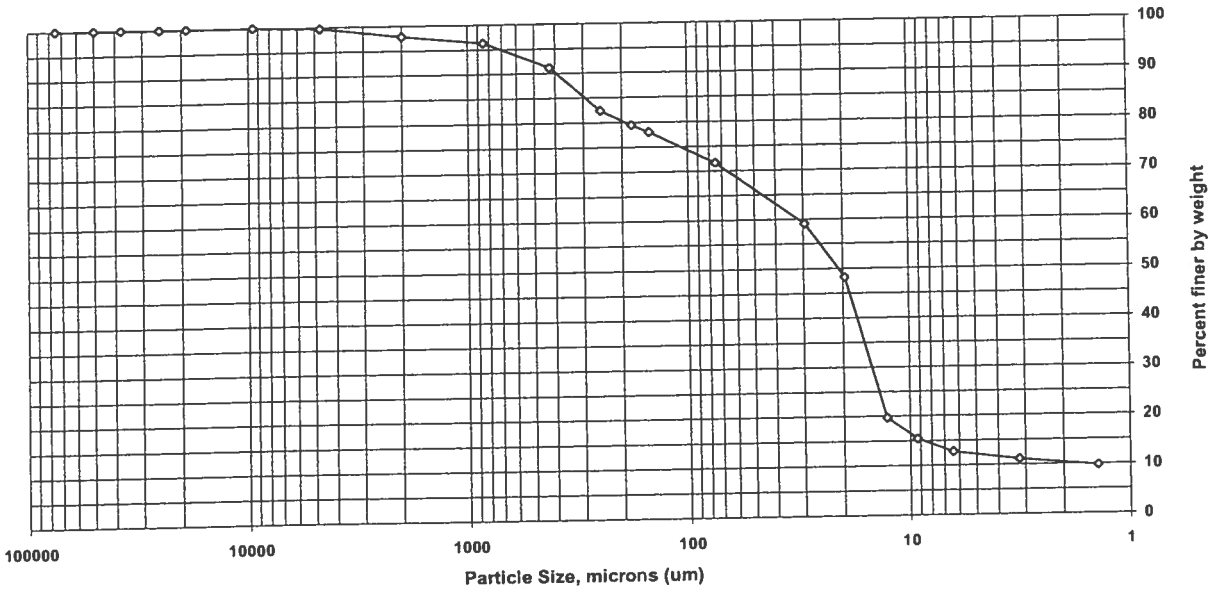
Sample ID: DSY-SD-GP03-0012
Lab ID: 200-7324-A-3

Percent Solids: 52.2%
Specific Gravity: 2.650

Date Received: 10/04/11
Start Date: 10/06/11
End Date: 10/11/11

Shape (> #10): subangular

Non-soil material: shell
Hardness (> #10): hard



Sieve size	Particle size, um	Percent finer	Incremental percent
3 inch	75000	100.0	0.0
2 inch	50000	100.0	0.0
1.5 inch	37500	100.0	0.0
1 inch	25000	100.0	0.0
3/4 inch	19000	100.0	0.0
3/8 inch	9500	100.0	0.0
#4	4750	99.7	0.3
#10	2000	97.8	1.9
#20	850	96.3	1.5
#40	425	91.2	5.1
#60	250	82.4	8.8
#80	180	79.4	3.0
#100	150	78.0	1.4
#200	75	71.6	6.4
Hyd1	29.5	59.1	12.5
Hyd2	19.6	48.2	10.9
Hyd3	12.7	19.7	28.5
Hyd4	9.3	15.4	4.3
Hyd5	6.4	12.7	2.7
Hyd6	3.2	11.1	1.6
Hyd7	1.4	9.7	1.4

Soil Classification	Percent of sample
Gravel	0.3
Sand	28.1
Coarse Sand	1.9
Medium Sand	6.6
Fine Sand	19.6
Silt	58.9
Clay	12.7

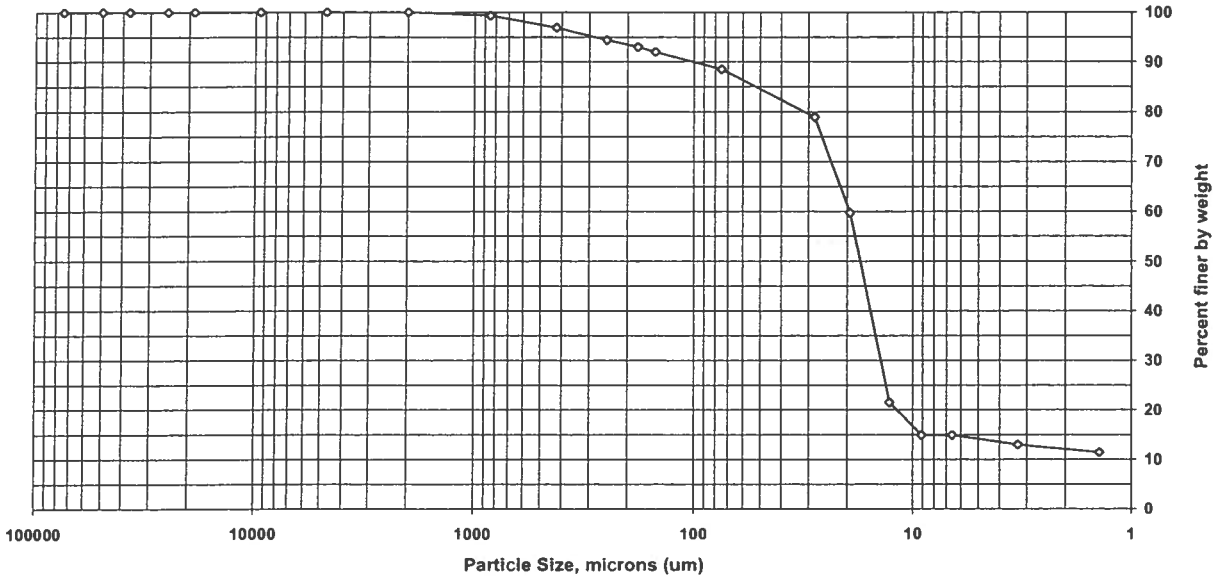
Particle Size of Soils by ASTM D422

				Date Received:	10/04/11
Sample ID:	DSY-SD-GP04-0012	Percent Solids:	36.1%	Start Date:	10/06/11
Lab ID:	200-7324-A-4	Specific Gravity:	2.650	End Date:	10/11/11

Shape (> #10): na

Non-soil material: na

Hardness (> #10): na



Sieve size	Particle size, um	Percent finer	Incremental percent
3 inch	75000	100.0	0.0
2 inch	50000	100.0	0.0
1.5 inch	37500	100.0	0.0
1 inch	25000	100.0	0.0
3/4 inch	19000	100.0	0.0
3/8 inch	9500	100.0	0.0
#4	4750	100.0	0.0
#10	2000	100.0	0.0
#20	850	99.3	0.7
#40	425	96.9	2.4
#60	250	94.4	2.5
#80	180	93.0	1.4
#100	150	92.0	1.0
#200	75	88.5	3.5
Hyd1	28.2	78.9	9.6
Hyd2	19.4	59.7	19.2
Hyd3	12.8	21.5	38.2
Hyd4	9.1	14.9	6.6
Hyd5	6.6	14.9	0.0
Hyd6	3.3	13.0	1.9
Hyd7	1.4	11.4	1.6

Soil Classification	Percent of sample
Gravel	0.0
Sand	11.5
Coarse Sand	0.0
Medium Sand	3.1
Fine Sand	8.4
Silt	73.6
Clay	14.9

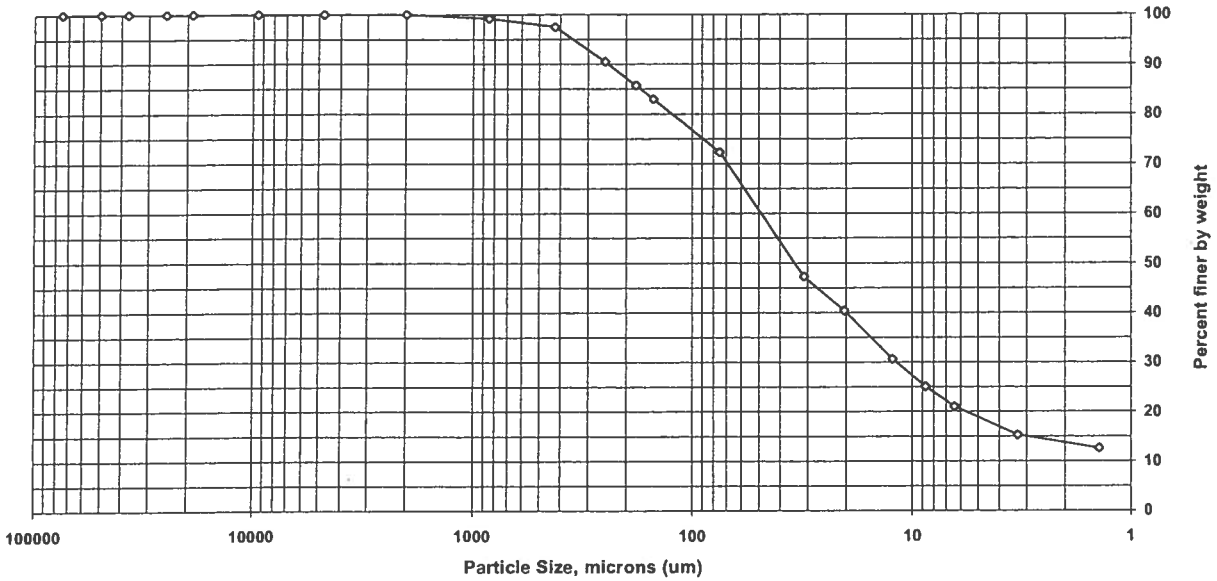
Particle Size of Soils by ASTM D422

				Date Received:	10/04/11
Sample ID:	DSY-SD-GP05-0012	Percent Solids:	60.8%	Start Date:	10/06/11
Lab ID:	200-7324-A-5	Specific Gravity:	2.650	End Date:	10/11/11

Shape (> #10): na

Non-soil material: na

Hardness (> #10): na



Sieve size	Particle size, um	Percent finer	Incremental percent
3 inch	75000	100.0	0.0
2 inch	50000	100.0	0.0
1.5 inch	37500	100.0	0.0
1 inch	25000	100.0	0.0
3/4 inch	19000	100.0	0.0
3/8 inch	9500	100.0	0.0
#4	4750	100.0	0.0
#10	2000	100.0	0.0
#20	850	99.2	0.8
#40	425	97.5	1.7
#60	250	90.5	7.0
#80	180	85.7	4.8
#100	150	83.0	2.7
#200	75	72.3	10.7
Hyd1	31.2	47.3	25.0
Hyd2	20.4	40.4	6.9
Hyd3	12.3	30.6	9.8
Hyd4	8.7	25.1	5.5
Hyd5	6.4	21.0	4.1
Hyd6	3.3	15.3	5.7
Hyd7	1.4	12.6	2.7

Soil Classification	Percent of sample
Gravel	0.0
Sand	27.7
Coarse Sand	0.0
Medium Sand	2.5
Fine Sand	25.2
Silt	51.3
Clay	21.0

Particle Size of Soils by ASTM D422

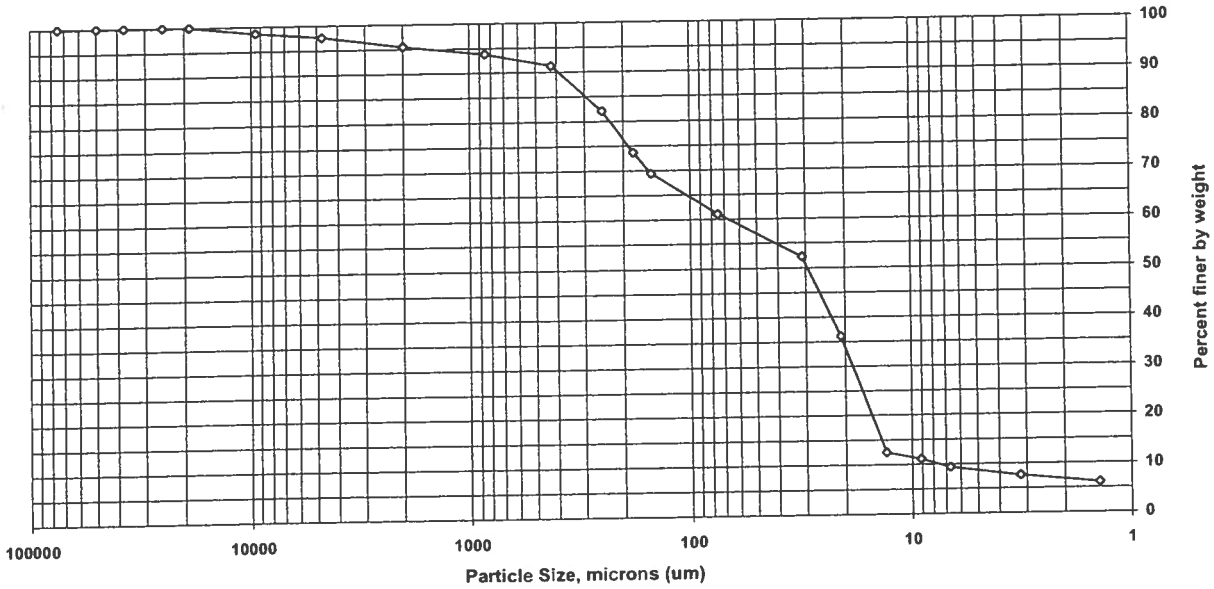
Sample ID: DSY-SD-GP06-0012
Lab ID: 200-7324-A-6

Percent Solids: 41.1%
Specific Gravity: 2.650

Date Received: 10/04/11
Start Date: 10/06/11
End Date: 10/11/11

Shape (> #10): subangular

Non-soil material: shell, plant
Hardness (> #10): hard



Sieve size	Particle size, um	Percent finer	Incremental percent
3 inch	75000	100.0	0.0
2 inch	50000	100.0	0.0
1.5 inch	37500	100.0	0.0
1 inch	25000	100.0	0.0
3/4 inch	19000	100.0	0.0
3/8 inch	9500	98.6	1.4
#4	4750	97.6	1.0
#10	2000	95.5	2.1
#20	850	93.8	1.7
#40	425	91.3	2.5
#60	250	82.1	9.2
#80	180	73.7	8.4
#100	150	69.4	4.3
#200	75	61.1	8.3
Hyd1	31.1	52.3	8.8
Hyd2	20.9	36.1	16.2
Hyd3	13.1	12.5	23.6
Hyd4	9.1	11.1	1.4
Hyd5	6.7	9.3	1.8
Hyd6	3.2	7.6	1.7
Hyd7	1.4	6.1	1.5

Soil Classification	Percent of sample
Gravel	2.4
Sand	36.5
Coarse Sand	2.1
Medium Sand	4.2
Fine Sand	30.2
Silt	51.8
Clay	9.3

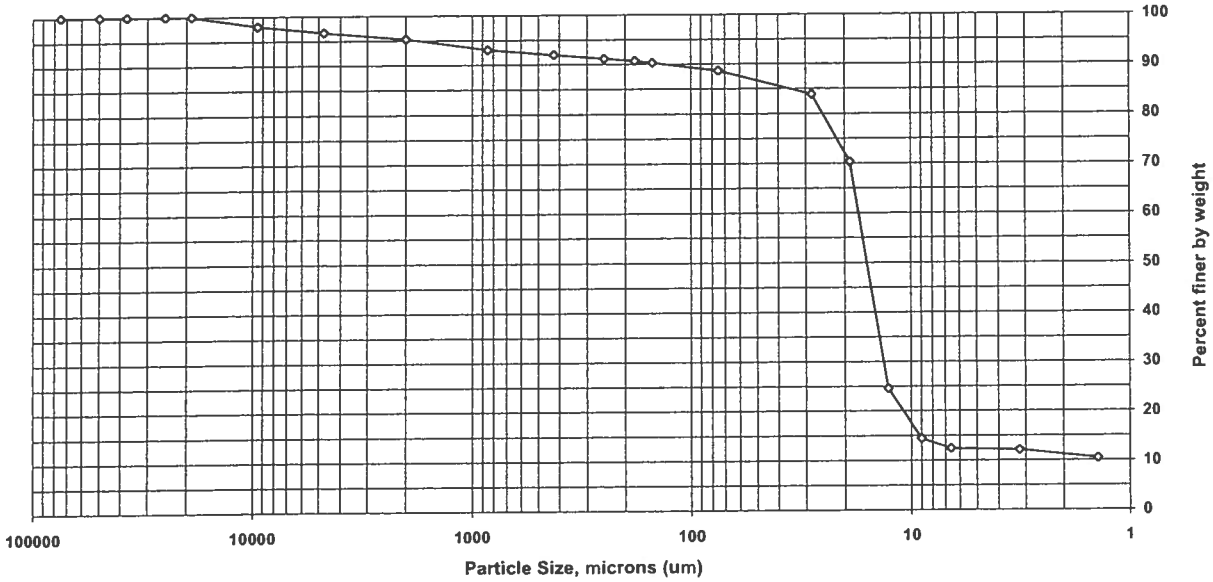
Particle Size of Soils by ASTM D422

Sample ID:	DSY-SD-GP07-0012	Percent Solids:	34.3%	Date Received:	10/04/11
Lab ID:	200-7324-A-7	Specific Gravity:	2.650	Start Date:	10/06/11
				End Date:	10/11/11

Shape (> #10): na

Non-soil material: shell

Hardness (> #10): na



Sieve size	Particle size, um	Percent finer	Incremental percent
3 inch	75000	100.0	0.0
2 inch	50000	100.0	0.0
1.5 inch	37500	100.0	0.0
1 inch	25000	100.0	0.0
3/4 inch	19000	100.0	0.0
3/8 inch	9500	98.0	2.0
#4	4750	96.7	1.3
#10	2000	95.3	1.4
#20	850	93.1	2.2
#40	425	92.0	1.1
#60	250	91.2	0.8
#80	180	90.7	0.5
#100	150	90.3	0.4
#200	75	88.7	1.6
Hyd1	28.2	83.9	4.8
Hyd2	18.9	70.3	13.6
Hyd3	12.7	24.6	45.7
Hyd4	9	14.4	10.2
Hyd5	6.6	12.4	2.0
Hyd6	3.2	12.1	0.3
Hyd7	1.4	10.4	1.7

Soil Classification	Percent of sample
Gravel	3.3
Sand	8.0
Coarse Sand	1.4
Medium Sand	3.3
Fine Sand	3.3
Silt	76.3
Clay	12.4

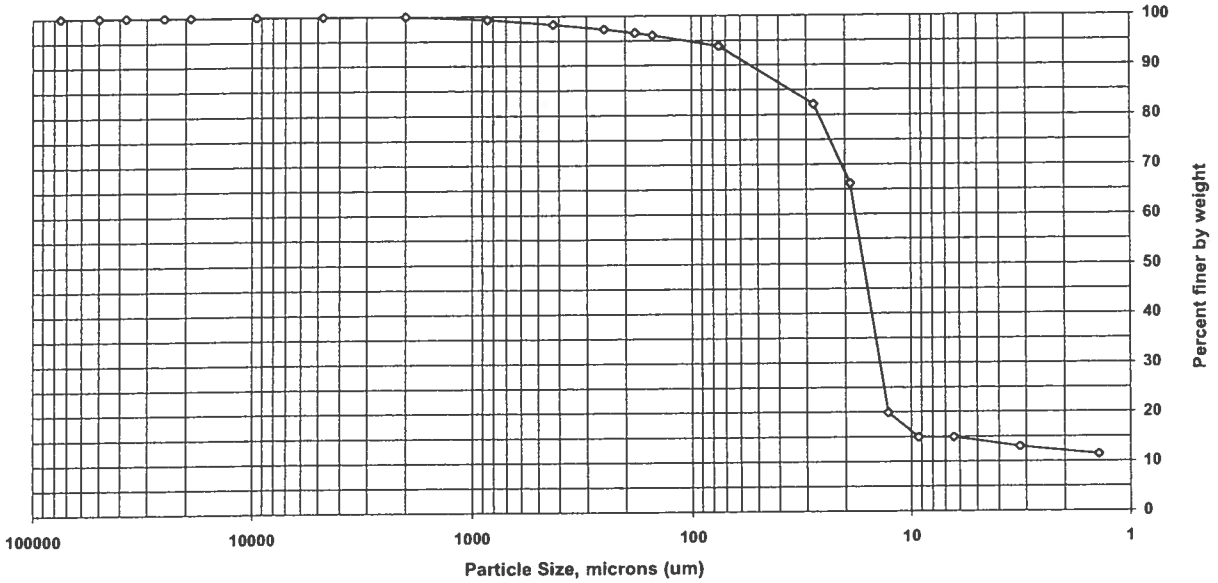
Particle Size of Soils by ASTM D422

Sample ID:	DSY-SD-GP08-0012	Percent Solids:	38.3%	Date Received:	10/04/11
Lab ID:	200-7324-A-8	Specific Gravity:	2.650	Start Date:	10/06/11
				End Date:	10/11/11

Shape (> #10): na

Non-soil material: na

Hardness (> #10): na



Sieve size	Particle size, um	Percent finer	Incremental percent
3 inch	75000	100.0	0.0
2 inch	50000	100.0	0.0
1.5 inch	37500	100.0	0.0
1 inch	25000	100.0	0.0
3/4 inch	19000	100.0	0.0
3/8 inch	9500	100.0	0.0
#4	4750	100.0	0.0
#10	2000	100.0	0.0
#20	850	99.3	0.7
#40	425	98.3	1.0
#60	250	97.3	1.0
#80	180	96.6	0.7
#100	150	96.1	0.5
#200	75	93.8	2.3
Hyd1	27.8	82.1	11.7
Hyd2	18.9	66.1	16.0
Hyd3	12.8	19.9	46.2
Hyd4	9.3	14.9	5.0
Hyd5	6.4	14.9	0.0
Hyd6	3.2	13.0	1.9
Hyd7	1.4	11.4	1.6

Soil Classification	Percent of sample
Gravel	0.0
Sand	6.2
Coarse Sand	0.0
Medium Sand	1.7
Fine Sand	4.5
Silt	78.9
Clay	14.9

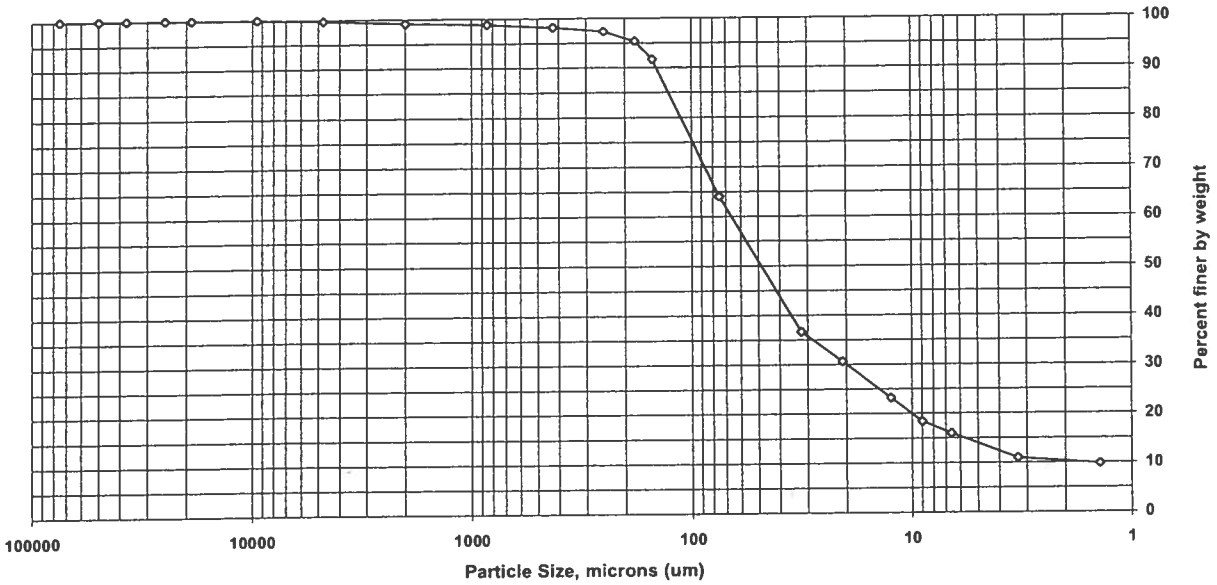
Particle Size of Soils by ASTM D422

Sample ID:	DSY-SD-GP09-0012	Percent Solids:	61.7%	Date Received:	10/04/11
Lab ID:	200-7324-A-9	Specific Gravity:	2.650	Start Date:	10/06/11
				End Date:	10/11/11

Shape (> #10): subangular

Non-soil material: shell

Hardness (> #10): hard



Sieve size	Particle size, um	Percent finer	Incremental percent
3 inch	75000	100.0	0.0
2 inch	50000	100.0	0.0
1.5 inch	37500	100.0	0.0
1 inch	25000	100.0	0.0
3/4 inch	19000	100.0	0.0
3/8 inch	9500	100.0	0.0
#4	4750	99.7	0.3
#10	2000	99.1	0.6
#20	850	98.8	0.3
#40	425	98.2	0.6
#60	250	97.3	0.9
#80	180	95.4	1.9
#100	150	91.7	3.7
#200	75	64.0	27.7
Hyd1	32	36.6	27.4
Hyd2	20.8	30.6	6.0
Hyd3	12.5	23.2	7.4
Hyd4	9	18.4	4.8
Hyd5	6.6	16.0	2.4
Hyd6	3.3	11.0	5.0
Hyd7	1.4	9.8	1.2

Soil Classification	Percent of sample
Gravel	0.3
Sand	35.7
Coarse Sand	0.6
Medium Sand	0.9
Fine Sand	34.2
Silt	48.0
Clay	16.0

Particle Size of Soils by ASTM D422

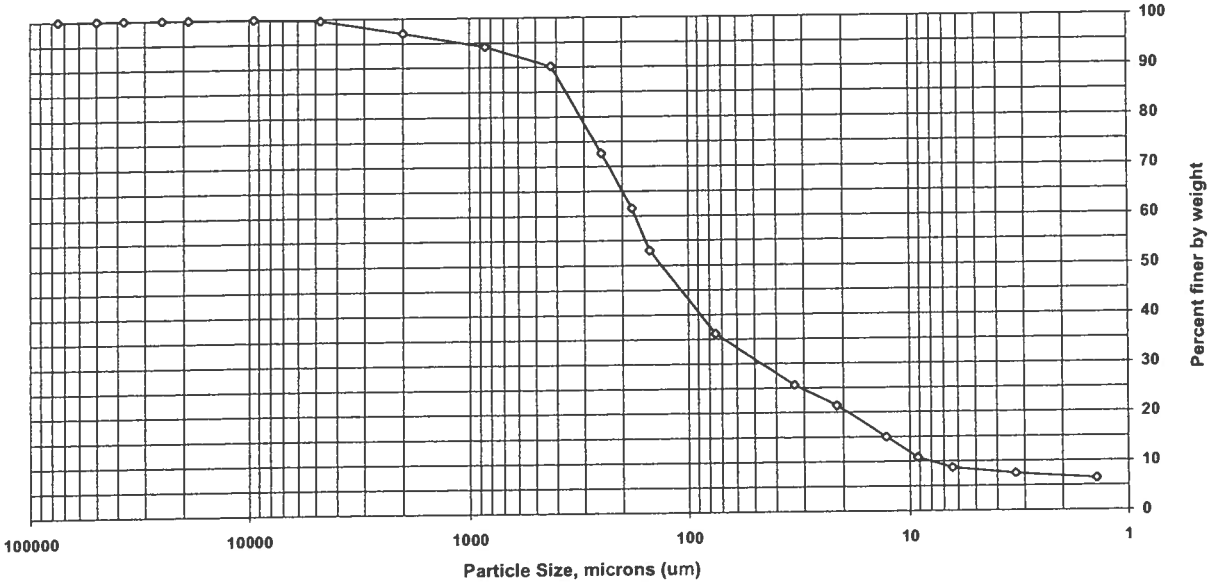
Sample ID: DSY-SD-GP10-0012
Lab ID: 200-7324-A-10

Percent Solids: 69.3%
Specific Gravity: 2.650

Date Received: 10/04/11
Start Date: 10/06/11
End Date: 10/11/11

Shape (> #10): subangular

Non-soil material: shell, plant
Hardness (> #10): hard



Sieve size	Particle size, um	Percent finer	Incremental percent
3 inch	75000	100.0	0.0
2 inch	50000	100.0	0.0
1.5 inch	37500	100.0	0.0
1 inch	25000	100.0	0.0
3/4 inch	19000	100.0	0.0
3/8 inch	9500	100.0	0.0
#4	4750	99.6	0.4
#10	2000	97.0	2.6
#20	850	94.2	2.8
#40	425	90.2	4.0
#60	250	72.6	17.6
#80	180	61.5	11.1
#100	150	53.0	8.5
#200	75	36.1	16.9
Hyd1	33.1	25.6	10.5
Hyd2	21.4	21.4	4.2
Hyd3	12.8	15.0	6.4
Hyd4	9.2	10.8	4.2
Hyd5	6.4	8.7	2.1
Hyd6	3.3	7.5	1.2
Hyd7	1.4	6.4	1.0

Soil Classification	Percent of sample
Gravel	0.4
Sand	63.5
Coarse Sand	2.6
Medium Sand	6.8
Fine Sand	54.1
Silt	27.4
Clay	8.7

Particle Size of Soils by ASTM D422

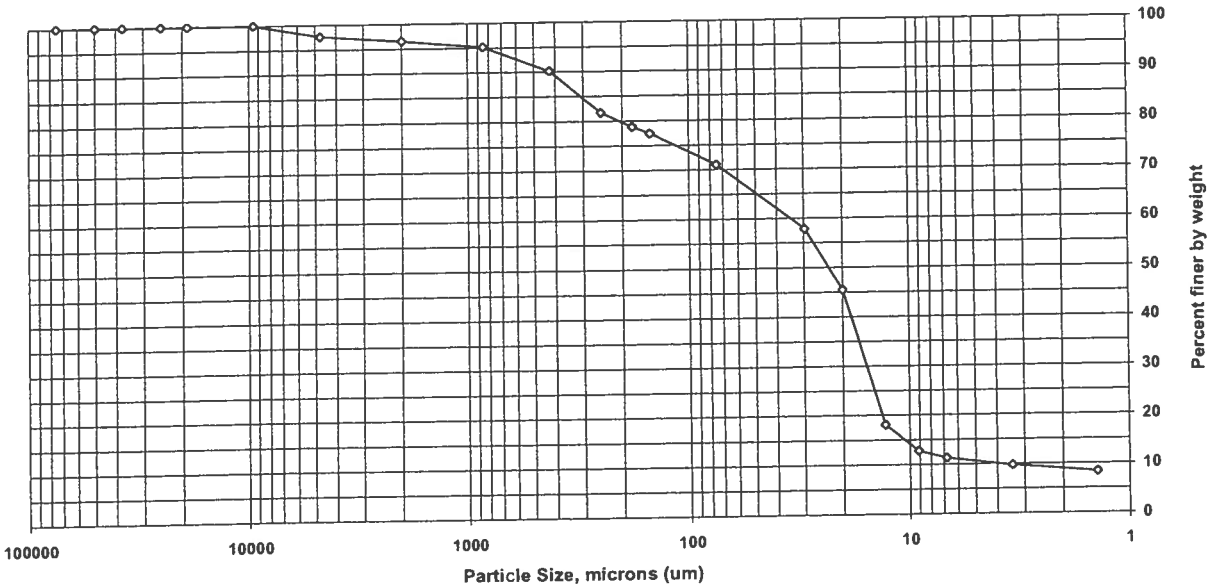
Sample ID: DSY-SD-DUP12-092711
Lab ID: 200-7324-A-11

Percent Solids: 54.8%
Specific Gravity: 2.650

Date Received: 10/04/11
Start Date: 10/06/11
End Date: 10/11/11

Shape (> #10): subangular

Non-soil material: shell, plant
Hardness (> #10): hard



Sieve size	Particle size, um	Percent finer	Incremental percent
3 inch	75000	100.0	0.0
2 inch	50000	100.0	0.0
1.5 inch	37500	100.0	0.0
1 inch	25000	100.0	0.0
3/4 inch	19000	100.0	0.0
3/8 inch	9500	100.0	0.0
#4	4750	97.6	2.4
#10	2000	96.6	1.0
#20	850	95.2	1.4
#40	425	90.2	5.0
#60	250	81.7	8.5
#80	180	78.8	2.9
#100	150	77.4	1.4
#200	75	71.0	6.4
Hyd1	29.7	57.8	13.2
Hyd2	20	45.4	12.4
Hyd3	12.9	18.1	27.3
Hyd4	9.1	12.7	5.4
Hyd5	6.8	11.3	1.4
Hyd6	3.4	9.8	1.6
Hyd7	1.4	8.4	1.4

Soil Classification	Percent of sample
Gravel	2.4
Sand	26.6
Coarse Sand	1.0
Medium Sand	6.4
Fine Sand	19.2
Silt	59.7
Clay	11.3

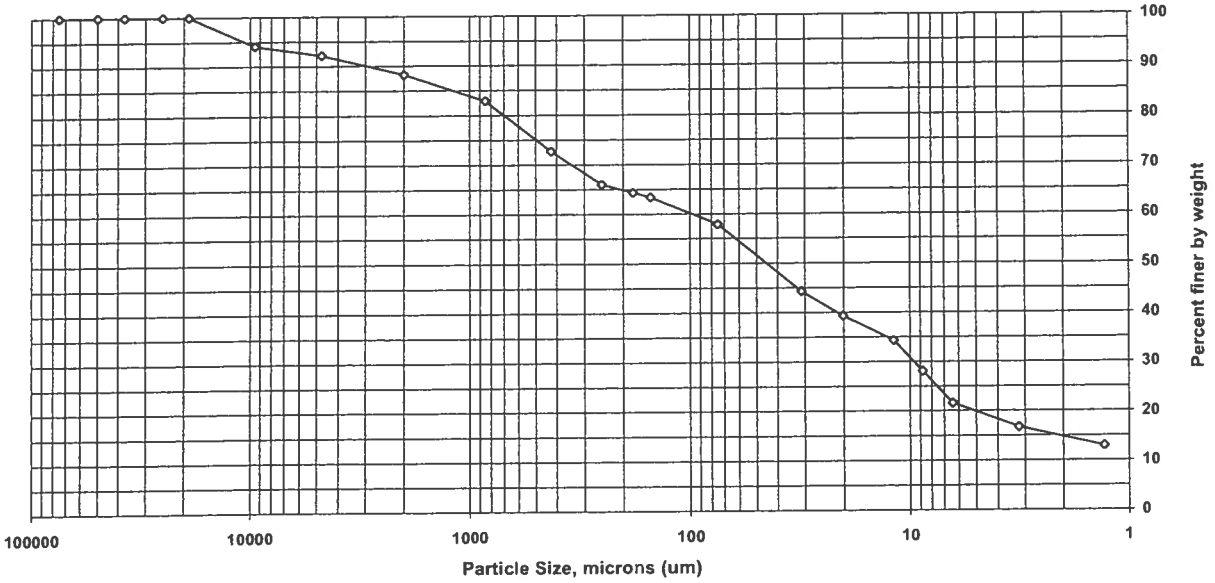
Particle Size of Soils by ASTM D422

Sample ID:	DSY-SD-GP02-0012	Percent Solids:	60.0%	Date Received:	10/04/11
Lab ID:	200-7324-A-2DU	Specific Gravity:	2.650	Start Date:	10/06/11
				End Date:	10/11/11

Shape (> #10): subangular

Non-soil material: shell

Hardness (> #10): hard



Sieve size	Particle size, um	Percent finer	Incremental percent
3 inch	75000	100.0	0.0
2 inch	50000	100.0	0.0
1.5 inch	37500	100.0	0.0
1 inch	25000	100.0	0.0
3/4 inch	19000	100.0	0.0
3/8 inch	9500	94.1	5.9
#4	4750	92.2	1.9
#10	2000	88.3	3.9
#20	850	82.9	5.4
#40	425	72.7	10.2
#60	250	66.0	6.7
#80	180	64.3	1.7
#100	150	63.4	0.9
#200	75	57.9	5.5
Hyd1	31.1	44.3	13.6
Hyd2	20.1	39.3	5.0
Hyd3	11.9	34.3	5.0
Hyd4	8.8	28.1	6.2
Hyd5	6.4	21.6	6.5
Hyd6	3.2	16.7	4.9
Hyd7	1.3	12.9	3.8

Soil Classification	Percent of sample
Gravel	7.8
Sand	34.3
Coarse Sand	3.9
Medium Sand	15.6
Fine Sand	14.8
Silt	36.3
Clay	21.6

APPENDIX D

SUPPORTING DOCUMENTS

D-1 COHESIVE SEDIMENT EROSION FIELD STUDY CODDINGTON COVE FEBRUARY 2012

LETTER REPORT

Cohesive Sediment Erosion Field Study: Coddington Cove, Narragansett Bay, Rhode Island

S. Jarrell Smith, David W. Perkey, and Joseph Z. Gailani

US Army Engineer Research and Development Center
Coastal and Hydraulics Laboratory
Vicksburg, Mississippi

—DRAFT DOCUMENT—

03 February 2012

Tetra Tech Inc., under Prime Contract with US Naval Facilities Engineering Command Atlantic, is evaluating the resuspension potential for sediments within Coddington Cove, Rhode Island. Of particular concern are fine-grained sediment deposits with high concentration of contaminants including PCBs and PAHs. As part of this assessment, a cohesive sediment transport model will be applied for the region. The cohesive sediment transport model requires parameterization of first-order transport processes (erosion and settling). This chapter describes field experiments conducted to define cohesive sediment erosion processes and analysis of these data to parameterize cohesive sediment transport in the numerical sediment transport model.

Cohesive Sediment Transport Processes

Sedimentation within Coddington Cove includes cohesive sediments. Non-cohesive sediment (sand and gravel) erosion and settling can be generally estimated from grain size distribution and mineral density. Cohesive sediment transport processes are dominated by other factors. Cohesive sediments are generally a mixture of sand, silt, and clay sized particles.

Erosion

A general definition for cohesive sediment is sediment for which the erosion rate cannot be estimated by standard sand/gravel transport methods. In these cases, cohesive forces are equivalent to or are greater than the gravitational forces that dominate sand transport. Cohesive sediment erosion characteristics are highly dependent upon factors such as particle size distribution, particle coatings, fine sediment mineralogy, organic content, bulk density, gas content, pore-water chemistry, and biological activity. Erosion rate and critical shear stress for erosion can vary significantly with small changes in only one of these inter-dependent parameters. It has been well demonstrated that critical stress and erosion rates for cohesive sediment can vary over several orders of magnitude for sediments with only slightly differing properties. Therefore, the influence of cohesion on sediment processes is significant. Qualitatively, it is understood which properties most significantly influence erosion. However, there are no quantitative methods available to determine erosion rate from cohesive sediment properties. Therefore, due to the sensitivity and wide range of influencing parameters, erosion characteristics of cohesive sediments are determined by site-specific analysis of erosion with erosion flumes.

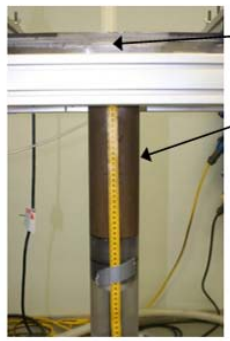
Several flumes are available to parameterize site-specific cohesive sediment erosion algorithms. Most of these devices operate over a range of low shear stress (<2 Pa) and are consequently capable of measuring only surface sediment erosion. Sedflume is an erosion device with capability to impose bed stresses in the range of 0.1 to 12 Pa and measures erosion rates from sediment cores taken from the field (for in-situ or stratified bed conditions) or prepared in the laboratory (for assessing disturbed sediments such as dredged material). Sedflume is designed to quantify erosion rates for surface and sub-surface sediments. These measurements permit description of the vertical variation of erosion rate within the bed. It should be noted that even if sediments are well mixed, cohesive sediment bed erosion will change with depth due to the influence of consolidation (bed density) on erosion rate. Erosion rate can vary by several orders of magnitude between surficial sediments and sediment buried less than 30 cm below the surface. Sedflume was selected to quantify erosion rate and erosion rate variation with depth (density) for this study.

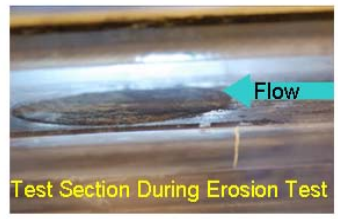
Methods

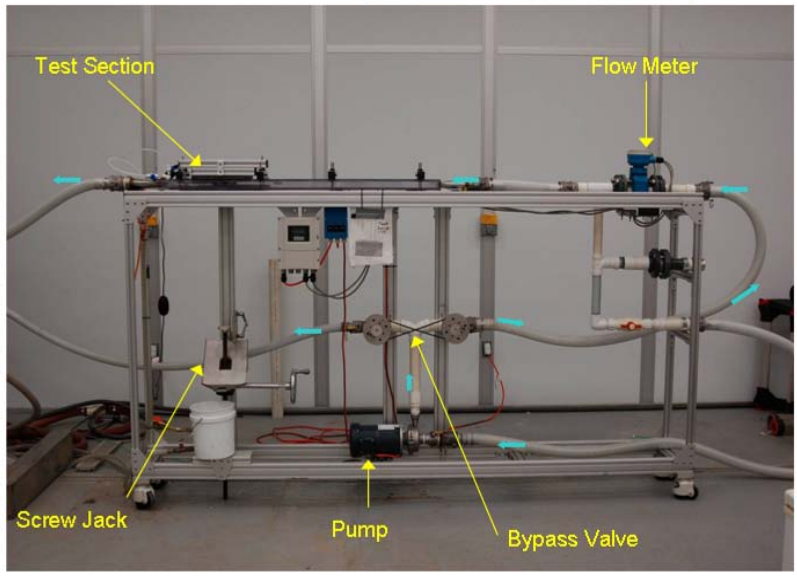
This section describes the field experiments, sampling and experimental methods, and data analysis methods used in determining cohesive sediment erosion within Coddington Cove. Background and technical information about the experimental device is presented first, followed by description of how these devices were deployed during field experiments to meet the study objectives.

Sedflume

Sedflume is a field- or laboratory-deployable flume for quantifying cohesive sediment erosion. The USACE-developed Sedflume is a derivative of the flume developed by researchers at the University of California at Santa Barbara (McNeil et al. 1996). The flume includes an 80-cm-long inlet section (Figure 1) with cross-sectional area of 2 × 10 cm for uniform, fully developed, smooth-turbulent flow. The inlet section is followed by a 15-cm-long test section with a 10 × 15 cm open bottom (the open bottom can accept cores with rectangular cross-section (10 × 15 cm) or circular cross-section (10-cm diameter)). Coring tubes and flume test section, inlet section, and exit sections are constructed of clear polycarbonate materials to permit observation of sediment-water interactions during the course of erosion experiments. The flume includes a port over the test section to provide access to the core surface for physical sampling. The flume accepts sediment cores up to 80-cm in length.







Shear stress t (Pa)	Flow Rate (GPM)
0.1	6.1
0.2	9.1
0.4	13.5
0.6	17.0
0.8	20.1
1.2	25.3
1.6	29.8
2.4	37.4
3.2	44.0
4	49.9
5	56.6
6.4	65.0
8	73.7
10	83.5
12	92.5
13	96.7
14	100.8

Figure 1. Sedflume erosion flume (lower right). Core inserted into test section (upper left). Core surface flush with bottom of flow channel (upper right). Table of shear stress associated with channel flow rates (lower left).

Erosion Experiments

Prior to the erosion experiment, descriptions of the core are recorded, including length, condition of the core surface, biological activity, and any visual evidence of layering. Cores are inserted into the testing section of Sedflume and a screw jack is used to advance the plunger such that the core surface becomes flush with the bottom wall of the flume. Flow is directed over the sample by diverting flow from a 3-hp pump, through a 5-cm inner diameter hose, into the flume. The flow through the flume produces shear stress on the surface of the core. (Numerical, experimental, and analytical analyses have been performed to relate flowrate to bottom shear stress.) Erosion of the surface sediment is initiated as the shear stress is increased beyond the critical stress for erosion, τ_{cr}. As sediment erodes from the core surface, the operator advances the screw jack to maintain the sediment surface flush with the bottom wall of the erosion flume. Figure 1 includes a photograph of the flume, a close-up photograph of the test section, and a table of flow rate/shear stress relationships.

Erosion rate is determined from the displacement of the core surface over the elapsed time of the experiment. Generally, erosion experiments are performed in repeating sequences of increasing shear stress. Operator experience permits sequencing of erosion tests to allow greater vertical resolution of shear stress/erosion rate data where required. The duration of each erosion experiment at a specified shear stress is dependent on the rate of erosion and generally is between 0.25 and 15 minutes. Shear stresses that induce no measurable erosion are also recorded. The

range of shear stress for each cycle is determined by the operator based on the previous erosion sequences and erosion behavior during the ongoing sequence.

Sediment Bulk Properties

Physical samples for bulk sediment property measurements are taken at approximately 3-5 cm intervals during erosion experiments, generally at the end of each shear stress cycle. Physical samples are collected by draining the flume channel, opening the port over the test section, and extracting a sample from the sediment bed. Properties measured include bulk density and grain-size distribution, and separate samples were collected from the core surface for these analyses. These properties strongly influence erosion; therefore, understanding their variation with depth is important in interpreting the erosion data.

Bulk Density Measurements. Bulk sediment density of physical samples is determined by a wet-dry weight analysis. Physical samples are extracted from the saturated core surface and placed in a pre-weighed aluminum tray. Sample weight is recorded immediately after collection and again after a minimum of 12 hours in an 90° C (194° F) drying oven. Wet weight of the sample was calculated by subtracting tare weight from the weight of the sample. The dry weight of the sample was calculated as the tare weight subtracted from the weight after drying. The water content w is then given

$$w = \left(\frac{m_w - m_d}{m_d} \right) \tag{1}$$

where m_w and m_d are the wet and dry weights, respectively. A volume of saturated sediment, V, consists of both solid particles and water and can be written as

$$V = V_s + V_w \tag{2}$$

where V_s is the volume of solid particles and V_w is the volume of water. If the sediment particles and water have density ρ_s and ρ_w, respectively, the water content of the sediment can be written as

$$w = \frac{\rho_w V_w}{\rho_s V_s} \tag{3}$$

A mass balance of the volume of sediment gives

$$\rho V = \rho_s V_s + \rho_w V_w \tag{4}$$

where ρ is the bulk density of the sediment sample.

(1)-(4) are used to derive an explicit expression for the bulk density of the sediment sample, ρ, as a function of the water content, w, and the densities of the sediment particles and water. This equation is

$$\rho = \rho_s + \frac{w\rho_s\left(\rho_w - \rho_s\right)}{\rho_w + w\rho_s} \tag{5}$$

For the purpose of these calculations, ρ_s = 2.65 g·cm^{-3} and ρ_w is calculated for measured pore water at sample temperature.

Particle-Size Distribution. Samples collected during erosion experiments were transported to the Sediment Laboratory at ERDC for grain size analysis. A Beckman-Coulter LS-100 laser diffraction particle-sizer was used to measure the particle-size distributions in sub-samples collected from the cores. The particle sizer measures particle size over the range 0.4 to 900 μm. Particle size distributions were determined by first removing and sieving (#20 mesh) sediment and shell fragments larger than 850 μm. The passing portion of the sample was added to a small volume of water (approximately 150 mL) and sonicated using a high-powered laboratory sonicator to disperse the sediment. The dispersed solution was placed in the particle sizer fluid module. The sample is pumped and recirculated through the optical module. The optical module includes a spatial filter assembly containing a laser diode and laser beam collimator. The diffraction detector assembly contains a custom photodetector array that is used for the measurement of light scattering by the suspended particles. The distribution of grain sizes and median grain sizes is derived from this light scattering measurement. Organic material was not oxidized before grain size analysis was performed; therefore grain size distributions include organic material.

Multivariate Erosion Rate Prediction

The goal of erosion data analysis is to determine appropriate parameterization of erosion processes for numerical modeling studies. For this study, the erosion data are to be described in the SEDZLJ model. SEDZLJ is flexible in the form of the erosion equation, and the effects of bulk density, depth, and applied shear stress may be represented as indicated by the erosion data. Analysis of the erosion data from Coddington Cove suggested that the erosion algorithm should be of the following form:

$$\begin{aligned} E &= 0; && (\tau < \tau_c) \\ E &= A\tau^n; && (\tau_c < \tau < \tau_m) \\ E &= A\tau_m^n; && (\tau > \tau_m) \end{aligned} \tag{6}$$

where E represents erosion rate (cm·s^{-1}) from the bed, τ is bed shear stress, τ_c is critical stress for erosion, A is an empirical constant, n is an empirical exponent, and τ_m is bed stress at which erosion rate becomes constant. Solution of Equation (6) to data requires solving for three parameters, τ_c, A, and n. Bed stress for the upper limit of erosion rate is determined by examining the data. The best fit of Equation (6) to measured data is accomplished through an iterative, multi-parameter, least-squares method on the linear transform of Equation (6).

Field Experiments

Field experiments were conducted from August 31 through September 8 of 2011. Field experiments included core collection and cohesive sediment erosion experiments.

Core Collection

On August 31, 2011, twelve 10-cm (4-inch) diameter cores were collected from ten locations (Figure 2, Table 1) within Coddington Cove for the purpose of erosion experiments. The ten core collection locations were provided to ERDC by Tetra Tech Inc. A gravity corer was used to collect a core from each location. In addition, a replicate gravity core was collected at both stations 7 and 8 to bring the total number of cores collected to twelve.

Table 1. Core Summary					
Core ID	**Latitude (North)**	**Longitude (West)**	**Collection Method**	**Collection Date**	**Sample Depth (cm below sediment surface)**
Station 1	41.5313	71.3153	Gravity	31 August 2011	16
Station 2	41.5283	71.3202	Gravity	31 August 2011	21
Station 3	41.5296	71.3172	Gravity	31 August 2011	27
Station 4	41.5297	71.3146	Gravity	31 August 2011	20
Station 5	41.5281	71.3163	Gravity	31 August 2011	16
Station 6	41.5288	71.3142	Gravity	31 August 2011	15
Station 7	41.5272	71.3158	Gravity	31 August 2011	15-21
Station 8	41.5271	71.3136	Gravity	31 August 2011	25-29
Station 9	41.5252	71.3145	Gravity	31 August 2011	22
Station 10	41.5240	71.3124	Gravity	31 August 2011	20

The ERDC gravity corer (Figure 3A) is constructed of steel and weighs approximately 32 kg (70 lbs). The gravity corer consists of a core barrel, check valve, fins, and cable harness. The gravity corer is lowered to the bottom and penetrates the bed by its own weight and momentum. The check valve serves to create a seal above the core to prevent the captured sediment core from slipping out of the core tube. Once the core is retrieved to the vessel, a plunger with Bentonite paste (for sealing and lubrication) is inserted into the bottom of the core and each end of the core is sealed with end caps (Figures 3B-C). Each core was labeled, logged, and stored submerged in water on the vessel deck.

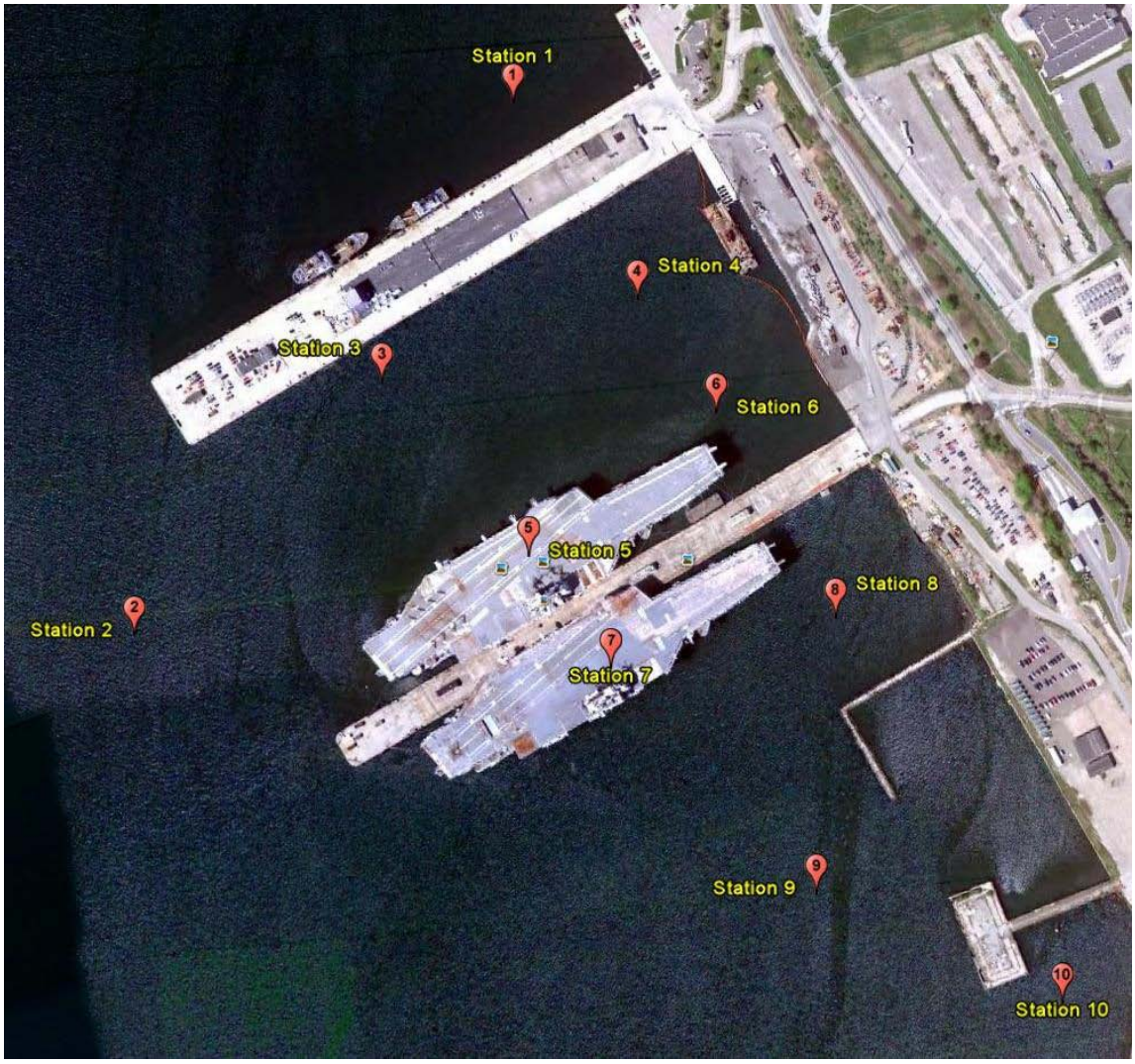


Figure 2. Coring locations in Coddington Cove, RI.

A) Gravity Corer

B) Plungers with Bentonite paste

C) Core with plunger inserted.

Figure 3. Sampling devices.

Erosion Experiments

Cores collected were transported by vessel to the ERDC-CHL Field Sediment Laboratory (located on Coddington Cove on the Newport Rhode Island Navy complex). Erosion experiments were conducted 02 September through 08 September 2011, in the field laboratory following the Sedflume methods presented earlier in this report. During the time of erosion experiments, sediment cores were stored in a shaded barrel, filled with site water.

Results and Discussion

Cohesive sediment transport process data collected during the field study were analyzed to determine SEDZLJ model parameterizations for cohesive sediment erosion and settling velocity. This section presents results of the data analysis, model parameterization, and general observation with discussion. The reader is referred to technical appendices for full presentation of the analyzed dataset. Appendix A presents physical descriptions of each core including:

photographs, bed density profiles, and grain size analysis. Appendix B provides erosion analysis of each core, including definition of bed layers that erode similarly. Appendix C provides grouping of bed layers across all cores collected, including confidence intervals on the parameterized erosion equations.

Cohesive Sediment Erosion

Analysis of cohesive sediment erosion data obtained from undisturbed field cores is inherently complex. Cohesive sediment erosion is sensitive to slight changes in bed density, deposit mineralogy, gas content, organic content, biological activity, debris and a host of other factors. In many cases, these factors change significantly at relatively small vertical scales (such as depositional bed sequences). Consequently, measured cohesive sediment erosion rates from field cores are notoriously variable. To compensate for the large variance in measured erosion rates, field erosion experiments are conducted in a manner to produce a large sample from which to derive statistically representative relationships for various numerical erosion algorithms. To ensure high quality in the data analysis, data and associated experimental notes are evaluated to identify outliers in the dataset. Outliers are rejected based on comparisons between adjacent data points and experimental log notes.

During the erosion experiments, all cores were found to be vertically stratified. The vertical variation in erosion characteristics was associated with shell content, vegetation, and/or sand content. Cores 07 and 08 included a significant amount of shells and shell fragments. Erosion measurement had to be halted for portions of these cores due to the presence of shells.

Erosion Parameterization

Erosion rate data were evaluated for relationships between erosion rate, bed density, and applied shear stress. Each of the cores analyzed indicated bed layering (as inferred from the visual observations, sediment size analysis, and erosion rates). In some cases, the boundaries between layers were very distinct, in other cases the layer boundaries transitioned more gradually. Each of the identified sediment layers within a core was first analyzed separately, then with other layers to form sediment groupings that contain a larger number of erosion data points and represent a larger area of influence.

The erosion data from Core 08B will be presented here to illustrate the parameterization of the erosion data from Coddington Cove. Figure 3 presents the erosion data with depth and the sediment bulk density profile determined from physical samples taken from the core. First, the erosion data were grouped vertically within cores. This grouping was accomplished by reviewing the erosion notes and erosion rate relationships to depth, density, and shear stress. At the sediment water interface, there is typically a thin, low-density layer that erodes more easily than the more highly consolidated sediments deeper in the sediment bed. This was observed for Core 08B between depths of 0 – 1 cm into the core, which is defined as Layer S08B-0. Beneath the surface layer was a layer from 2 – 13 cm that was consistent in sediment size distribution and for which the erosion rate data followed similar relationships to bed density and shear stress (Figure 4).

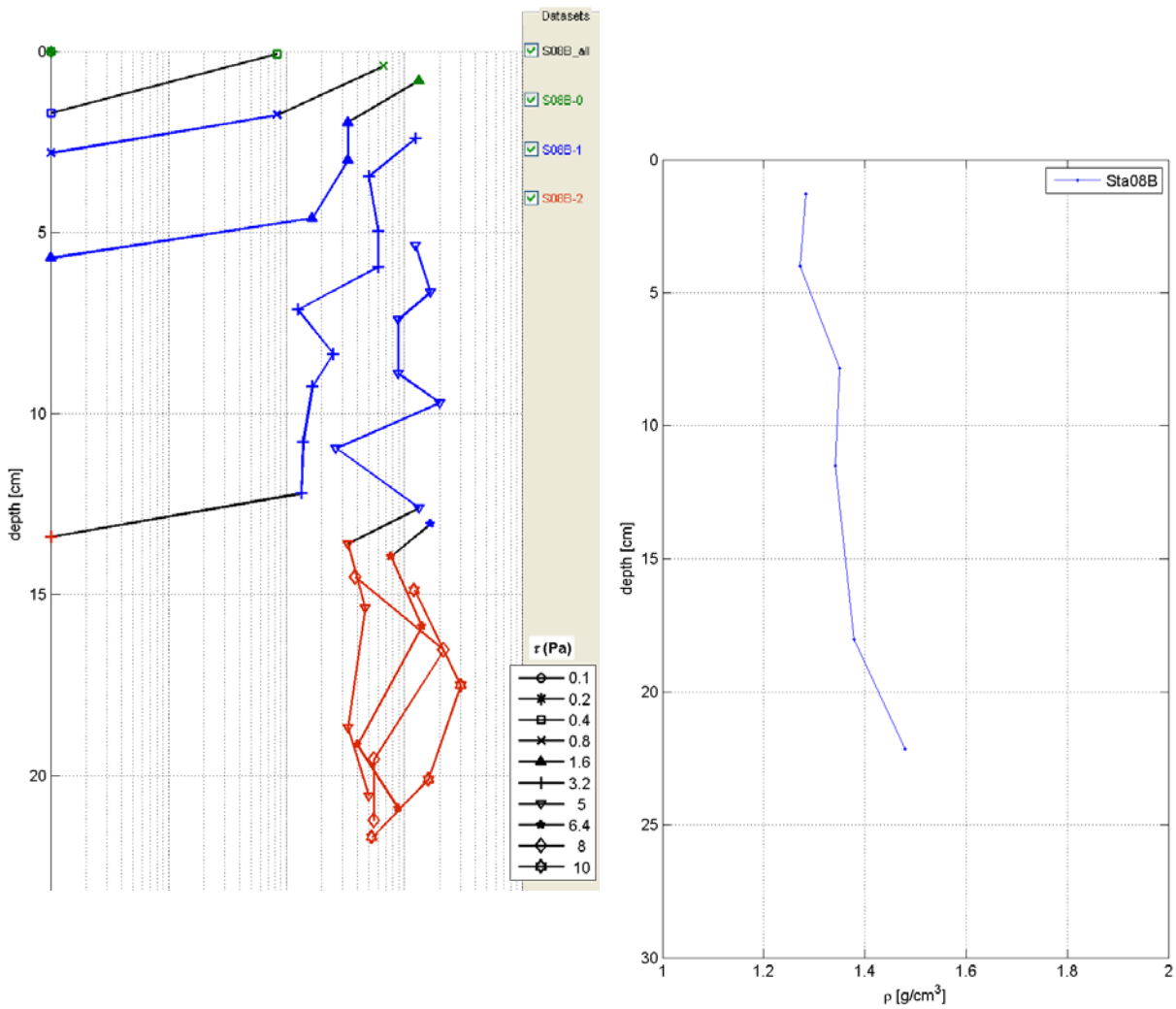


Figure 3. Erosion rate data (left) and bulk density profile (right) of Core 08B. For erosion rate data set, colors indicate the layers of the core as inferred from erosion data, visual observations, and physical properties.

A multivariate least squares fit of erosion rate to shear stress and bed density (Core 08B, Layer 1) is presented in the upper plot of Figure 4. Layer 08B-1 was one of the few layers that demonstrated a clear relationship between erosion and bed density. For most of the layers, other factors such as vegetation, mussels, shell hash, or sand content influenced erosion more than bed density. In these cases, the erosion relationship was characterized by a simpler relationship of only shear stress (Figure 4, bottom).

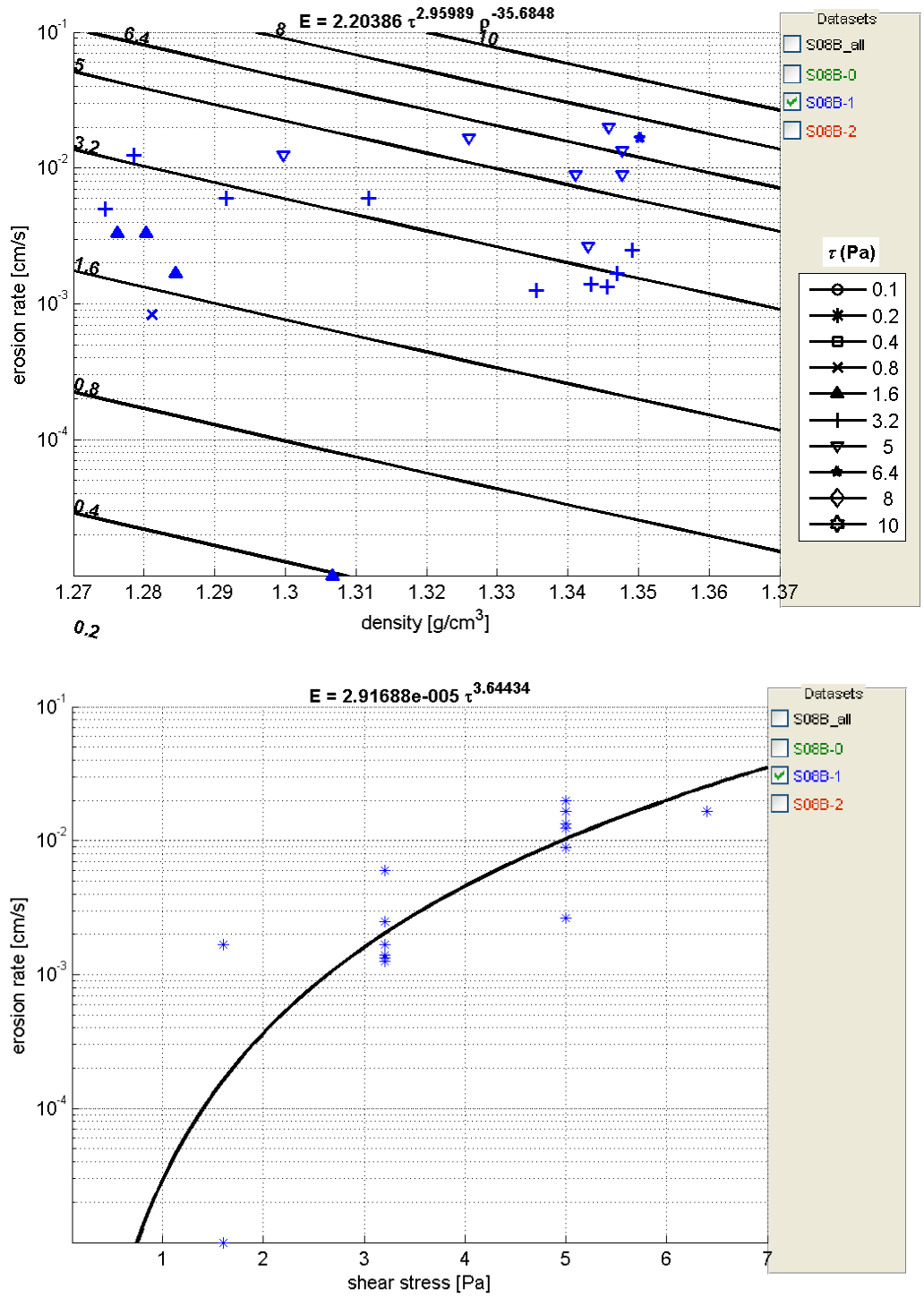


Figure 4. Erosion parameterization for Core 08b, Layer 1. (Top) Multivariable least squares fit of erosion to bulk density and shear stress. (Bottom) Least squares fit of erosion to shear stress for bottom half of Layer 1. (Upper half of Layer 1 has different response to shear stress which is related to density, see top plot).

After evaluating layers in individual cores, the layers were grouped together to identify sediments that eroded similarly across samples at the site. For example, Layer 08B-1 from Figures 3 and 4 was grouped with Layers 07A-1, 08A-1, and 09-1 to form Group C (Figure 5). In this case, the grouped data provide a reasonably sized dataset (number of samples, $N = 63$) to provide a significant correlation ($r^2 = 0.56$, $p \ll 0.01$) between erosion and shear stress. The least-squares fit to $E = A\tau^n$ is indicated by "fit". The 68% confidence intervals (± 1 σ) on the data around the least squares fit ("ci data") are indicated. The confidence intervals suggest that erosion varies by approximately a factor of 2 around the best fit line, not an uncommon level of variance in erosion rates for field samples. Furthermore, there is uncertainty in the *A* coefficient and *n* exponent of the best fit line. The "ci fit param" indicates the resulting fit of $E = (A + \delta A)\tau^{(n+\delta n)}$ and $E = (A - \delta A)\tau^{(n-\delta n)}$, where δ indicates parameter uncertainty. Seven data groupings were determined from the Coddington Cove dataset. The grouped data, fit statistics, and confidence intervals are presented in Appendix C and summarized in Table 2.

All cores collected exhibited cohesive erosion behavior. Critical shear stress for erosion generally increased with depth and erosion rates at a given shear stress decreased with depth. This is a common observation associated with stronger bonding with increased sediment consolidation and density. All cores exhibited some degree of bed layering, which influenced the cohesive sediment transport rates. Bed layering was associated with sand content, vegetation, and

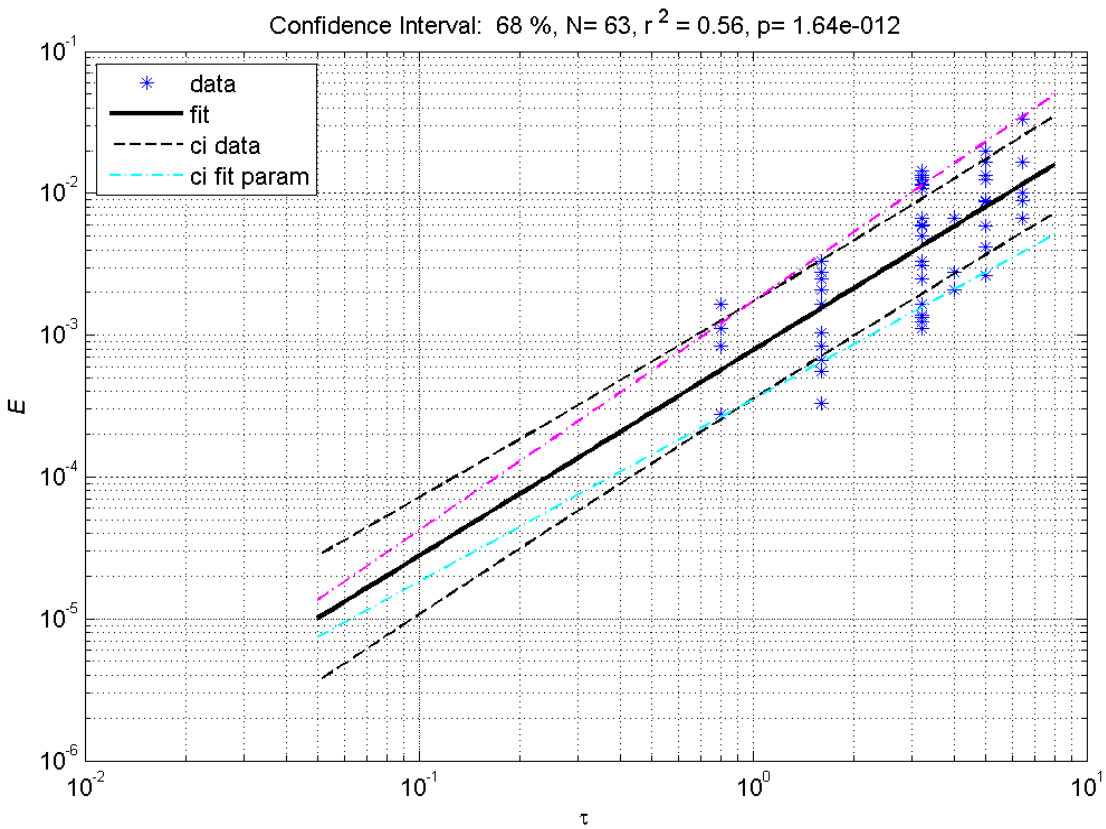


Figure 5. Erosion parameterization for Group C (composed of Layers 07A-1, 08A-1, 08B-1, and 09-1). Shear stress(τ) in Pa and erosion rate (E) in cm/s. The fit to $E = A\tau^n$, 68% confidence intervals (± 1σ) on the data ("ci data"), and 68% confidence intervals on the fit parameters ("ci fit param") are provided.

shell. Groups A-E were composed of relatively shell- and sand-free cohesive beds, with varying clay content and bed density. Cores with substantial shell and vegetation were grouped into Group F. Cores 9 and 10 had layers with more than 20% sand by weight, which were combined to form Group G.

Table 2. Cohesive Sediment Erosion Parameterization for SEDZLJ

Group	DataSets	Depth (cm)	Fit Parameters				
			Fit	τ_{cr} (Pa)	τ_{max} (Pa)	*A*	*n*
A	All	0-1	Best	0.2	2	7.8e-3	1.58
			Low	0.2	2	3.9e-3	1.37
			High	0.2	2	15.5e-3	1.80
B	S03-1	1.5 - 5.5	Best	0.4	8	1.2e-3	1.34
	S04B-1	2 – 6.5	Low	0.4	8	0.56e-3	1.12
	S05-1	2.3 – 7.5	High	0.4	8	2.4e-3	1.55
C	S07A-1	3.0 – 6.5	Best	0.4	9	0.78e-3	1.45
	S08A-1	2.0 – 11.5	Low	0.4	9	0.35e-3	1.29
	S08B-1	2 - 13	High	0.4	9	1.7e-3	1.61
	S09-1	1.5 – 7.5					
D	S08A-2	12 - 20	Best	1.6	12	1.3e-3	0.98
	S08B-2	13 - 22	Low	1.6	12	0.68e-3	0.72
			High	1.6	12	2.4e-3	1.24
E	S03-2	7.0 – 9.5	Best	0.8	9	0.64e-3	1.56
	S05-2	6.0 – 11.0	Low	0.8	9	0.28e-3	1.22
	S07B-2	5.5 – 8.0	High	0.8	9	1.5e-3	1.90
F	S07A-2	7.0 – 9.0	Best	0.8	12	0.32e-3	1.05
	S02-3	7.0 – 14.0	Low	0.8	12	0.16e-3	0.86
	S03-3	10 - 15	High	0.8	12	0.66e-3	1.25
	S07B-3	12 - 14					
	S03-4	15 - 21					
G	S09-2	8.0 – 10.5	Best	0.8	12	0.51e-3	1.42
	S09-3	11.5 - 18	Low	0.8	12	0.23e-3	1.18
	S10-1	1.8 – 4.0	High	0.8	12	1.1e-3	1.67
	S10-3	5 - 12					

Summary and Conclusions

Tetra Tech NUS commissioned the ERDC to conduct cohesive sediment erosion testing services for the purpose of defining erosion rates of contaminated sediments at Coddington Cove, Narragansett Bay, Rhode Island. ERDC-CHL conducted the erosion testing in August/September 2011.

Twelve, 4-inch (10-cm) diameter sediment cores were collected from within Coddington Cove. The cores were eroded in the Field Sediment Transport Laboratory that was operated at the Newport Rhode Island Naval Base. During erosion experiments, the cores were visually described, eroded, and subsampled for physical properties. Erosion data were analyzed by the layers evident in each core and later grouped by core layers that demonstrated similar erosion characteristics. Empirical coefficients were determined for modeling cohesive sediment bed erosion for individual core layers and groups of core layers that had similar erosion behavior.

Acknowledgements

Vessel support for core sampling was provided by the Environmental Protection Agency (EPA), Environmental Effects Research Laboratory – Narragansett. Mr. Skip Nelson and Ms. Barbara Bergen (EPA) are acknowledged for their assistance during core collection. Mr. Tommy Kirklin (contractor for USACE-CHL) assisted with core collection, erosion experiments, and sample analysis. Mr. Richard Hudson (USACE-Environmental Laboratory) performed the grain size analysis on physical samples.

References

Jepsen, R., Roberts, J, and Lick, W. 1997a. 'Effects of bulk density on sediment erosion rates', Water, Air, and Soil Pollution, 99, 21-31.

Appendix A. Core Descriptions

Appendix A includes core photographs, core descriptions, locations and analysis of physical samples.

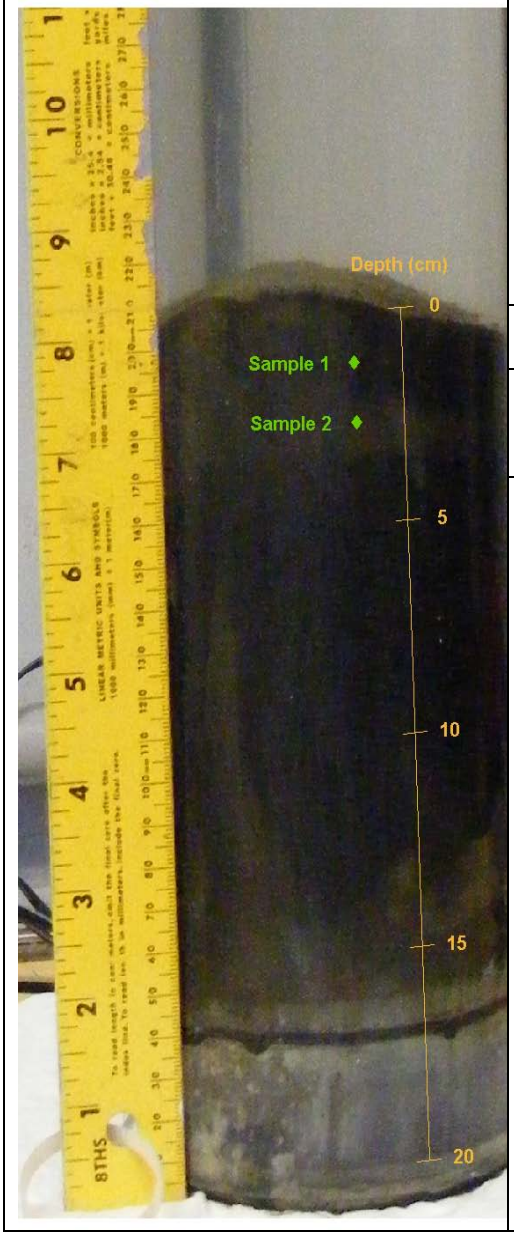
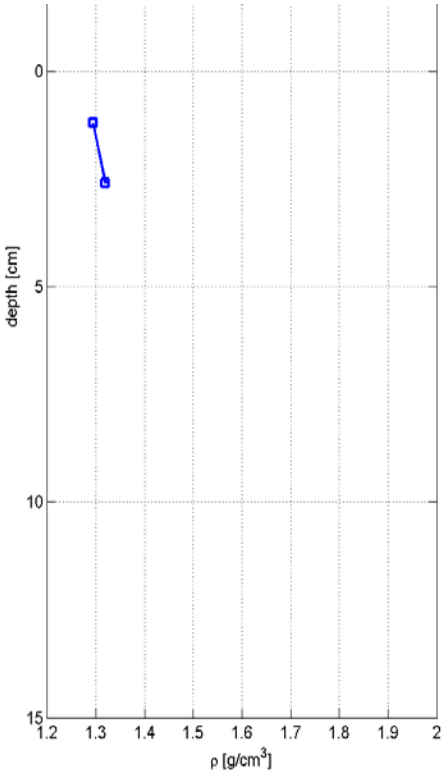
Table A-1a. Core Description, Station 1		
Photograph	**Description**	**Density Profile**
	Overlying Water Surface sediment is light brown in color with a fluffy texture. Below the surface and down to a depth of 4cm, the sediment is a mix of dark and light brown layers. Sediments throughout the remainder of the core are dark brown in color. Shell hash is apparent at 10 cm down core.	

Table A-1b. Core Surface Photographs, Station 1	
Sample 1	
Sample 2	

Table A-1c. Physical Sample Properties, Station 1

Sample #	Depth (cm)	Bulk Density (g/cm^3)	d_{10} (μm)	d_{50} (μm)	d_{90} (μm)	% Sand	% Silt	% Clay
0	0.00		1.72	9.64	53.10	7.41	65.74	26.85
1	1.20	1.29	1.63	9.38	45.61	5.27	67.06	27.67
2	2.60	1.32	1.66	9.44	48.89	6.06	66.44	27.49

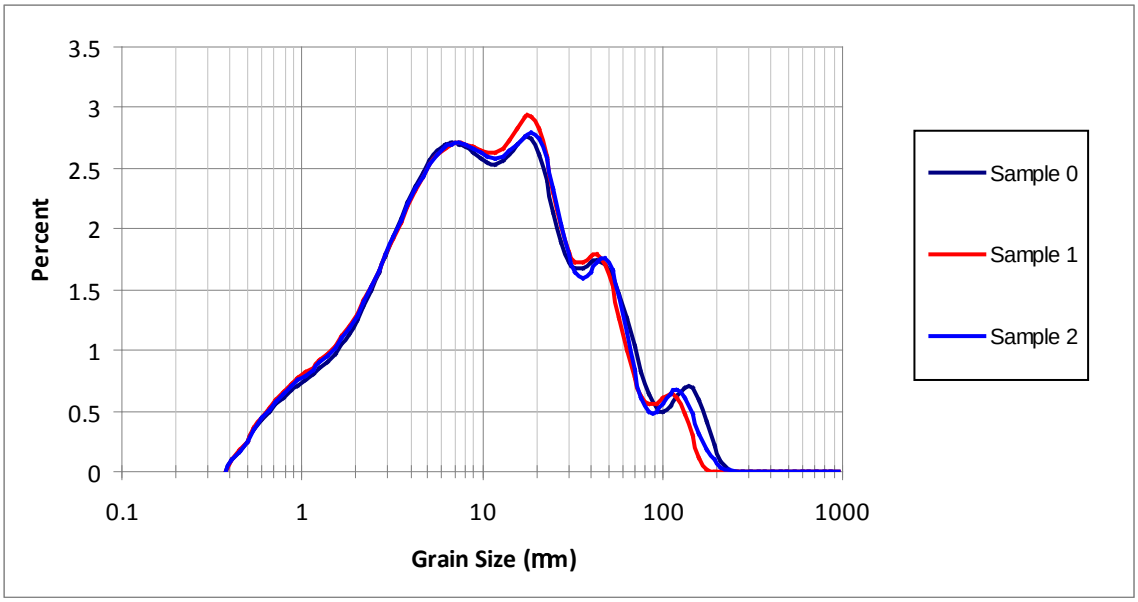


Figure A-1a. Grain size distributions for Station 1 physical samples.

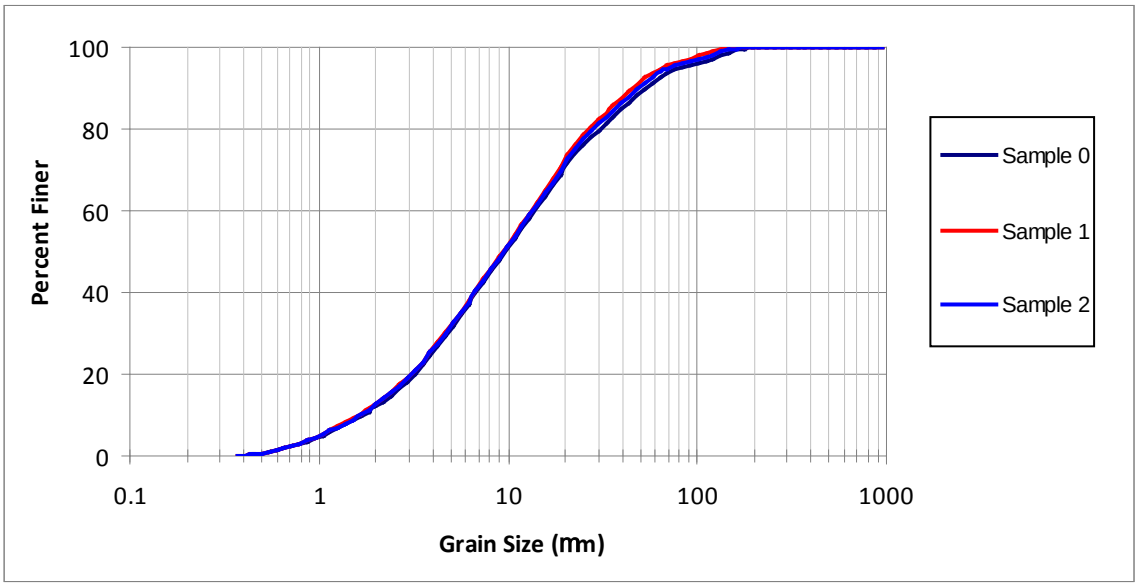


Figure A-1b. Cumulative grain size distributions for Station 1 physical samples.

Table A-2a. Core Description, Station 2

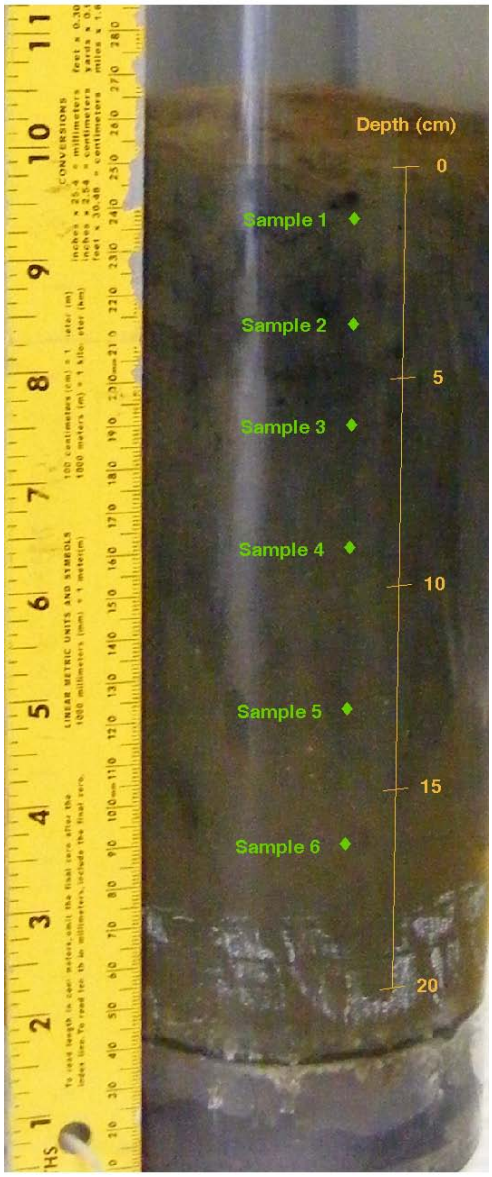
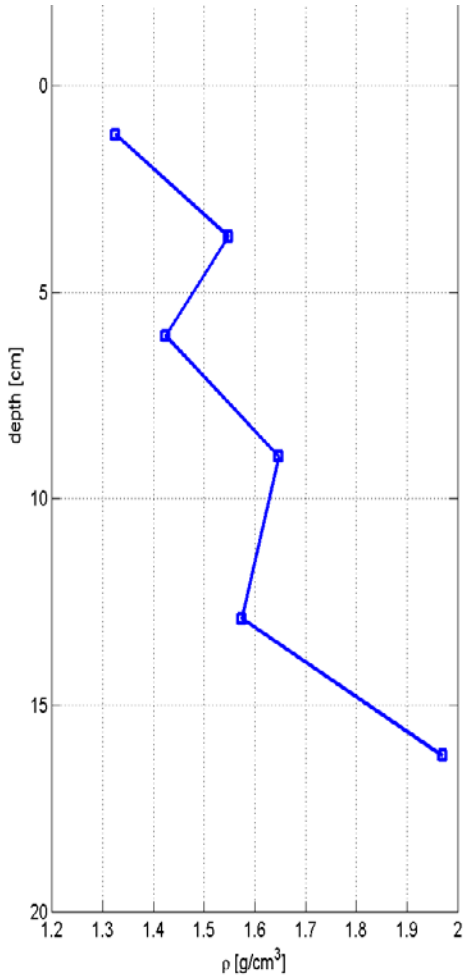
Photograph	Description	Density Profile
	Overlying water .	
	Surface sediments are light brown in color with a fluffy texture.	
	Remainder of core sediment is predominately light to dark grey in color. A lens of black sediment, 5cm in diameter, is apparent at 3-7cm depth down core	

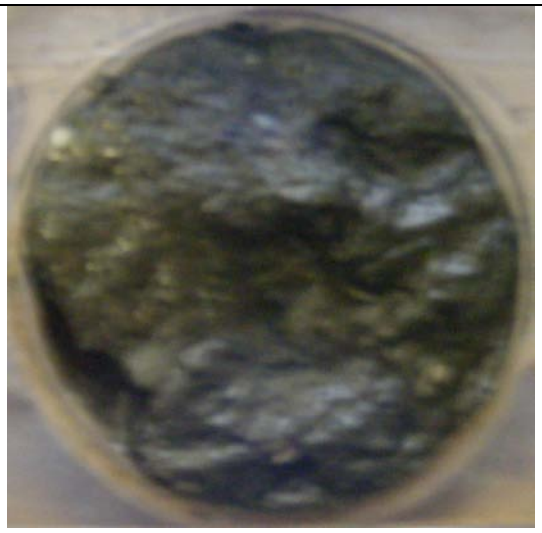
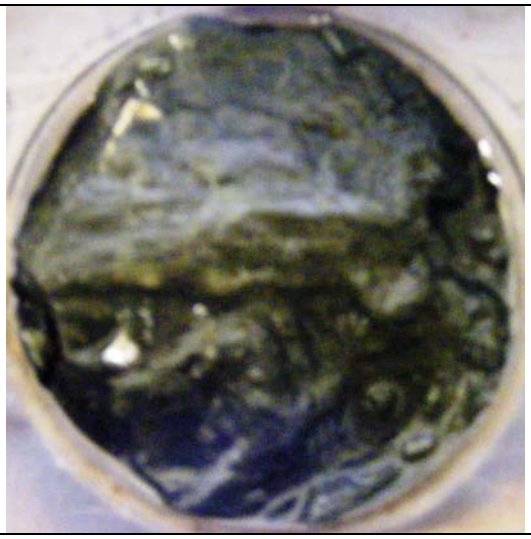
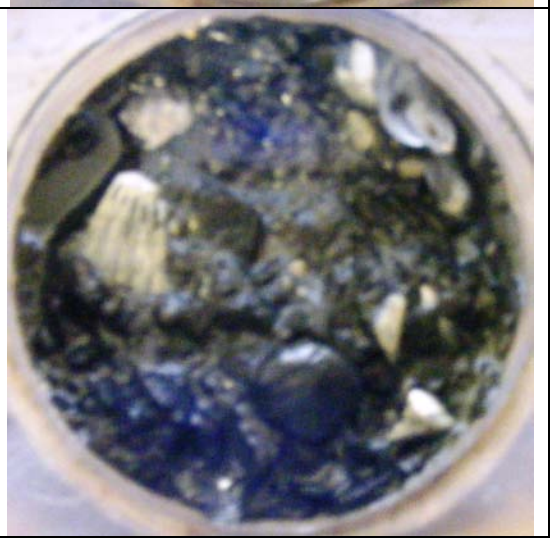
Table A-2b. Core Surface Photographs, Station 2			
Sample 1		**Sample 4**	
Sample 2		**Sample 5**	
Sample 3		**Sample 6**	

Table A-2c. Physical Sample Properties, Station 2								
Sample #	Depth (cm)	Bulk Density (g/cm^3)	d_{10} (μm)	d_{50} (μm)	d_{90} (μm)	% Sand	% Silt	% Clay
0	0.00		1.88	10.54	10.54	7.87	67.31	24.82
1	1.20	1.33	1.79	11.38	58.21	8.54	66.59	24.88
2	3.70	1.55	1.91	12.78	69.93	12.02	64.89	23.10
3	6.10	1.42	1.86	12.79	71.48	12.29	64.37	23.34
4	9.00	1.65	1.94	13.85	79.50	14.67	62.84	22.49
5	12.90	1.57	1.85	13.55	76.23	13.40	63.60	23.00
6	16.20	1.97	1.95	11.86	76.24	12.86	63.82	23.32

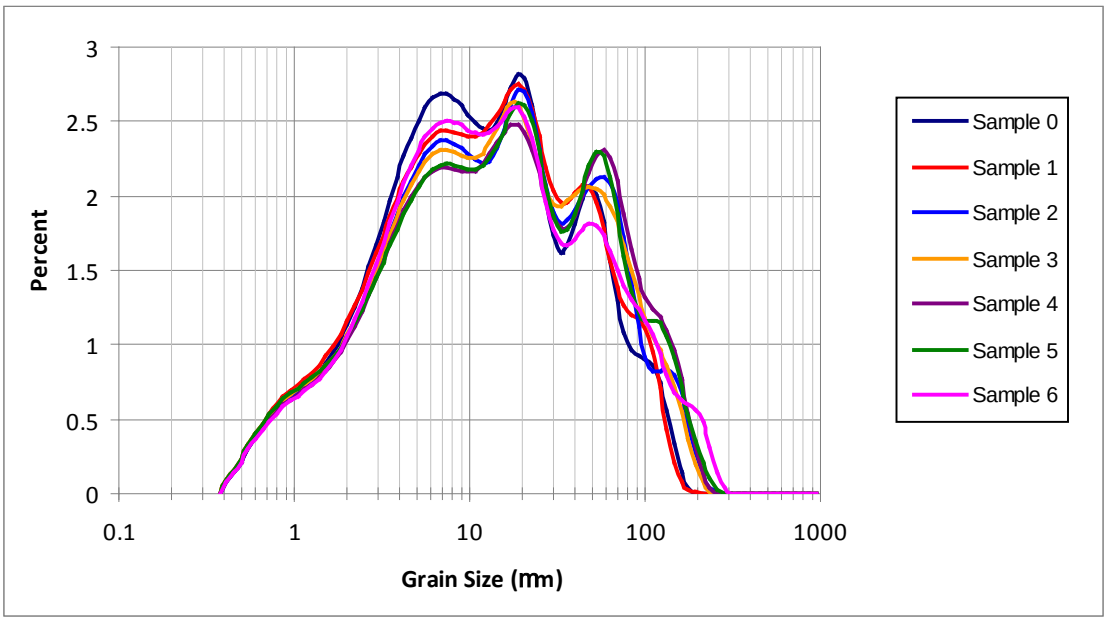


Figure A-2a. Grain size distributions for Station 2 physical samples.

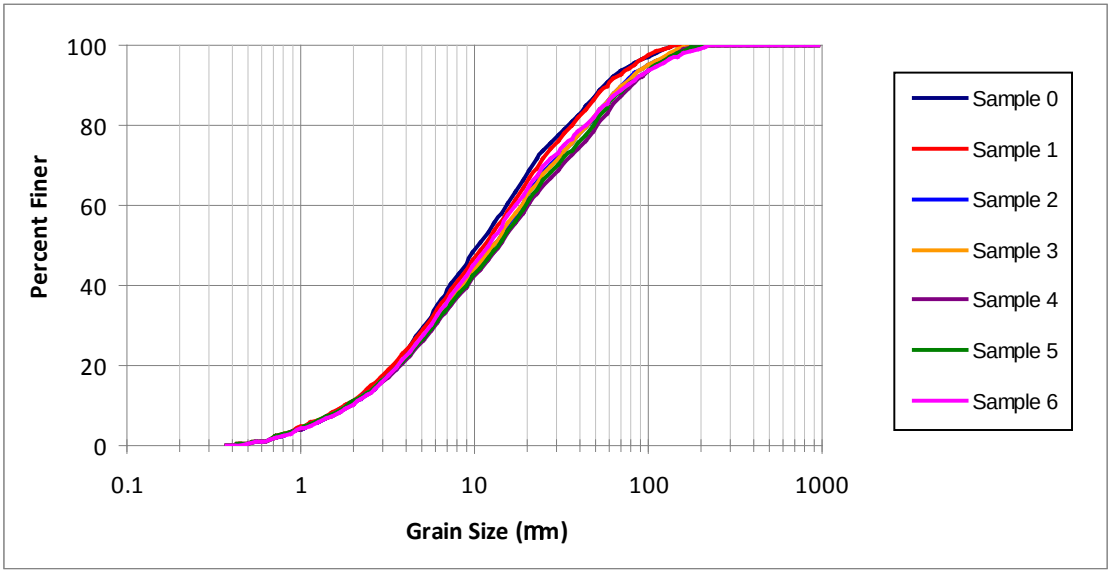


Figure A-2b. Cumulative grain size distributions for Station 2 physical samples

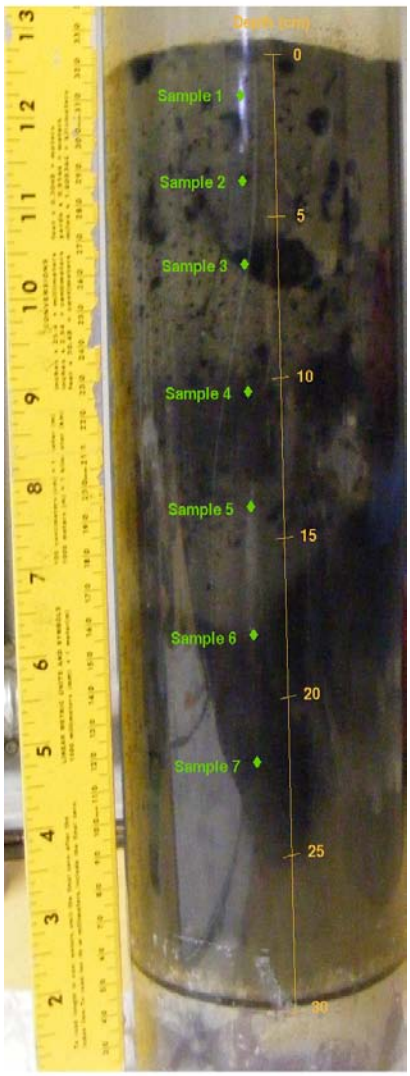
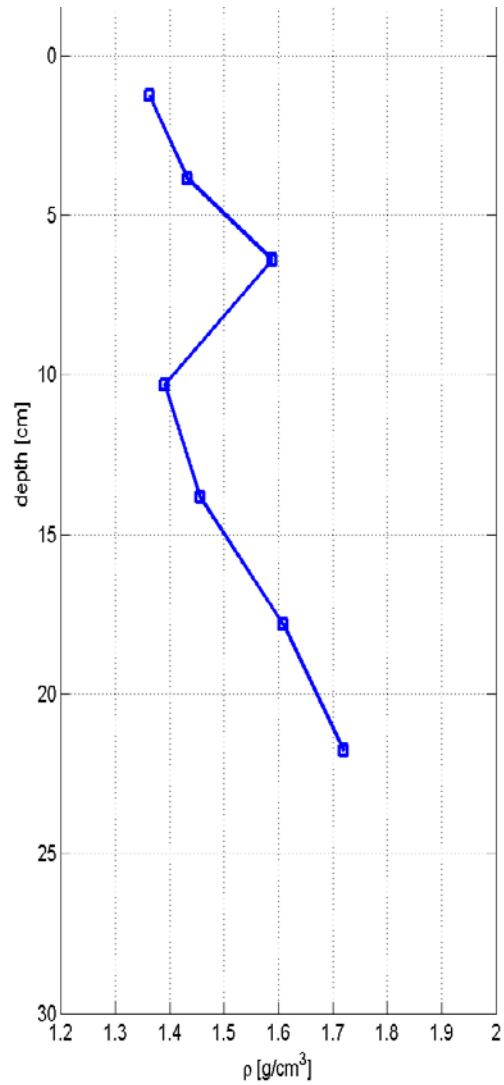
Table A-3a. Core Description, Station 3		
Photograph	**Description**	**Density Profile**
	Overlying water Surface sediment is light brown in color with a fluffy texture. Sediment throughout remainder of core is brownish-grey and black in color.	

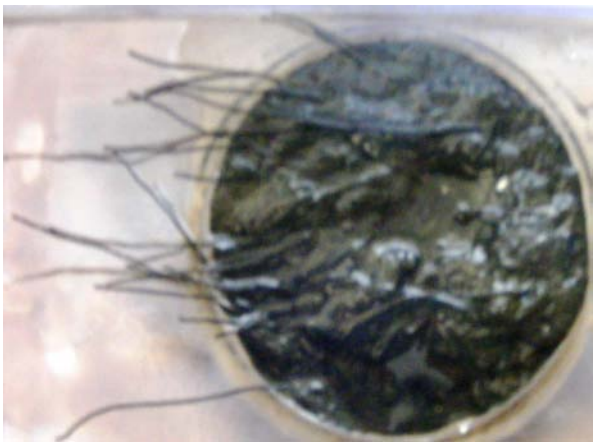
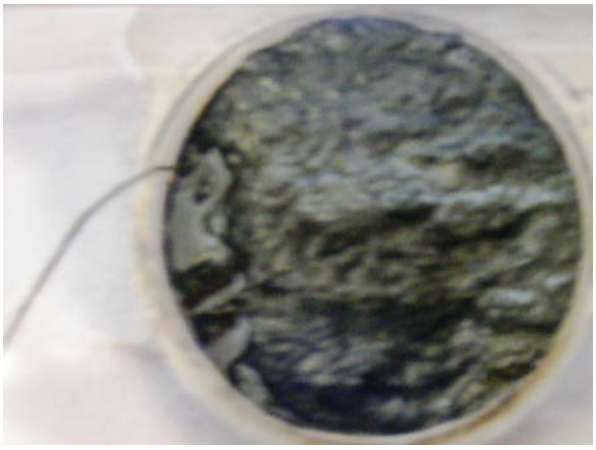
Table A-3b. Core Surface Photographs, Station 3			
Sample 1		**Sample 4**	
Sample 2		**Sample 5**	
Sample 3		**Sample 6**	

Table A-3b. Core Surface Photographs, Station 3 (cont.)	
Sample 7	

Table A-3c. Physical Sample Properties, Station 3								
Sample #	Depth (cm)	Bulk Density (g/cm^3)	d_{10} (μm)	d_{50} (μm)	d_{90} (μm)	% Sand	% Silt	% Clay
0	0.00		1.51	8.68	41.17	4.09	66.29	29.62
1	1.30	1.36	1.70	11.16	58.59	8.63	66.10	25.27
2	3.80	1.43	2.07	12.93	83.29	14.78	63.61	21.61
3	6.40	1.59	2.00	14.85	92.39	17.69	60.70	21.62
4	10.30	1.39	1.76	11.65	62.19	9.65	65.61	24.74
5	13.80	1.46	1.79	10.54	56.55	8.17	66.32	25.51
6	17.80	1.61	1.95	14.06	94.81	18.10	59.41	22.50
7	21.80	1.72	2.10	15.17	102.32	20.83	57.87	21.29

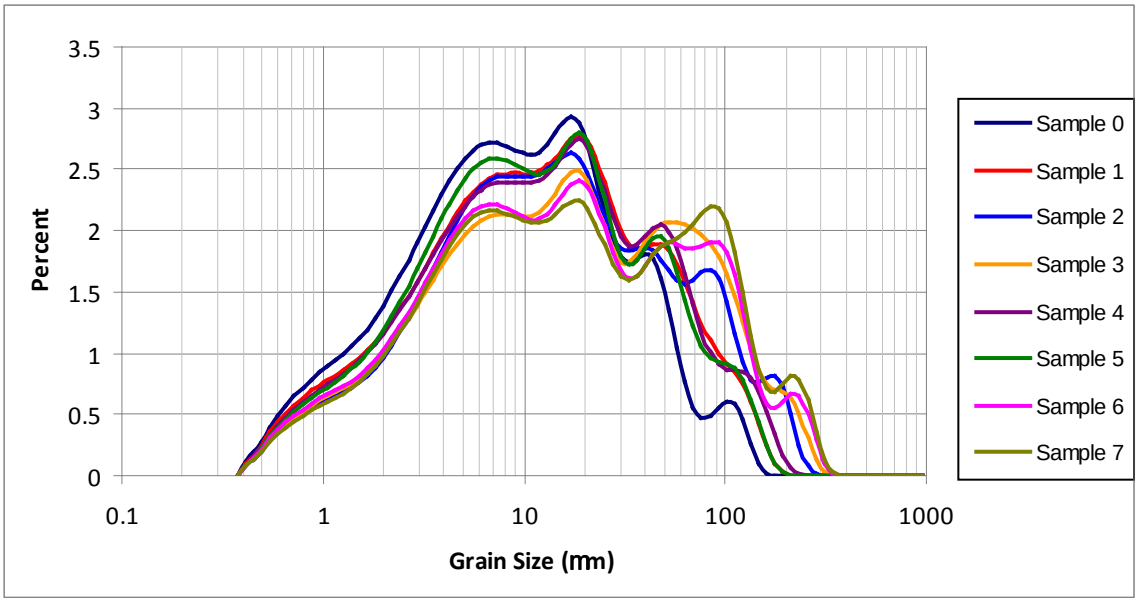


Figure A-3a. Grain size distributions for Station 3 physical samples.

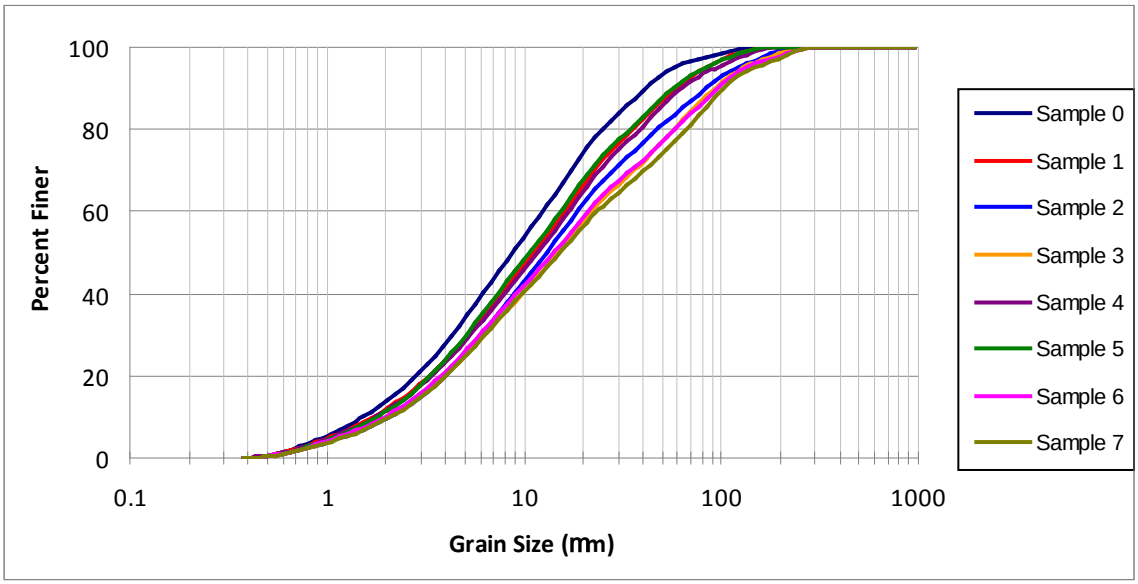


Figure A-3b. Cumulative grain size distributions for Station 3 physical samples.

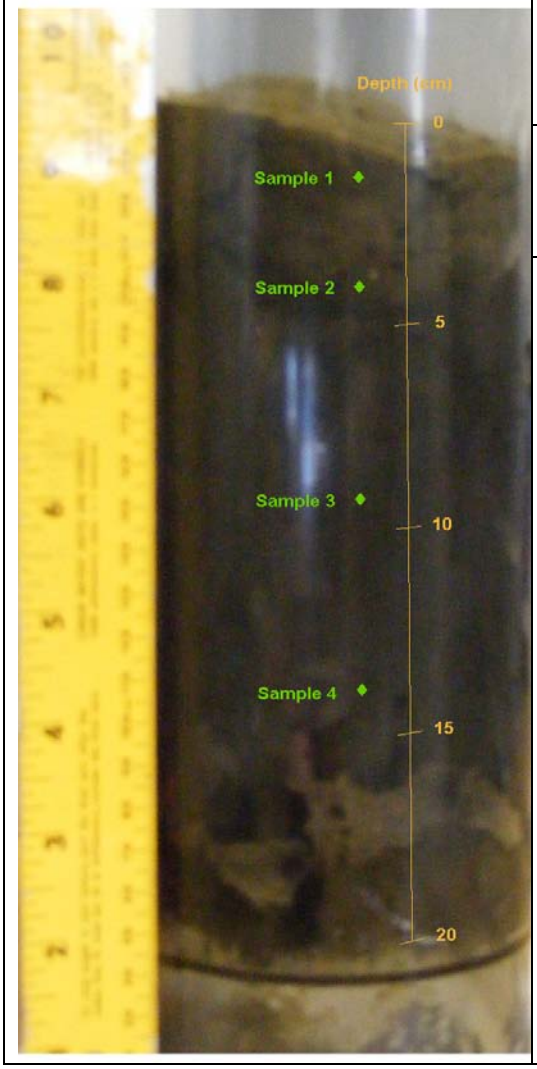
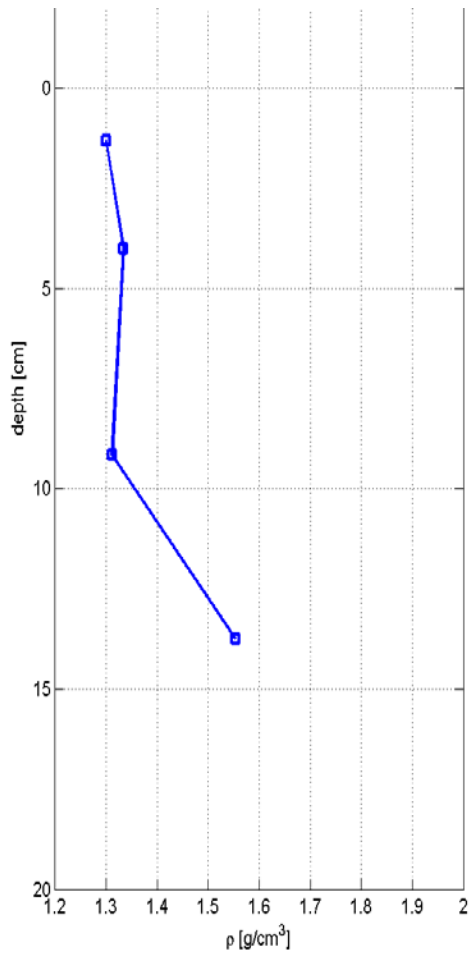
Table A- 4a. Core Description, Station 4B		
Photograph	**Description**	**Density Profile**
	Overlying Water Surface sediment is light brown in color and has a fluffy texture (2-3cm thick) Sediment throughout remainder of core is dark grey in color. A large horizontal void (2 cm in length) is apparent 2-3cm above core bottom.	

Table A 4b. Core Surface Photographs, Station 4B			
Sample 1		**Sample 3**	
Sample 2		**Sample 4**	

Table A-4c. Physical Sample Properties, Station 4B

Sample #	Depth (cm)	Bulk Density (g/cm^3)	d_{10} (μm)	d_{50} (μm)	d_{90} (μm)	% Sand	% Silt	% Clay
0	0.00		1.82	9.83	45.82	5.11	69.21	25.68
1	1.30	1.30	1.81	10.03	48.24	5.83	68.65	25.51
2	4.00	1.33	1.77	10.28	49.59	5.92	68.55	25.53
3	9.20	1.31	1.67	10.37	45.46	4.72	69.32	25.96
4	13.80	1.55	2.02	11.43	74.18	12.13	64.25	23.63

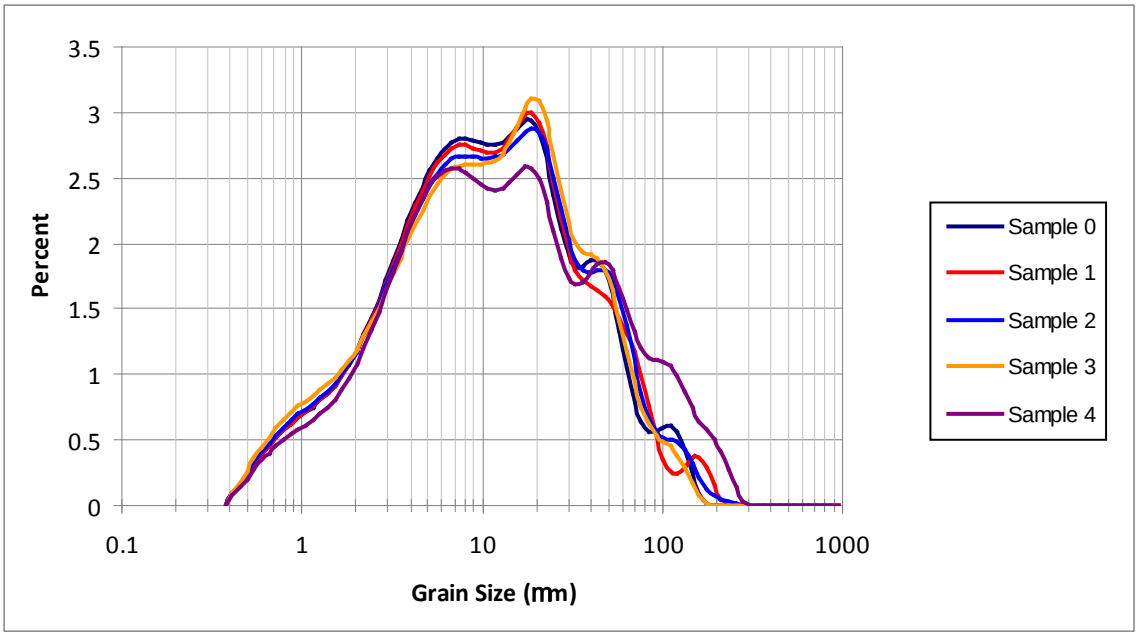


Figure A-4a. Grain size distributions for Station 4B physical samples.

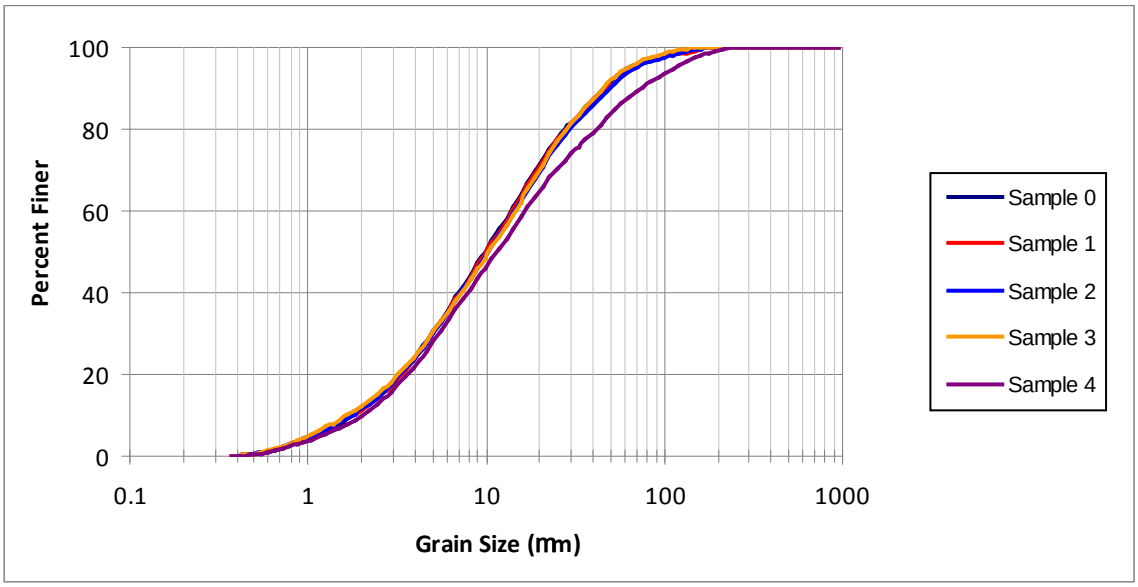


Figure A-4b. Cumulative grain size distributions for Station 4B physical samples.

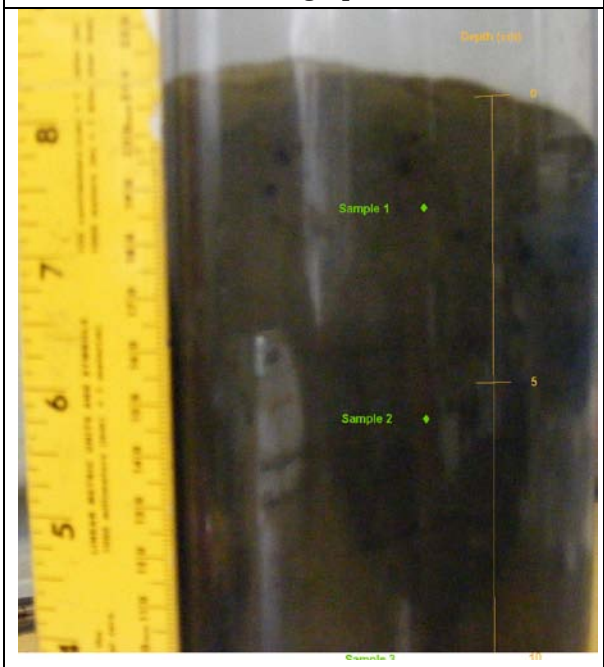
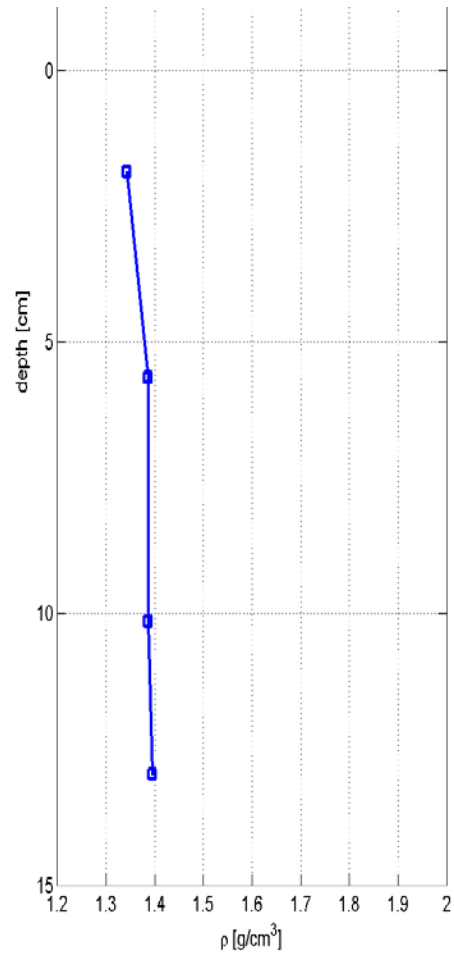
Table A-5a. Core Description, Station 5		
Photograph	**Description**	**Density Profile**
	Overlying Water Surface sediment is light brown and has a fluffy texture (1-2mm thick) Below surface layer and down to a depth of 4cm sediment is light grey in color. Sediment throughout remainder of core is dark grey to black in color.	

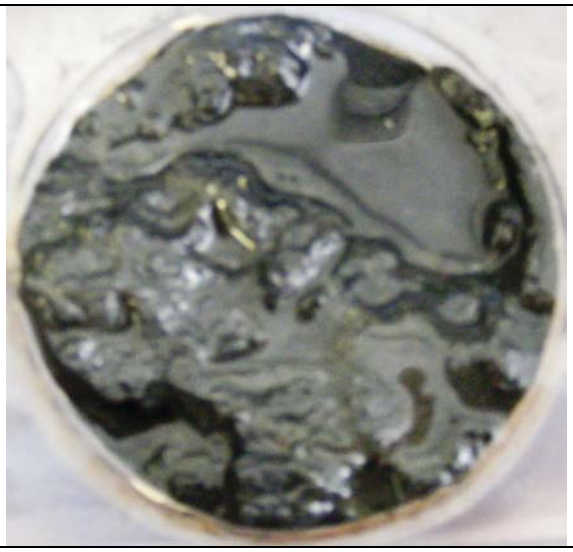
Table A-5b. Core Surface Photographs, Station 5			
Sample 1		**Sample 3**	
Sample 2		**Sample 4**	

Table A-5c. Physical Sample Properties, Station 5								
Sample #	Depth (cm)	Bulk Density (g/cm^3)	d_{10} (μm)	d_{50} (μm)	d_{90} (μm)	% Sand	% Silt	% Clay
0	0.00		1.83	12.13	64.01	10.15	65.92	23.93
1	1.90	1.34	1.79	11.24	60.54	9.28	65.70	25.02
2	5.70	1.39	1.83	11.38	65.98	10.62	64.64	24.73
3	10.10	1.39	1.91	11.32	57.97	8.21	67.77	24.02
4	12.90	1.39	1.79	10.09	54.76	7.62	66.19	26.19

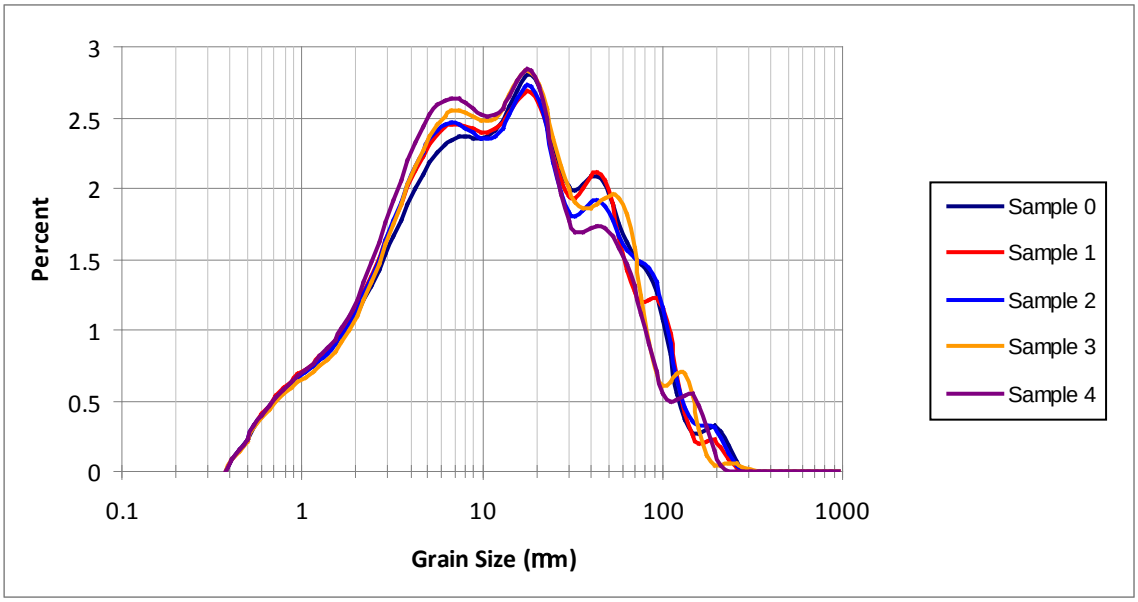


Figure A-5a. Grain size distributions for Station 5 physical samples.

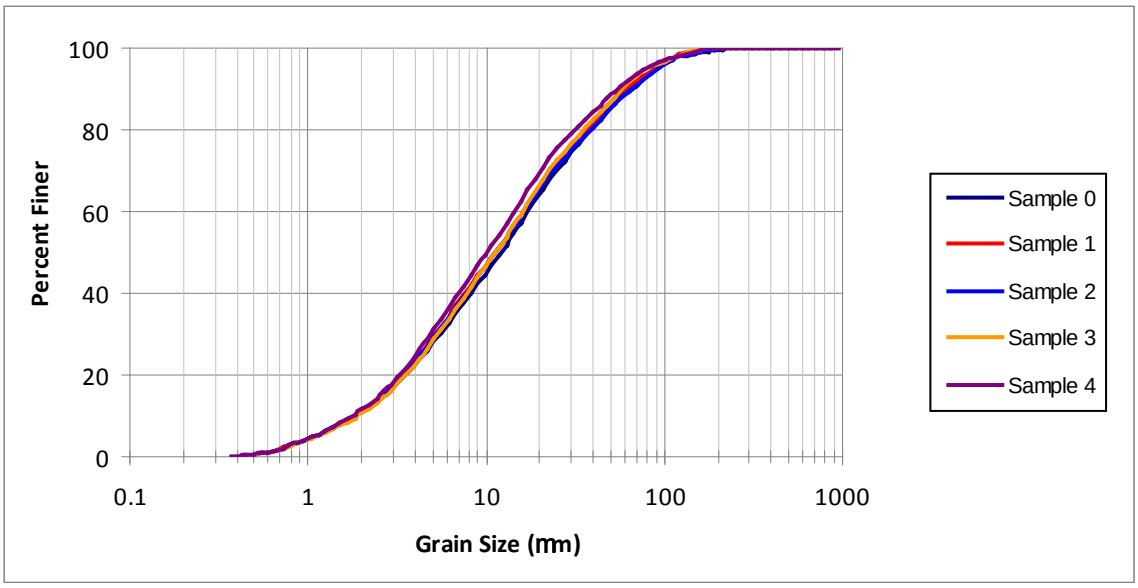


Figure A-5b. Cumulative grain size distributions for Station 5 physical samples.

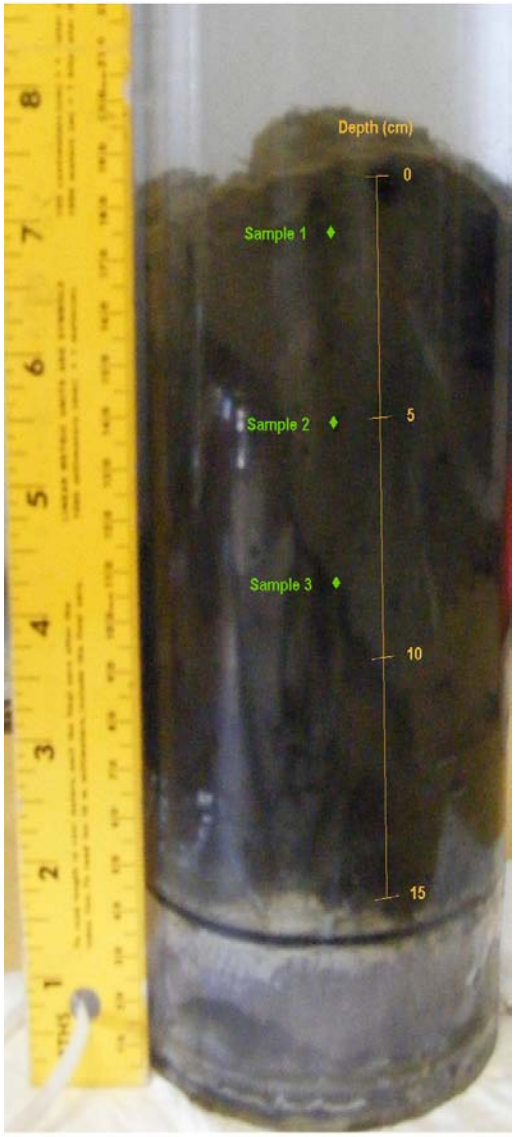
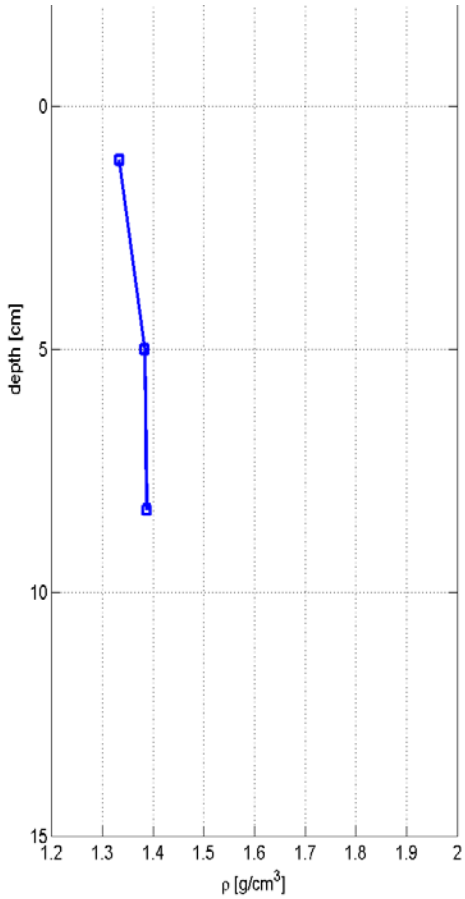
Table A-6a. Core Description, Station 6		
Photograph	**Description**	**Density Profile**
	Overlying Water Surface sediment is light brown in color with a fluffy texture. Sediment throughout the remainder of the core is light grey to black in color	

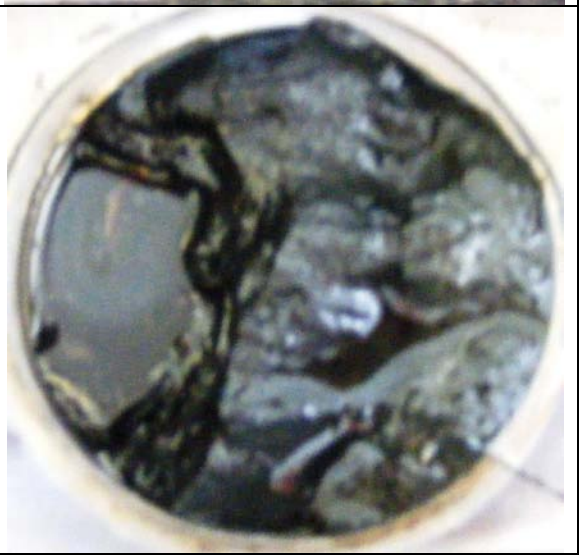
Table A-6b. Core Surface Photographs, Station 6	
Sample 1	
Sample 2	
Sample 3	

Table A-6c. Physical Sample Properties, Station 6								
Sample #	Depth (cm)	Bulk Density (g/cm^3)	d_{10} (μm)	d_{50} (μm)	d_{90} (μm)	% Sand	% Silt	% Clay
0	0.00		1.83	10.44	56.53	8.52	66.08	25.40
1	1.10	1.33	1.66	10.47	53.18	7.14	66.64	26.22
2	5.00	1.38	1.90	10.51	57.76	8.63	66.72	24.65
3	8.30	1.39	1.80	10.90	64.39	10.11	64.85	25.03

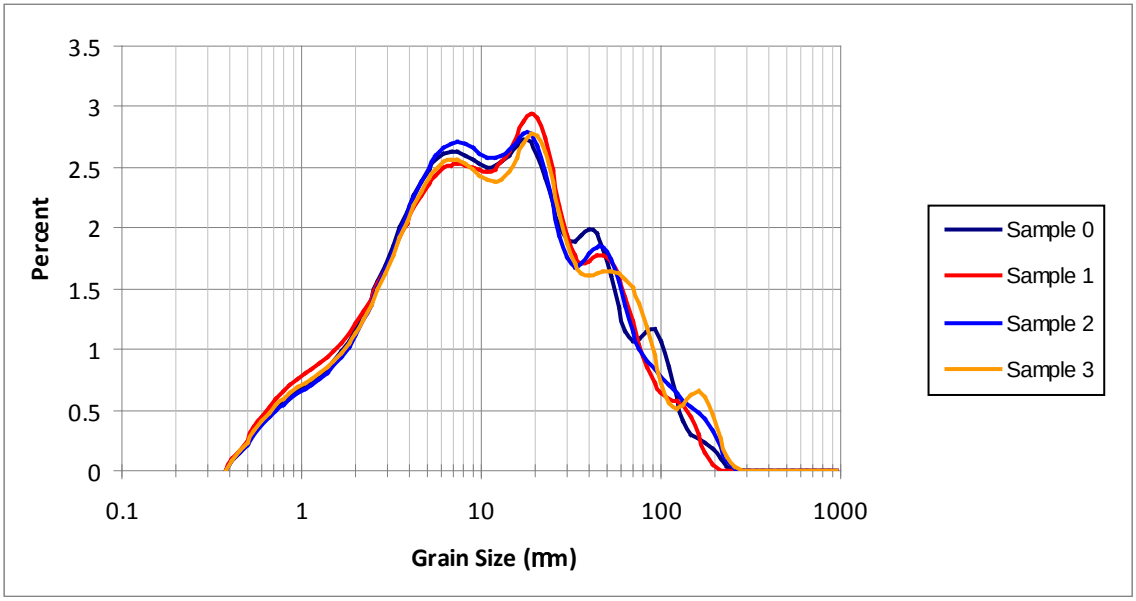


Figure A-6a. Grain size distributions for Station 6 physical samples.

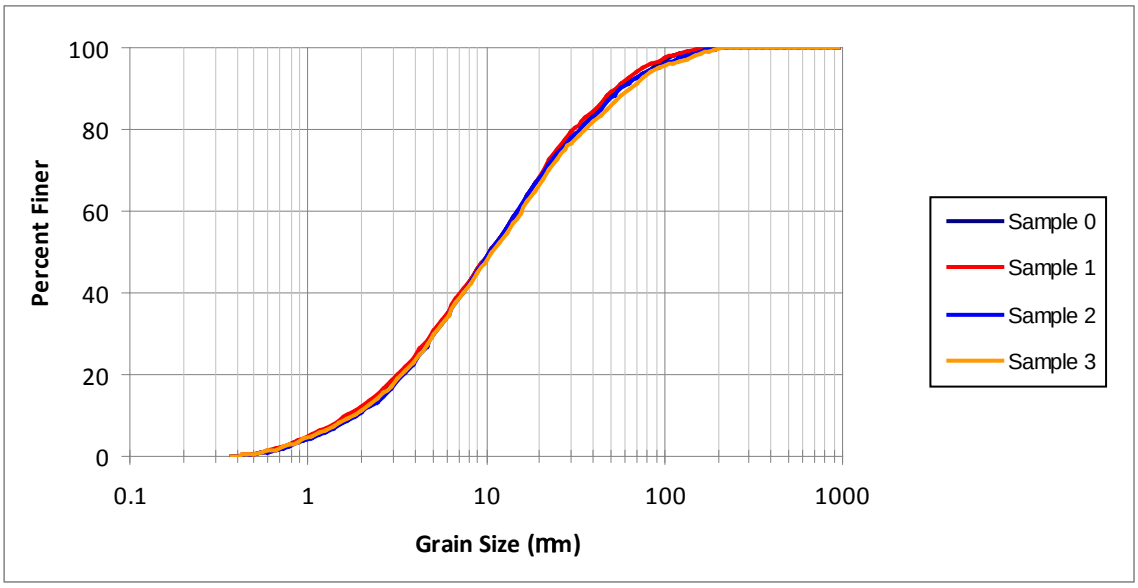


Figure A-6b. Cumulative grain size distributions for Station 6 physical samples.

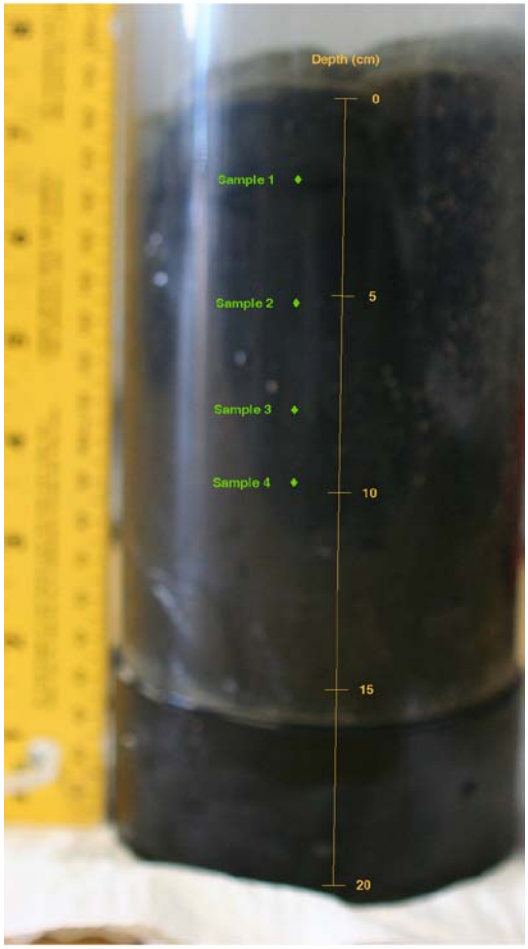
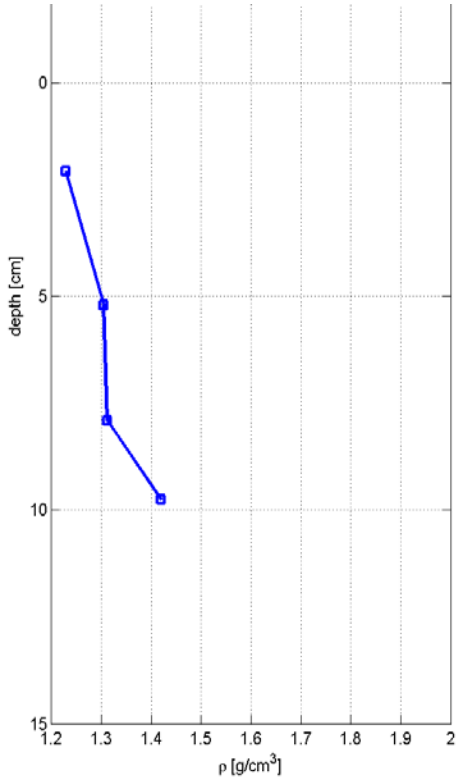
Table A-7a. Core Description, Station 7A		
Photograph	**Description**	**Density Profile**
	Overlying water Surface sediments (0.5cm thick) are light brown in color with a fluffy texture Sediments throughout the remainder of the core are dark grey in color. Some gas voids and cracks are evident at 2cm depth down core.	

Table A-7b. Core Surface Photographs, Station 7A			
Sample 1 **Shells were removed after picture and prior to sampling**		**Sample 3** **Shells were removed after picture and prior to sampling**	
Sample 2 **Shells were removed after picture and prior to sampling**		**Sample 4** **Shells were removed after picture and prior to sampling**	

Table A-7c. Physical Sample Properties, Station 7A								
Sample #	Depth (cm)	Bulk Density (g/cm^3)	d_{10} (μm)	d_{50} (μm)	d_{90} (μm)	% Sand	% Silt	% Clay
0	0.00		1.63	9.71	44.99	4.82	67.85	27.33
1	2.10	1.23	1.49	7.95	41.93	4.19	64.44	31.37
2	5.20	1.30	1.59	9.28	40.24	2.91	69.19	27.90
3	7.90	1.31	1.78	10.31	55.44	8.04	66.08	25.89
4	9.80	1.42	1.86	11.38	56.77	8.05	67.48	24.47

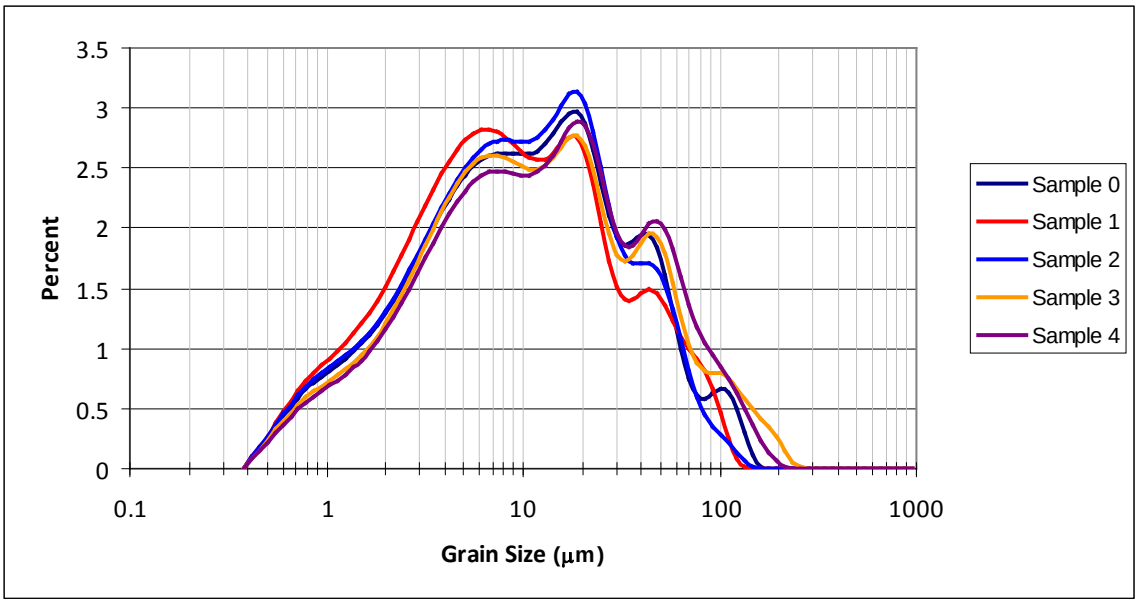


Figure A-7a. Grain size distributions for Station 7A physical samples.

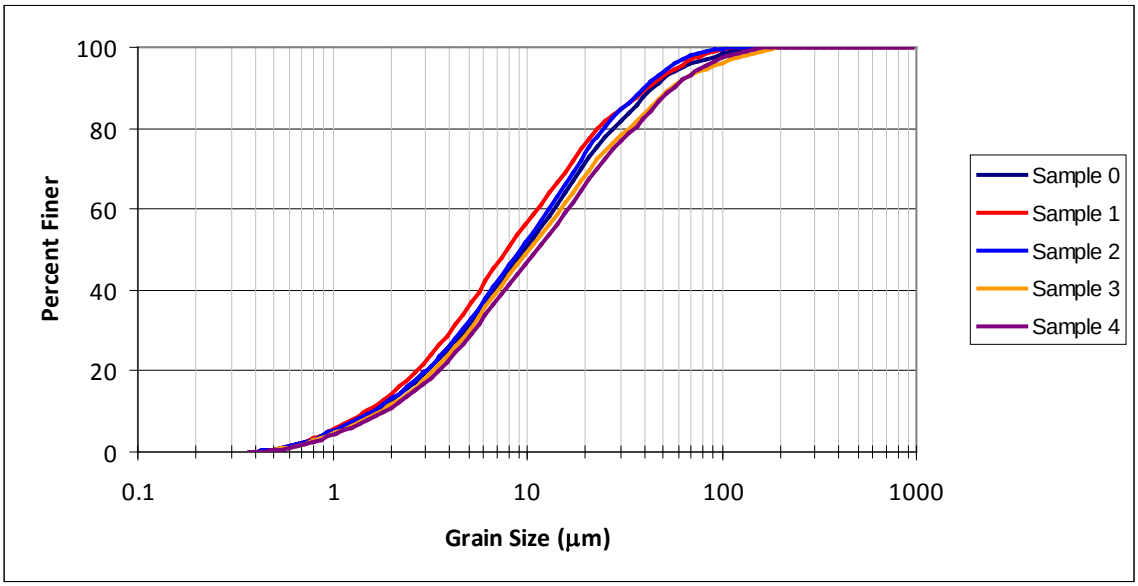


Figure A-7b. Cumulative grain size distributions for Station 7A physical samples.

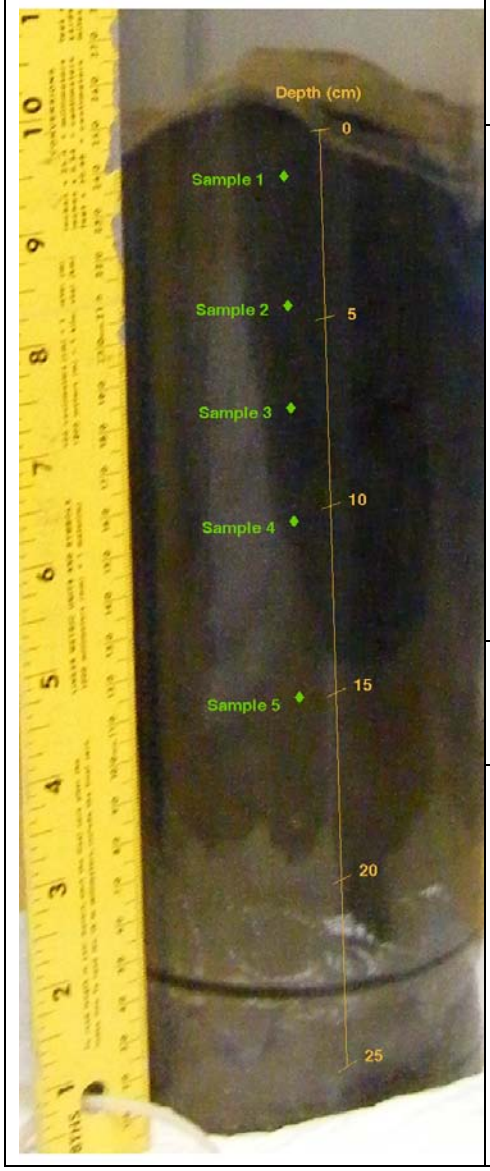
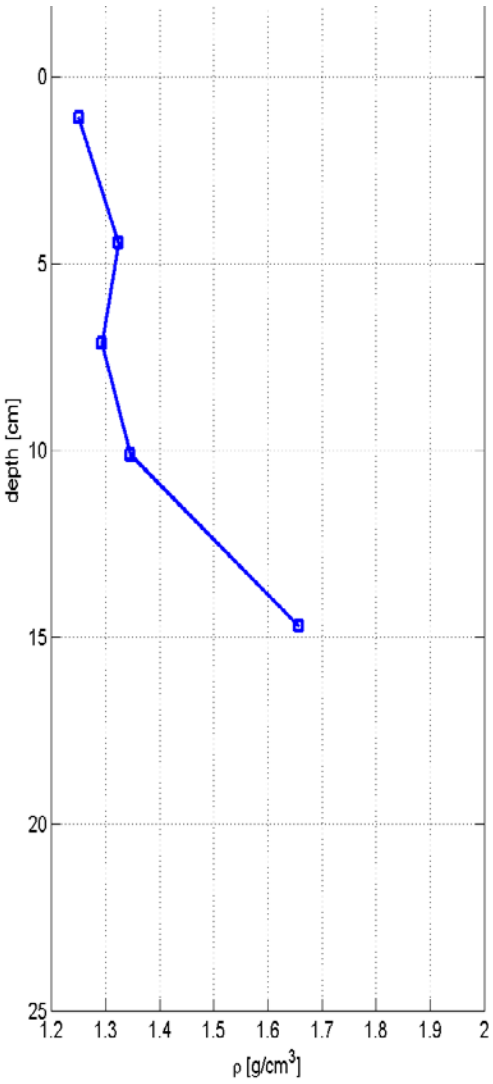
Table A-8a. Core Description, Station 7B		
Photograph	**Description**	**Density Profile**
	Overlying water Surface sediments are light brown in color with a fluffy texture. Some pieces of broken bivalve shells are visible at core surface. Below the surface layer, and down to a depth of 14-16cm, the sediment is predominately dark grey to black in color. A 1cm wide gas void is visible at a depth of 6cm down core. Below 16cm and down to the bottom of the core the sediment is predominately light grey and brown in color.	

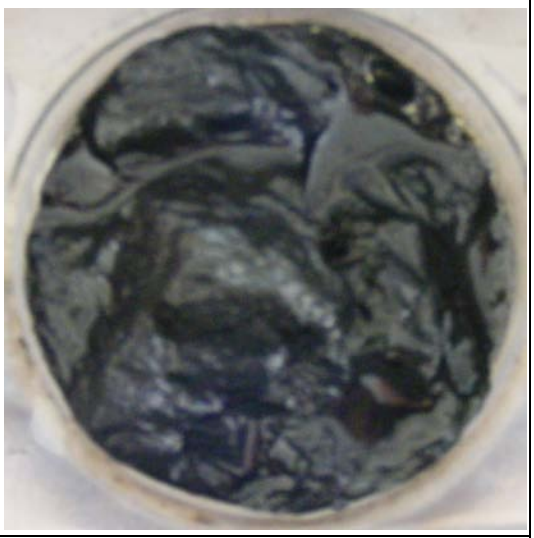
Table A-8b. Core Surface Photographs, Station 7B			
Sample 1 **Shells were removed after picture and prior to sampling**		**Sample 3**	
Sample 2		**Sample 5**	

Table A-8c. Physical Sample Properties, Station 7B

Sample #	Depth (cm)	Bulk Density (g/cm^3)	d_{10} (μm)	d_{50} (μm)	d_{90} (μm)	% Sand	% Silt	% Clay
0	0.00		1.73	10.25	49.21	5.26	68.56	26.18
1	1.10	1.25	1.65	8.87	45.41	4.40	67.23	28.38
2	4.50	1.32	1.69	9.37	47.29	5.49	66.99	27.52
3	7.10	1.29	1.72	9.33	48.53	4.96	67.86	27.18
4	10.10	1.34	1.92	12.13	58.46	8.68	67.81	23.51
5	14.70	1.66	2.57	25.25	95.52	24.13	59.66	16.22

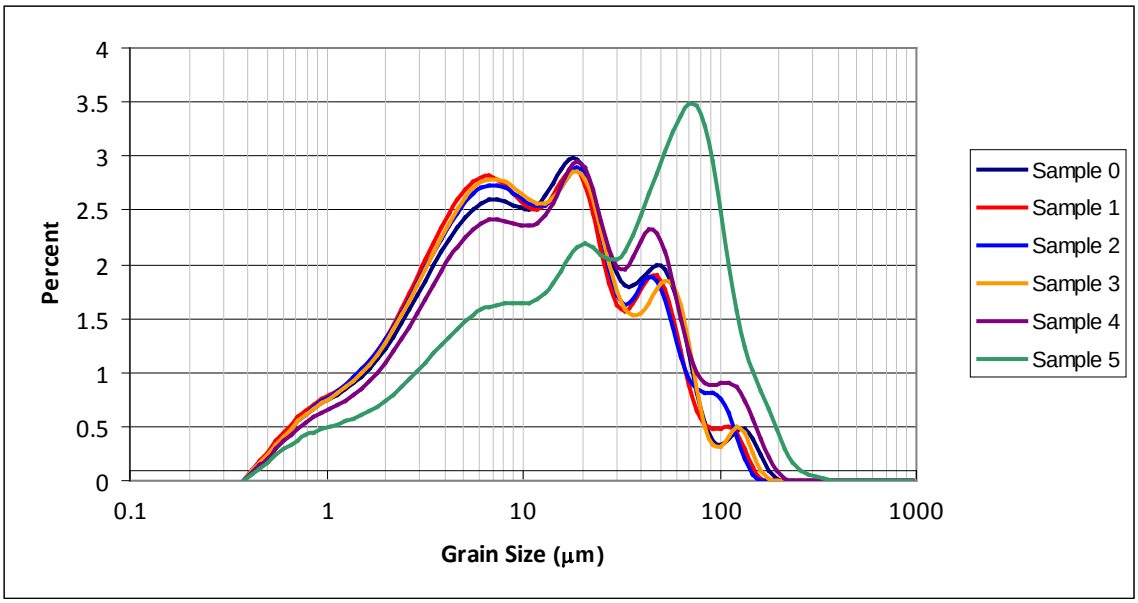


Figure A-8a. Grain size distributions for Station 7B physical samples.

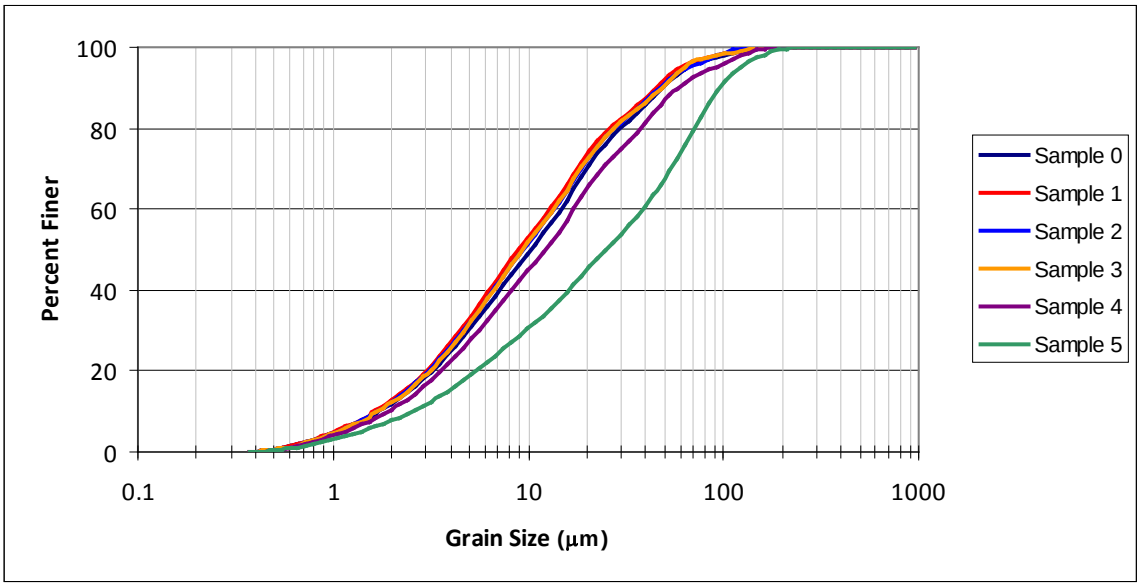


Figure A-8b. Cumulative grain size distributions for Station 7B physical samples.

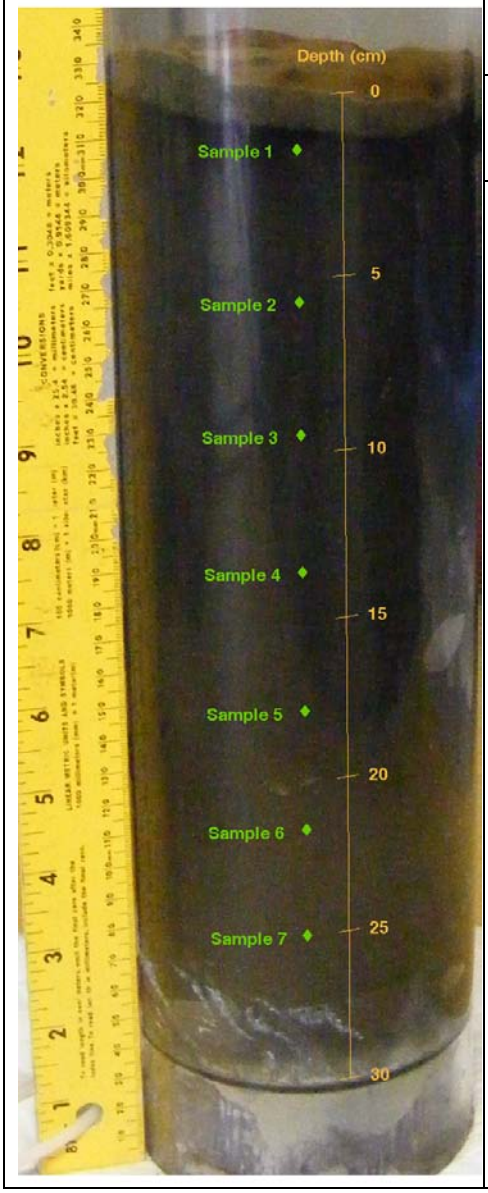
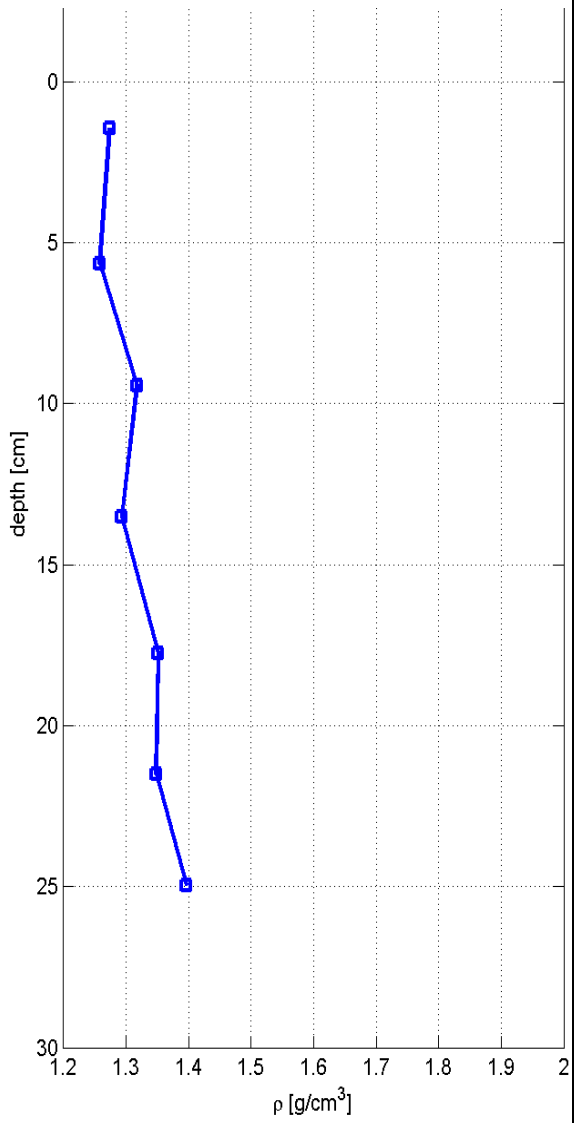
Table A-9a. Core Description, Station 8A		
Photograph	**Description**	**Density Profile**
	Overlying water The surface sediments and down to 1cm is predominately light brown in color with a fluffy texture. Sediment throughout the remainder of the core is dark grey in color. Small cracks and air voids are apparent at many depths throughout the core.	

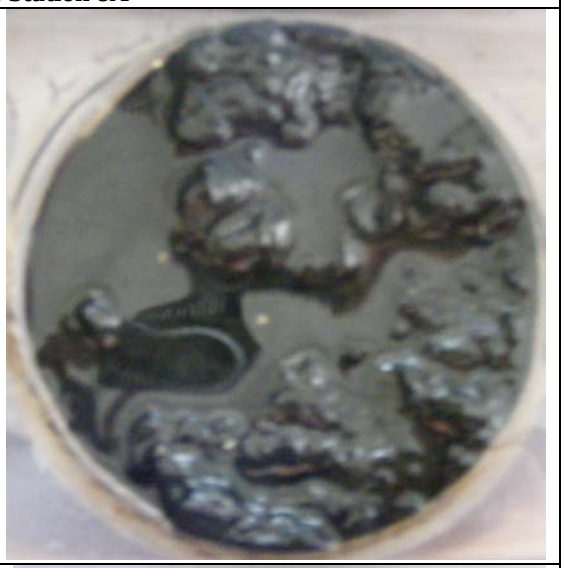
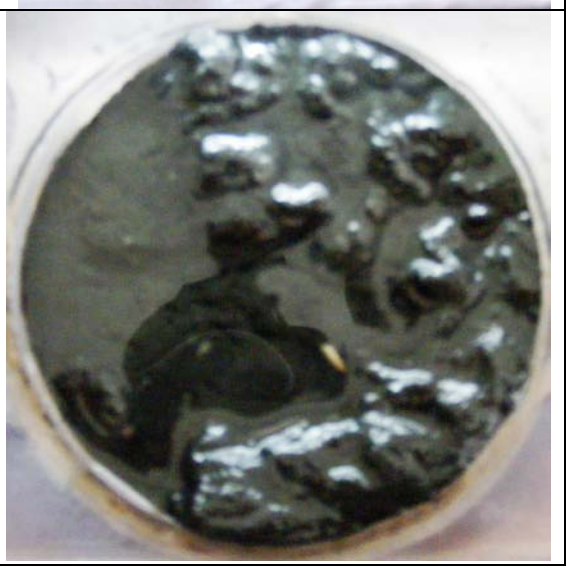
Table A-9b. Core Surface Photographs, Station 8A			
Sample 1		**Sample 4**	
Sample 2		**Sample 5**	
Sample 3		**Sample 6**	

Table A-9b. Core Surface Photographs, Station 8A (cont.)	
Sample 7	

Table A-9c. Physical Sample Properties, Station 8A								
Sample #	Depth (cm)	Bulk Density (g/cm^3)	d_{10} (μm)	d_{50} (μm)	d_{90} (μm)	% Sand	% Silt	% Clay
0	0.00		1.89	12.03	51.21	6.69	70.19	23.11
1	1.50	1.27	1.77	10.74	44.50	4.17	70.64	25.19
2	5.70	1.23	1.85	10.36	50.19	6.45	68.37	25.18
3	9.50	1.32	1.80	11.15	52.24	7.12	68.04	24.84
4	13.50	1.29	1.80	11.18	50.97	6.40	68.89	24.71
5	17.80	1.35	2.05	10.40	47.55	5.24	71.28	23.48
6	21.50	1.35	1.72	10.62	54.91	7.61	66.45	25.95
7	25.00	1.40	1.97	12.75	64.33	10.23	67.44	22.33

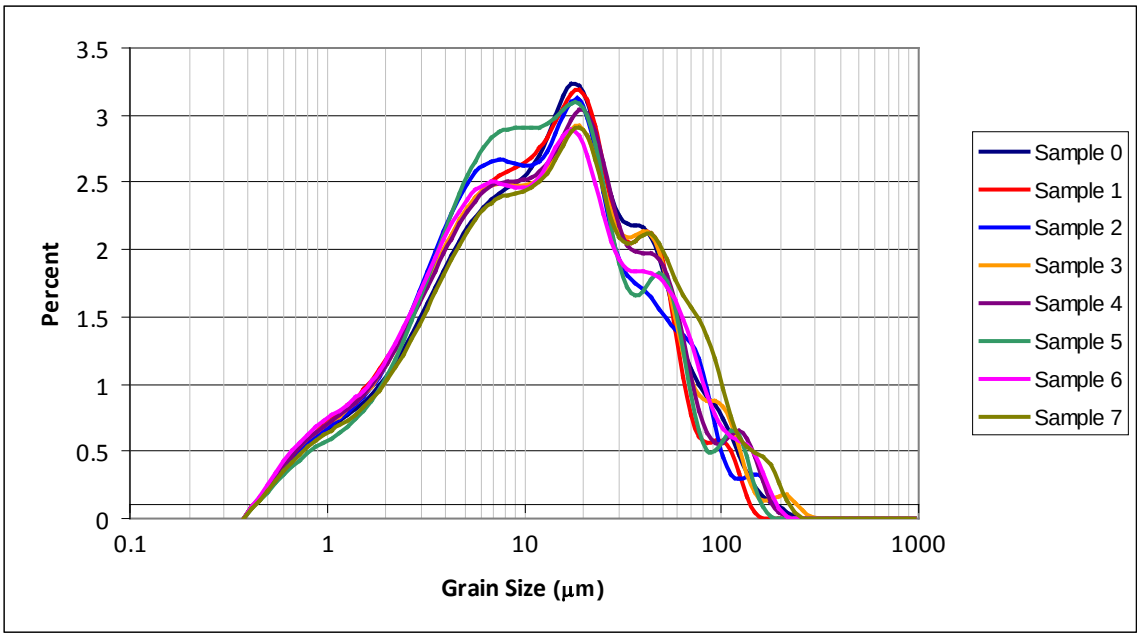


Figure A-9a. Grain size distributions for Station 8A physical samples.

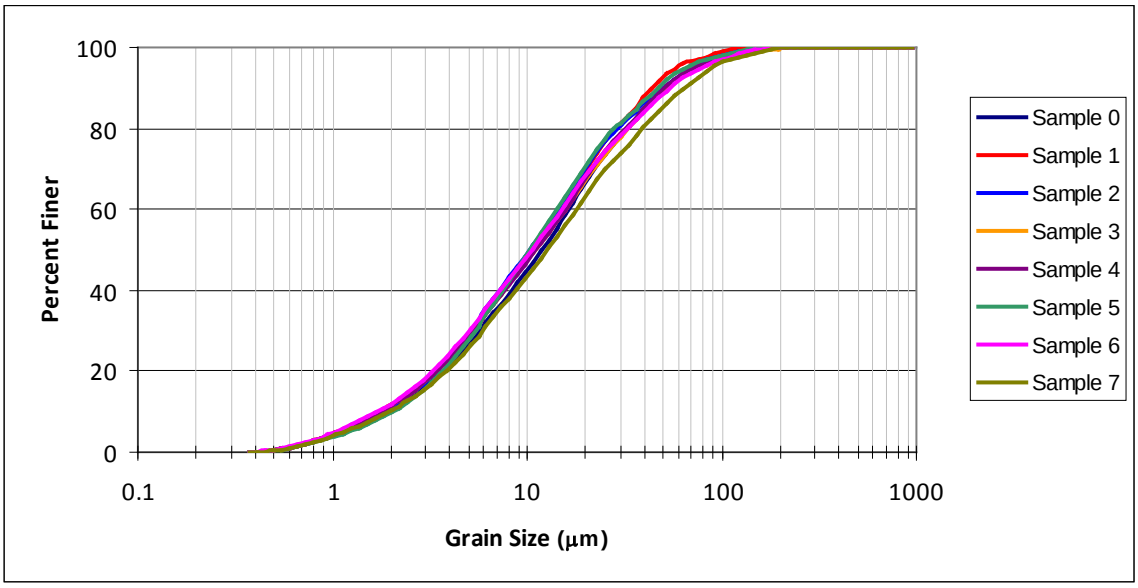


Figure A-9b. Cumulative grain size distributions for Station 8A physical samples.

Table A-10a. Core Description, Station 8B

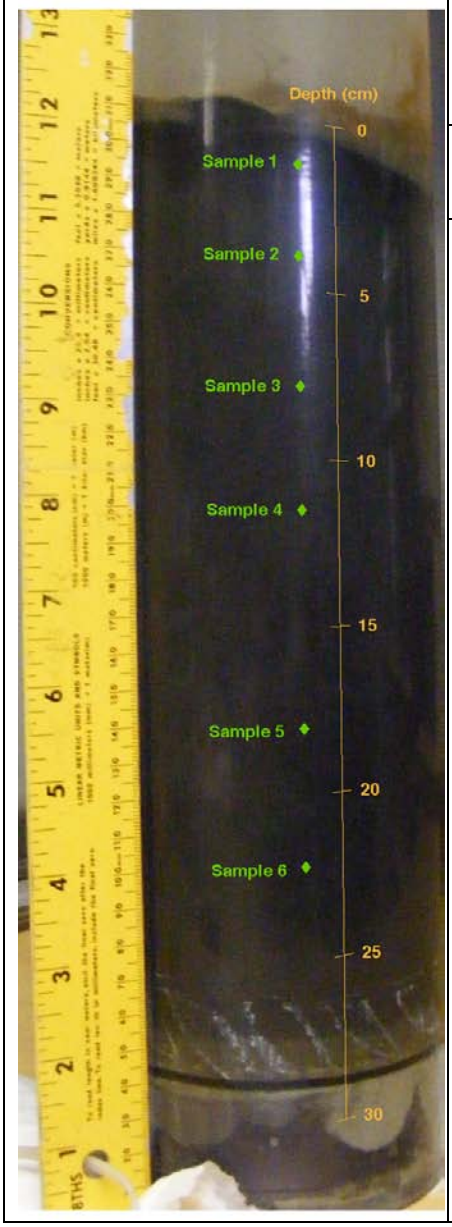
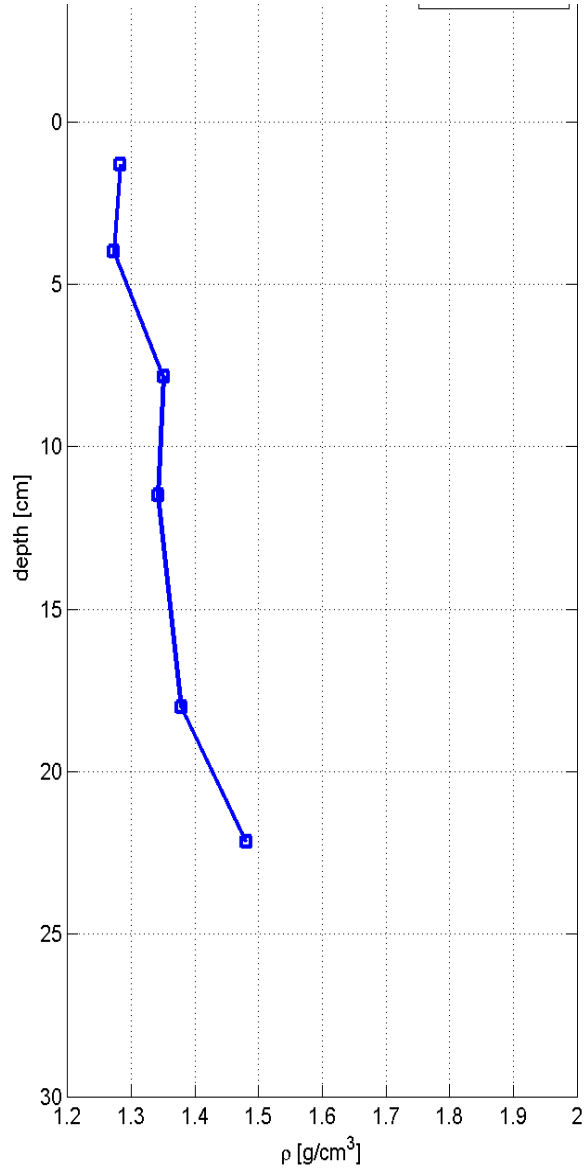
Photograph	Description	Density Profile
	Overlying water Surface sediments and down to 0.5cm are predominately light brown in color with a fluffy texture. Sediment throughout the remainder of the core is dark grey in color. No large cracks or gas voids are apparent.	

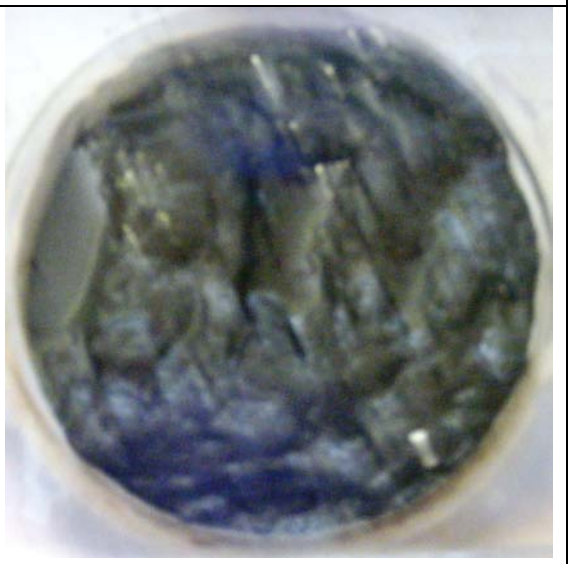
Table A-10b. Core Surface Photographs, Station 8B			
Sample 1		**Sample 4**	
Sample 2		**Sample 5**	
Sample 3		**Sample 6**	

Table A-10c. Physical Sample Properties, Station 8B								
Sample #	Depth (cm)	Bulk Density (g/cm^3)	d_{10} (µm)	d_{50} (µm)	d_{90} (µm)	% Sand	% Silt	% Clay
0	0.00		1.96	11.02	50.95	5.97	70.18	23.85
1	1.30	1.28	1.76	11.14	47.52	4.96	70.37	24.67
2	4.00	1.27	1.67	10.11	45.60	4.96	68.71	26.33
3	7.80	1.35	1.77	10.55	51.03	6.32	68.30	25.38
4	11.50	1.34	1.77	10.31	52.14	6.95	67.07	25.99
5	18.00	1.38	1.84	10.25	51.84	6.69	68.06	25.25
6	22.10	1.48	1.93	10.51	55.49	7.90	67.80	24.30

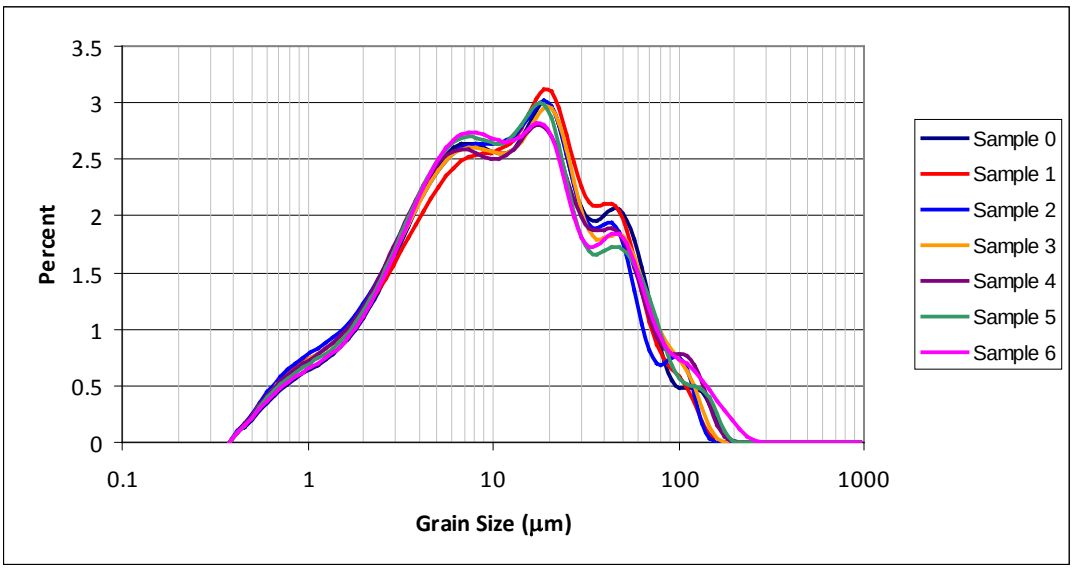


Figure A-10a. Grain size distributions for Station 8B physical samples.

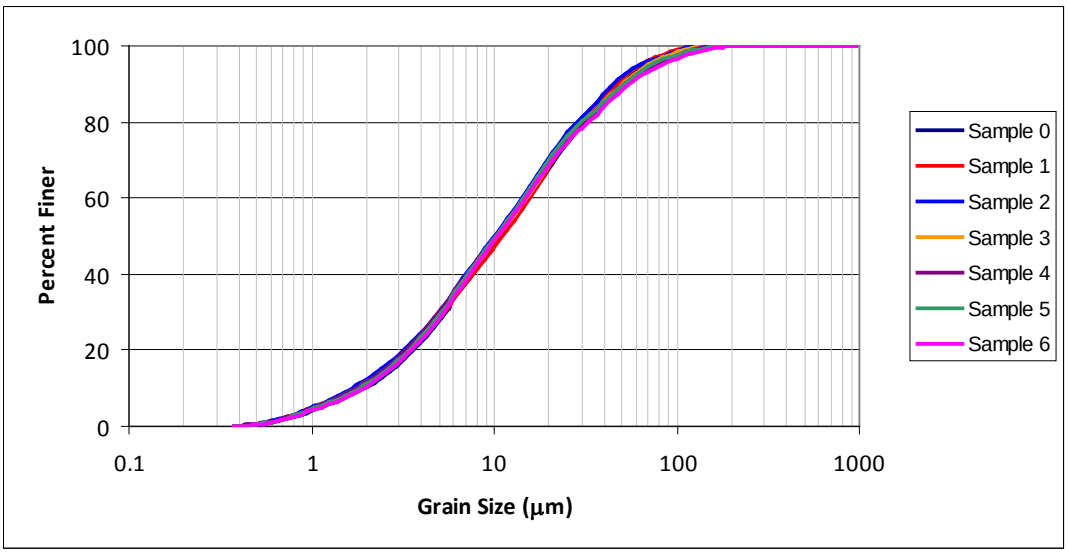


Figure A-10b. Cumulative grain size distributions for Station 8B physical samples

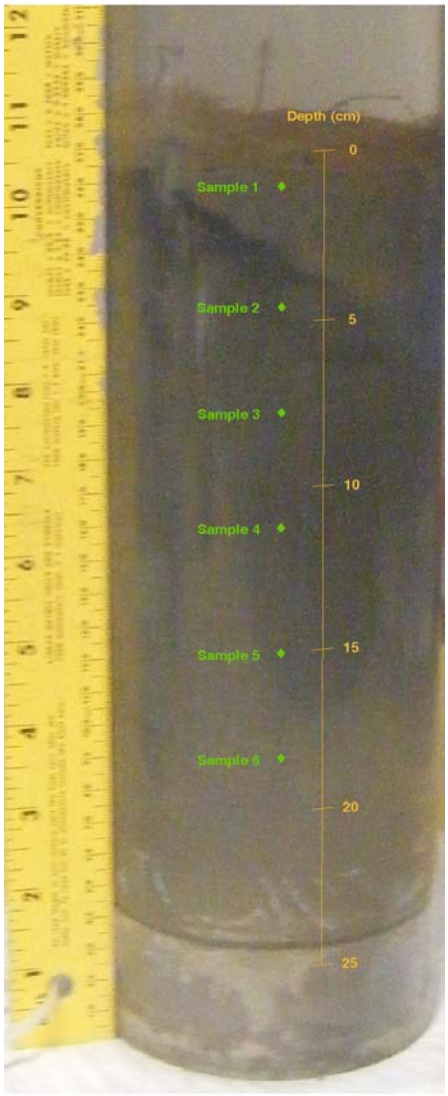
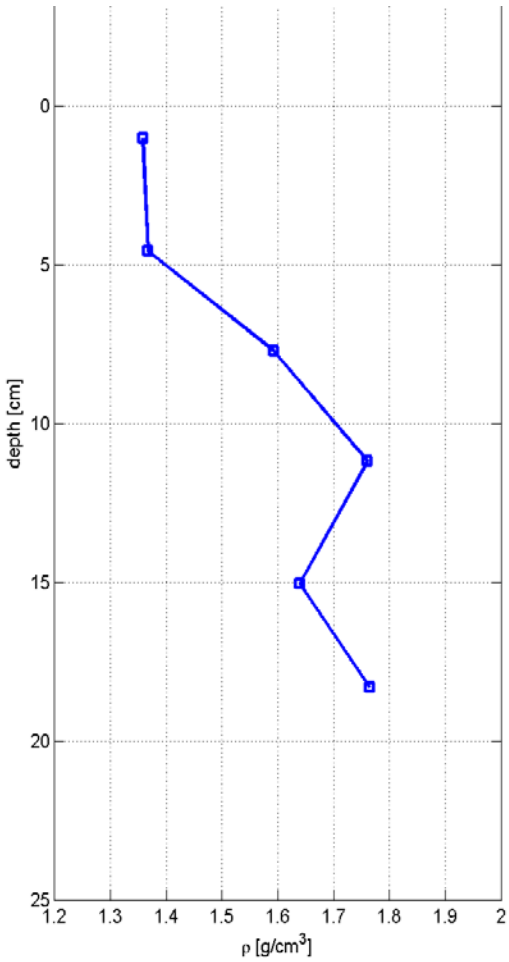
Table A-11a. Core Description, Station 9		
Photograph	**Description**	**Density Profile**
	Overlying water Surface sediments are predominately light brown in color with a fluffy texture. Plant/root-like material is visible at the core surface. Below the surface and down to a depth of 3cm the sediment is light grey to brown in color. Sediment throughout the remainder of the core is dark grey in color.	

Table A-11b. Core Surface Photographs, Station 9			
Sample 1		**Sample 4**	
Sample 2		**Sample 5**	
Sample 3		**Sample 6**	

Table A-11c. Physical Sample Properties, Station 9								
Sample #	Depth (cm)	Bulk Density (g/cm^3)	d_{10} (μm)	d_{50} (μm)	d_{90} (μm)	% Sand	% Silt	% Clay
0	0.00		2.09	13.57	81.64	14.76	63.37	21.86
1	1.00	1.36	2.11	13.71	79.96	14.30	64.15	21.55
2	4.50	1.37	1.68	11.02	61.46	9.41	64.90	25.69
3	7.70	1.59	2.43	18.52	99.24	20.75	61.13	18.12
4	11.20	1.76	3.29	35.91	137.16	35.41	51.50	13.09
5	15.00	1.64	3.06	33.12	130.70	33.57	52.56	13.87
6	18.30	1.76	2.79	25.98	117.94	29.62	54.76	15.62

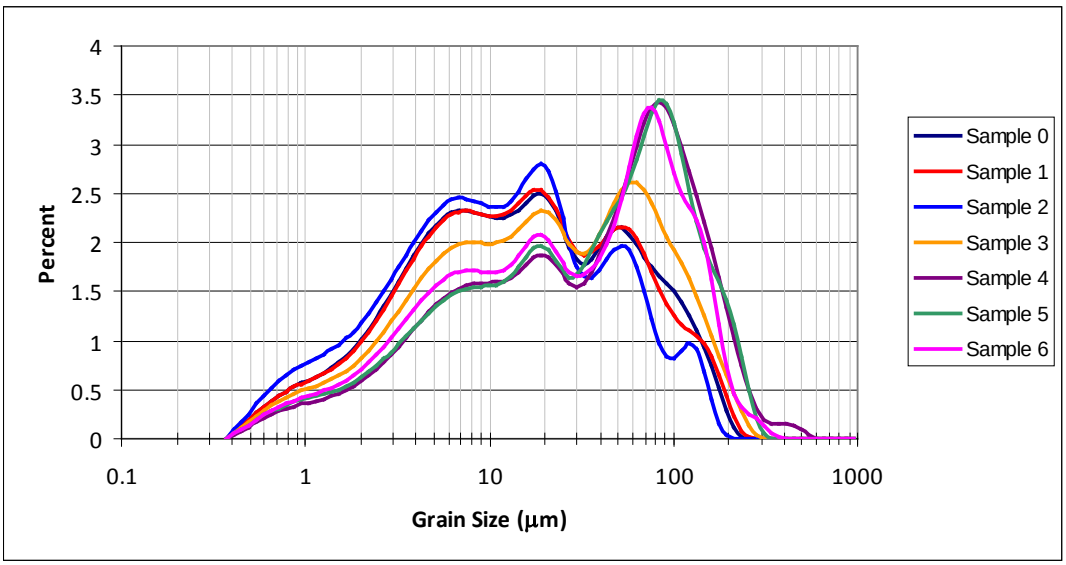


Figure A-11a. Grain size distributions for Station 9 physical samples.

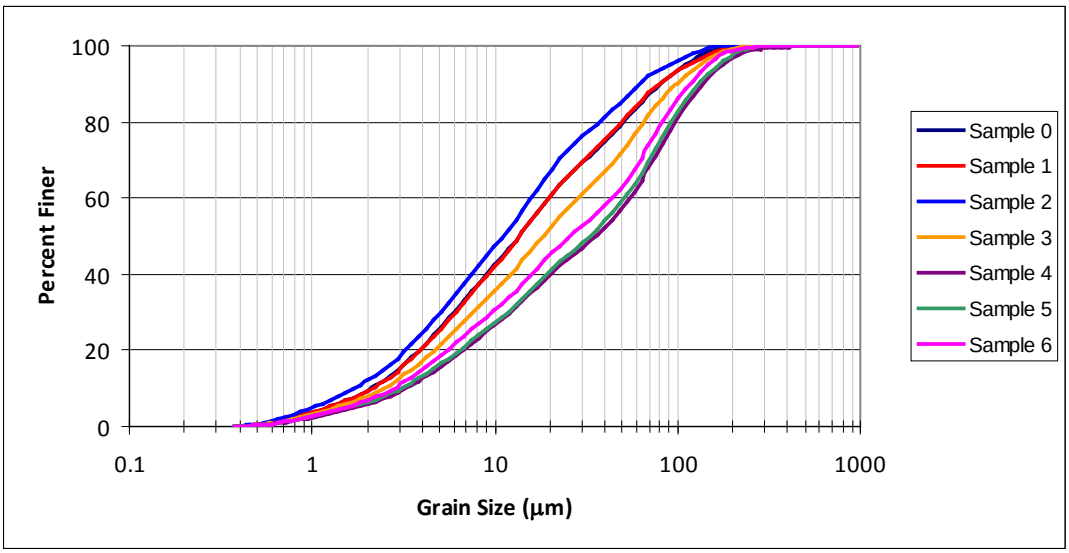


Figure A-11b. Cumulative grain size distributions for Station 9 physical samples.

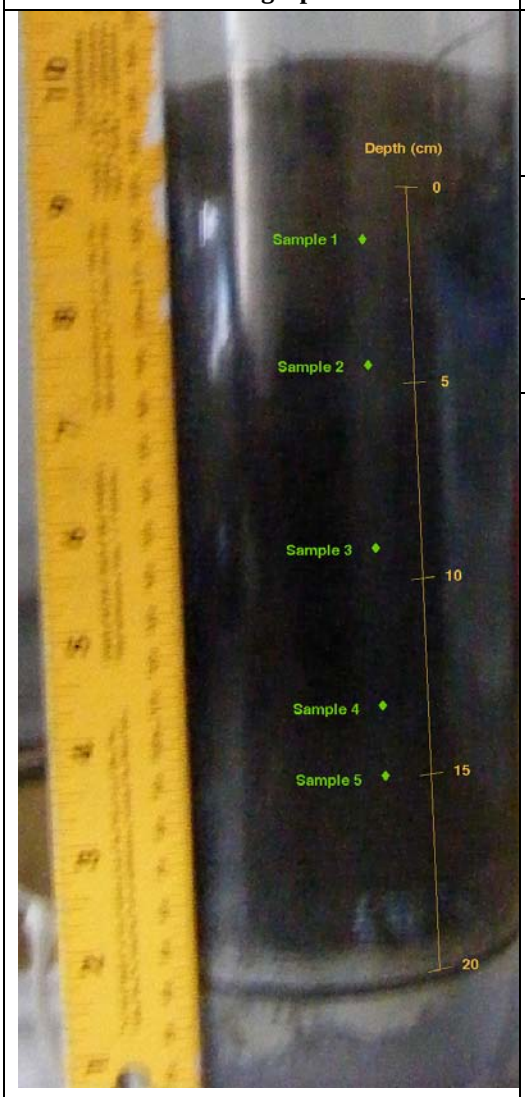
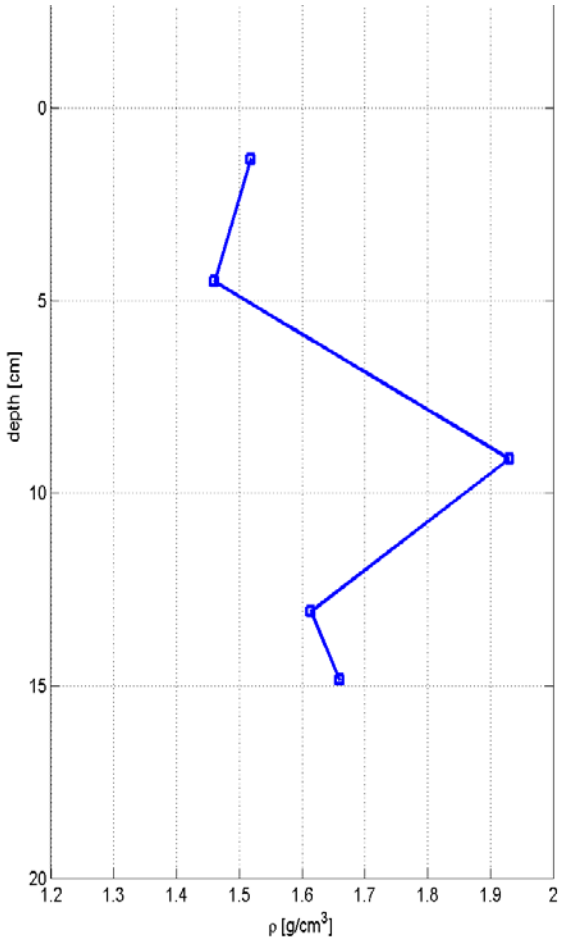
Table A-12a. Core Description, Station 10		
Photograph	**Description**	**Density Profile**
	Overlying water Surface sediments are predominately light brown in color with a fluffy texture. Plant material is visible at the core surface Below the surface and down to a depth of 4cm the sediment is light grey in color. Sediment throughout the remainder of the core is dark grey in color.	

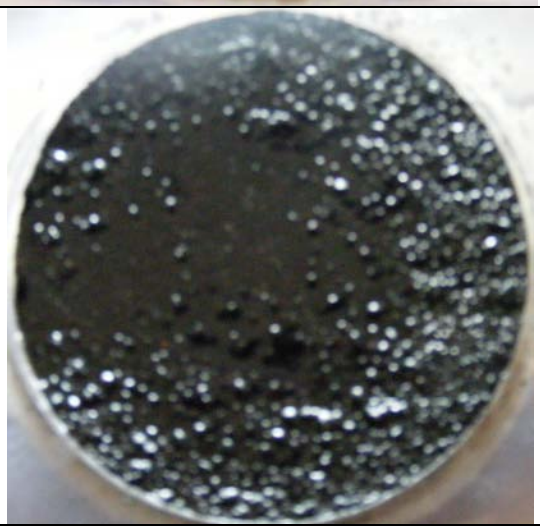
Table A-12b. Core Surface Photographs, Station 10			
Sample 1		**Sample 4**	
Sample 2		**Sample 5**	
Sample 3 **This region of the core is dominated by small black granular sediment (possibly coal).** **No cohesive behavior observed.**			

Table A-12c. Physical Sample Properties, Station 10								
Sample #	Depth (cm)	Bulk Density (g/cm^3)	d_{10} (μm)	d_{50} (μm)	d_{90} (μm)	% Sand	% Silt	% Clay
0	0.00		2.59	14.96	104.40	18.13	63.76	18.10
1	1.30	1.52	1.86	12.84	107.84	17.75	58.71	23.54
2	4.50	1.46	1.83	12.02	93.53	15.43	60.16	24.41
3	9.10	1.93	1.94	15.16	41.88	0.44	79.89	19.67
4	13.10	1.61	2.44	16.22	138.20	22.61	58.38	19.00
5	14.80	1.66	2.36	17.46	189.53	27.04	53.88	19.08

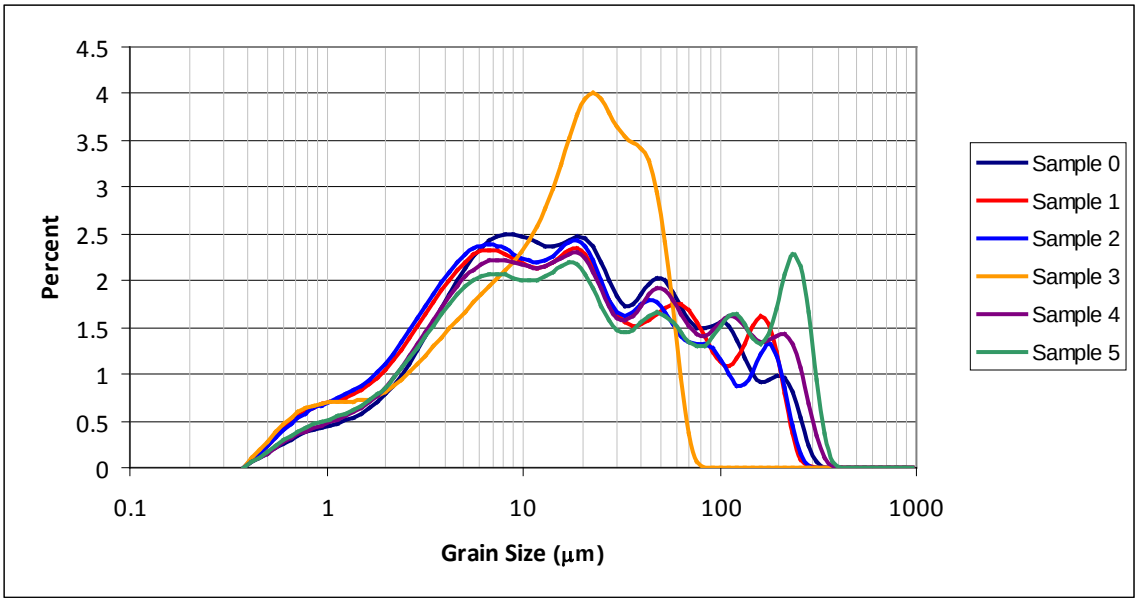


Figure A-12a. Grain size distributions for Station 10 physical samples.

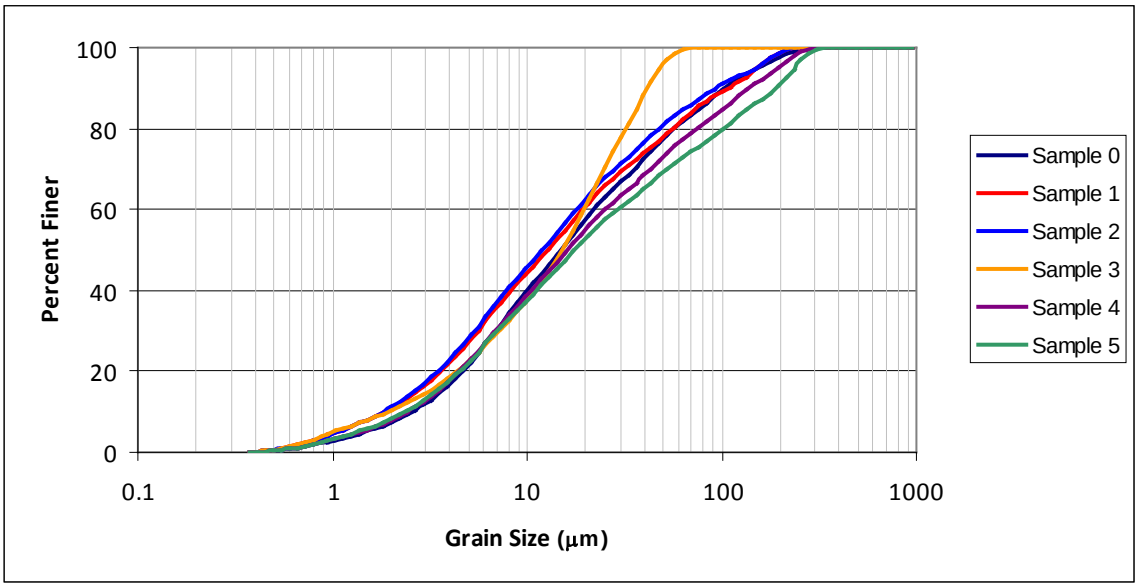


Figure A-12b. Cumulative grain size distributions for Station 10 physical samples.

Appendix B. Sedflume Erosion Rate Analysis for Individual Stations

This Appendix contains results of Sedflume erosion rate analysis. Erosion rate vs depth plots, which present sediment layers that were identified based on density, grain size and erosion rate data are provide for all stations. Erosion Rate vs Shear Stress plots are presented for each identified layer; along with Erosion Rate vs Density plots for those layers that showed a correlation to density.

Station 1

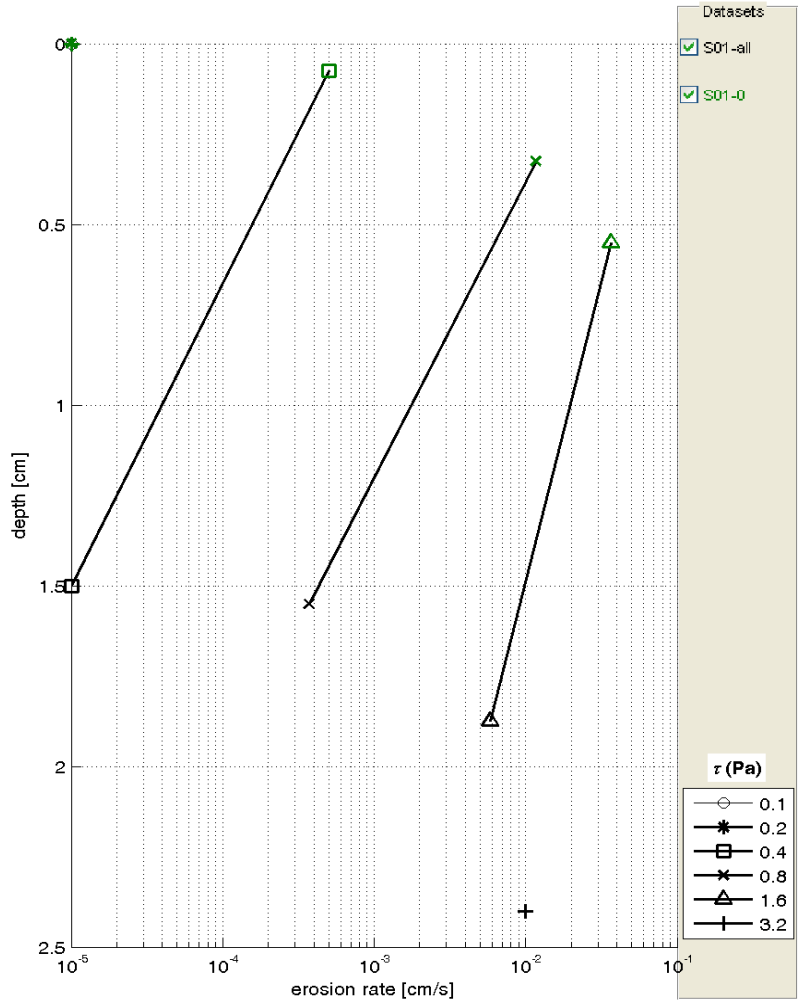


Figure B-1. Erosion rate versus depth and applied shear stress for Station 1. Layer 0 (green) is composed of surface material that was eroded in the first sequence of erosion tests. Core failure occurred after the second sequence so no further layers were identified.

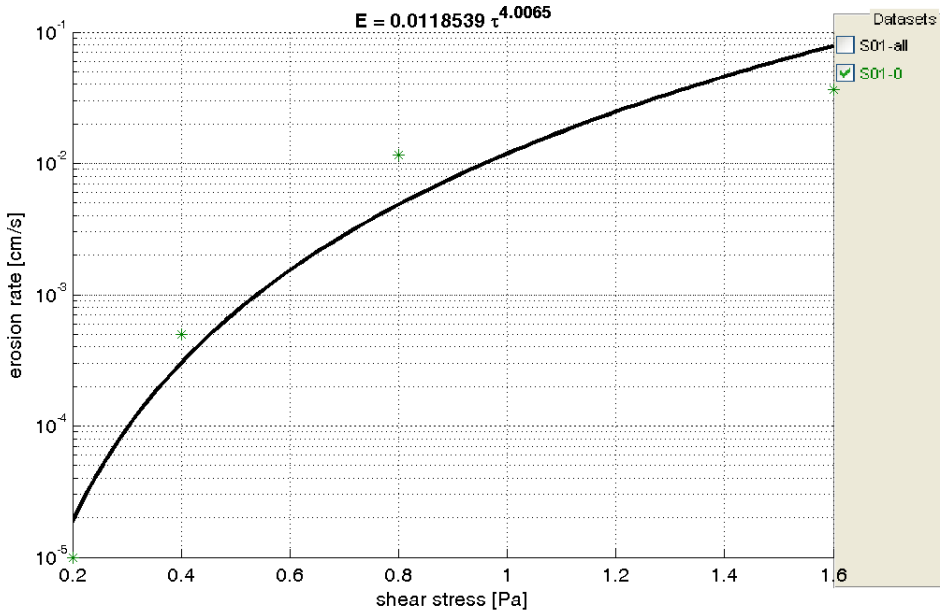


Figure B-2. Station 1, Layer 0 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data.

Station 2

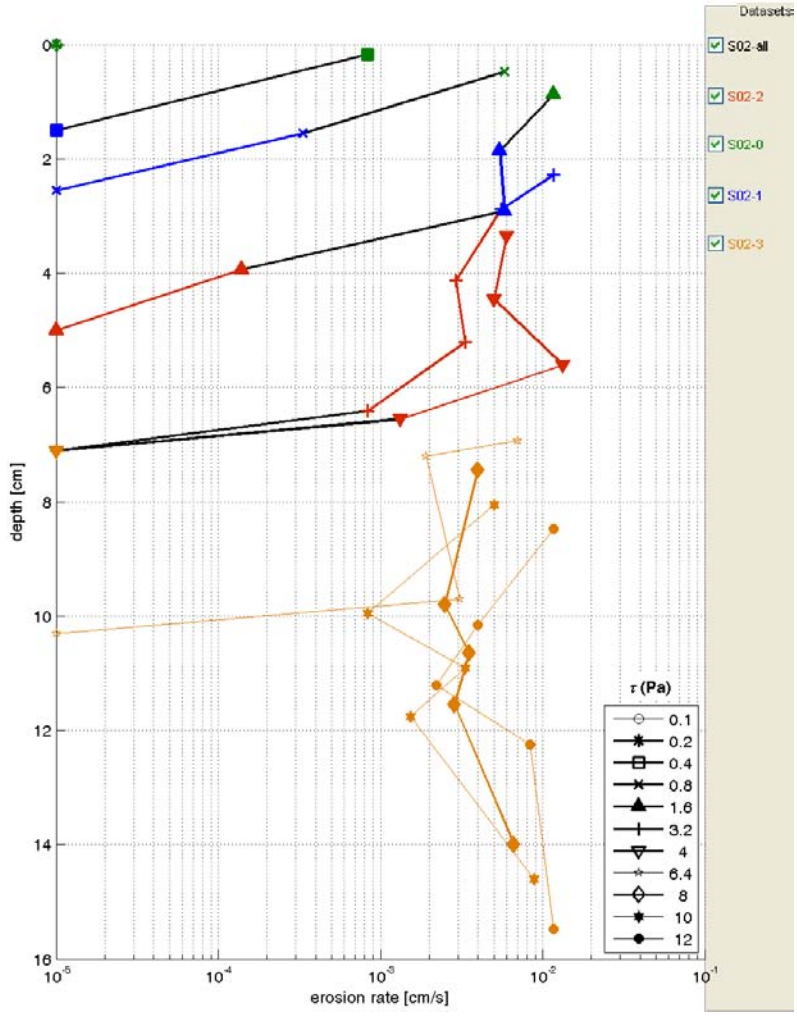


Figure B-3. Erosion rate versus depth and applied shear stress for Station 2. Layer 0 (green) is composed of surface material that was eroded in the first sequence of erosion tests. Layers 1(blue), 2(red), and 3(orange) were determined based on density, grain size and erosion rate data.

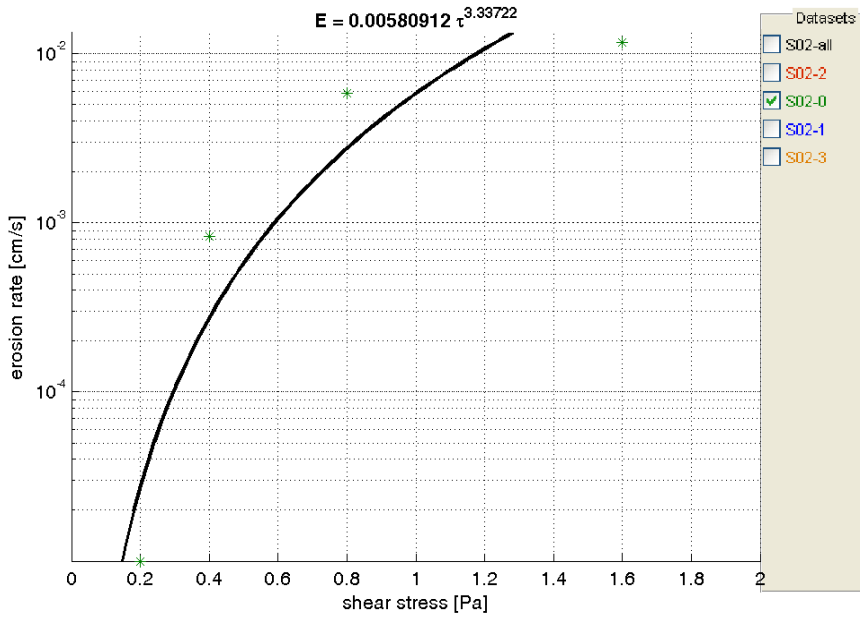


Figure B-4. Station 2, Layer 0 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data.

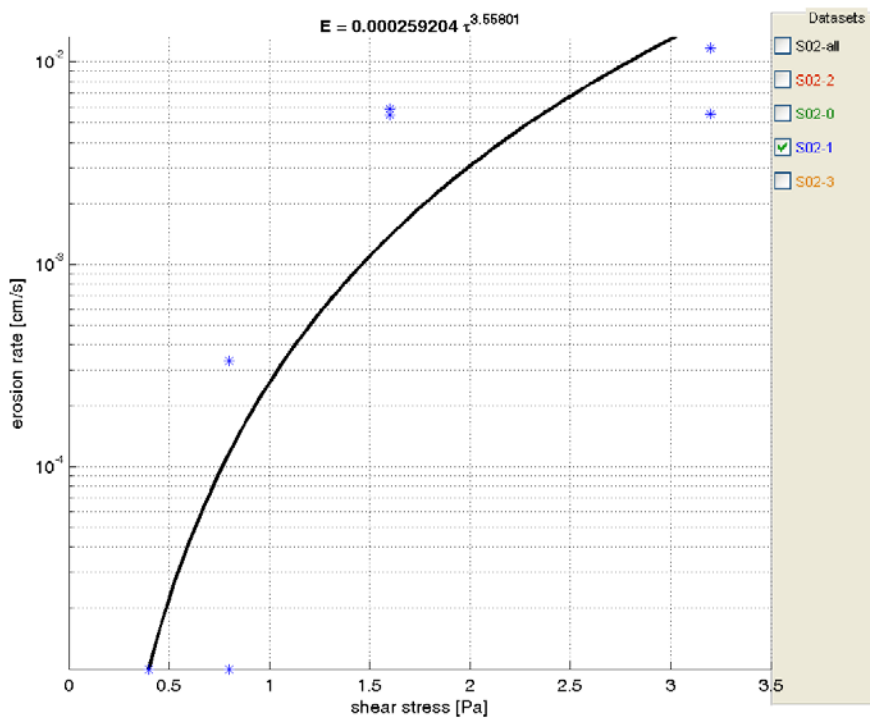


Figure B-5. Station 2, Layer 1 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data.

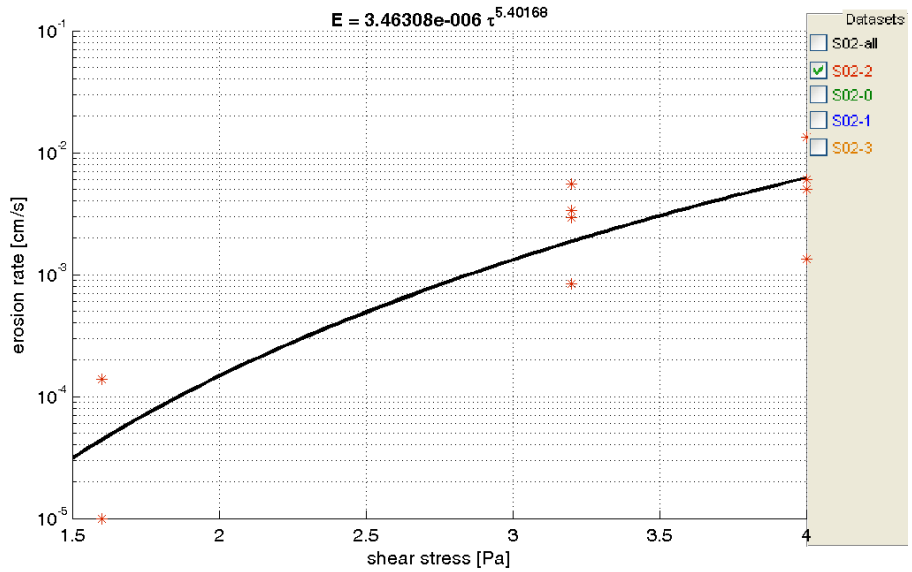


Figure B-6. Station 2, Layer 2 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

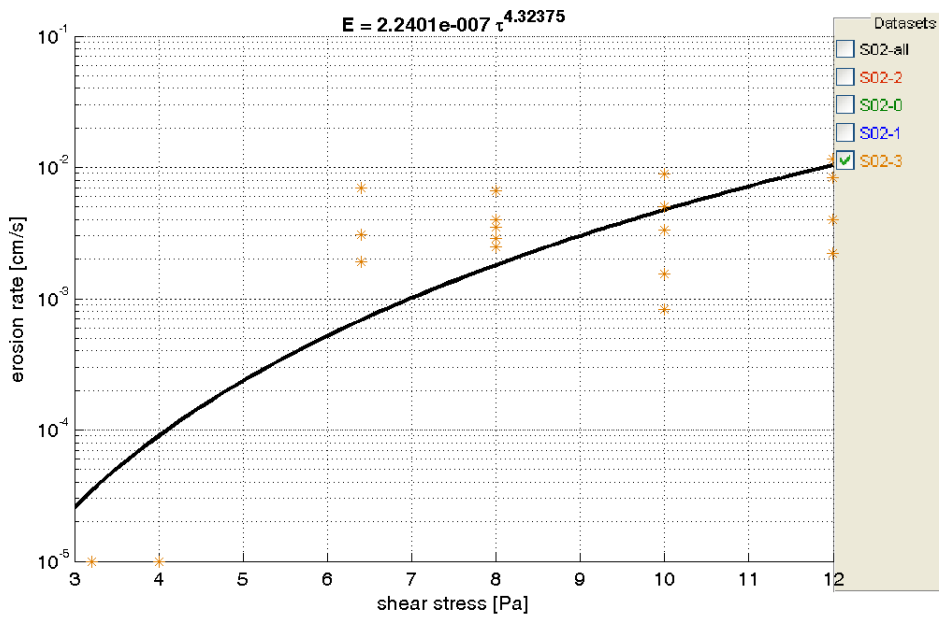


Figure B-7. Station 2, Layer 3 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

Station 3

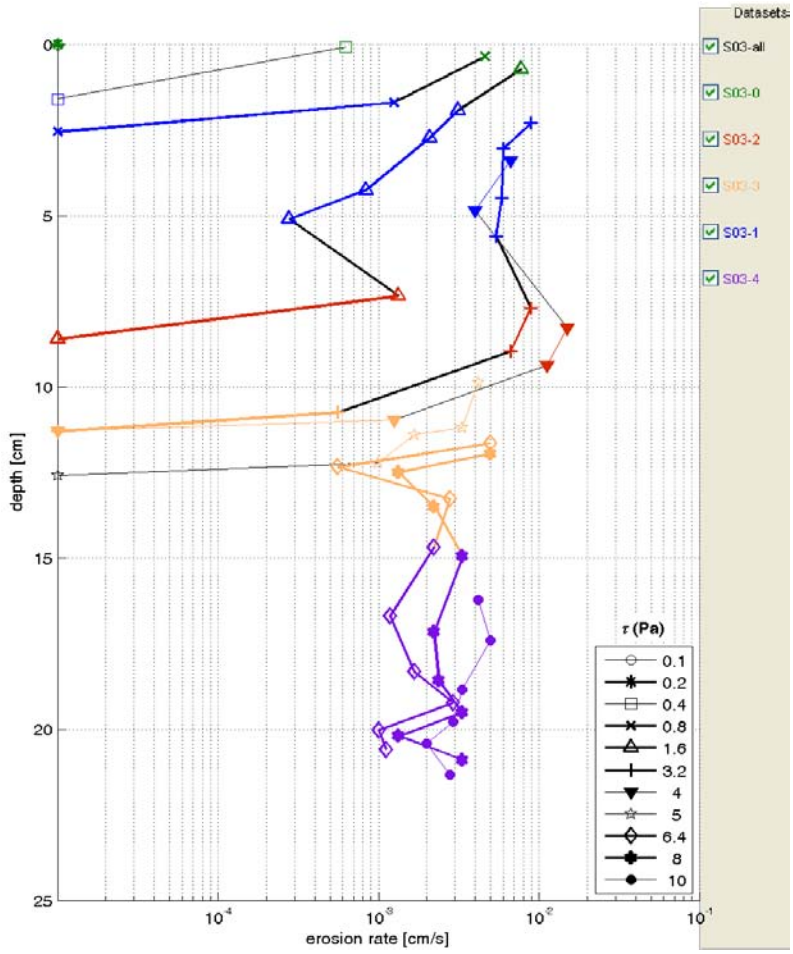


Figure B-8. Erosion rate versus depth and applied shear stress for Station 3. Layer 0 (green) is composed of surface material that was eroded in the first sequence of erosion tests. Layers 1(blue), 2(red), 3(orange), and 4(purple) were determined based on density, grain size and erosion rate data.

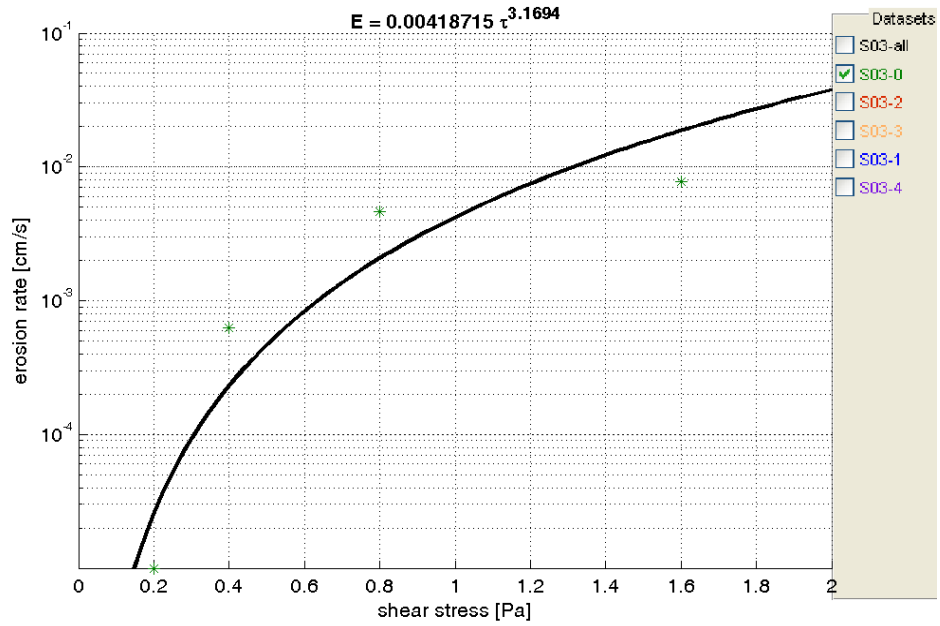


Figure B-9. Station 3, Layer 0 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

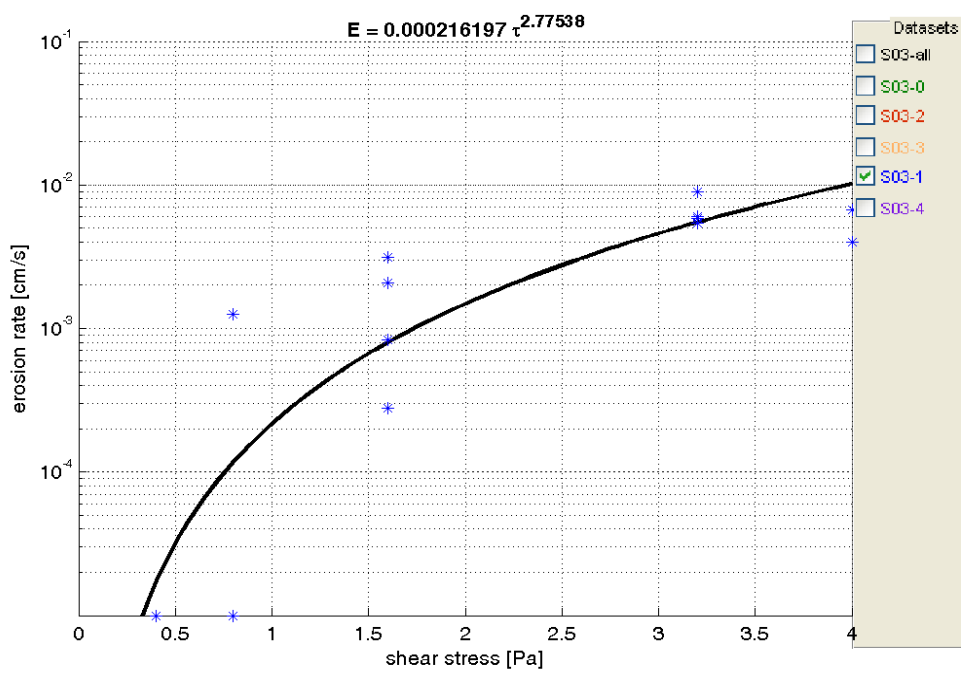


Figure B-10. Station 3, Layer 1 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

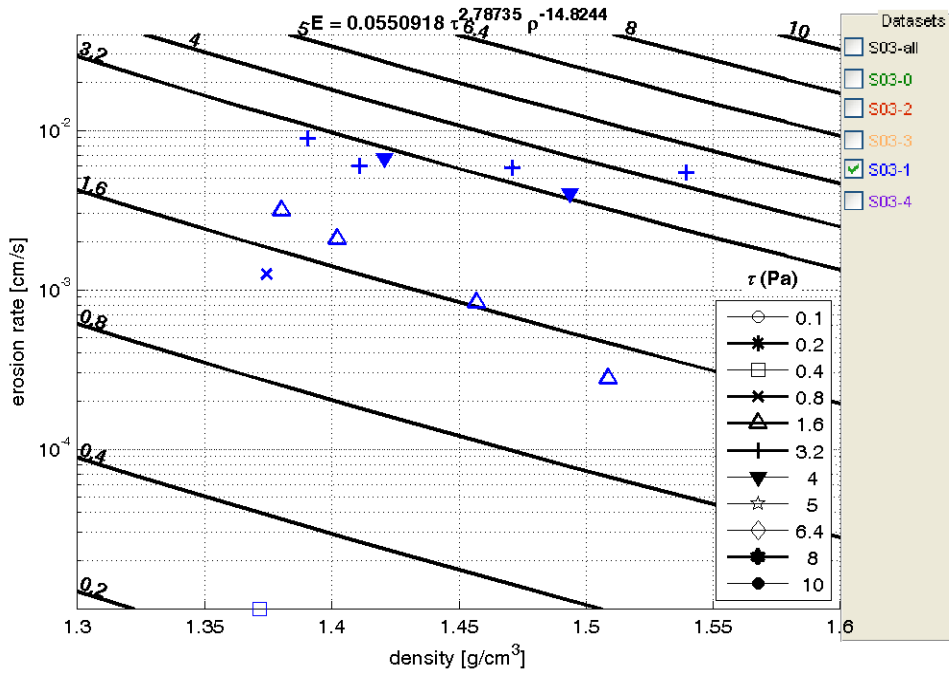


Figure B-11. Station 3, Layer 1 erosion rate vs. density. Lines show optimized function values for each value of shear stress.

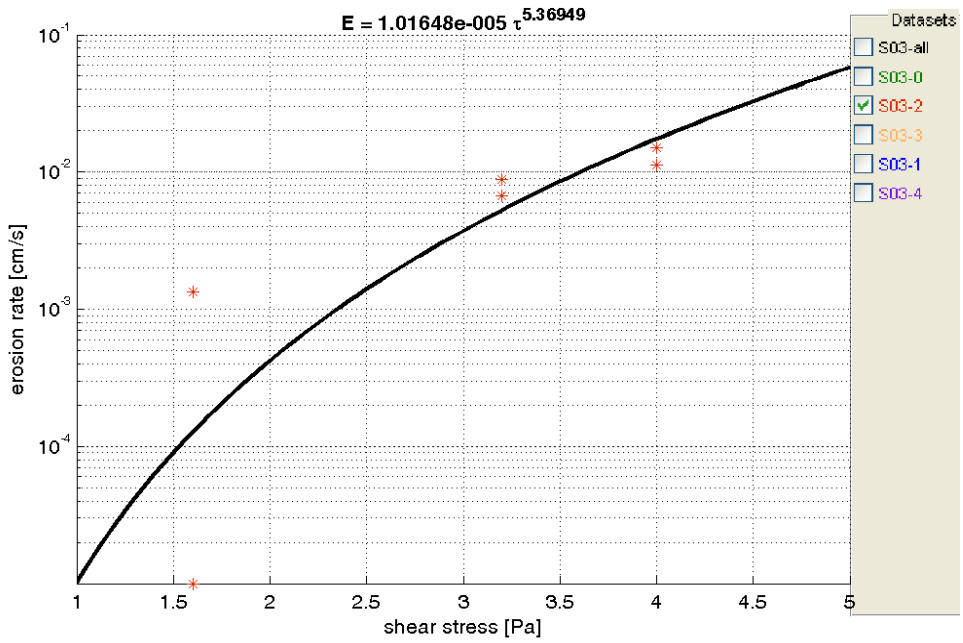


Figure B-12. Station 3, Layer 2 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

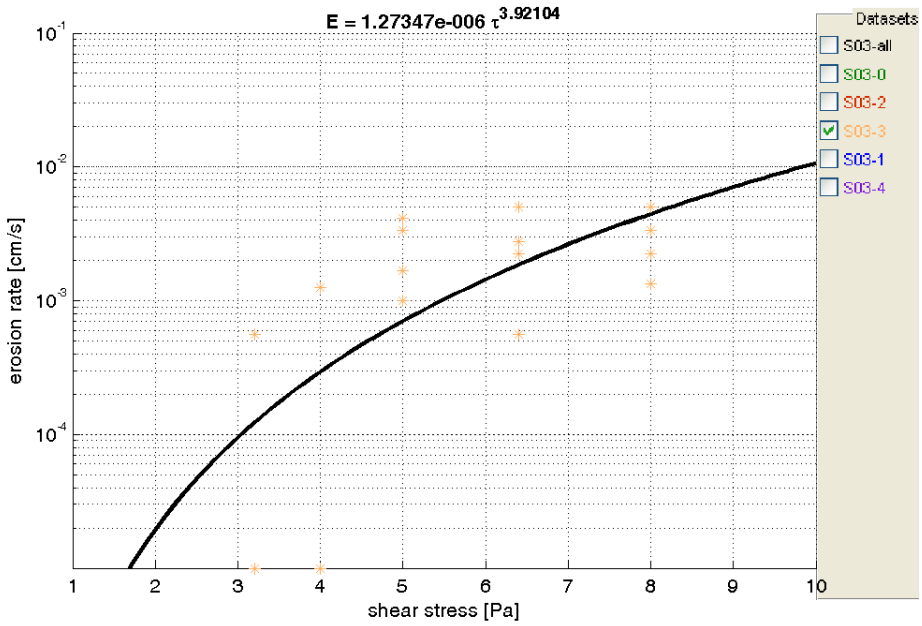


Figure B-13. Station 3, Layer 3 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

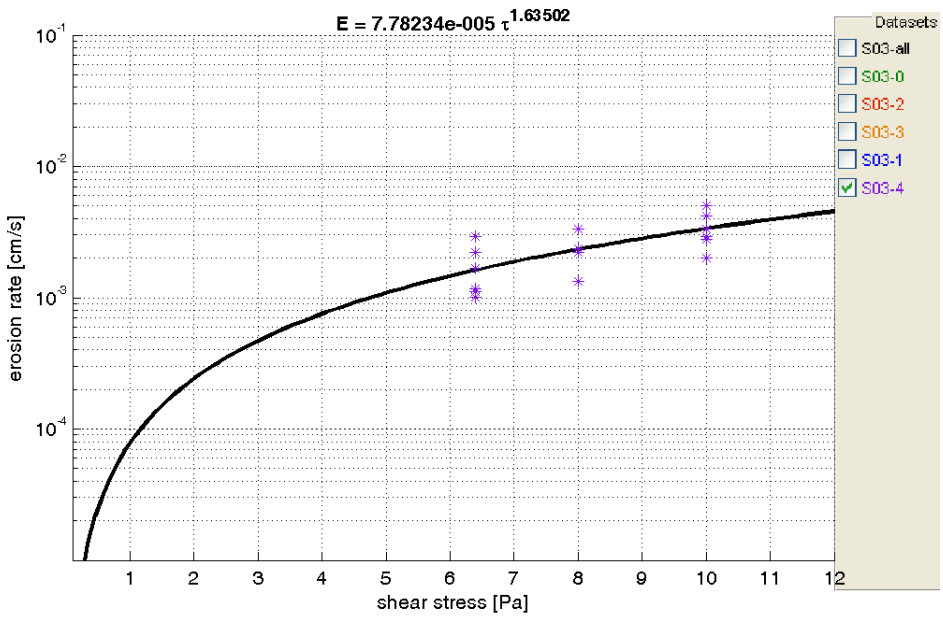


Figure B-14. Station 3, Layer 4 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

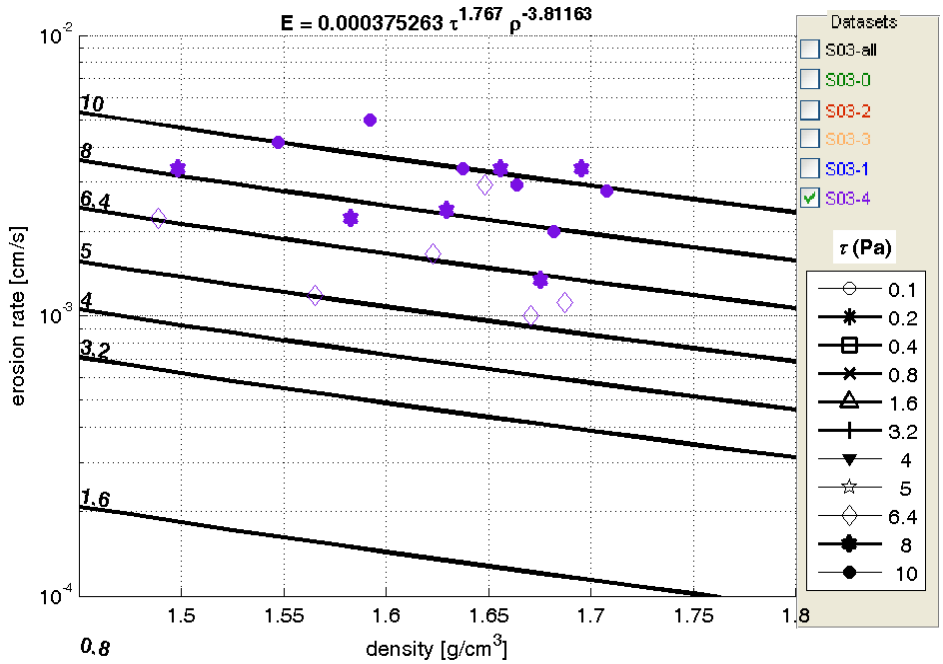


Figure B-15. Station 3, Layer 4 erosion rate vs. density. Lines show optimized function values for each value of shear stress.

Station 4B

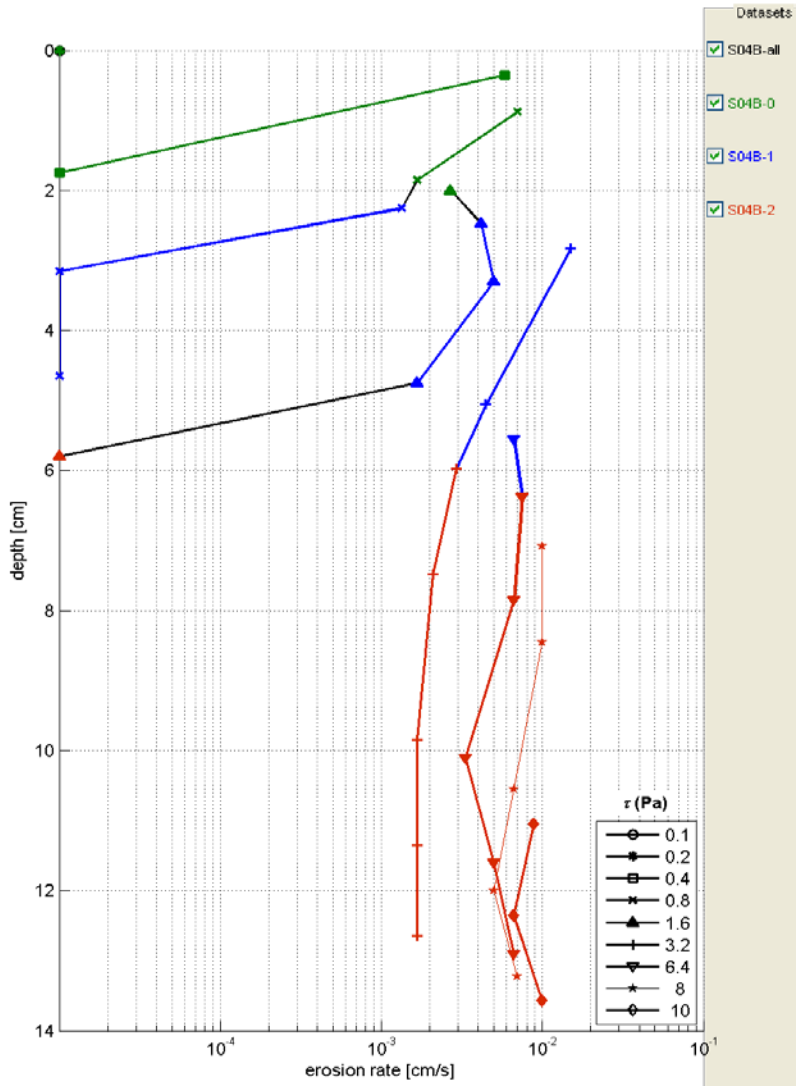


Figure B-16. Erosion rate versus depth and applied shear stress for Station 4B. Layer 0 (green) is composed of surface material that was eroded in the first sequence of erosion tests. Layers 1(blue) and 2(red) were determined based on density, grain size and erosion rate data.

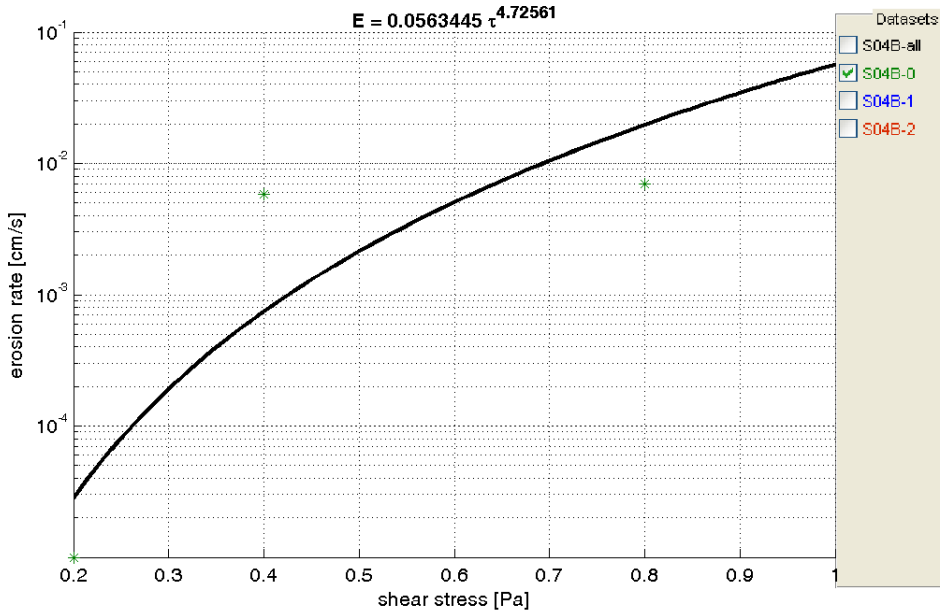


Figure B-17. Station 4B, Layer 0 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

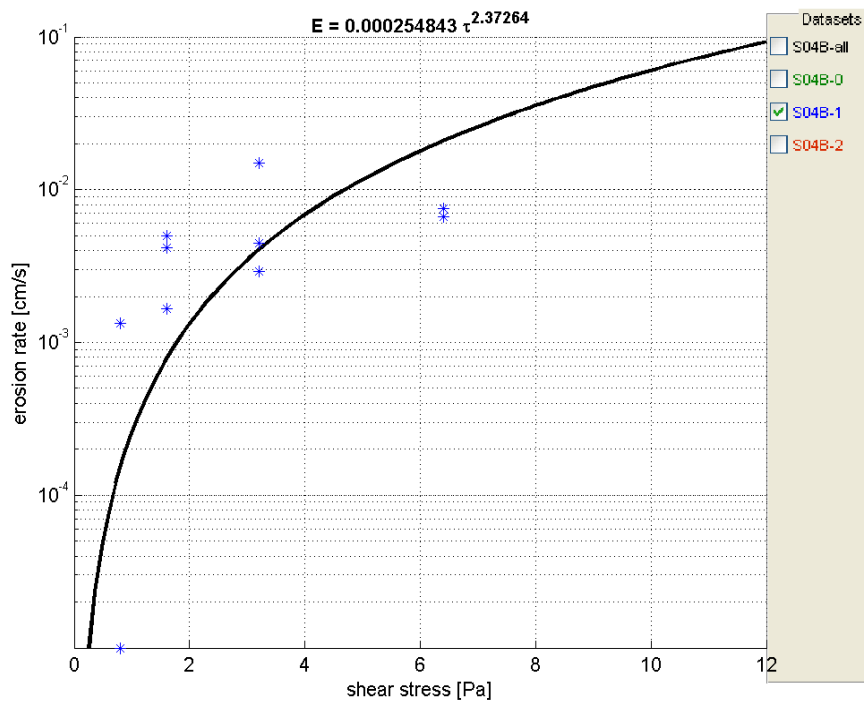


Figure B-18. Station 4B, Layer 1 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

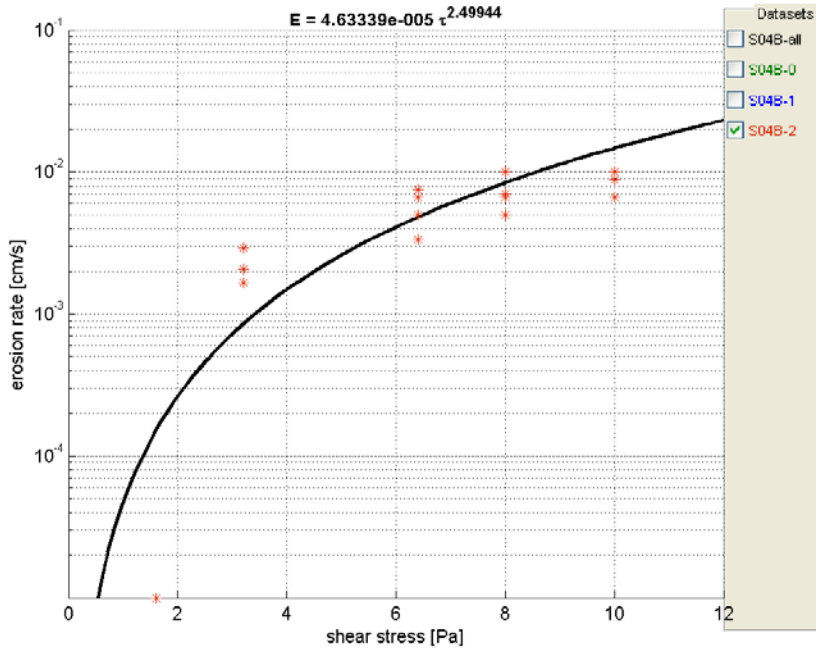


Figure B-19. Station 4B, Layer 2 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

Station 5

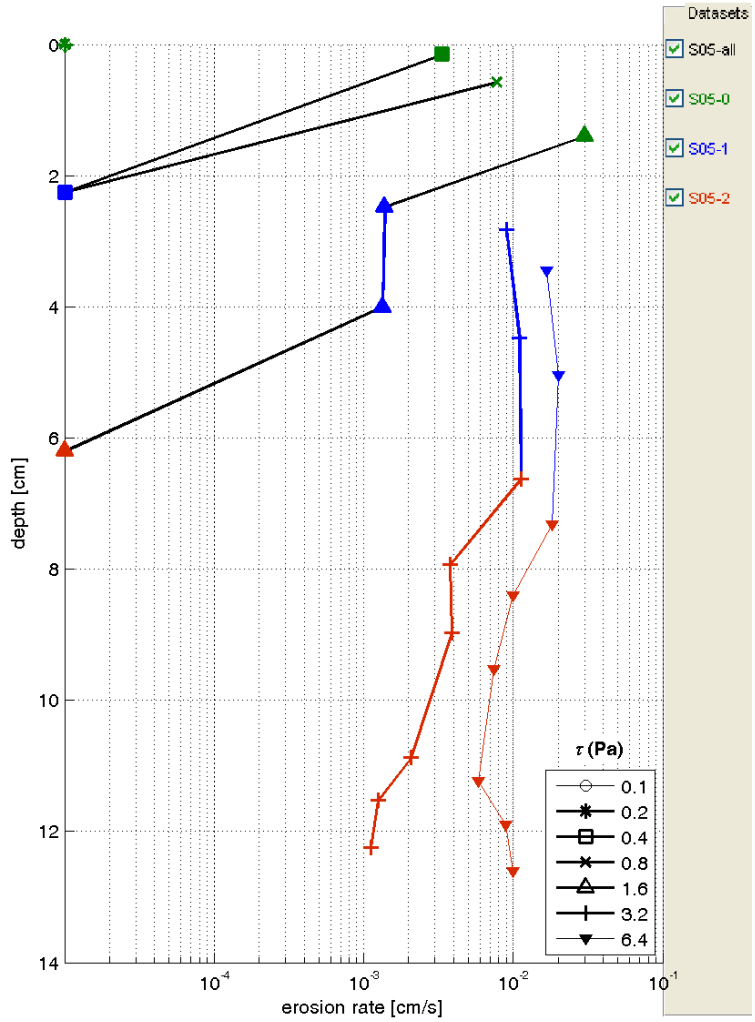


Figure B-20. Erosion rate versus depth and applied shear stress for Station 5. Layer 0 (green) is composed of surface material that was eroded in the first sequence of erosion tests. Layers 1(blue) and 2(red) were determined based on density, grain size and erosion rate data.

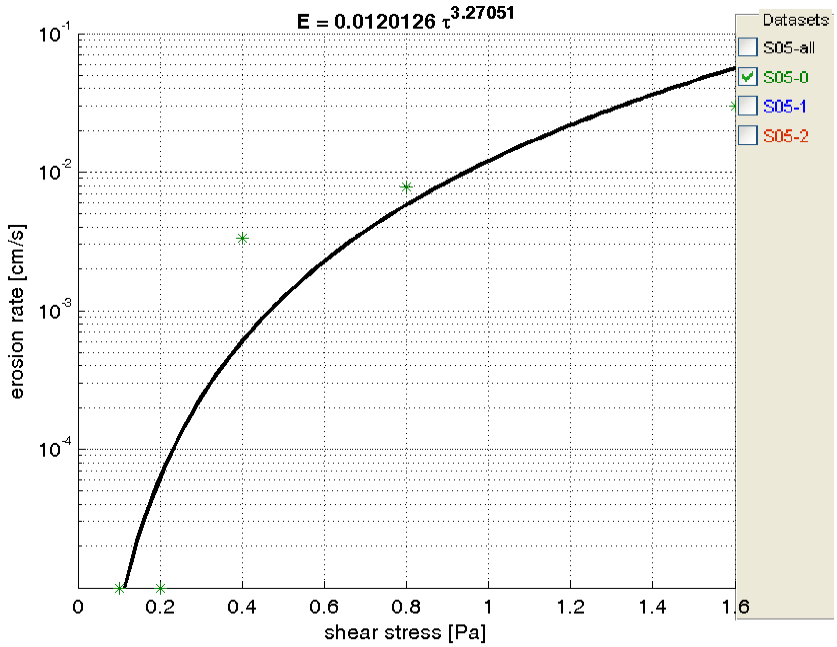


Figure B-21. Station 5, Layer 0 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

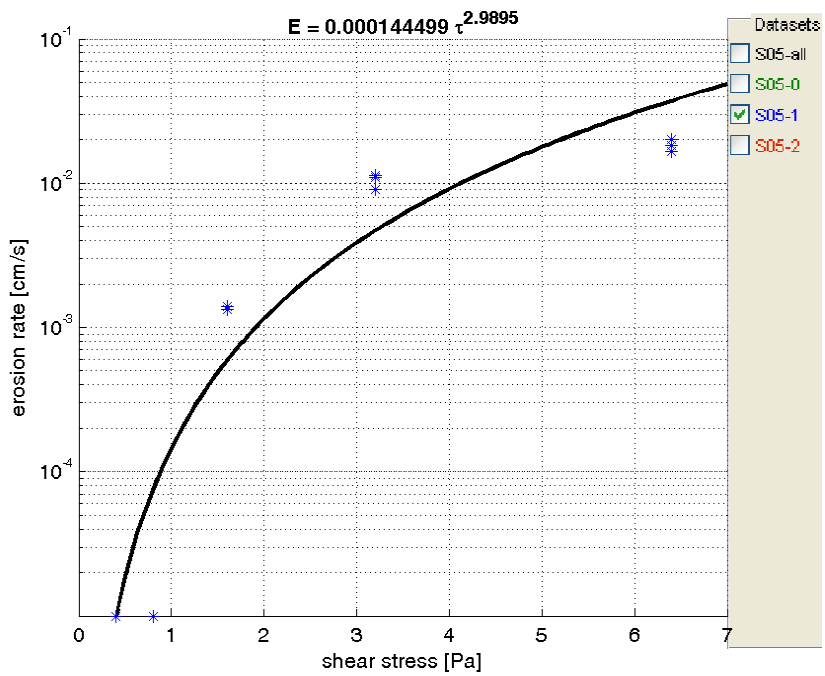


Figure B-22. Station 5, Layer 1 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

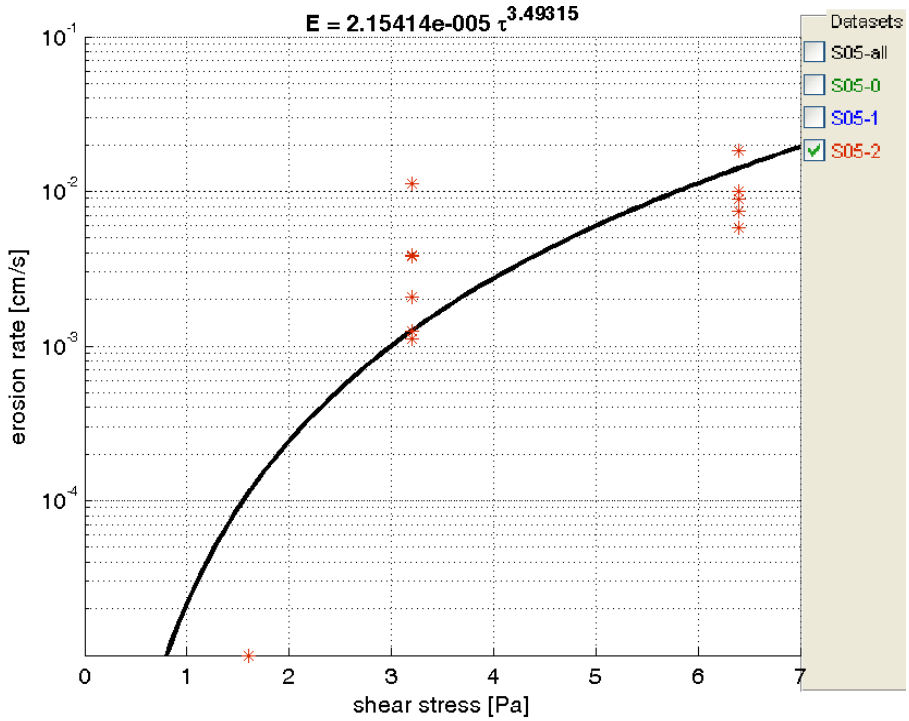


Figure B-23. Station 5, Layer 2 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

Station 6

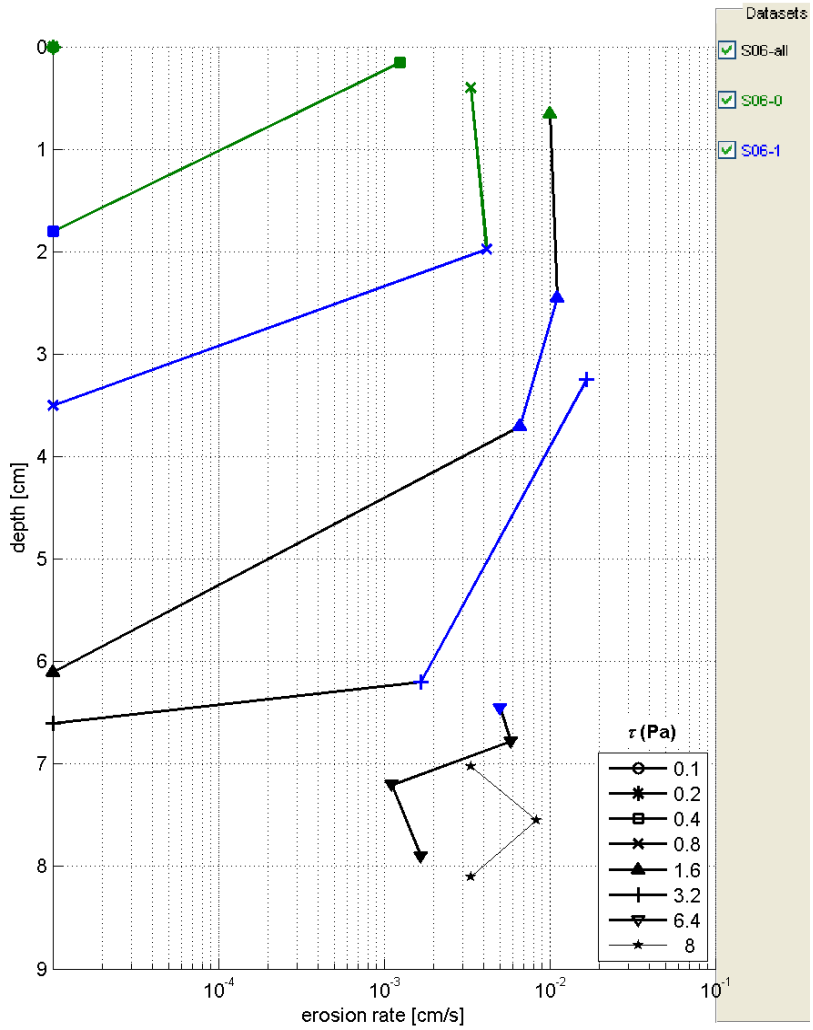


Figure B-24. Erosion rate versus depth and applied shear stress for Station 6. Layer 0 (green) is composed of surface material that was eroded in the first sequence of erosion tests. Layers 1(blue) was determined based on density, grain size and erosion rate data.

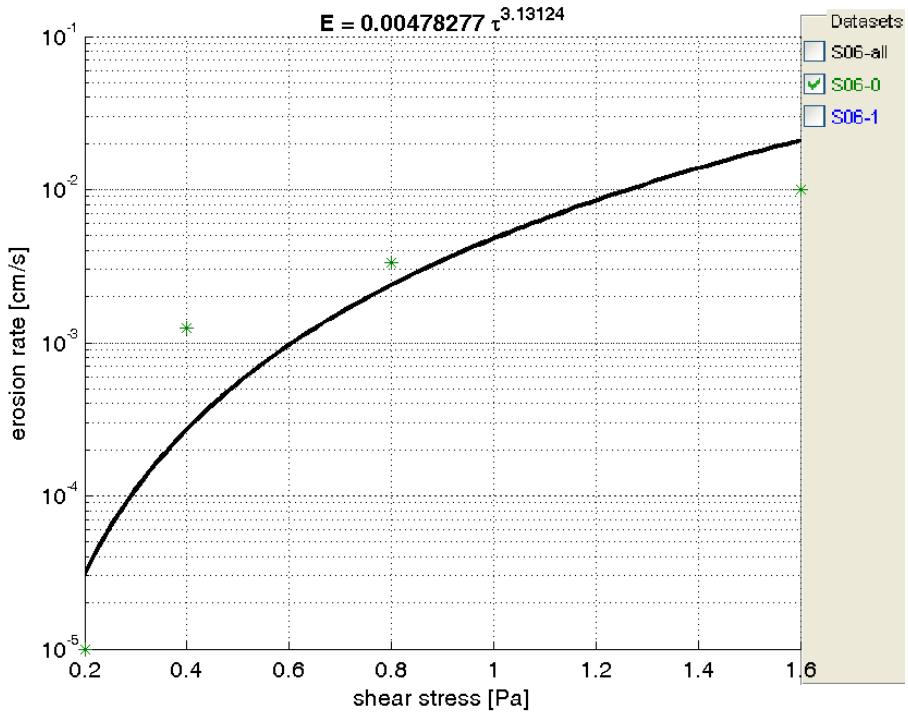


Figure B-25. Station 6, Layer 0 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

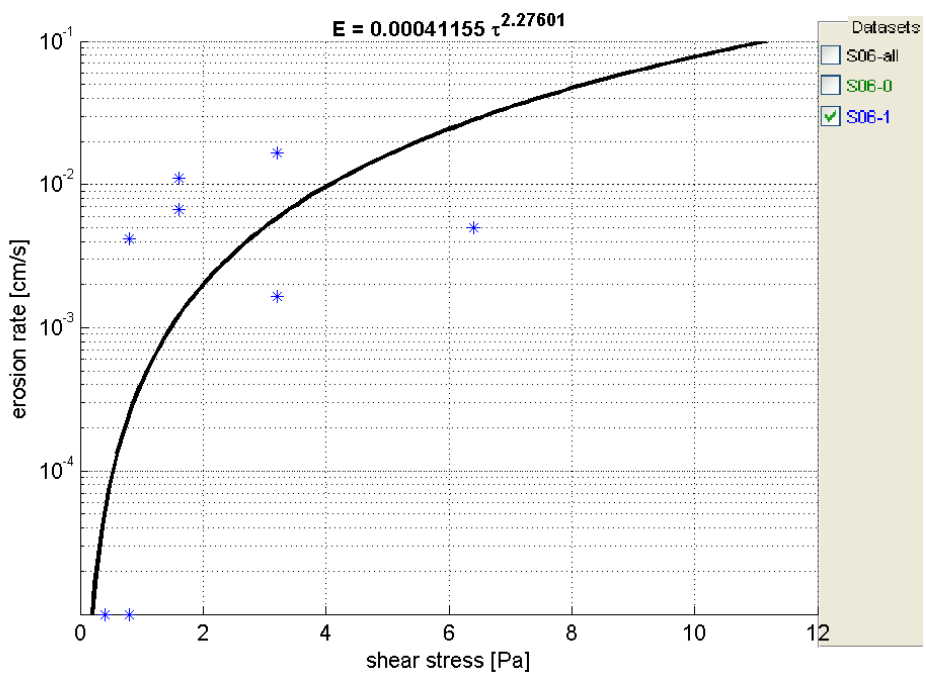


Figure B-26. Station 6, Layer 1 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

Station 7A

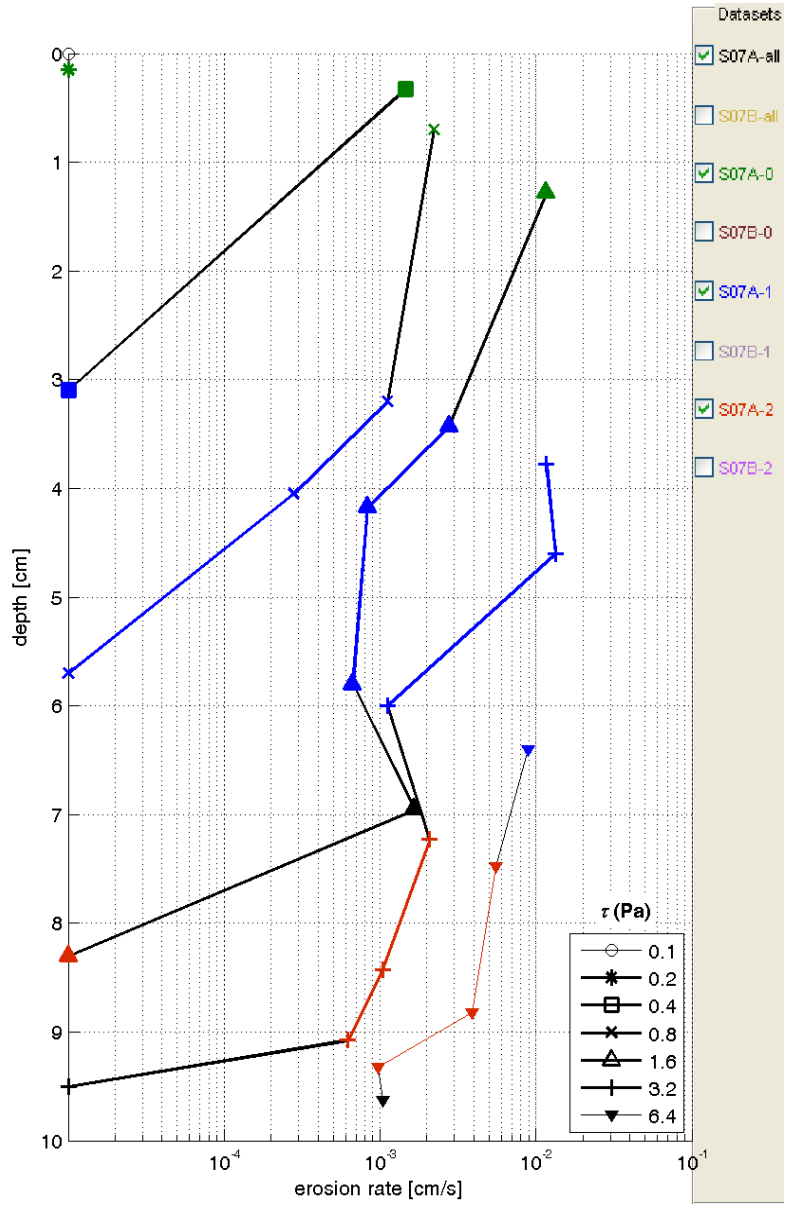


Figure B-27. Erosion rate versus depth and applied shear stress for Station 7A. Layer 0 (green) is composed of surface material that was eroded in the first sequence of erosion tests. Layers 1(blue) and 2(red) were determined based on density, grain size and erosion rate data.

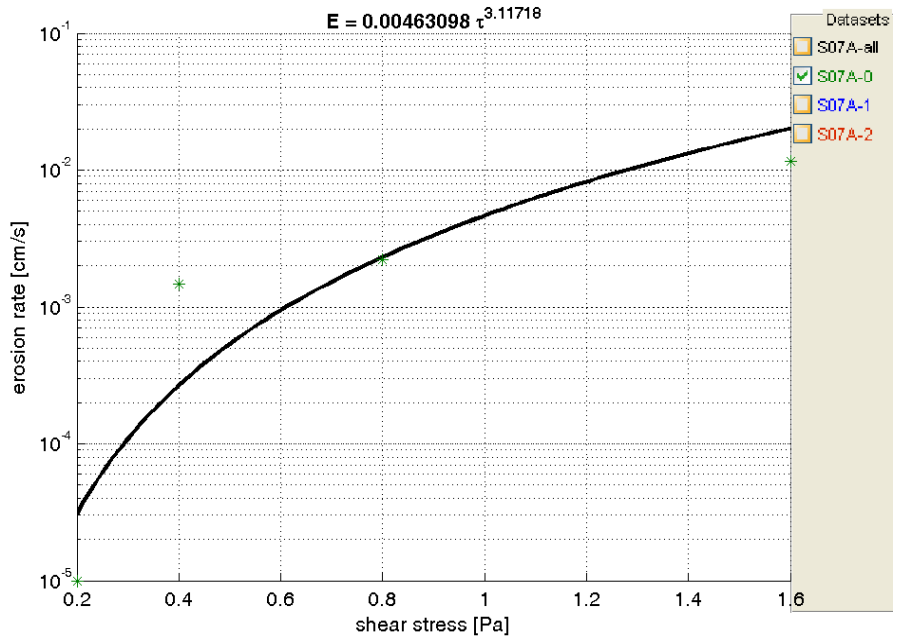


Figure B-28. Station 7A, Layer 0 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

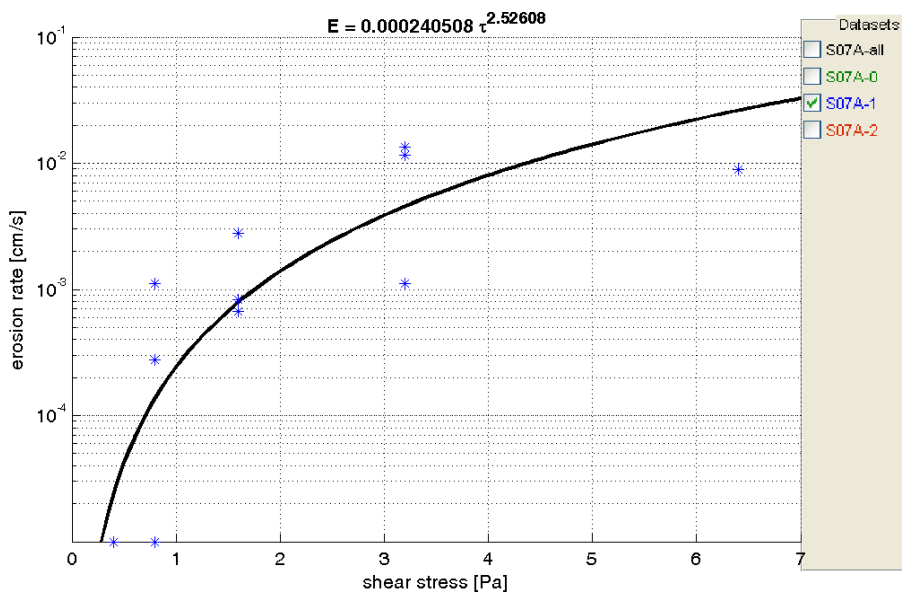


Figure B-29. Station 7A, Layer 1 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

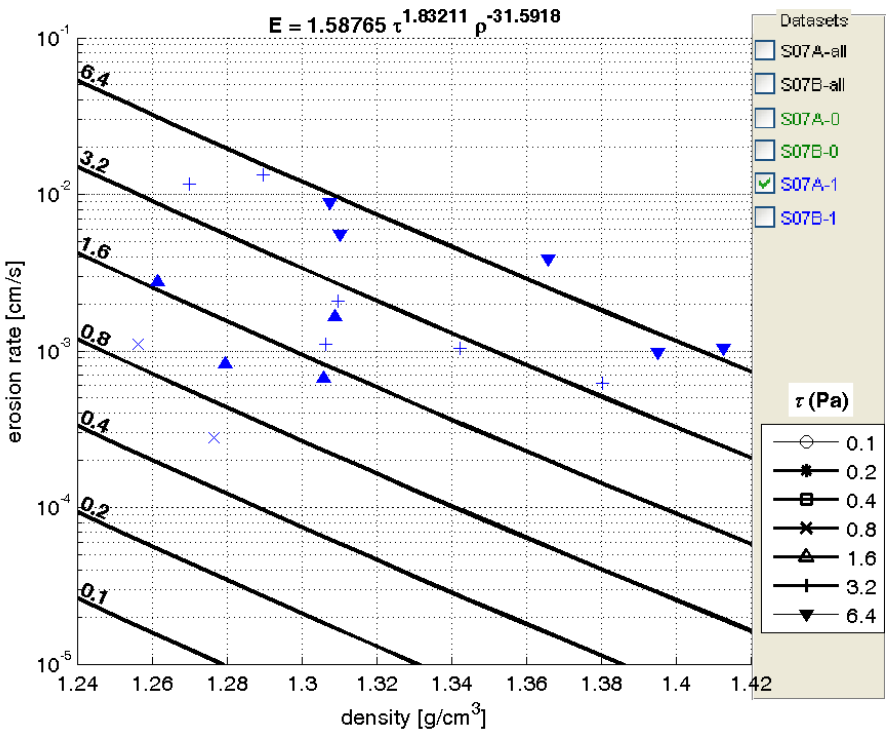


Figure B-30. Station 7A, Layer 1 erosion rate vs. density. Lines show optimized function values for each value of shear stress.

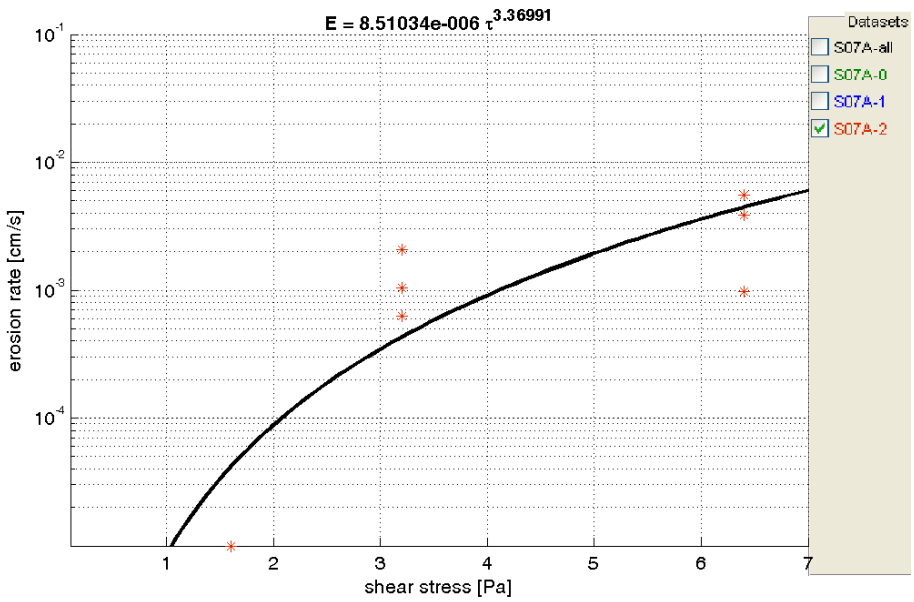


Figure B-31. Station 7A, Layer 2 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

Station 7B

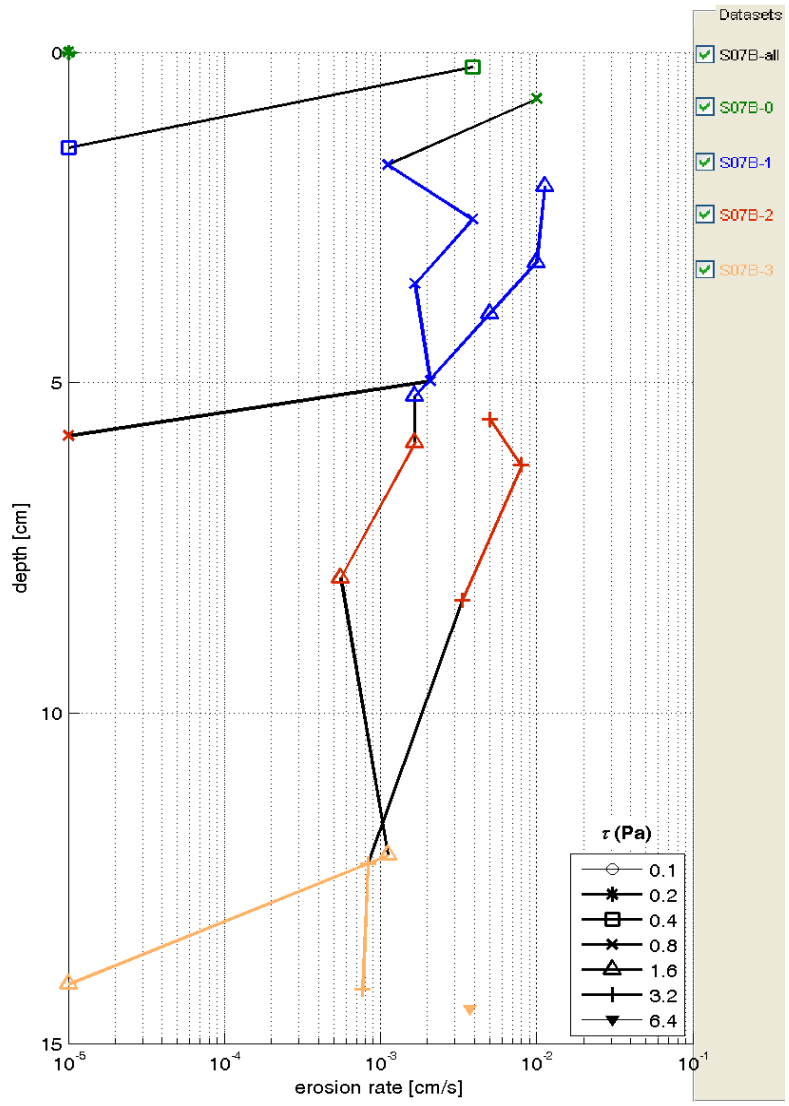


Figure B-32. Erosion rate versus depth and applied shear stress for Station 7B. Layer 0 (green) is composed of surface material that was eroded in the first sequence of erosion tests. Layers 1(blue), 2(red), and 3(orange) were determined based on density, grain size and erosion rate data.

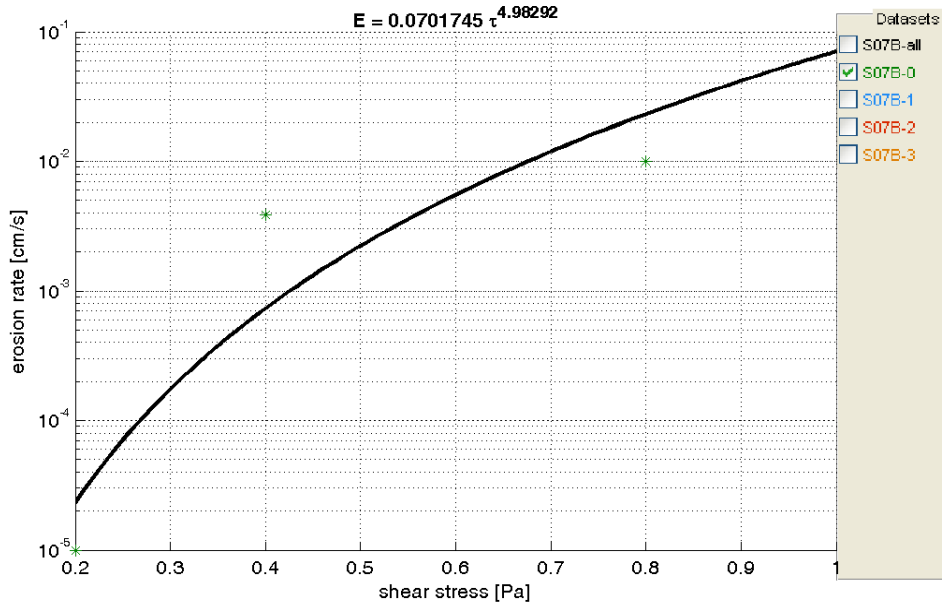


Figure B-33. Station 7B, Layer 0 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

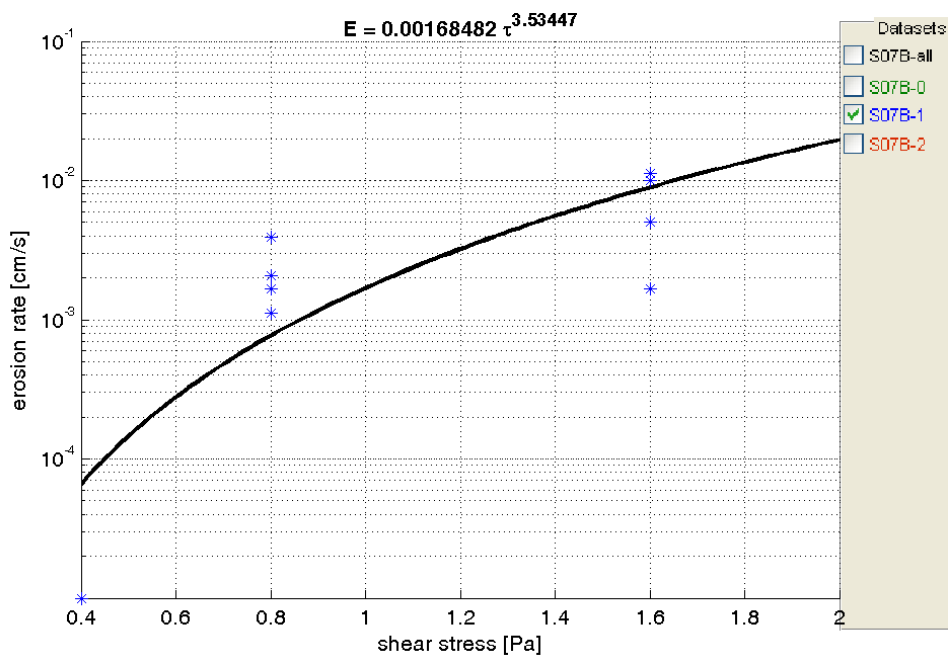


Figure B-34. Station 7B, Layer 1 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

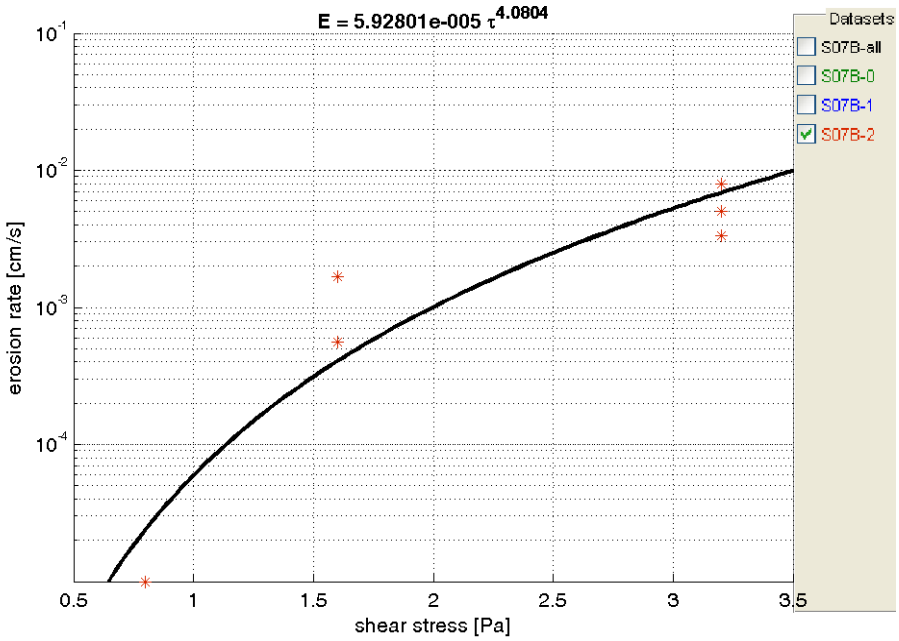


Figure B-35. Station 7B, Layer 2 erosion rate vs. shear stress. Line shows best fit of $E = A\,\tau^n$ for data

Station 8A

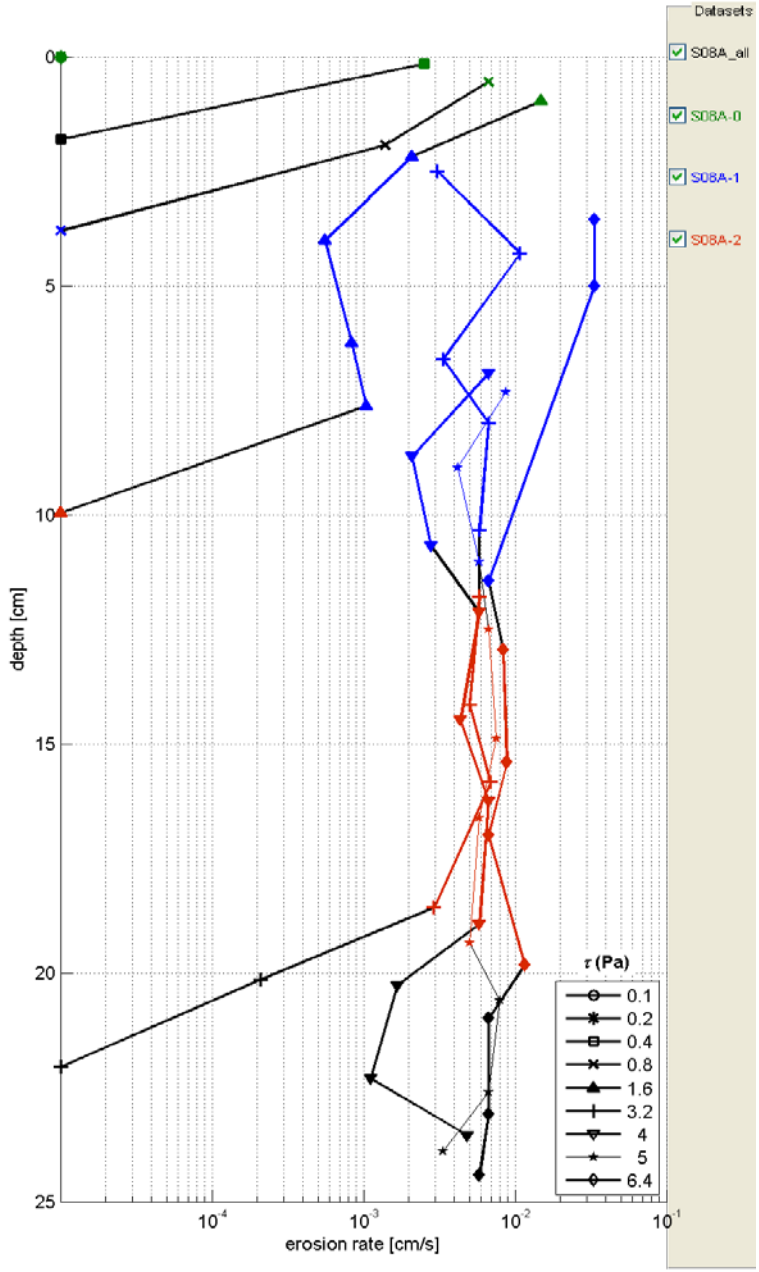


Figure B-36. Erosion rate versus depth and applied shear stress for Station 8A. Layer 0 (green) is composed of surface material that was eroded in the first sequence of erosion tests. Layers 1(blue) and 2(red) were determined based on density, grain size and erosion rate data.

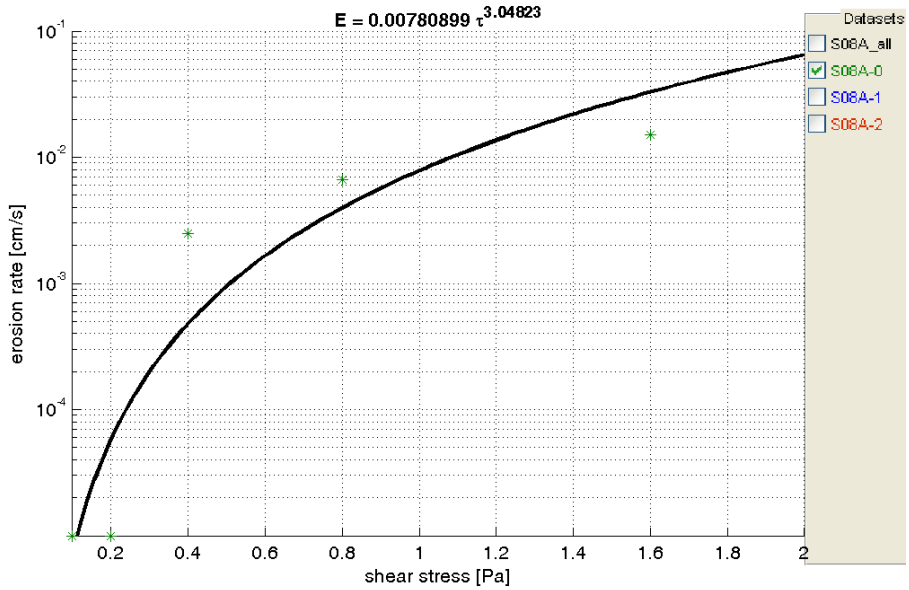


Figure B-37. Station 8A, Layer 0 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

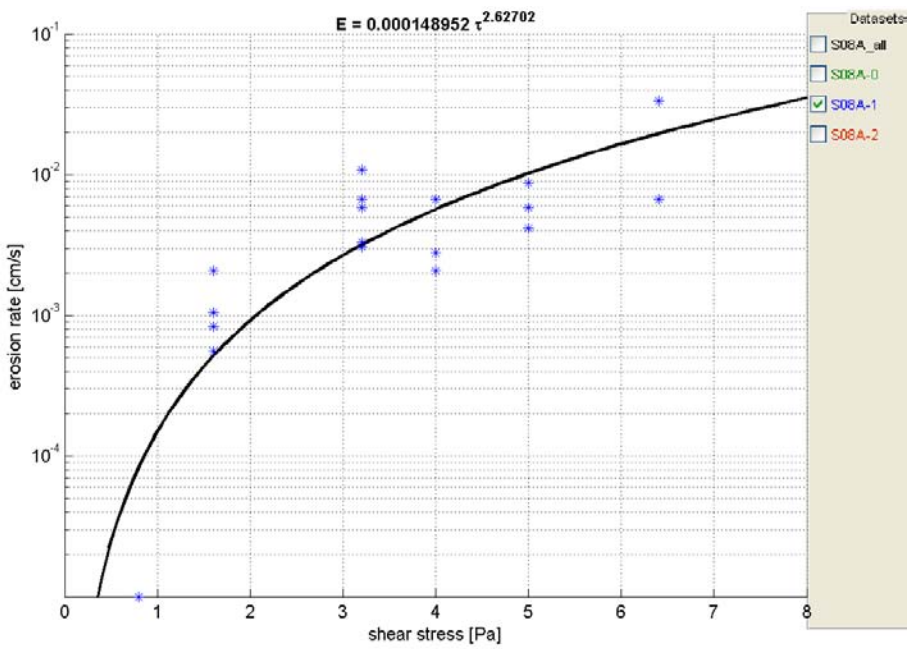


Figure B-38. Station 8A, Layer 1 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

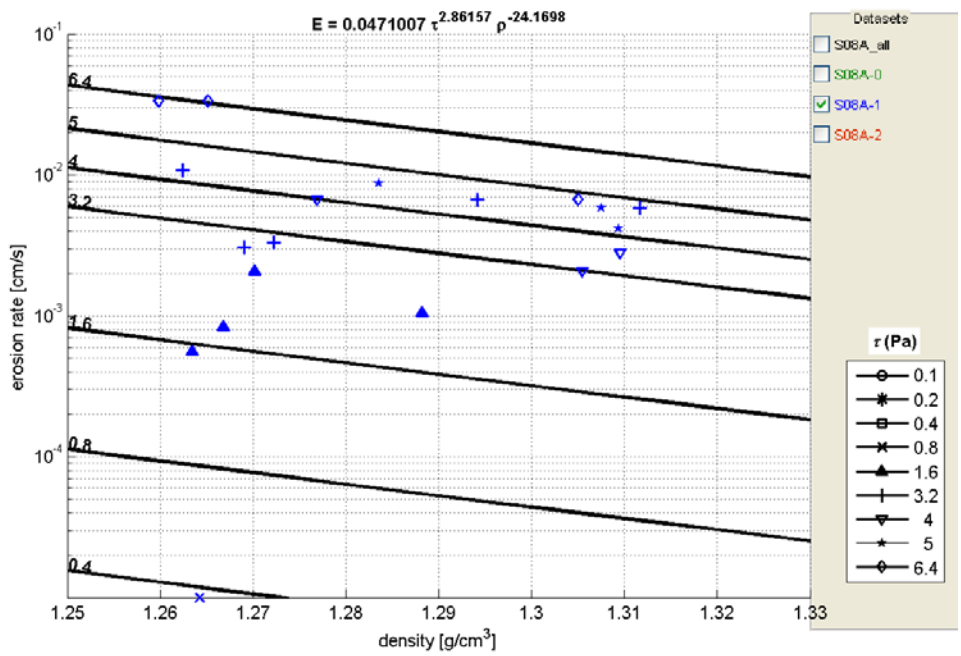


Figure B-39. Station 8A, Layer 1 erosion rate vs. density. Lines show optimized function values for each value of shear stress.

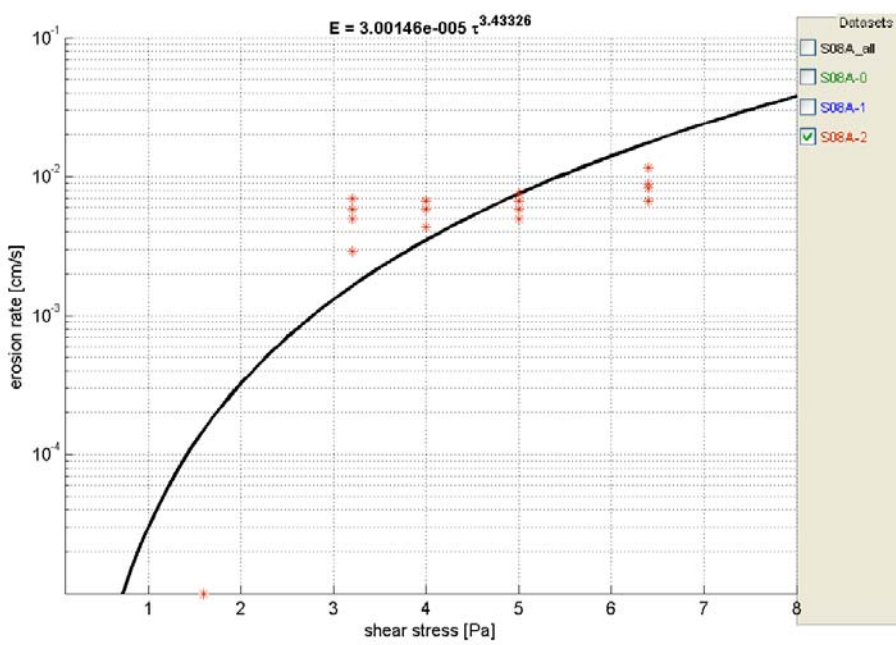


Figure B-40. Station 8A, Layer 2 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

Station 8B

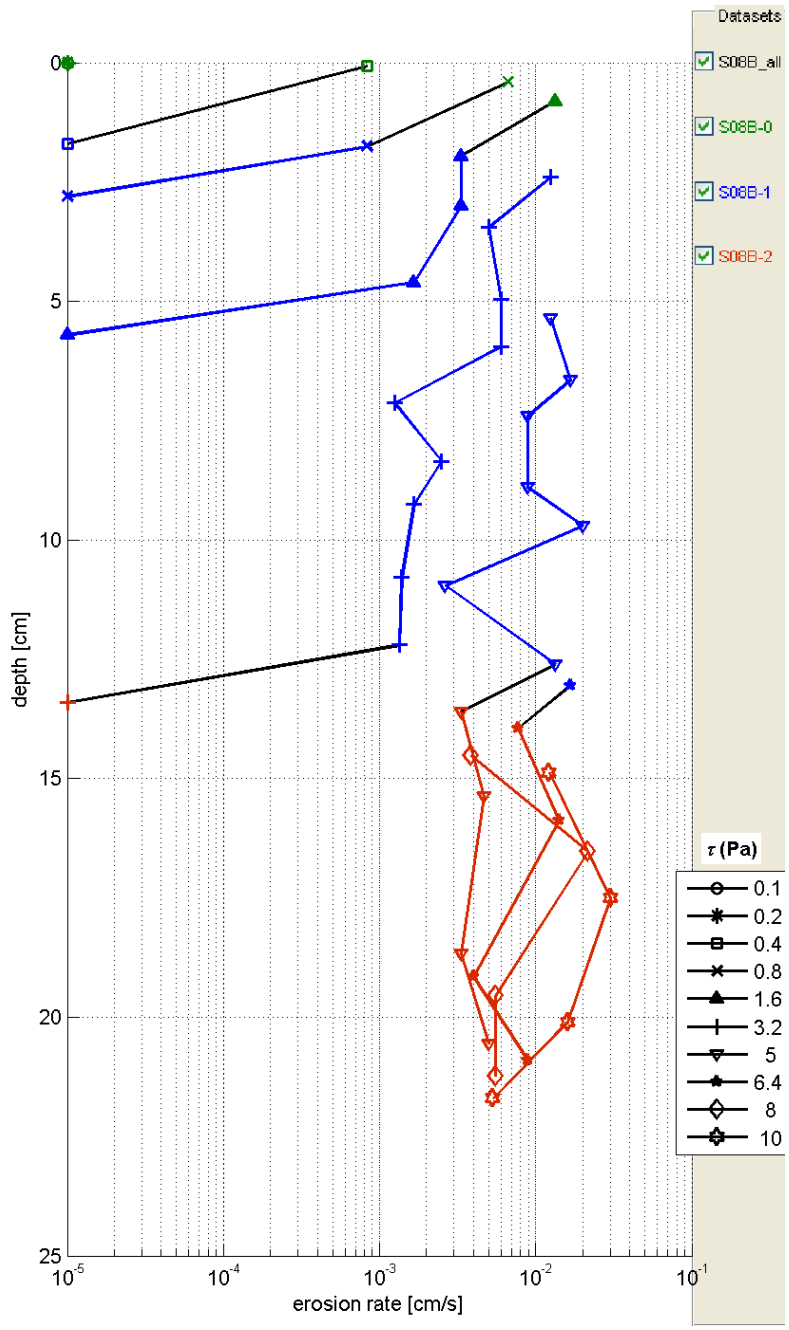


Figure B-41. Erosion rate versus depth and applied shear stress for Station 8B. Layer 0 (green) is composed of surface material that was eroded in the first sequence of erosion tests. Layers 1(blue) and 2(red) were determined based on density, grain size and erosion rate data.

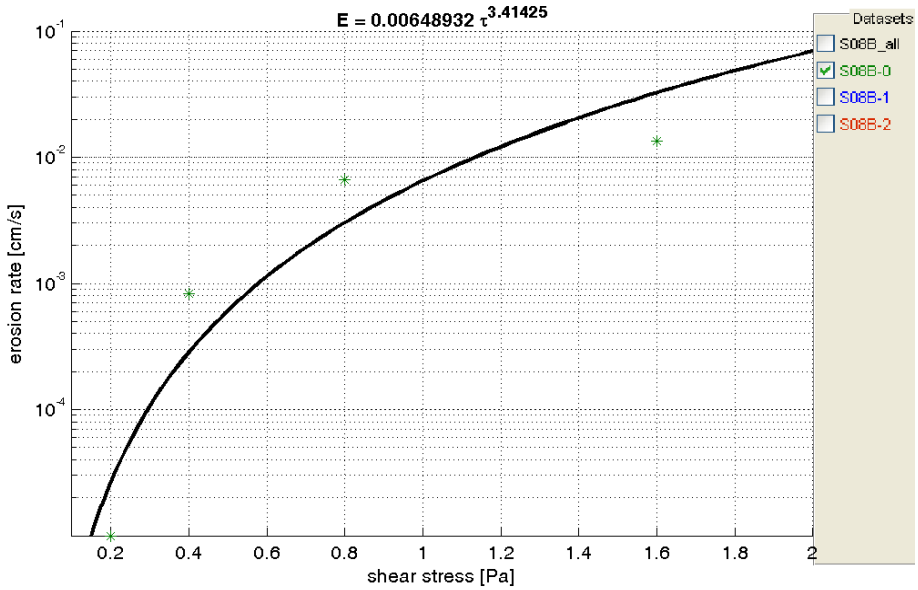


Figure B-42. Station 8B, Layer 0 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

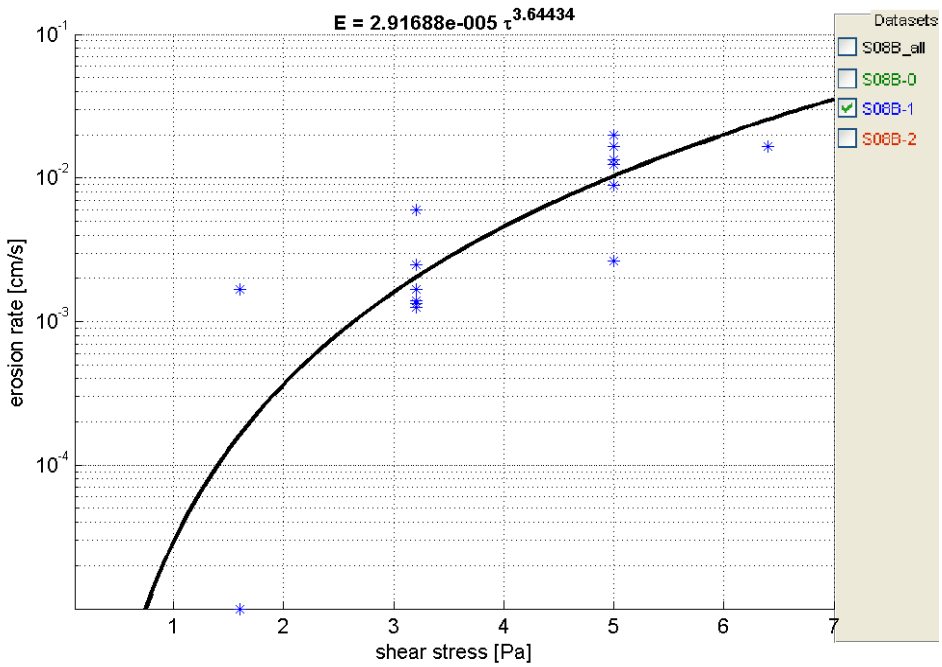


Figure B-43. Station 8B, Layer 1 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

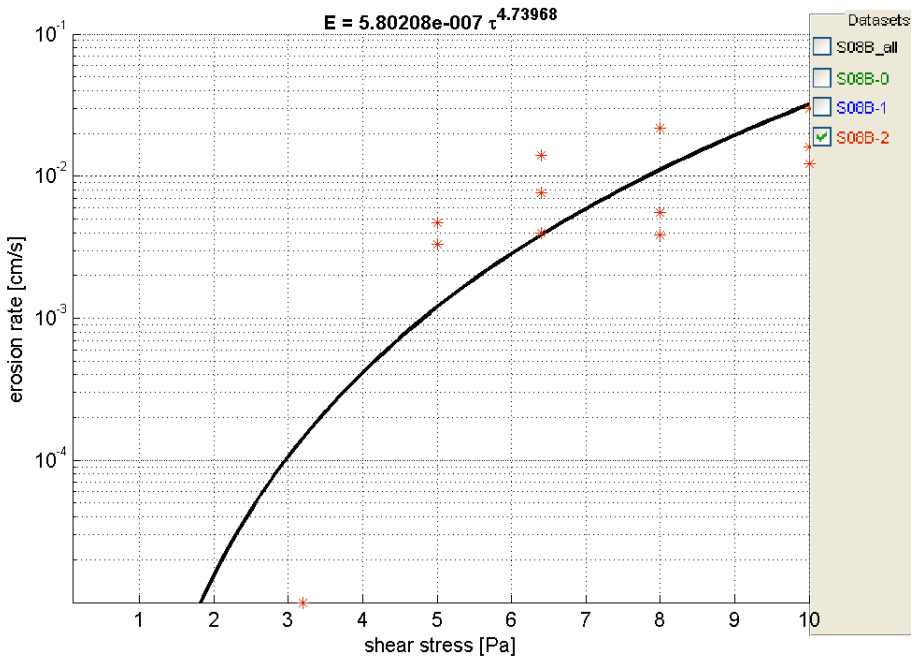


Figure B-44. Station 8B, Layer 2 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

Station 9

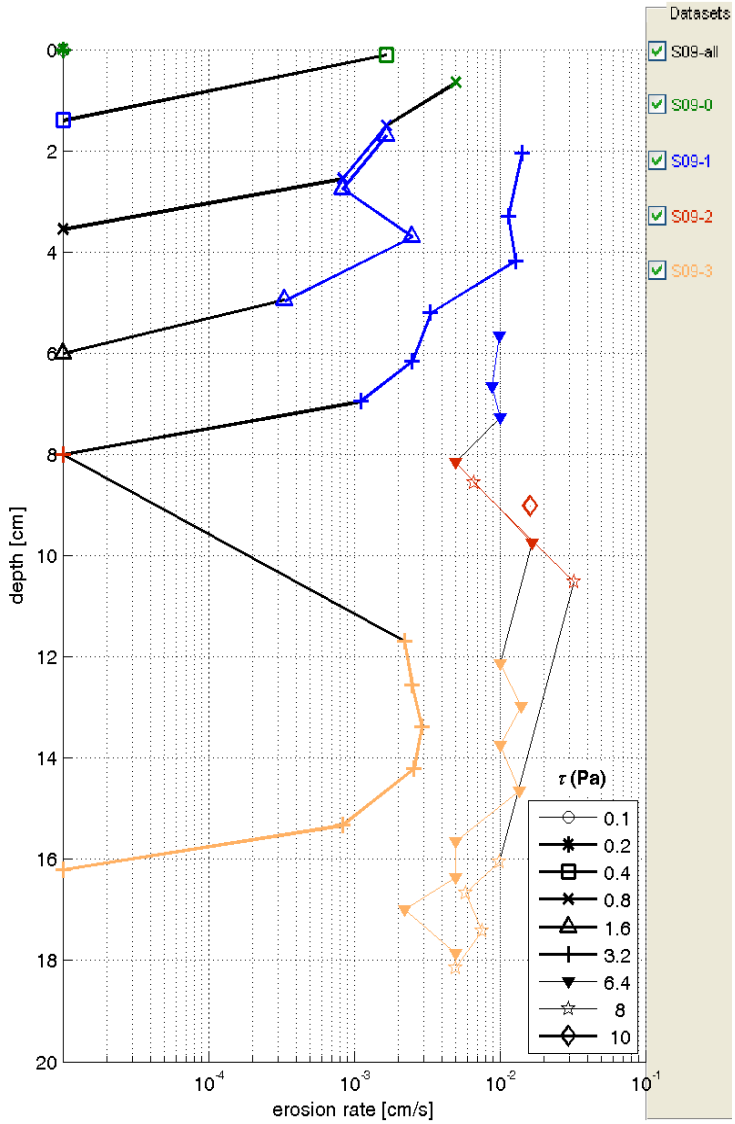


Figure B-45. Erosion rate versus depth and applied shear stress for Station 9. Layer 0 (green) is composed of surface material that was eroded in the first sequence of erosion tests. Layers 1(blue), 2(red), and 3(orange) were determined based on density, grain size and erosion rate data.

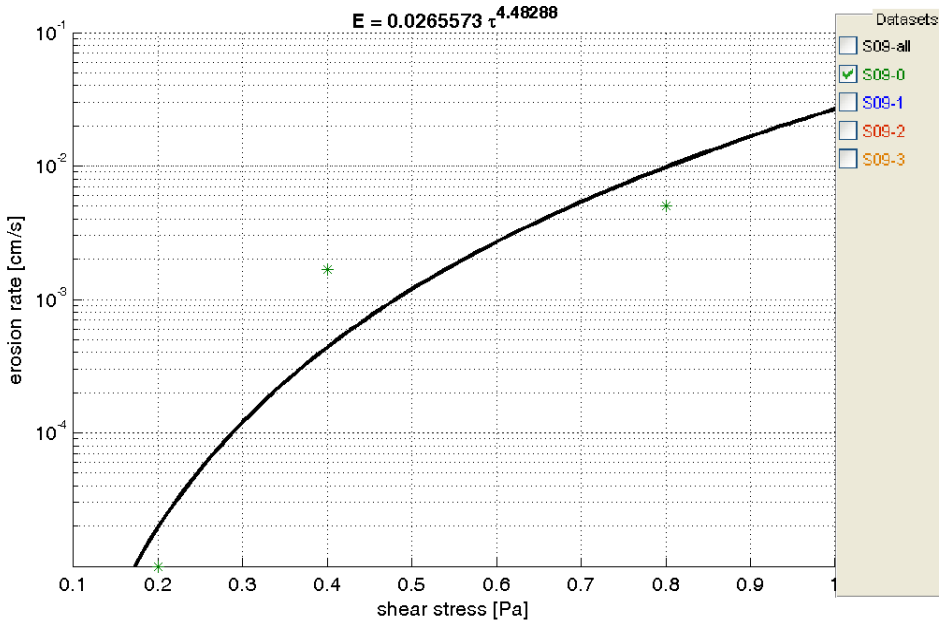


Figure B-46. Station 9, Layer 0 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

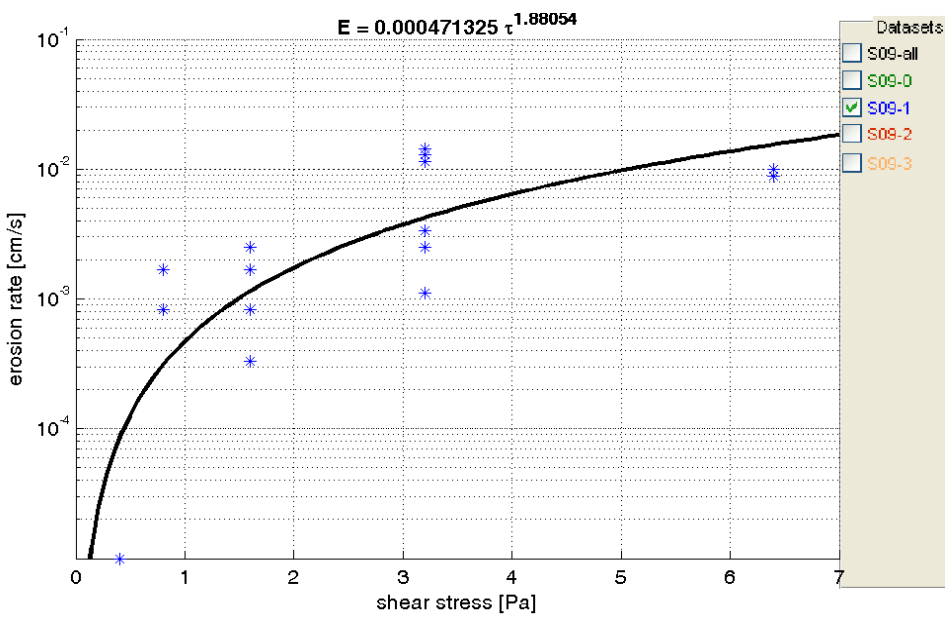


Figure B-47. Station 9, Layer 1 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

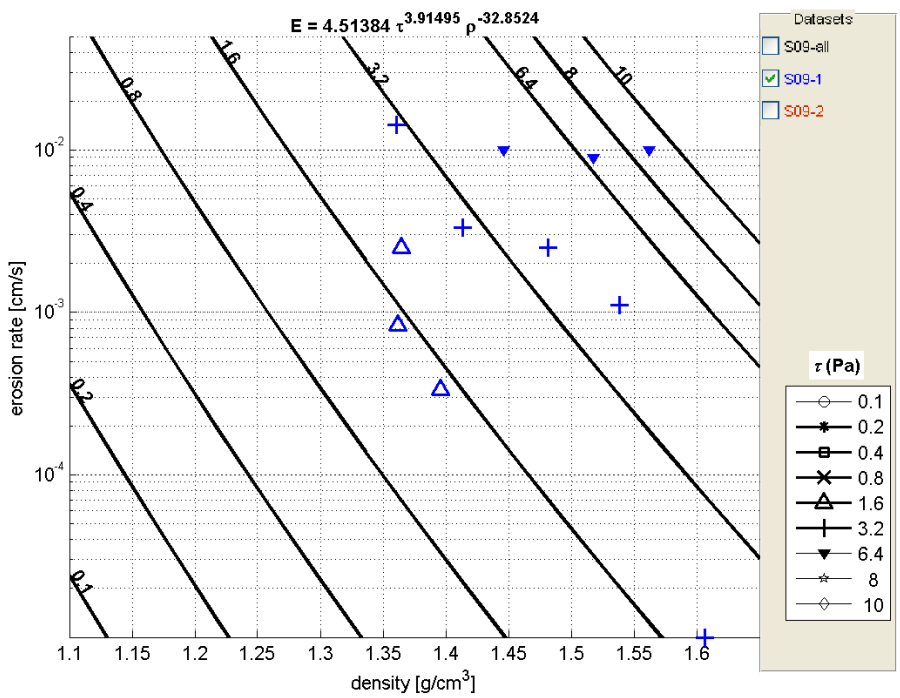


Figure B-48. Station 9, Layer 1 erosion rate vs. density. Lines show optimized function values for each value of shear stress.

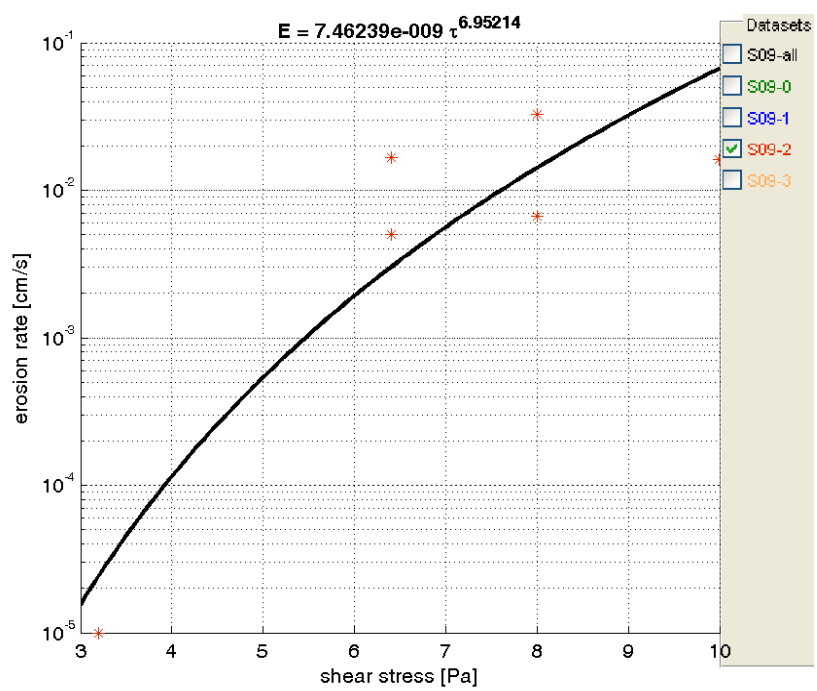


Figure B-49. Station 9, Layer 2 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

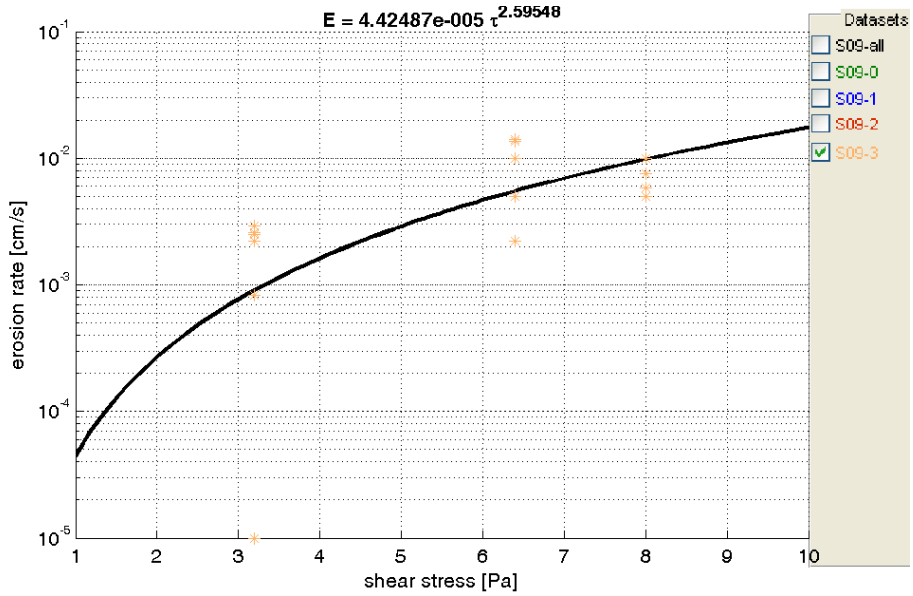


Figure B-50. Station 9, Layer 3 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

Station 10

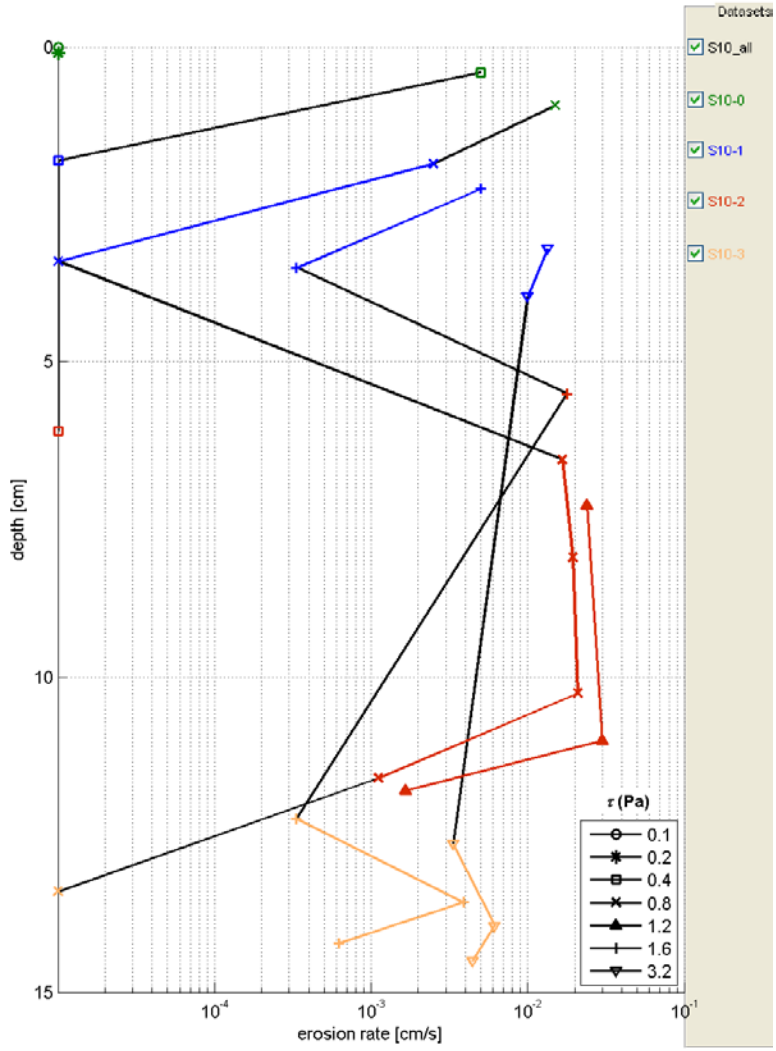


Figure B-51. Erosion rate versus depth and applied shear stress for Station 10. Layer 0 (green) is composed of surface material that was eroded in the first sequence of erosion tests. Layers 1(blue), 2(red), and 3(orange) were determined based on density, grain size and erosion rate data.

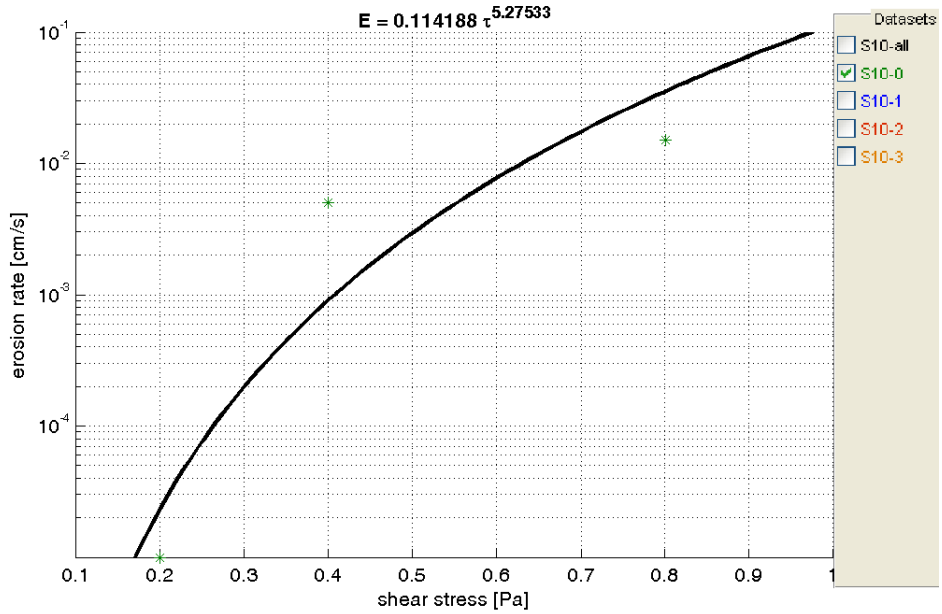


Figure B-52. Station 10, Layer 0 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

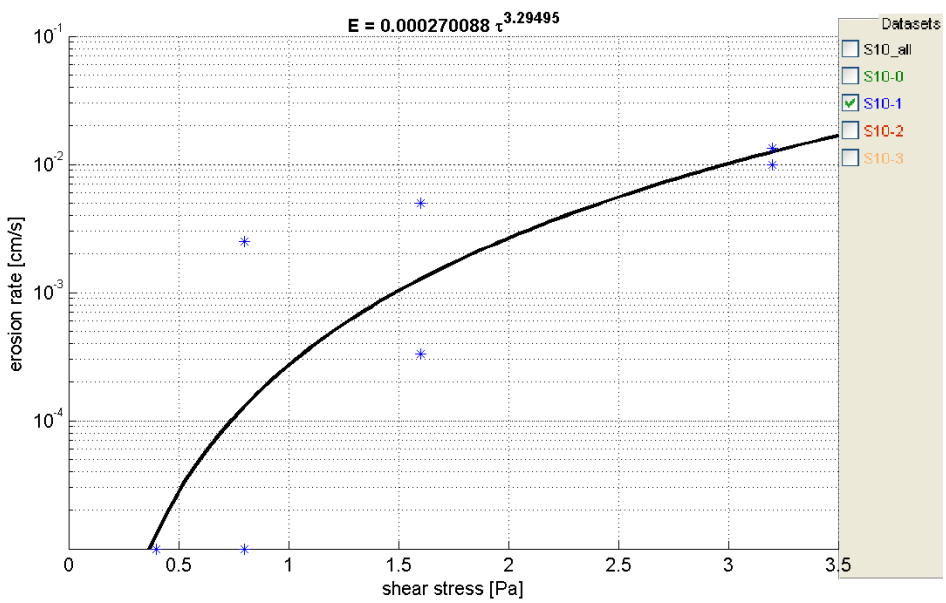


Figure B-53. Station 10, Layer 1 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

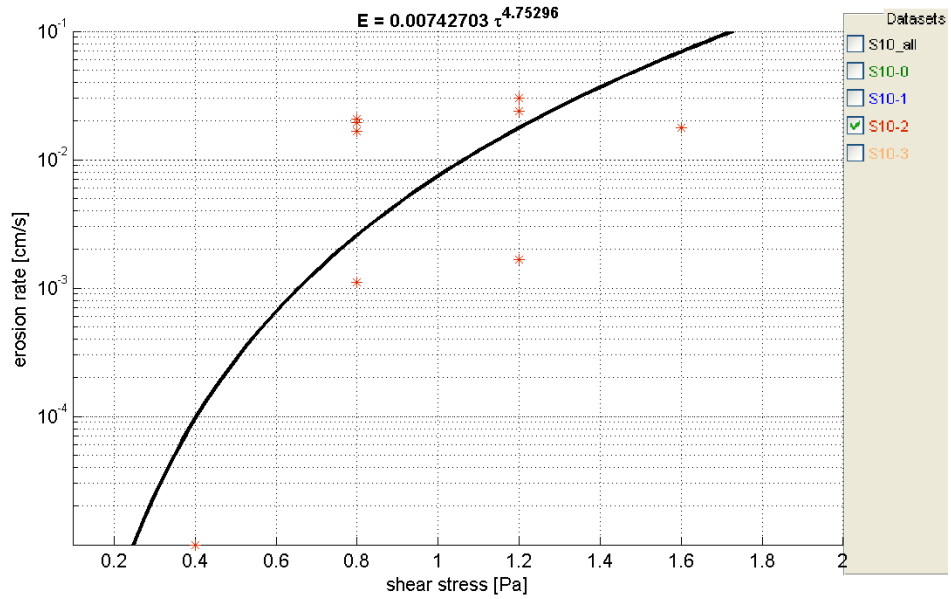


Figure B-54. Station 10, Layer 2 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

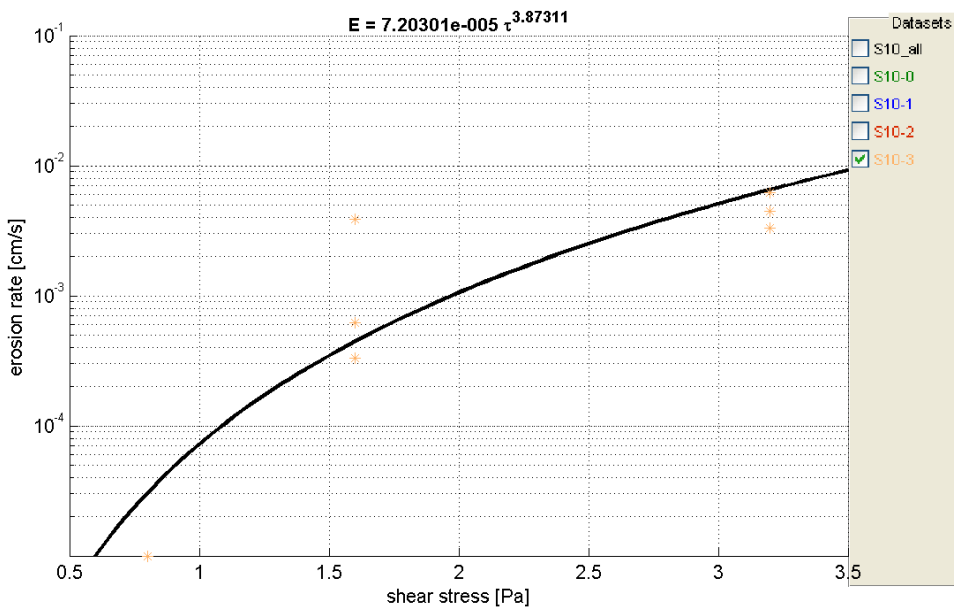


Figure B-55. Station 10, Layer 3 erosion rate vs. shear stress. Line shows best fit of $E = A\ \tau^n$ for data

Appendix C. Sedflume Erosion Rate Parameterization Analysis

This Appendix contains results of Sedflume erosion rate parameterization analysis. Erosion rate data were evaluated for relationships between erosion rate and applied shear stress. Table C-1 shows the groupings that were identified within the data collected in Coddington Cove. Figures C-1 through C-4 show the linear fit of $E = A\ \tau^n$ to the data for each grouping.

Table C-1. Cohesive Sediment Erosion Parameterization for SEDZLJ						
Group	Layers	Depth (cm)	τ_{cr} (Pa)	τ_{max} (Pa)	A	n
A	Layer 0 from all stations	0 - 1.5	0.2	1.6	7.8E-03	1.6
B	S3-1, S4B-1, S5-1	1.5 - 7.5	0.4	6.4	1.2E-03	1.3
C	S7A-1, S8A-1, S8B-1, S9-1	1.5 - 13	0.4	6.4	7.8E-04	1.4
D	S8A-2, S8B-2	12 - 20	1.6	10.0	1.3E-03	1.0
E	S3-2, S5-2, S7B-2	5.5 - 12.5	0.8	6.4	6.4E-04	1.6
F	S2-3, S3-3, S3-4, S7A-2, S7B-3	7 - 21	0.8	12.0	3.2E-04	1.0
G	S9-2, S9-3, S10-3	8 - 18	0.8	10.0	5.0E-04	1.4

Group A

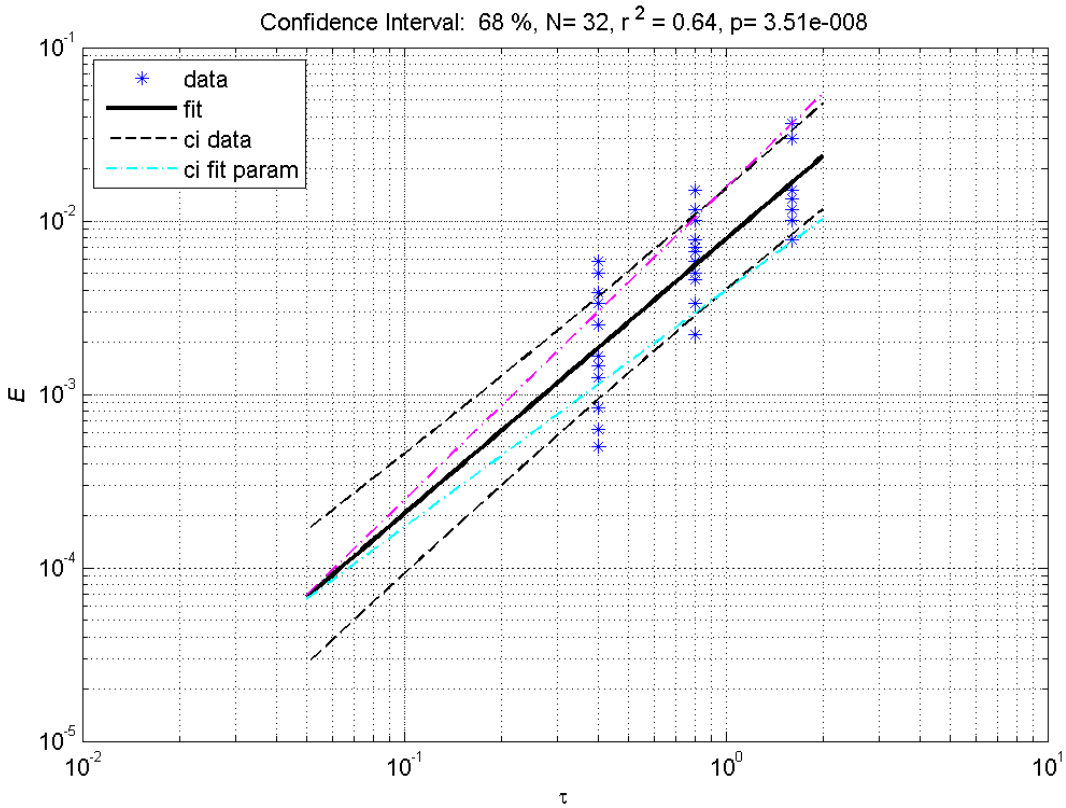


Figure C-1. Erosion rate versus applied shear stress for Group A. The solid black line represents best fit for $E = A\ \tau^n$ to the data. The dashed lines represent the confidence interval at 68% ($\pm\sigma$) of the data (black) and the fit parameters (pink and blue).

Group B

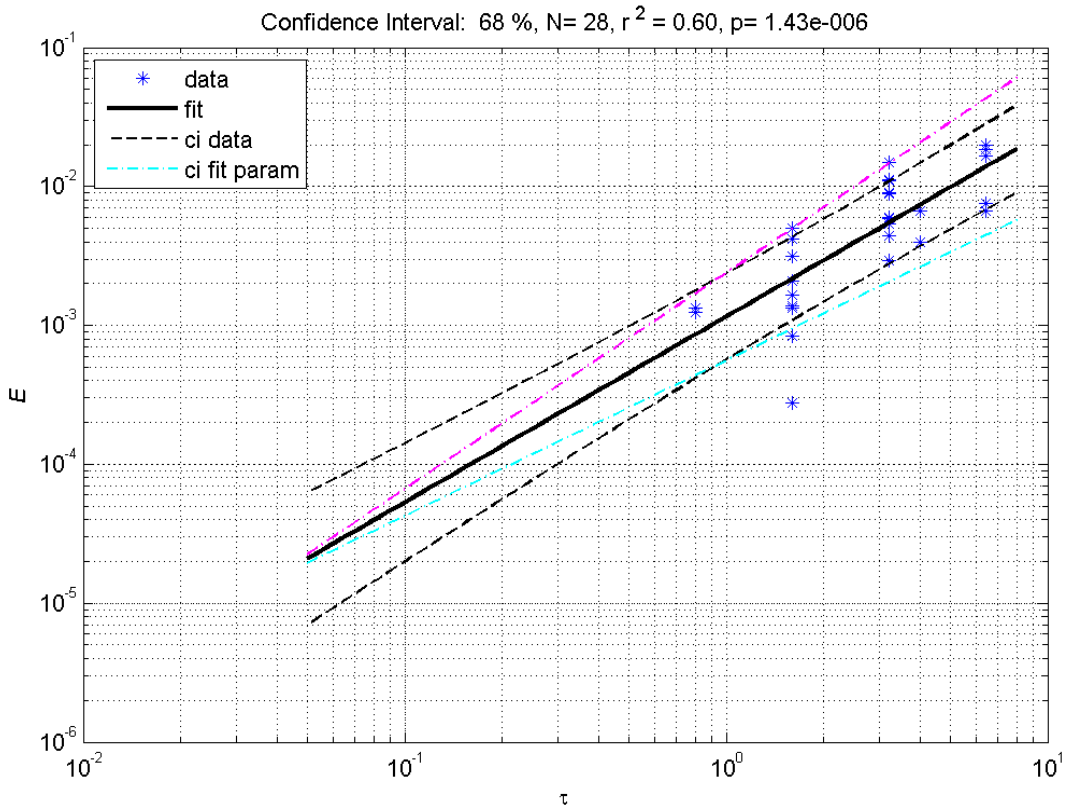


Figure C-2. Erosion rate versus applied shear stress for Group B. The solid black line represents best fit for $E = A\ \tau^n$ to the data. The dashed lines represent the confidence interval at 68% ($\pm\sigma$) of the data (black) and the fit parameters (pink and blue).

Group C

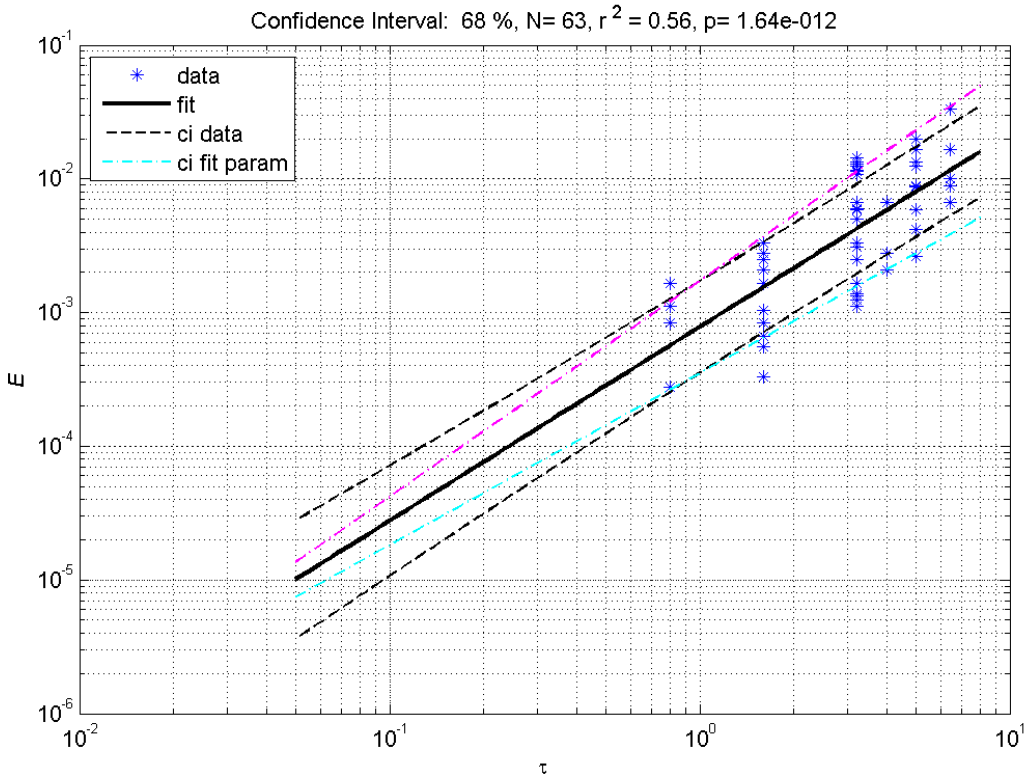


Figure C-2. Erosion rate versus applied shear stress for Group C. The solid black line represents best fit for $E = A\ \tau^n$ to the data. The dashed lines represent the confidence interval at 68% ($\pm\sigma$) of the data (black) and the fit parameters (pink and blue).

Group D

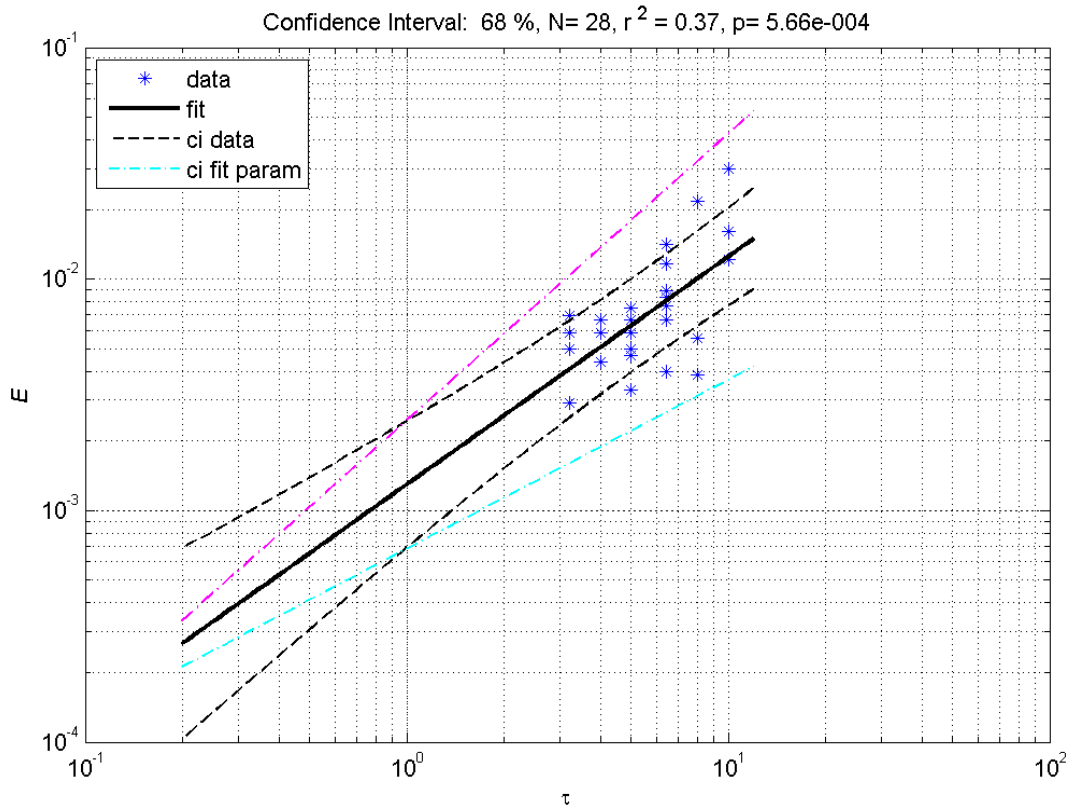


Figure C-3. Erosion rate versus applied shear stress for Group D. The solid black line represents best fit for $E = A\ \tau^n$ to the data. The dashed lines represent the confidence interval at 68% ($\pm\sigma$) of the data (black) and the fit parameters (pink and blue).

Group E

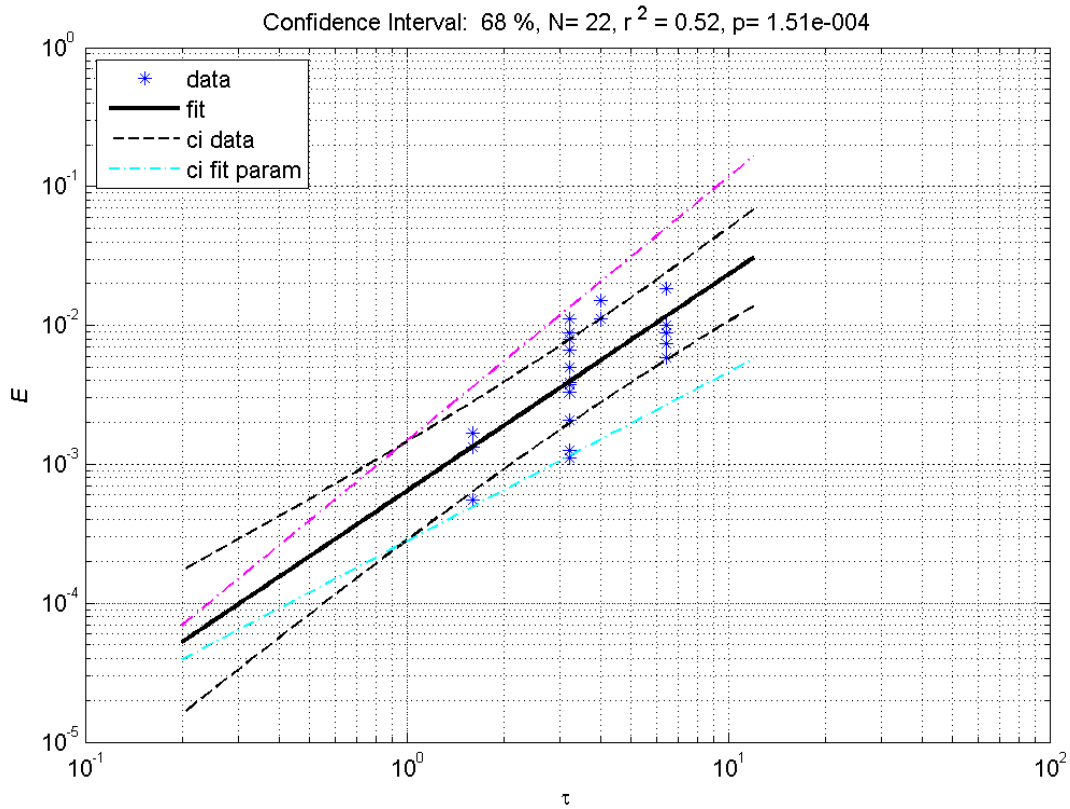


Figure C-4. Erosion rate versus applied shear stress for Group E. The solid black line represents best fit for $E = A\ \tau^n$ to the data. The dashed lines represent the confidence interval at 68% ($\pm\sigma$) of the data (black) and the fit parameters (pink and blue).

Group F

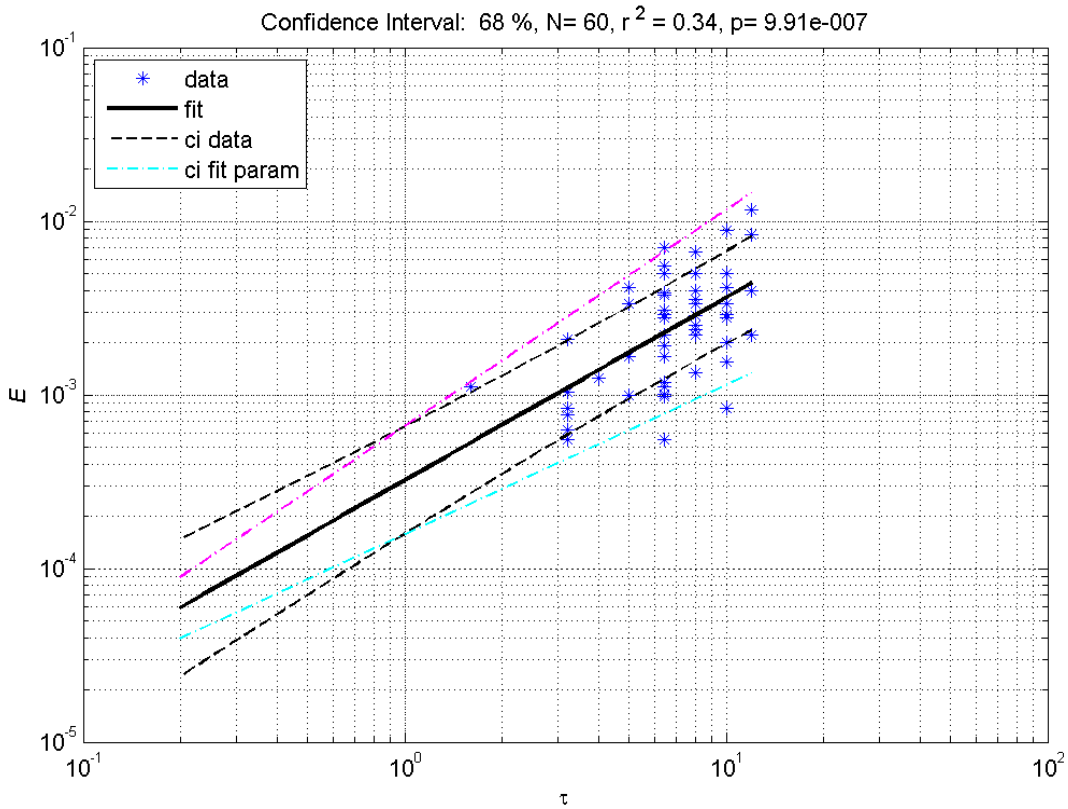


Figure C-4. Erosion rate versus applied shear stress for Group F. The solid black line represents best fit for $E = A\ \tau^n$ to the data. The dashed lines represent the confidence interval at 68% ($\pm\sigma$) of the data (black) and the fit parameters (pink and blue).

Group G

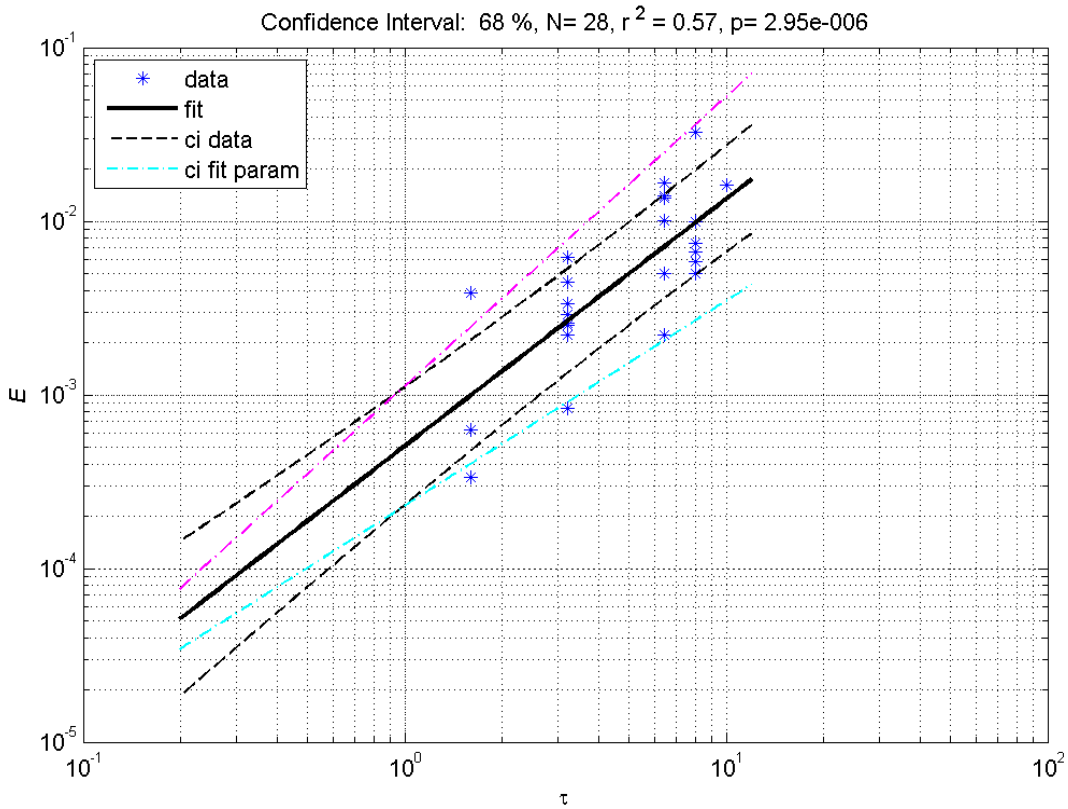


Figure C-4. Erosion rate versus applied shear stress for Group G. The solid black line represents best fit for $E = A\ \tau^n$ to the data. The dashed lines represent the confidence interval at 68% ($\pm\sigma$) of the data (black) and the fit parameters (pink and blue).

D-2 CURRENT, WAVE AND TIDAL ANALYSIS, SEPTEMBER 2011

Coddington Cove, Narragansett Bay RI
Current, Wave and Tidal Analysis
September, 2011

ROGUE WAVE FIELD SERVICES AND OCEAN DATA TECHNOLOGIES
NOVEMBER, 2011

Table of Contents

Table of Contents 2
Introduction 3
Methods 6
Tidal Elevations 7
Currents and Circulation 9
Waves and Wind 14
Turbidity and Backscatter 15

List of Tables

Table 1: ADCP locations and depths p.7
Table 2: Tidal Constituents in Coddington Cove p.8
Table 3: Near-Surface Flow Statistics p.14
Table 4: Near-Bottom Flow Statistics p.14
Table 5: Near-Bottom Temperature Statistics p.14
Table 6: Wave statistics p.15
Table 7: Total Suspended Solids versus ADCP backscatter p.17

List of Figures

Figure 1: Nautical chart of the East Passage in Narragansett Bay and Coddington Cove p.4
Figure 2: Location of the ten (1) ADCP stations p.5
Figure 3: Tidal elevations in Coddington Cove from September 1 to September 17 p.8
Figure 4: Color panels of current speed and direction at site COD01 p.17
Figure 5: Time series of current speed and direction at site COD01. p.18
Figure 6: Color panels of current speed and direction at site COD02. p.19
Figure 7: Time series of current speed and direction at site COD02. p.20
Figure 8: Color panels of current speed and direction at site COD03. p.21
Figure 9: Time series of current speed and direction at site COD03. p.22
Figure 10: Color panels of current speed and direction at site COD04. p.23
Figure 11: Time series of current speed and direction at site COD04. p.24
Figure 12: Color panels of current speed and direction at site COD05. p.25
Figure 13: Time series of current speed and direction at site COD05. p.26
Figure 14: Color panels of current speed and direction at site COD06. p.27
Figure 15: Time series of current speed and direction at site COD06. p.28
Figure 16: Color panels of current speed and direction at site COD07. p.29
Figure 17: Time series of current speed and direction at site COD07. p.30
Figure 18: Color panels of current speed and direction at site COD08. p.31
Figure 19: Time series of current speed and direction at site COD08. p.32

Figure 20: Color panels of current speed and direction at site COD09. p.33
Figure 21: Time series of current speed and direction at site COD09. p.34
Figure 22: Color panels of current speed and direction at site COD10. p.35
Figure 23: Time series of current speed and direction at site COD10. p.36
Figure 24: Mean flow vectors in Coddington Cove just after the time of low water. p.37
Figure 25: Mean flow vectors 1-to-2 hours after low water p.38
Figure 26: Mean flow vectors 2-to-3 hours after low water p.39
Figure 27: Mean flow vectors 3-to-4 hours after low water p.40
Figure 28: Mean flow vectors 2-to-3 hours before high water p.41
Figure 29: Mean flow vectors 1-to-2 hours before high water p.42
Figure 30: Mean flow vectors 0-to-1 hour before high water p.43
Figure 31: Mean flow vectors 0-to-1 hour after high water p.44
Figure 32: Mean flow vectors 1-to-2 hours after high water p.45
Figure 33: Mean flow vectors 2-to-3 hours after high water p.46
Figure 33: Mean flow vectors 2-to-3 hours after high water p.47
Figure 34: Mean flow vectors 2-to-3 hours before low water p.48
Figure 35: Mean flow vectors 1-to-2 hours before low water p.49
Figure 36: Mean flow vectors 0-to-1 hours before low water p.50
Figure 37: Relative phase between tidal elevations and near-surface tidal velocities p.51
Figure 38: Progressive vector diagram for near-bottom flow at sites 1, 4, 6 and 8 p.52
Figure 39: Progressive vector diagram for near-bottom flow at sites 2, 3, 5, and 7 p.53
Figure 40: Progressive vector diagram for near-bottom flow at sites 9 and 10 p.54
Figure 41: Wind speed and direction during the ADCP deployment p.55
Figure 42: Significant wave height for station COD01. p.56
Figure 43: Significant wave height for station COD02. p.57
Figure 44: Significant wave height for station COD04. p.58
Figure 45: Significant wave height for station COD05. p.59
Figure 46: Significant wave height for station COD06. p.60
Figure 47: Significant wave height for station COD07. p.61
Figure 48: Significant wave height for station COD08. p.62
Figure 49: Significant wave height for station COD09. p.63
Figure 50: Significant wave height for station COD10. p.64
Figure 51: ADCP backscatter nearest the bottom at Sites 01 through 05 p.65
Figure 52: ADCP backscatter nearest the bottom at Sites 06 through 10 p.66
Figure 53: TSS concentrations estimated from ADCP backscatter measurements p.67

Introduction

Acoustic Doppler current profilers (ADCPs) were installed within Coddington Cove (Figure 1) for an approximate 17-day period in early September 2011. Ten (10) locations were instrumented (Figure 2), each ADCP was mounted in a fixed frame on the seabed, and with few exceptions measured tidal elevation, water temperature, current profiles, and surface waves. The units were deployed September 1 and recovered about September 17. One station (GP05) was maintained until September 30. Station GP07 failed after 7 days of operation; however near-bottom data collected by this unit during these seven days appeared suspect and was therefore ignored.

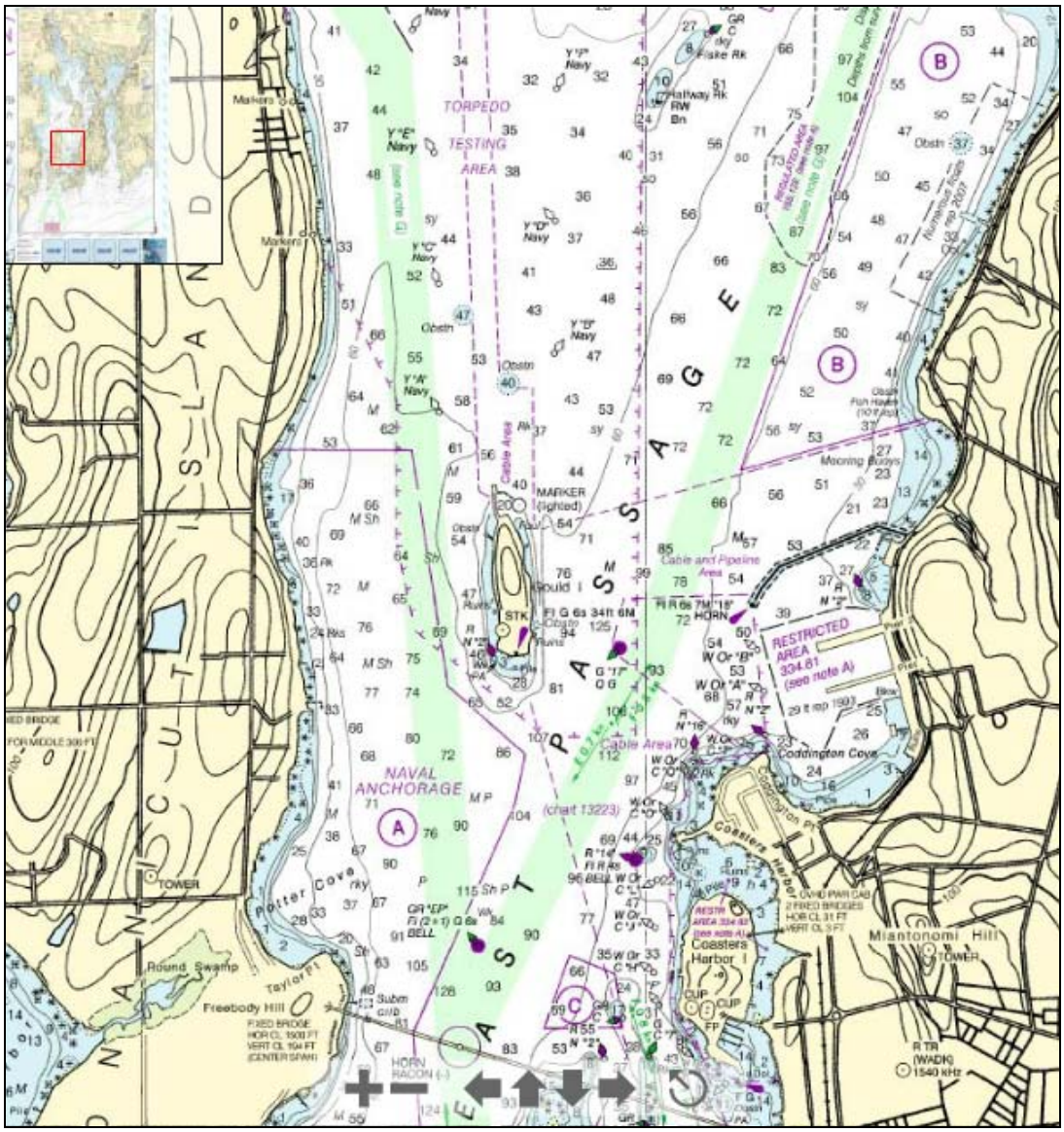


Figure 1: Nautical chart of the East Passage in Narragansett Bay and Coddington Cove on the eastern shore. The Cove's geometry and northern breakwater provides shelter from most directions, steering circulation and limiting wave energy.

The collected data are presented in this section. Because tides dominate circulation processes, tidal elevation data are presented initially, followed by currents and general circulation, then wind and waves. Finally, an analysis of the acoustic backscatter data and comparison to suspended sediment samples is presented. All data are presented graphically as well as summarized in tables of calculated statistics.

In general, there was little energy found within Coddington Cove; currents were weak and wave heights small. Tides dominated the circulation. Few wind events occurred during the deployment to induce mixing or other non-tidal responses. This is unsurprising given the Cove's geometry and physical barriers such as the breakwater to the north, which serves to shelter the Cove from physical processes occurring in the more energetic Narragansett Bay. Turbidity – as estimated by ADCP backscatter – appeared to be relatively low during this time period, with some evidence of elevated turbidity during wind events.

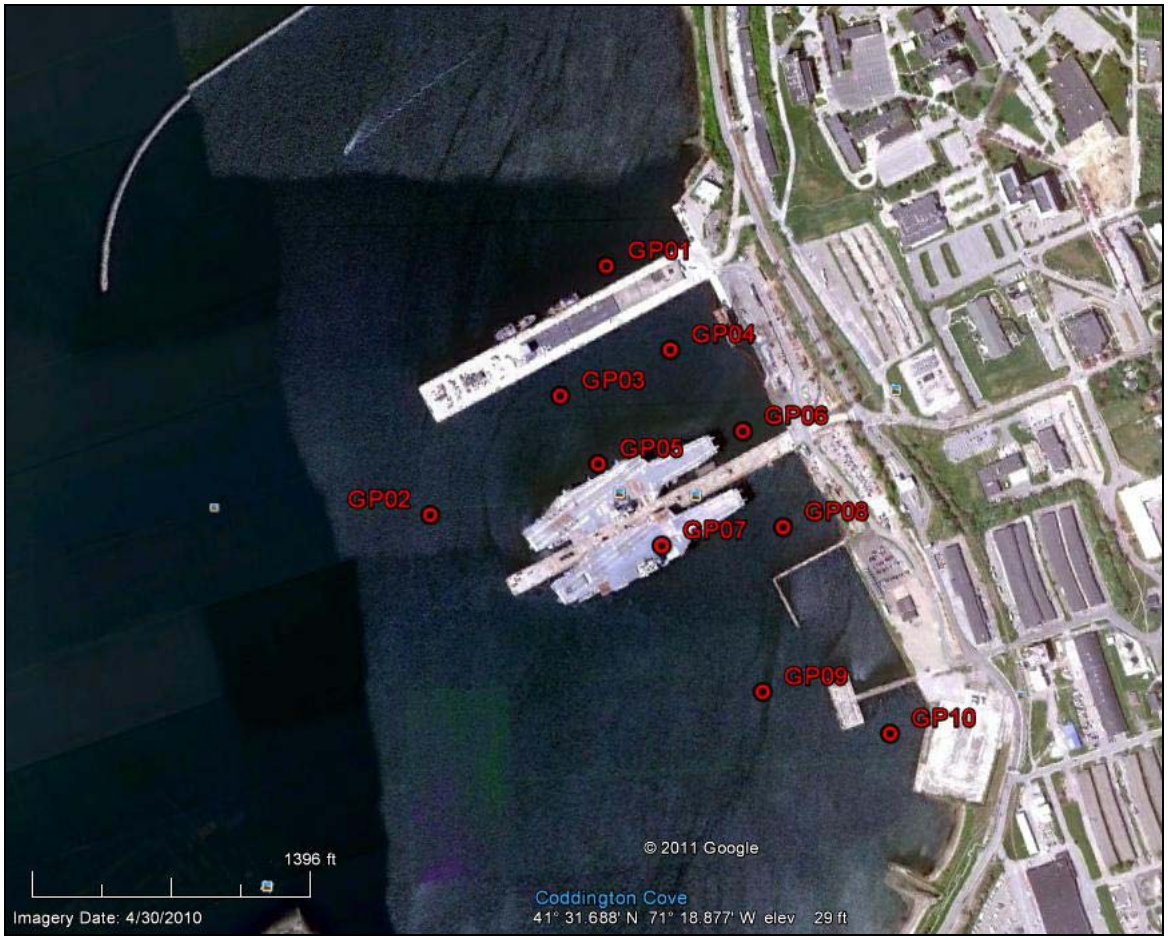


Figure 2: Location of the ten (1) ADCP stations, deployed from September 1 to September 17. Location GP05 was deployed for 30 days. The aircraft carriers shown in this photograph were not present during the deployment.

Methods

On September 1, 2011, Rogue Wave Field Services (RWFS) and TG&B deployed 10 bottom mounted RDI Acoustic Doppler Current Profilers (ADCP) at several locations in the vicinity of the former Director's Shipyard in Coddington Cove, RI. The instruments were deployed for 16 days prior to being recovered. All the instruments except for 1 (GP03) were able to measure water column profiles of both current speed and direction, and wave height and direction. Because of the difficulty in obtaining 10 wave ADCPS during that time of year we obtained permission from the client and were authorized to deploy 1 non wave ADCP which only measures currents. Two frequencies of ADCPs were used, (1200 and 600 kHz), both with high enough resolution for the measurements that were being obtained in that depth of water. Figure 2 shows the ADCP deployment locations and Table 1 provides the station coordinates as well as the water depth at each station.

On September 17th 9 of the 10 instruments were recovered using SCUBA divers without any difficulty. Station GP05 which was deployed just north of the USS Saratoga eluded the divers despite there being 4 dives to recover the instrument. Station GP05 was recovered September 30th.

Station Number	North	West	Water Depth (ft.)
GP01	41 31.8677	71 18.9297	30
GP02	41 31.6998	71 19.1749	42.5
GP03	41 31.7728	71 19.0088	38
GP04	41 31.7899	71 18.8808	39
GP05	41 31.7110	71 18.9723	42
GP06	41 31.7123	71 18.8222	38
GP07	41 31.6346	71 18.9351	40
GP08	41 31.6286	71 18.8013	39
GP09	41 31.5002	71 18.8610	28
GP10	41 31.4449	71 18.7346	19

Table 1: ADCP Station Locations

Tidal Elevations

Tides dominate circulation processes within Coddington Cove. The tide range was about 1.4 meters during spring tides; the neap tide range was approximately 0.8 meters (Figure 3).

Based on the 30+ day tide record from station 05 we were able to calculate the following constituent amplitudes (Table 2). The largest contributor to tidal variability is the lunar semi-diurnal (M2) tide with an amplitude of 0.51 meters. Surrounding semi-diurnal tides have lesser amplitudes, the solar S2 and lunar elliptic (N2), about 0.13-0.14 m. Diurnal tides K1 and O1 have amplitudes about an order of magnitude less than the lunar semidiurnal. Frictional overtides of the lunar semi-diurnal, the M4 tide, had an amplitude about twice the diurnal constituents (0.07m).

Table 2: Tidal Constituents in Coddington Cove (Location 5, 29+ day record)

Constituent	Symbol	Period (hours)	Amplitude (m)
Lunar Semi-diurnal	M2	12.42	0.51
Solar Semi-diurnal	S2	12.00	0.13
Larger lunar elliptic semi-diurnal	N2	12.66	0.14
Lunisolar Diurnal	K1	23.93	0.04
Principal lunar diurnal	O1	25.82	0.05
Shallow-water overtide of principal lunar	M4	6.21	0.07

Tidal modulation is the interaction/combination of the various constituents. The diurnal tidal inequality, which is manifest as one high tide being greater than the next high tide (i.e. the high-high tide and low-high tide each day), and the fortnightly spring-neap cycle are two examples of such tidal modulation. The semi-diurnal tide was an order of magnitude larger than the diurnal constituents, so the diurnal inequality therefore would be relatively small. At Coddington Cove, the diurnal inequality results with one high tide – on average – about 0.1-0.2 m higher than the succeeding high tide. Fortnightly spring-neap cycles result from modulation of neighboring semi-diurnal tides; tide range was about 1.4m during spring tide phase in early September and about 0.8m during the neap phase a week later.

Distortion of the tidal signal results from fictional effects as the tide propagates through the system. The frictional overtides such the M4 constituent will tend to shorten one phase of the tide cycle and elongate the next cycle. At Coddington Cove, the falling (ebb) tide was - on average - about 5.6 hours in duration. The rising (or flood) tide was much longer, approximately 6.8 hours in duration. The relative durations of the flood versus ebb cycles at Coddington Cove is in marked contrast to most estuarine tides in this region. Most estuaries have a longer falling/ebb tide, due largely to the longer time

required to drain water from marshes and other tidal areas, and a shorter rising/flood tide. As a consequence, flood tides normally feature much faster speeds than ebb tides since the same volume of water must be transported in/out of the embayment but over a shorter time period, hence a slightly faster flow. Estuarine systems with faster flood tides are referred to as 'flood-dominant' systems. In this case however the ebb tides are shorter and therefore faster, so based on this calculus Coddington Cove might be considered an 'ebb-dominant' system. The upshot of tidal distortion is that ebb-dominant estuaries will tend to flush particles/sediments from the system more readily since the faster ebb current speeds are more capable of initiating particle transport. Flood-dominant estuaries on the other hand tend to be a net trap for sediments.

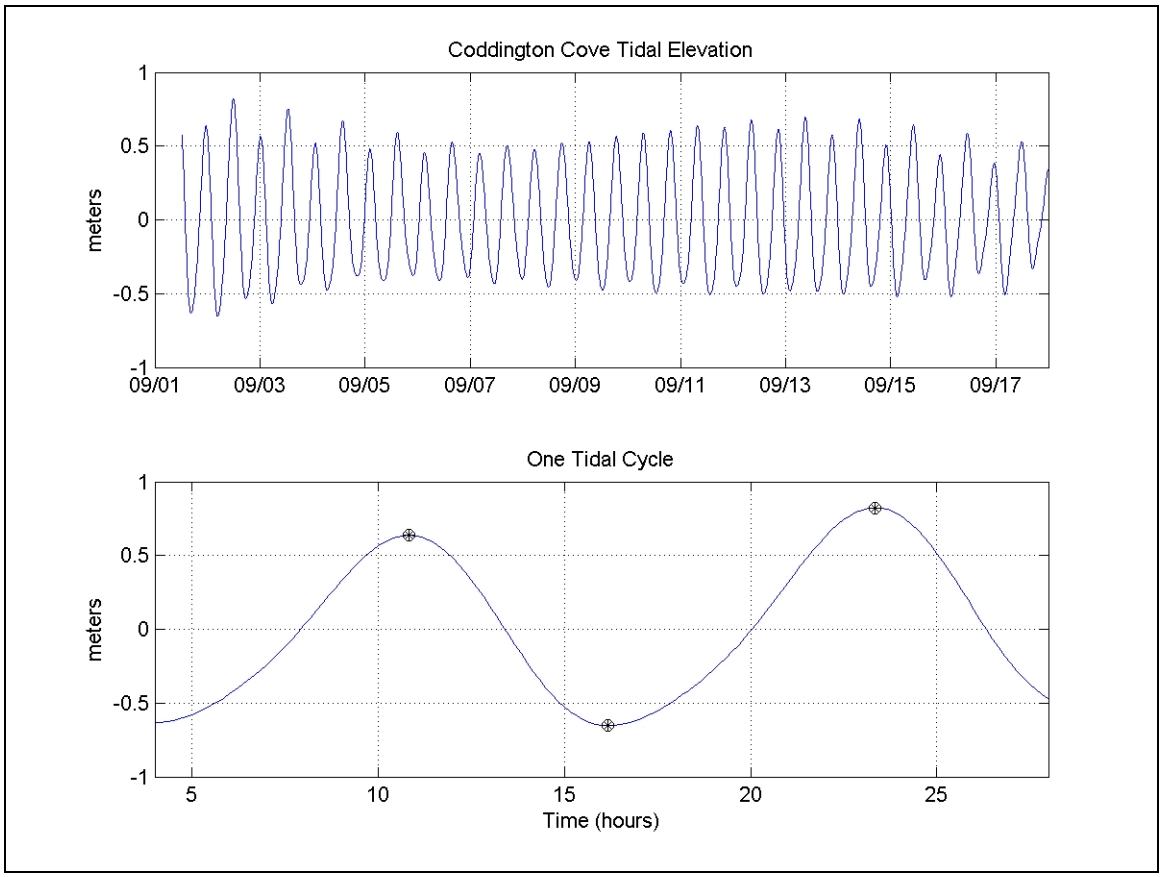


Figure 3: Tidal elevations in Coddington Cove from September 1 to September 17, 2011 (top plot). The bottom plot shows one (typical) tidal cycle distorted by shallow-water frictional processes. Markers show the top and bottom of the tide. The falling/ebb tide, about 5.6 hours in duration on average, was shorter than the rising/flood tide, which was about 6.8 hours in duration.

Currents and Circulation

Currents in Coddington Cove were dominated by tides, but due to Cove geometry and sheltering from the northern breakwater current speeds were quite weak throughout the deployment, never exceeding 40 cm/sec (about 0.8 knots). Wind effects on overall circulation were small during this time since few storms occurred during the deployment.

Current data are presented in total in Figures 4 through Figure 23. The graphics include color-contoured plots of current speed and direction, a high-resolution presentation at 10-minute samples and 0.25-m depth resolution. To the right of the color-contour plots are vertical profiles, the speed profile to the upper right and the current direction profile to the lower right. Both mean speed/direction and maximum speed /direction of the maximum speed profiles are presented. In addition, time series of the (averaged) near-surface and near-bottom layer speeds and directions are plotted. To the right of the time series graphs are simple scatterplots. These graphics provide a relatively complete view of the flow measurements at each location.

Table 3 and Table 4 present current statistics for each of the ten ADCP locations. The measurements were separated into two layers, the near-surface or upper half of the water column and the near-bottom (or lower half of the water column). The mean speed and direction for these layers at each station were calculated (as a true vector average), along with a reporting of the peak speed, direction of the peak speed, and the overall signal variance. The variance provides an indication of the overall current energy at each location.

A few details regarding the data processing should be noted. The ADCPs were mounted on the bottom, looking upward, and configured for small bins, generally about 0.25m bin sizes (i.e. vertical resolution). The ADCPs cannot measure very close to reflective boundaries – such as the sea surface – due to acoustic interference and associated side lobe reflections which overwhelm the current-measuring acoustic pulse. So the bins close to the surface become biased and therefore discarded. When this near-boundary bias is coupled with tidal elevation changes of ~0.8m to 1.4m, the uppermost bins that were measured reliably under all conditions were roughly ~2m below the mean sea surface. So the resulting near-surface layer – after discarding upper bins biased by interference and tidal variability – was centered roughly ~4m below the mean sea surface. The near-bottom measurements were centered roughly ~8m below mean water, or about 3m above the bottom. Each site was slightly different based on the actual water depth. For the shallow-water stations, 09 and 10, the near-surface means were centered 2.8m and 1.9m, respectively, and the near-bottom means centered 2.3 and 1.5m above the bottom.

The peak measured speed –after layer averaging was performed - within Coddington Cove was 29.3 cm/sec (about 0.57 knots), observed near the surface at Station 02. This maximum speed was towards the north-northeast (33°). Station 03, located northeast of Station 02, recorded a peak speed of 22 cm/sec toward the east-northeast. Station 2 had the greatest mean velocity (~3 cm/sec) and also the highest variance (energy). Station 3 was found to be the next most energetic, with variance about one-half that at Station 2. Station 9 was also relatively energetic, with a mean velocity of 2.3 cm/sec, and a variance measure about one-third of Station 02.

Station 02 also recorded the strongest bottom flows, 17.3 cm/sec, but this maximum current was oriented to the south-southeast, opposite the peak surface flow. Opposing surface and bottom flows were found at several locations. For example, the mean surface flow at Station 01 was westward while the mean bottom flow was ~northeastward. The same was true for Stations 03 and 05, the mean flows were opposite. This change of the mean flow directions between surface and bottom layers are highlighted in the color-contoured graphics. The right-hand plots are the maximum and mean current profiles, current speed shown as the top plot and current direction shown as the lower plot.

The direction and speed of currents measured at the various locations appeared dependent upon the particulars of each site. Unlike tidal elevations, which vary little between stations within the Cove, currents can vary significantly from one location to the next, primarily due to the presence of nearby structures and other flow barriers which steer the flow accordingly. Some sites were located near the piers, and hence observed flow was parallel to those pier structures. Other locations were closer to the shoreline, with flow generally parallel to that boundary.

In an attempt to visualize the general circulation patterns within the Cove, velocities at each location were sectioned, averaged, then overlaid as geo-referenced vectors on the shoreline and pier structures. Since tides were the dominant physical process, and tides are conveniently periodic, we sectioned the time series into discrete tidal cycles. A total of 30 tidal cycles occurred during the deployment. Each cycle was then divided into finite time periods: 1 hour after high water, 2 hours after high water, 3 hours after high water, then 3 hours before low water, 2 hours before low water, etc. Velocities measured at each location for these cycle sub-sections were grouped together and averaged, such that the 'mean' flow 1 hour after high water, 2 hours after high water, etc., could be visualized. This calculation was done for both the near-surface layer and the near-bottom layer. The mean tidal circulation patterns emerged from this analysis.

Figures 24 through 36 show the mean flow vectors at hourly increments of the tidal cycle. The left-hand plot depicts the surface layer circulation; the right-hand plots are the near-bottom vectors. The first increment, Figure 24, is for the time period 0-to-1 hour after low water and shows relatively strong flow eastward into the Cove. As the eastward flows meet the bulkheads on the shoreline it appears to split, most flowing southward parallel to shore but a small amount flowing northward (at Station 1). This general circulation pattern holds until 3-to-4 hours after low water (Figure 27), when the flow weakens about 2-to-3 hours before high water (Figure 28). As high water approaches the circulation

appears to turn westward, or drain from the Cove, continuing a westward trend 2 hours before high water until about 2 hours after high water. Currents appear to rotate northward about 1-to-2 hours before low water, then northeastward, then eastward to complete the cycle. Bottom currents follow the same general trends, albeit weaker than surface flow and – at times –in an opposite direction.

An interesting issue is the relative phase of tidal elevations and tidal velocities, particularly at Station 02 in the center of the Cove. Typically, high and low water are associated with slack currents, and peak tidal velocities are usually found at the half tides. Tidal velocities are generally a quarter cycle, or 90 degrees, out of phase with tidal heights. However it appeared surface velocity and height were 180 degrees out of phase, in other words, highest incoming velocities were found surrounding the time of low water. The greatest ebb velocities were observed during high water (Figure 37). Vertical stratification – differences between near-surface and near-bottom flow - may also play a role in this observation, as near-bottom flood/ebb velocities appeared to be in phase with tidal elevations.

The relative phase between tidal elevation and surface flood/ebb velocities seemingly contradicts the previous statement that Coddington Cove appeared to be an 'ebb-dominant' system. This assessment stemmed from the asymmetry of the tidal curve, noting that the flood tide duration was relatively longer than the ebb tide duration, and infers that higher outgoing ebb velocities will tend to flush particles from the system. A flood-dominant system would tend to be a net trap of particles. But Figure 37 – at Station 02 - shows that the incoming flood velocities were much greater than the ebb flows, at least in the near-surface layer at that one location. The explanation for this seemingly contradictory evidence must lie in spatial variability of the flow field. If Station 02 is experiencing strong incoming flow around low water – even as the water level continues to drop – then flow at other locations must be exiting the system. Outbound flow must be occurring at the edges of the entrance – Coddington Point or the corner of the northern breakwater– to balance the tidal elevation curve with overall velocities.

The complexity of the tidal wave traveling through the East Passage of Narragansett Bay – and the frictional characteristics affecting tidal asymmetry - must also be considered. Tidal energy at the entrance to the Cove is the forcing function governing responses within the cove. The East Passage is relatively deep compared with the tidal range, an approximate tidal amplitude/channel depth ratio of 1:10; estuaries with this ratio are nearly always ebb-dominant, and so the characteristics of Coddington Cove can be traced directly to tidal forcing in the East Passage which, unfortunately, was not monitored during this program.

Another useful tool for assessing sediment transport tendencies at various locations is progressive vector diagrams. These diagrams show the (theoretical) net drift path taken by an in situ particle based on bottom current speeds/directions. If the bottom speed was 10 cm/sec to the west, and samples were obtained every 10 minutes, a particle would travel – theoretically– 6000 centimeters westward over the sample interval. If the next measurement were 5 cm/sec to the north, then the particle would travel 3000 cm

northward from the previous point. Progressive vector diagrams therefore provide an indication of the net drift over the course of the deployment. These diagrams are shown for all stations as Figures 38 through 40. Figure 38 presents stations 01, 04, 06, and 08, all located in the northern nearshore areas. The net drift for 01, 06, and 08 is essentially southeastward parallel to the shoreline. Station 04 is eastward, into the shore. Station 02 (Figure 39) was southeastward also, but meandered in what appear to be tidal ellipses. Station 05 was eastward, along the pier, while Station 03 was westward, also parallel to the pier but in the opposite direction. This may suggest a counterclockwise circulation pattern between the two piers. Progressive drift at Station 09 was southwestward, parallel to the shoreline in that area, while Station 10 was northward, also roughly parallel to the shoreline.

Table 3: Near-Surface Flow Statistics

Station	Mean depth of Measurement	Mean speed (cm/sec)	Mean Direction (degrees)	Maximum speed (cm/sec)	Direction of Peak Speed	Variance $(cm/sec)^2$
01	3.9	0.6	270	9.6	358	9.28
02	4.0	2.9	32	29.3	33	62.13
03	3.9	1.6	80	22.2	61	34.65
04	4.1	0.3	111	16.9	339	18.79
05	4.4	0.4	257	12.9	83	13.58
06	3.8	0.2	82	13.7	17	17.48
07**	4.0	0.6	162	16.0	109	19.20
08	3.8	0.5	192	11.8	49	9.84
09	2.8	2.3	159	15.4	177	22.04
10	1.9	0.7	12	8.0	356	5.47

***Only 7 days of valid data were recorded*

Table 4: Near-Bottom Flow Statistics

Station	Mean depth of Measurement	Mean speed (cm/sec)	Mean Direction (degrees)	Maximum speed (cm/sec)	Direction of Peak Speed	Variance $(cm/sec)^2$
01	7.4	0.2	51	9.7	132	9.96
02	7.8	1.0	55	17.3	160	42.61
03	7.9	0.3	227	14.2	73	22.01
04	8.2	0.3	132	8.5	117	7.97
05	8.9	0.6	79	14.6	89	16.79
06	7.6	0.1	96	8.5	204	7.33
07**	7.3	1.1	245	12.3	102	14.36
08	7.8	0.3	203	7.3	77	4.59
09	5.6	1.4	172	12.6	177	19.46
10	3.2	0.8	5	8.6	28	4.95

***Only 7 days of valid data were recorded*

Table 5: Near-Bottom Temperature Statistics

Station	Depth of Measurement	Mean Temperature (deg C)	Minimum Temperature	Maximum Temperature
01	11.1	20.09	19.21	21.50
02	11.4	19.60	18.74	20.58
03	10.9	20.12	19.16	21.49
04	11.1	19.94	19.01	21.27
05	12.0	19.94	19.08	20.99
06	10.4	19.97	18.93	21.44
07**	11.0	20.29	19.42	21.12
08	10.7	20.14	19.15	21.48
09	7.9	20.46	19.34	21.88
10	4.7	20.78	19.63	22.13

***Only 7 days of valid data were recorded*

Waves and Wind

The shoreline and north breakwater shelter Coddington Cove from long-fetch waves from nearly every direction; the exception the western entrance open to the East Passage. Yet westerly fetch is also limited to a few miles by Gould and Conanicut Islands (Jamestown), which limits wave field development. The Cove geometry, coupled with the lack of significant wind events over the two-week measurement period, resulted in very low-amplitude wave observations. Low signal energy resulted in variable/noisy wave period and wave direction calculations, which is common in low signal-to-noise environments. Maximum significant wave heights were less than 0.4 meters; rarely did the significant wave height exceed 20 cm. Wave time series are shown as fFigures 42 through 50.

Sites 09 and 10 featured the largest waves, occurring September 16 when winds shifted from the southwest to the north (Figure 41) and increased to approximately 10 m/s (~20 knots). Wave period were about 3 seconds – locally generated wind waves – from the west and northwest. These northerly winds must have created south-propagating waves in Narragansett Bay which bent around the breakwater and impacted the southern nearshore sites. This event appeared to be the only notable wave event.

Table 6 (below) tallies various statistics for each site: peak Hs, most common wave period, mean wave direction, and total wave variance. Peak Hs is the maximum significant wave height observed during the deployment, 0.37m, at location 09. Wave period mode refers to the most common wave period (after filtering out data when wave heights were less than 5 cm); generally waves were very short, typical of sheltered areas. The mean wave direction was calculated (correctly) as a vector-mean. Total variance was calculated as the sum of all waves, using the relationship Hs=4*sqrt(Variance), and represents the summed energy of all waves during the deployment. This value suggests Site #5 was the most energetic location, followed by Sites 3, 4, and 9.

Table 6: Wave statistics

Site	Peak Hs (meters)	Wave Period Mode (most frequent occurrence, seconds)	Mean Wave Direction (vector mean)	Total Variance (sum of all waves)	Percent Hs>5 cm	Percent Hs>10 cm
01	0.27	7.7	196	0.09	24.7	8.6
02	0.23	1.8	304	0.06	19.2	6.0
04	0.19	2.3	234	0.11	40.1	10.7
05	0.32	2.4	235	0.18	37.5	10.3
06	0.23	8.2	16	0.06	26.4	4.4
07	0.16	2.2	269	0.10	94.4	11.7
08	0.19	8.2	83	0.05	22.5	3.4
09	0.37	2.3	300	0.11	36.2	8.8
10	0.24	8.2	134	0.06	23.5	3.1

Turbidity and Backscatter

ADCPs record echo amplitude as well as current information, where echo amplitude is a measure of the loudness of the returning acoustic pulse. A louder echo, or higher echo amplitude, generally indicates the presence of a higher concentration of sound scatterers within the water column. Once adjusted for sound absorption, attenuation, distance and other factors, echo amplitude is used to calculate relative acoustic backscatter, which when calibrated properly can be used as a proxy indication of suspended sediment. Figure 51 and Figure 52 present the near-bottom average backscatter time series for all locations. There does appear to be some dependence of backscatter on wind events during the deployment, particularly at Stations 09 and 10 where wave heights were elevated on September 16.

Water samples were obtained at each of the ten ADCP stations in an attempt to calibrate ADCP backscatter data with total suspended solids (TSS). Sampling was performed on three occasions: September 1, September 6, and September 17. Each water sample was obtained approximately 1 meter above the seabed. The purpose of this comparison was to determine how well backscatter can be used as an indicator of absolute suspended sediment concentrations to provide quantitative measures of concentrations where/when water samples were not obtained. It should be noted that the backscatter data from one specific ADCP cannot be compared directly to backscatter from another, different ADCP unit, even if the units operate at the same frequencies. For this reason, each ADCP was calibrated using the three bottle sample points; three points are considered the minimum required for a reasonable calibration. Some problems were encountered during the calibration. In many cases, the depth of the bottle sample was deeper than the first ADCP bin, so the first ADCP bin was chosen for. These depth errors were as small as 20 cm in some cases but as large as 3 meters in others, always with the ADCP backscatter estimate at the shallower depth. Secondly, on a few occasions the time of the bottle sample was either before the ADCP was deployed on September 1 or after the ADCP had been recovered on September 17, so an exact match in time was impossible. In these cases, the closest valid ADCP measurement was used for comparison.

Physical conditions on these sampling days were mild. Bottom currents were less than 10 cm/sec, except for locations 02 and 03 where currents were slightly greater than 10 cm/sec. Wave heights were less than 10 cm. Conditions did not appear sufficient to initiate sediment suspension in the water column. As a result, both measured TSS and backscatter signals were relatively low, indicating little suspended material in the water column at the time of sampling.

Water samples collected at all stations were linked to the respective ADCP backscatter data to identify the precise ADCP time/ensemble/depth for each water sample. One ADCP backscatter value was determined for each water sample. For each water sample, the average ADCP backscatter values across all four acoustic beams were calculated. Because backscatter measurements are dependent upon the volume/size of sound scatters (i.e. the combination of suspended sediments, fish, plankton, detritus, vegetation, even air bubbles), the data can be biased significantly by non-sediment sources. As a quality

assurance indicator the standard deviation of average value of backscatter values was determined. Low variance indicated the average value was valid. High variance within the sample neighborhood indicated backscatter values varied considerably in both time and space, and that the sample may not be suitable for inclusion into the calibration procedure. No samples were discarded due to high variance, although variations of ~20 dB were found for some units, which is an unusually high spread. These high spreads were caused by high counts on individual beams, perhaps due to interference with nearby structures or inherent differences in the individual transducers.

Since ADCP backscatter is a logarithmic function of echo amplitude, backscatter data were plotted against the natural log of TSS for comparison at each site. This log-linear plotting procedure follows that of Battisto and Freidrichs (2002). Regression coefficients were determined between ADCP backscatter and log(TSS) to gauge the goodness-of-fit between the two quantities. Regression values of 1 indicate the calibration fit accurately predicts 100% of the true TSS signal. Regression values less than about 0.6 indicate poor calibration results. Only three stations: 01, 02, and 06 had regression coefficients indicating reasonable calibration.
TSS estimates from the two sites with the best calibration results, stations 02 and 06 with R^2 values better than 90%, are presented as Figure 53. These estimates were obtained from the backscatter-water sample calibration coefficients (after transforming TSS back from the natural log values). These estimates suggest TSS values ranging from near zero to ~20 mg/L. TSS values at Station 02 were relatively constant throughout the deployment, about 7 mg/L, not surprising given the lack of strong currents and/or wave events that might cause sediment transport. Station 06 showed much more variability, particularly brief, abrupt spikes (which suggest noise or passing fish), although there was some correlation to wind/wave events such as the increase in TSS on September 16 when wave heights were greatest. TSS values spiked above 20 mg/L during this event.

Table 7: Total Suspended Solids versus ADCP backscatter

Station	Depth of sample (m)	ADCP Backscatter (dB)			TSS Water Sample (mg/L)			Regression Fit (R^2)
		Sept-01	Sept-06	Sept-17	Sept-01	Sept-06	Sept-17	
01	10.7	70.42	72.30	71.21	8.0	2.0	9.0	0.77
02	12.2	71.93	69.32	67.79	6.4	6.8	7.6	0.90
03	11.0	65.69	63.52	60.12	9.6	7.6	7.6	0.63
04	11.0	81.63	73.13	78.89	26.0	6.4	6.4	0.56
05	11.9	77.27	73.80	75.85	19.0	5.6	36.0	0.52
06	10.7	76.59	74.36	76.77	7.6	4.4	8.0	1.00
07**	11.3	-	-	-	13.0	8.4	18.0	-
08	10.7	80.92	78.24	81.69	12.0	9.2	7.6	0.01
09	7.9	77.82	72.07	72.83	12.0	35.0	8.0	0.14
10	4.9	77.05	75.27	90.86	4.4	8.0	6.0	0.01

*** Instrument malfunction prevented backscatter comparisons at Station 07*

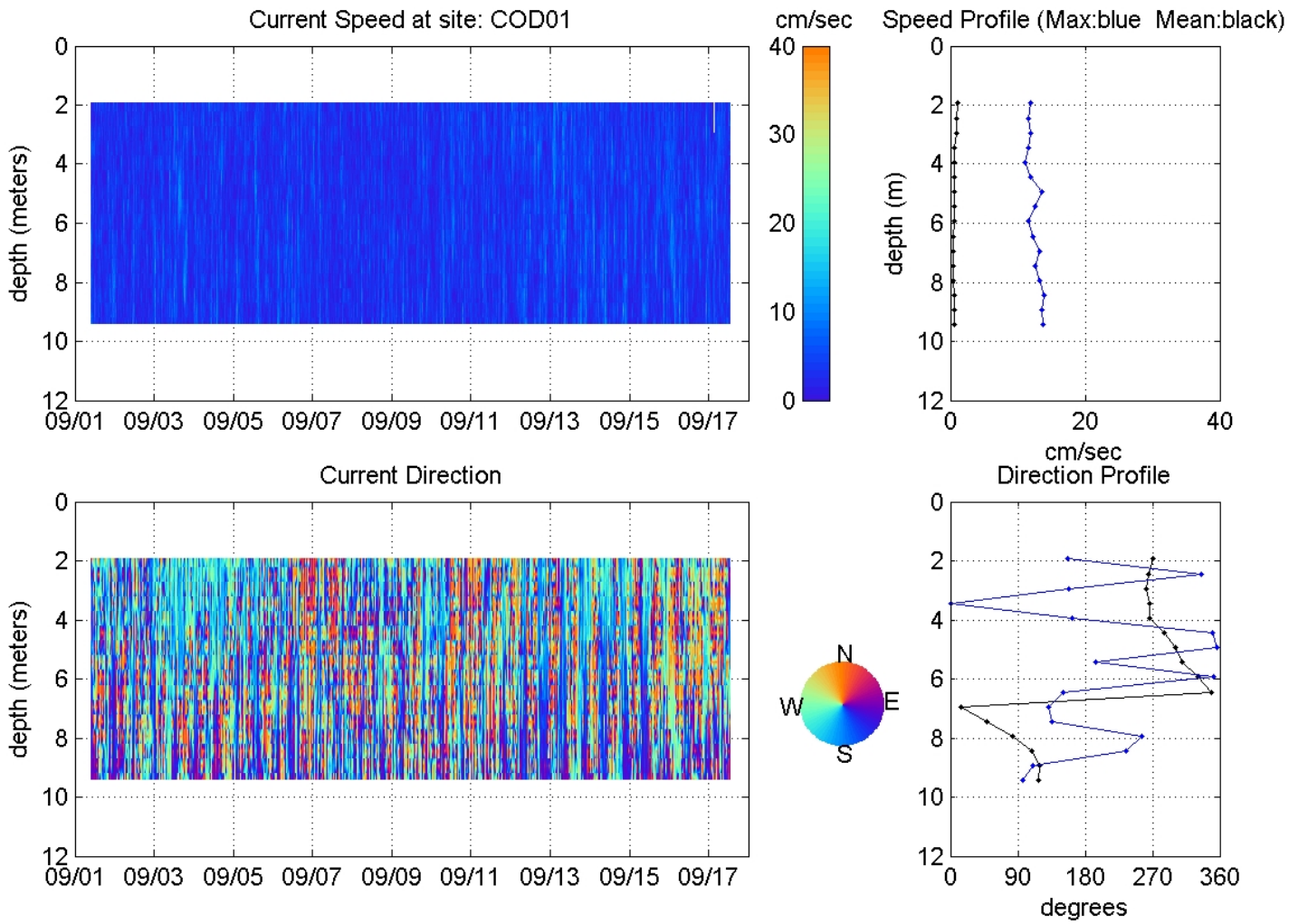


Figure 4: (Right) Color panels of current speed and direction at site COD01. (Left) vertical profiles of speed (upper) and direction (lower). Blue profiles represent the maximum speed and direction of the maximum speed. Black lines represent the mean speed and mean direction.

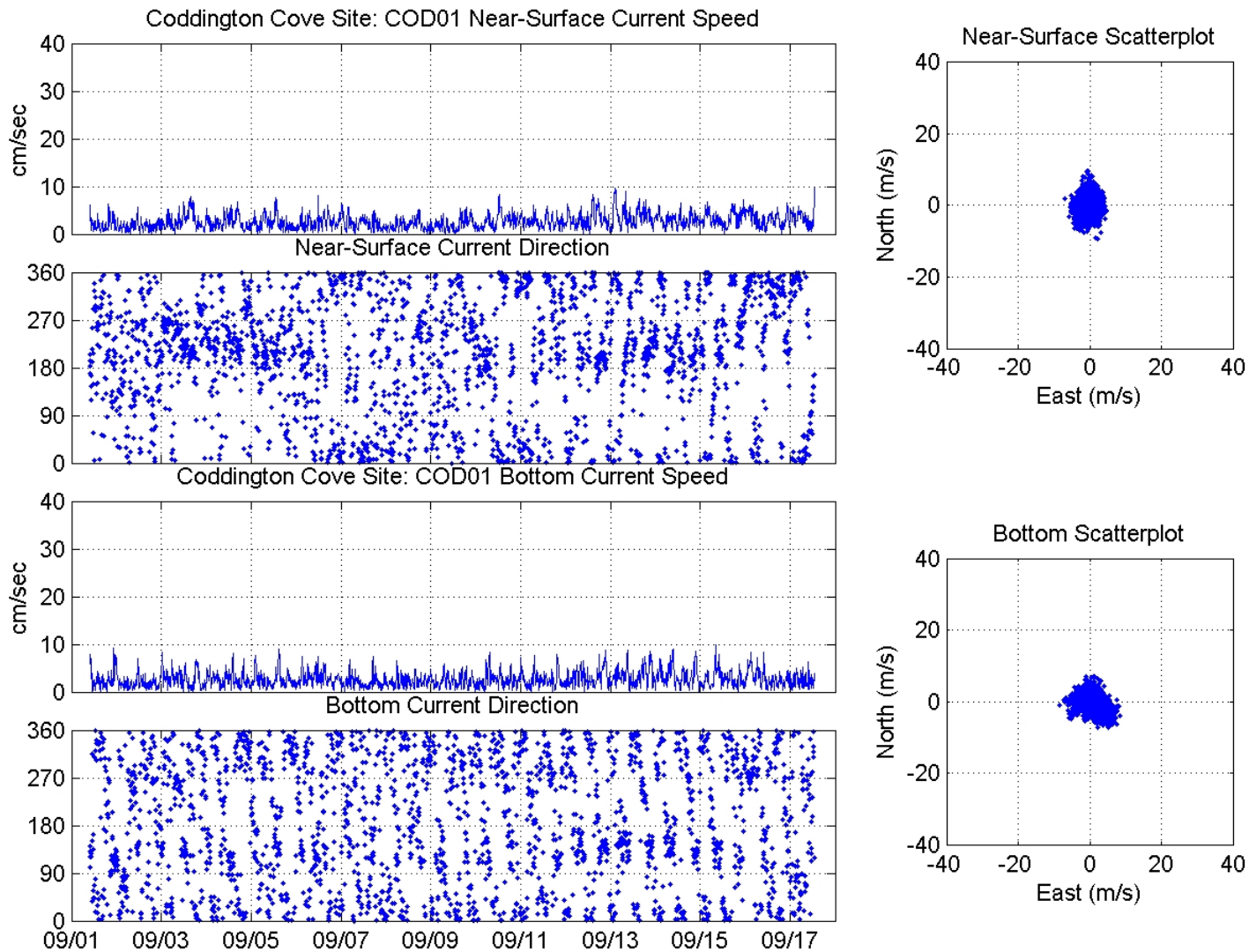


Figure 5: (Right) Time series of current speed and direction at site COD01. Near-surface currents are presented as the top two plots; near-bottom as the lower two plots. (Left) Scatterplots of near-surface (top) and near-bottom (lower) currents.

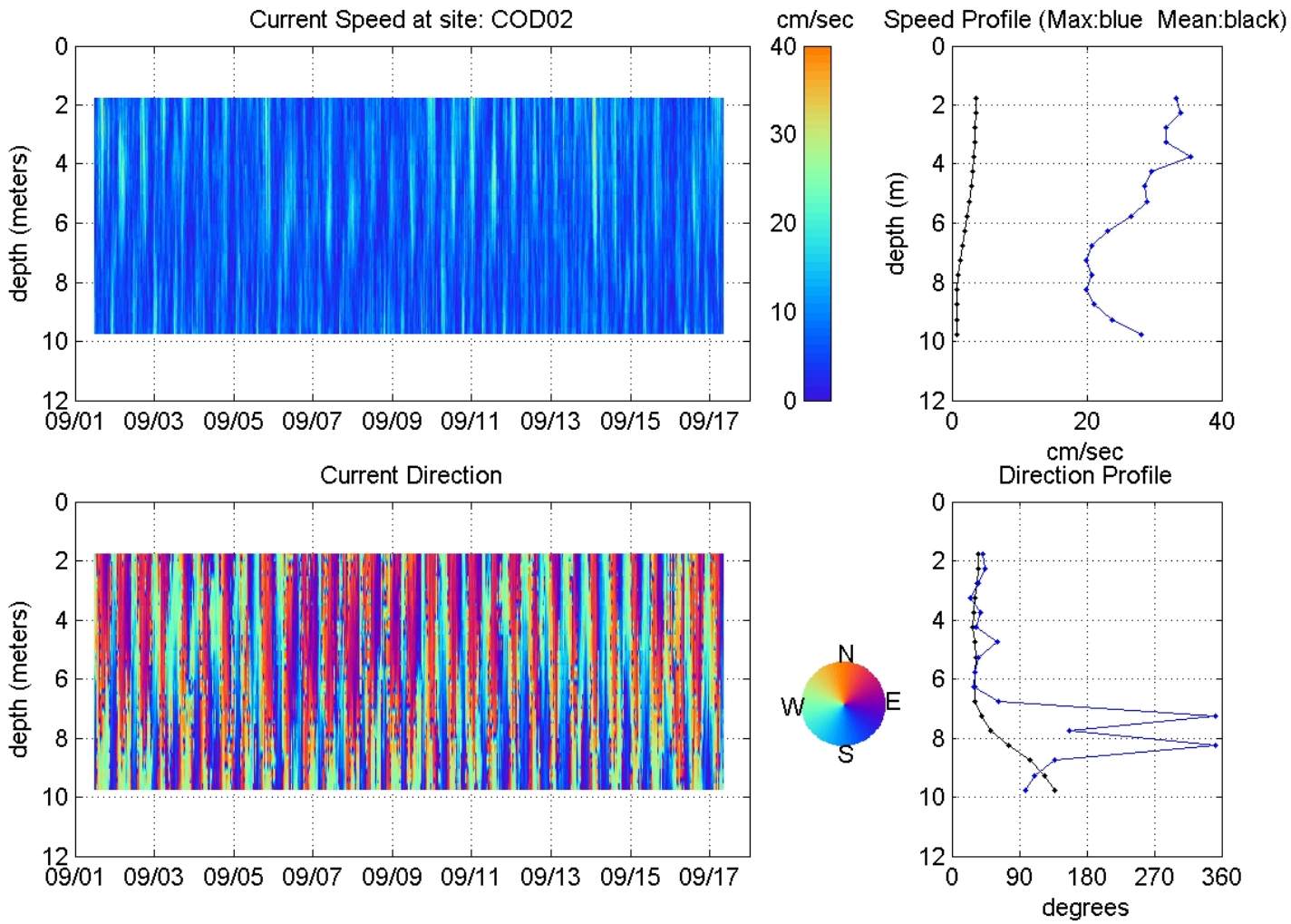


Figure 6: (Right) Color panels of current speed and direction at site COD02. (Left) vertical profiles of speed (upper) and direction (lower). Blue profiles represent the maximum speed and direction of the maximum speed. Black lines represent the mean speed and mean direction.

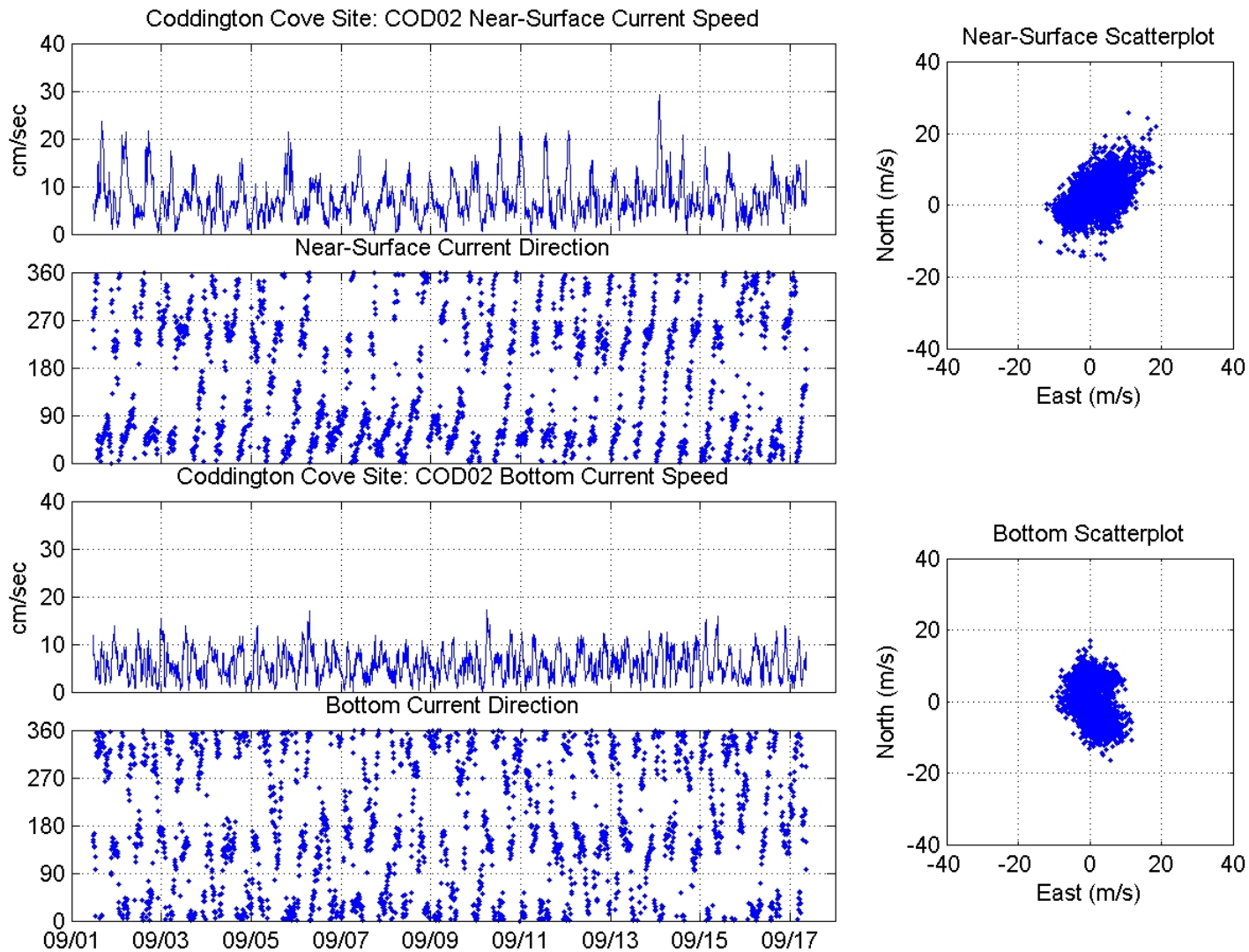


Figure 7: (Right) Time series of current speed and direction at site COD02. Near-surface currents are presented as the top two plots; near-bottom as the lower two plots. (Left) Scatterplots of near-surface (top) and near-bottom (lower) currents.

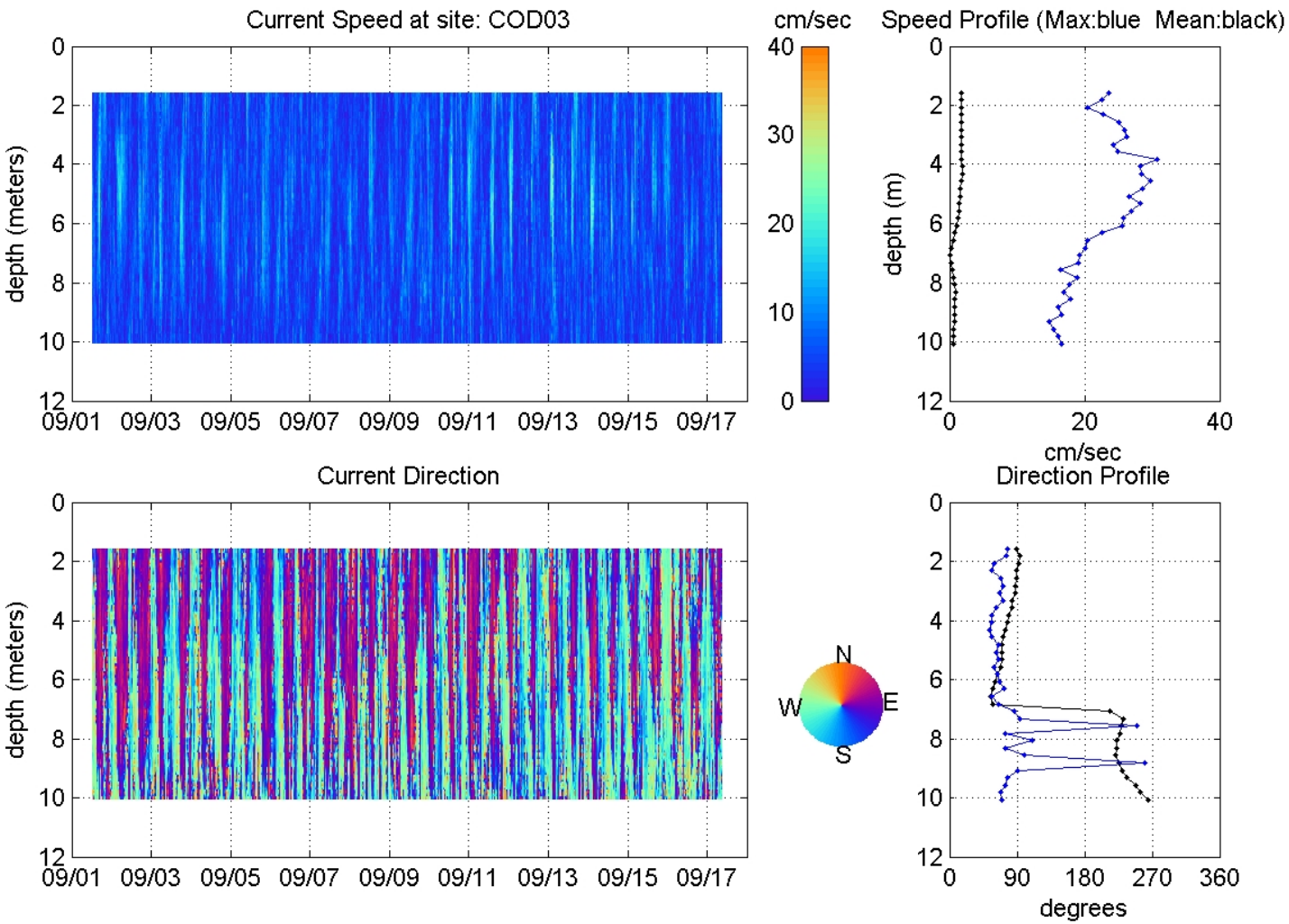


Figure 8: (Right) Color panels of current speed and direction at site COD03. (Left) vertical profiles of speed (upper) and direction (lower). Blue profiles represent the maximum speed and direction of the maximum speed. Black lines represent the mean speed and mean direction.

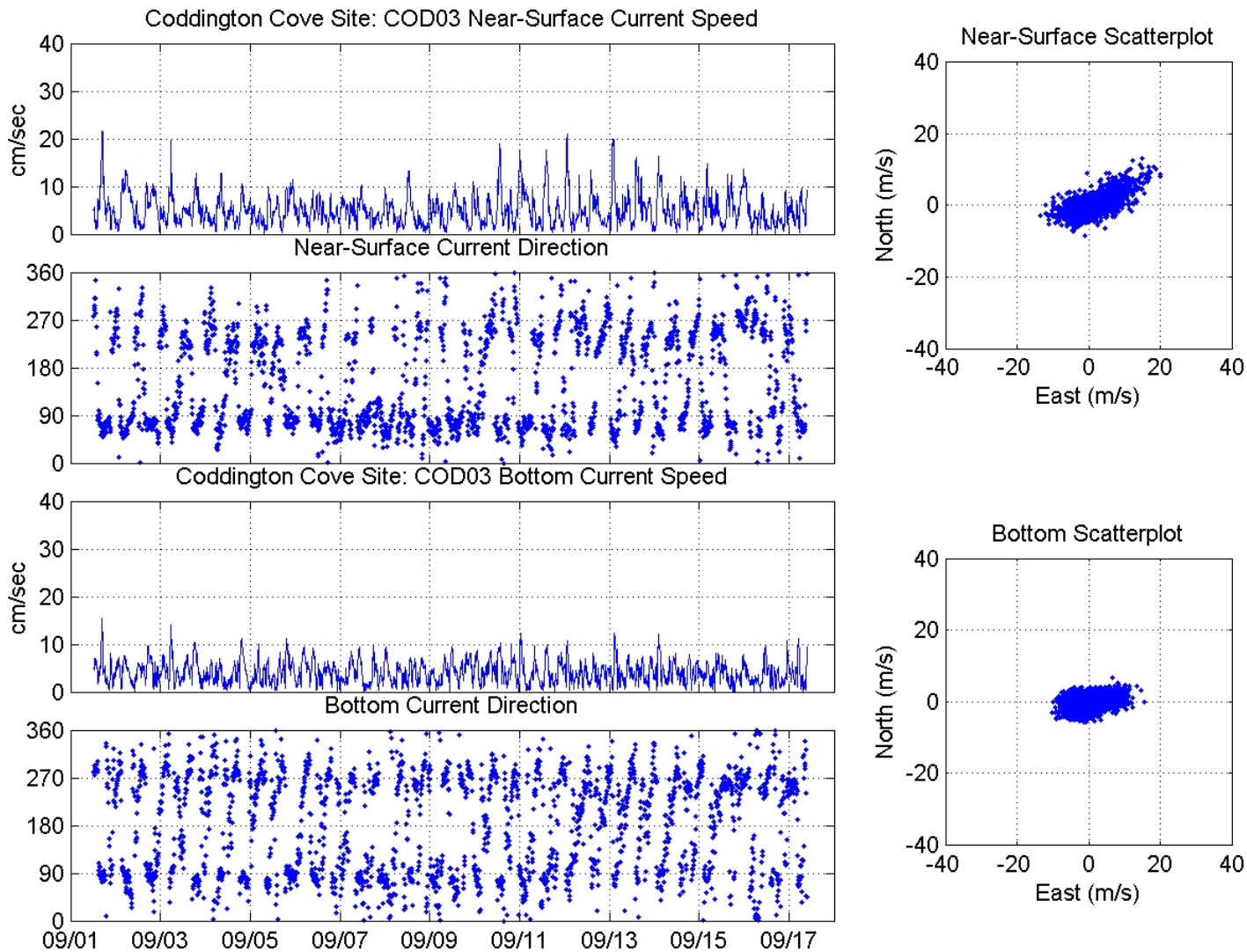


Figure 9: (Right) Time series of current speed and direction at site COD03. Near-surface currents are presented as the top two plots; near-bottom as the lower two plots. (Left) Scatterplots of near-surface (top) and near-bottom (lower) currents.

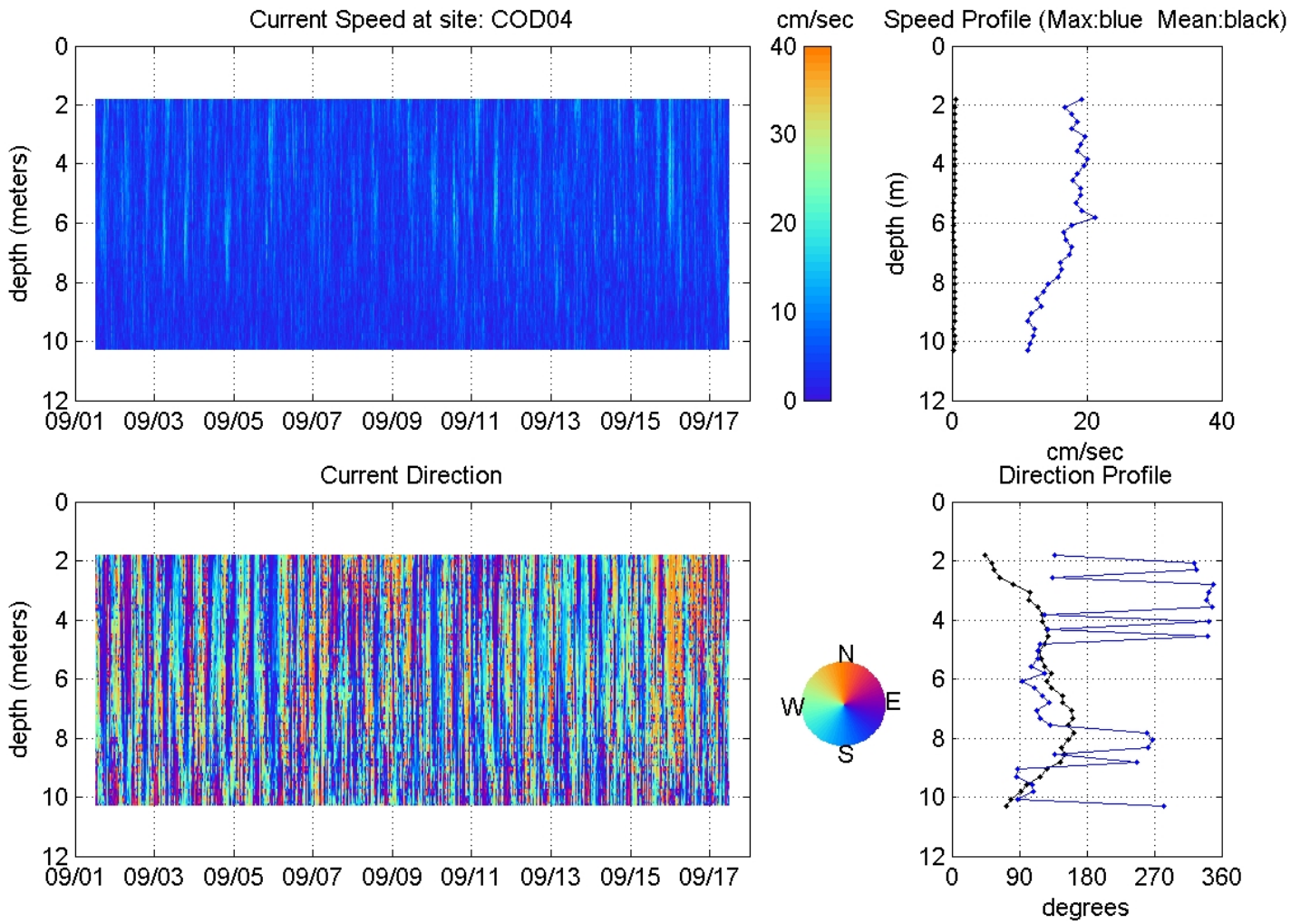


Figure 10: (Right) Color panels of current speed and direction at site COD04. (Left) vertical profiles of speed (upper) and direction (lower). Blue profiles represent the maximum speed and direction of the maximum speed. Black lines represent the mean speed and mean direction.

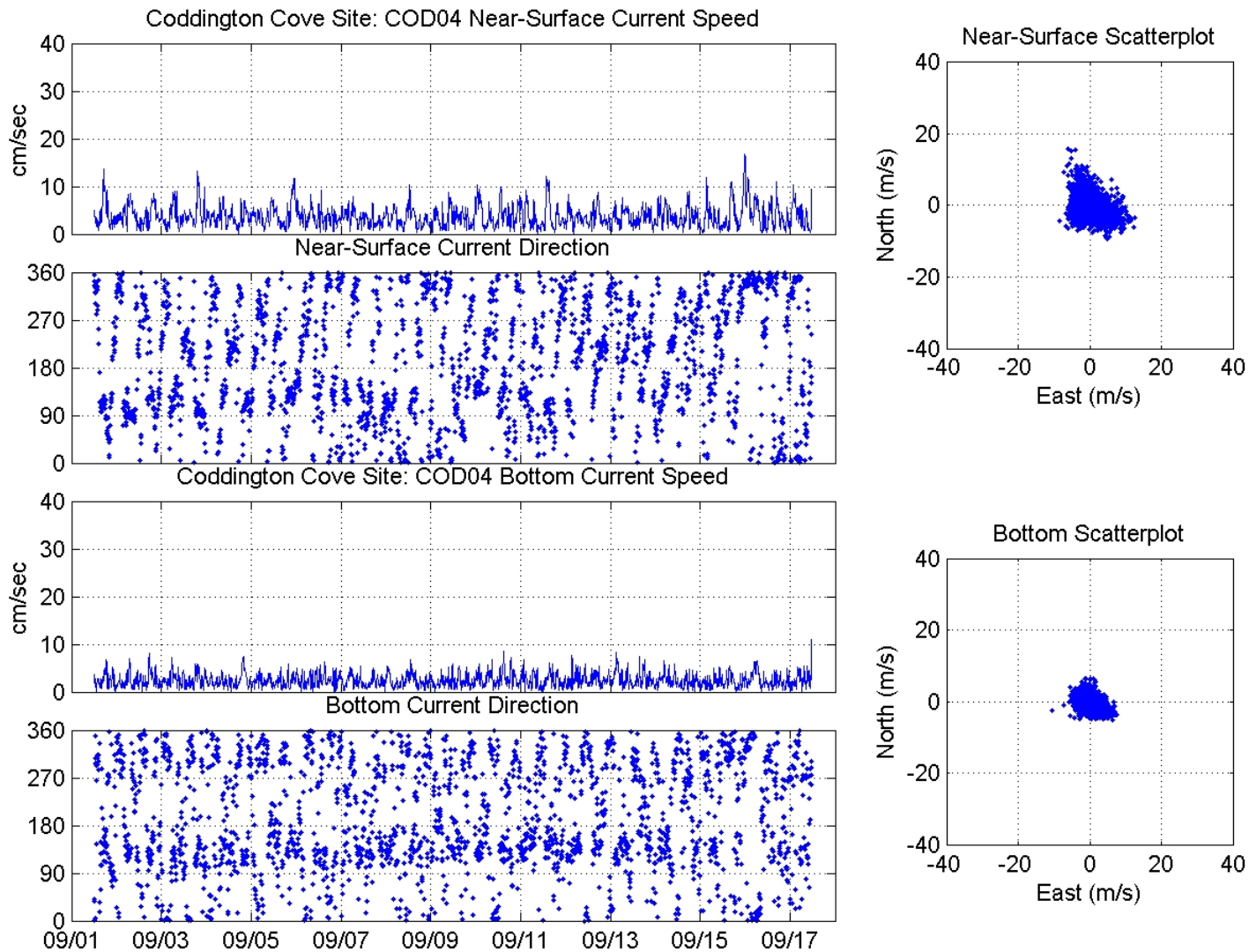


Figure 11: (Right) Time series of current speed and direction at site COD04. Near-surface currents are presented as the top two plots; near-bottom as the lower two plots. (Left) Scatterplots of near-surface (top) and near-bottom (lower) currents.

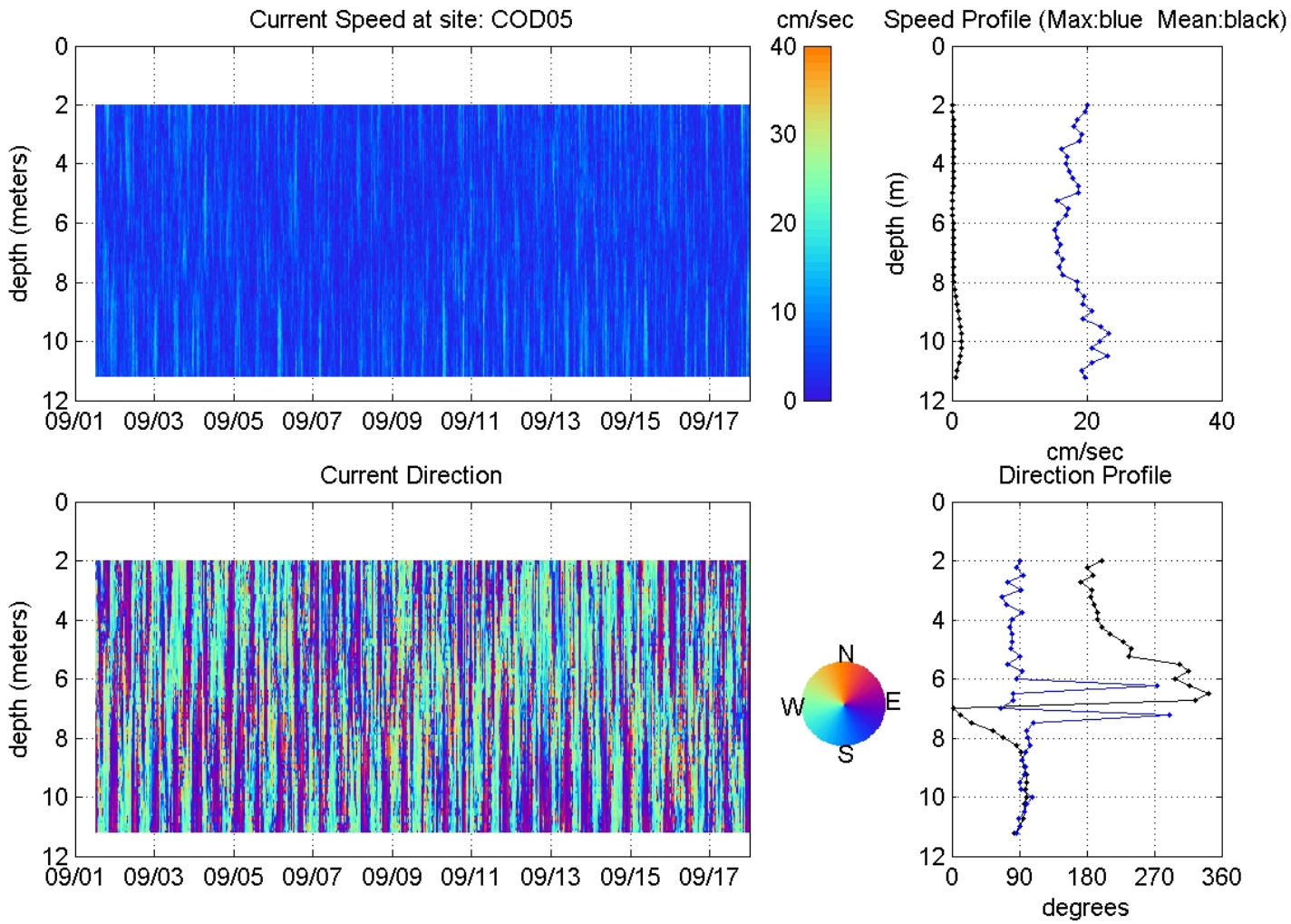


Figure 12: (Right) Color panels of current speed and direction at site COD05. (Left) vertical profiles of speed (upper) and direction (lower). Blue profiles represent the maximum speed and direction of the maximum speed. Black lines represent the mean speed and mean direction.

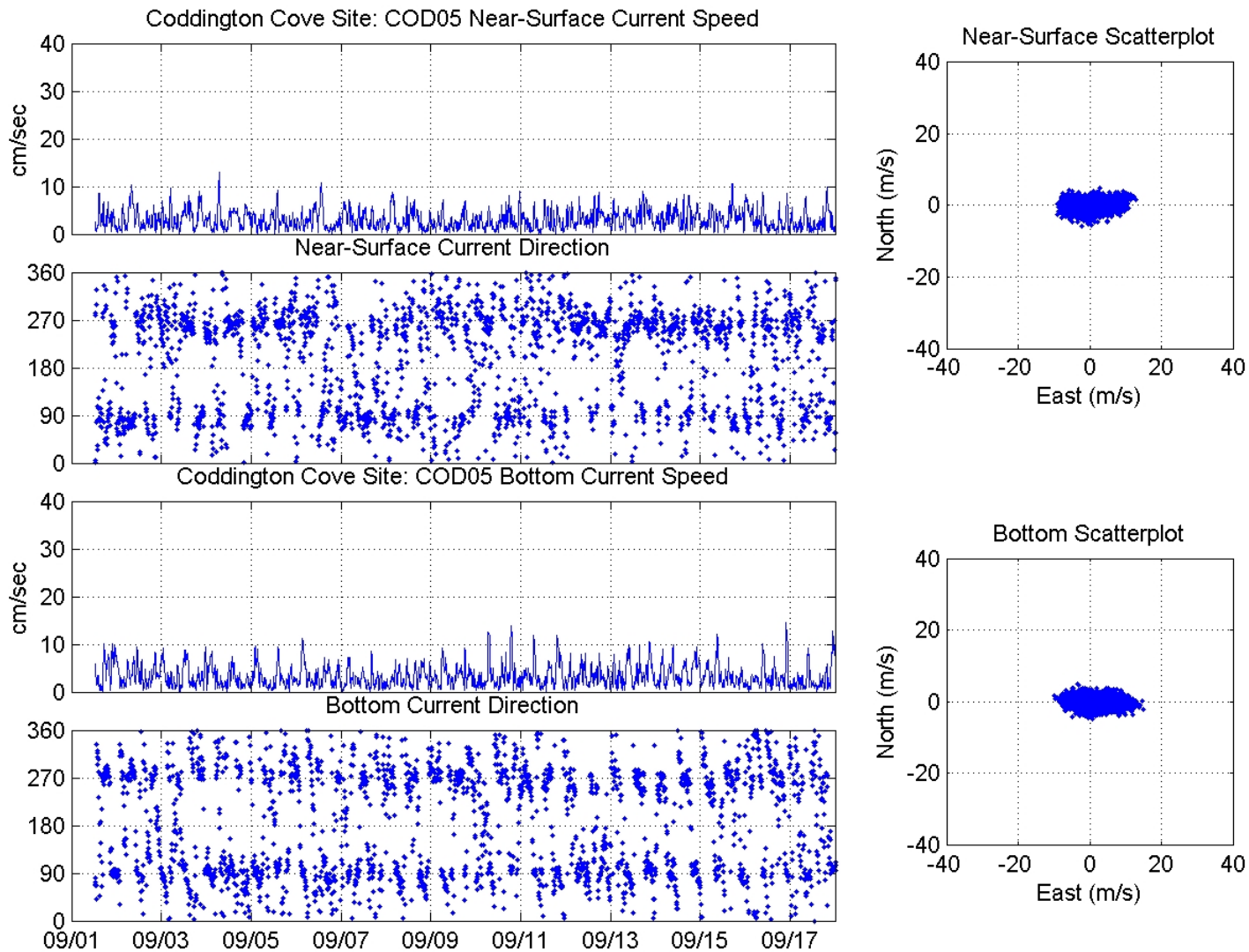


Figure 13: (Right) Time series of current speed and direction at site COD05. Near-surface currents are presented as the top two plots; near-bottom as the lower two plots. (Left) Scatterplots of near-surface (top) and near-bottom (lower) currents.

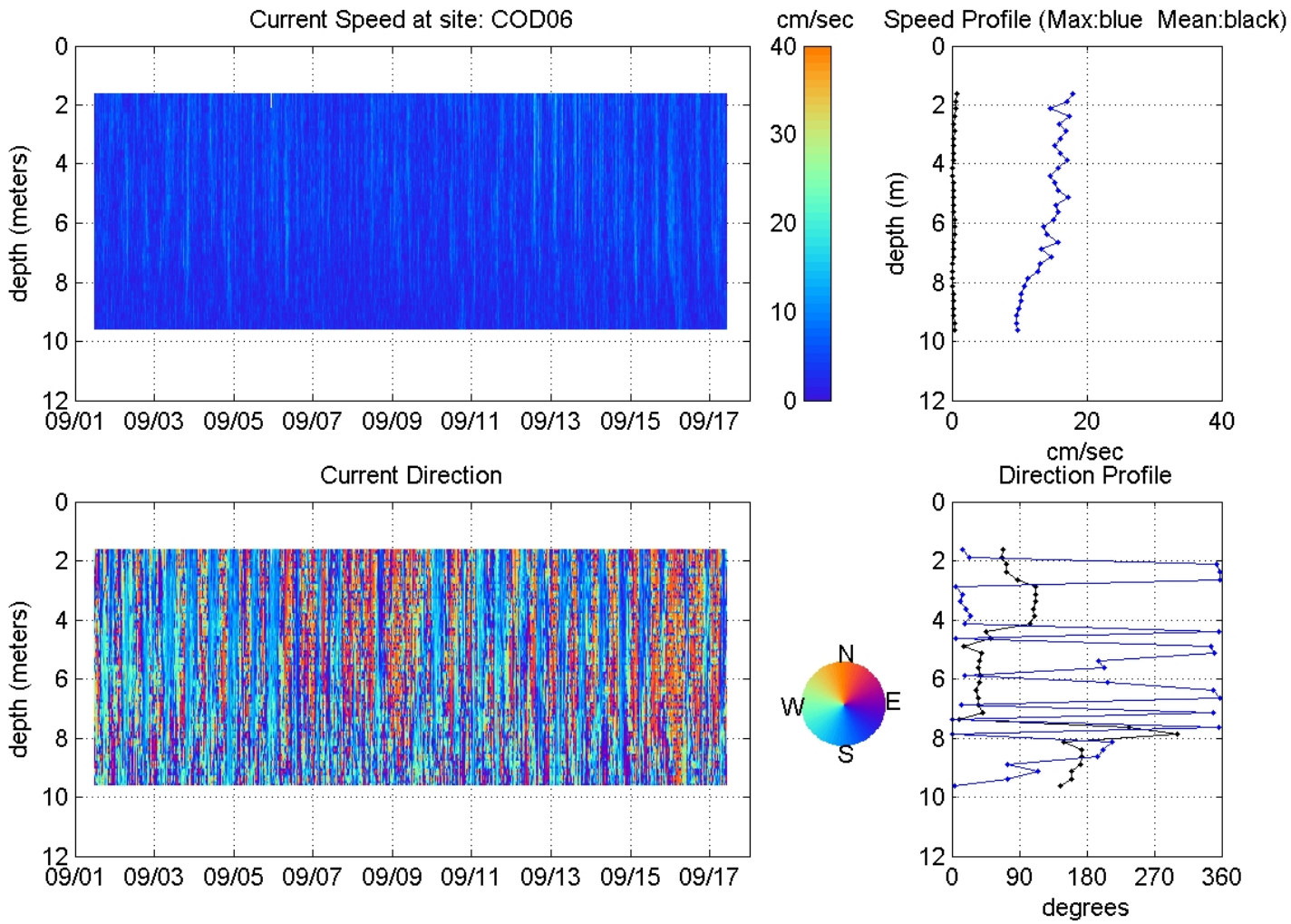


Figure 14: (Right) Color panels of current speed and direction at site COD06. (Left) vertical profiles of speed (upper) and direction (lower). Blue profiles represent the maximum speed and direction of the maximum speed. Black lines represent the mean speed and mean direction.

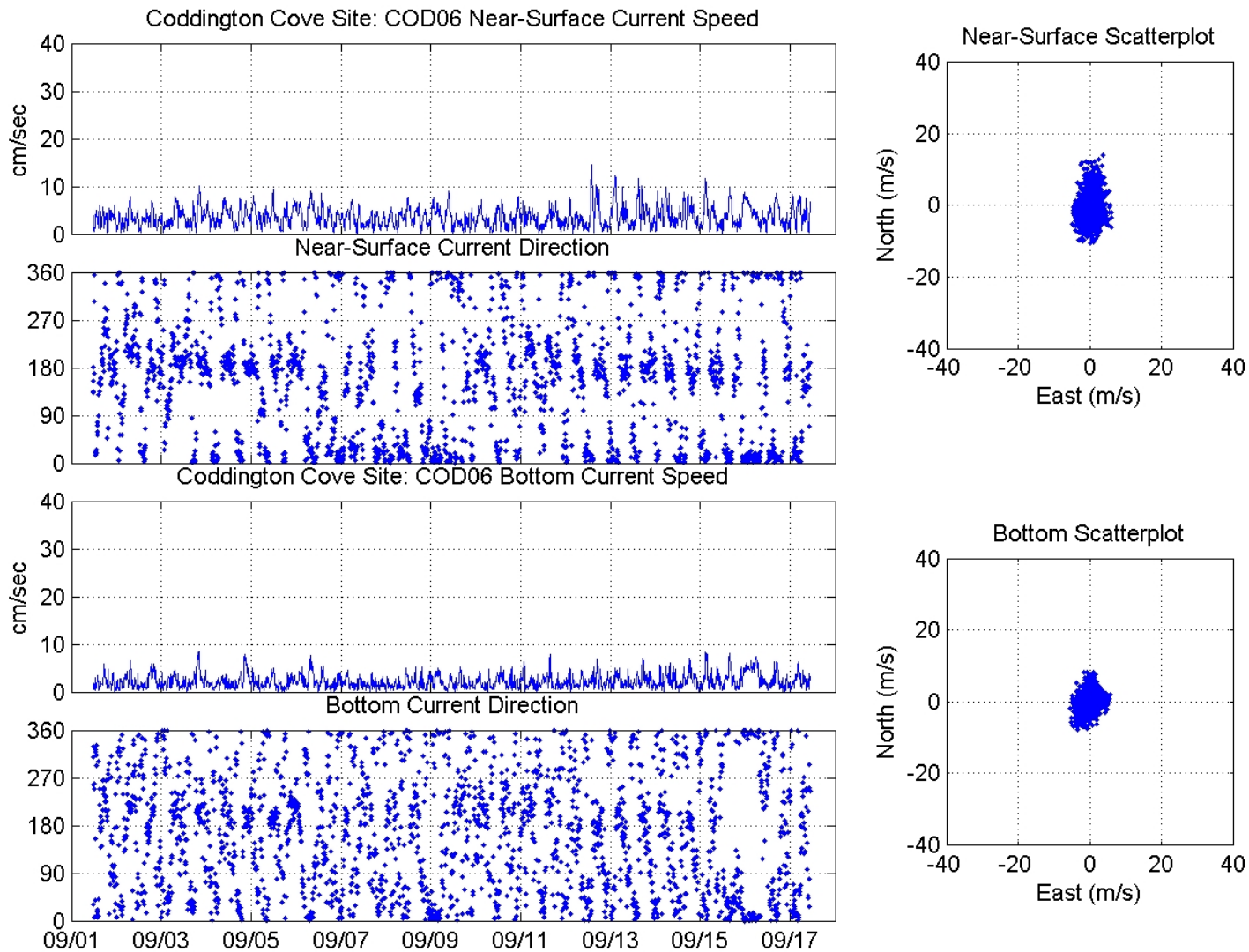


Figure 15: (Right) Time series of current speed and direction at site COD06. Near-surface currents are presented as the top two plots; near-bottom as the lower two plots. (Left) Scatterplots of near-surface (top) and near-bottom (lower) currents.

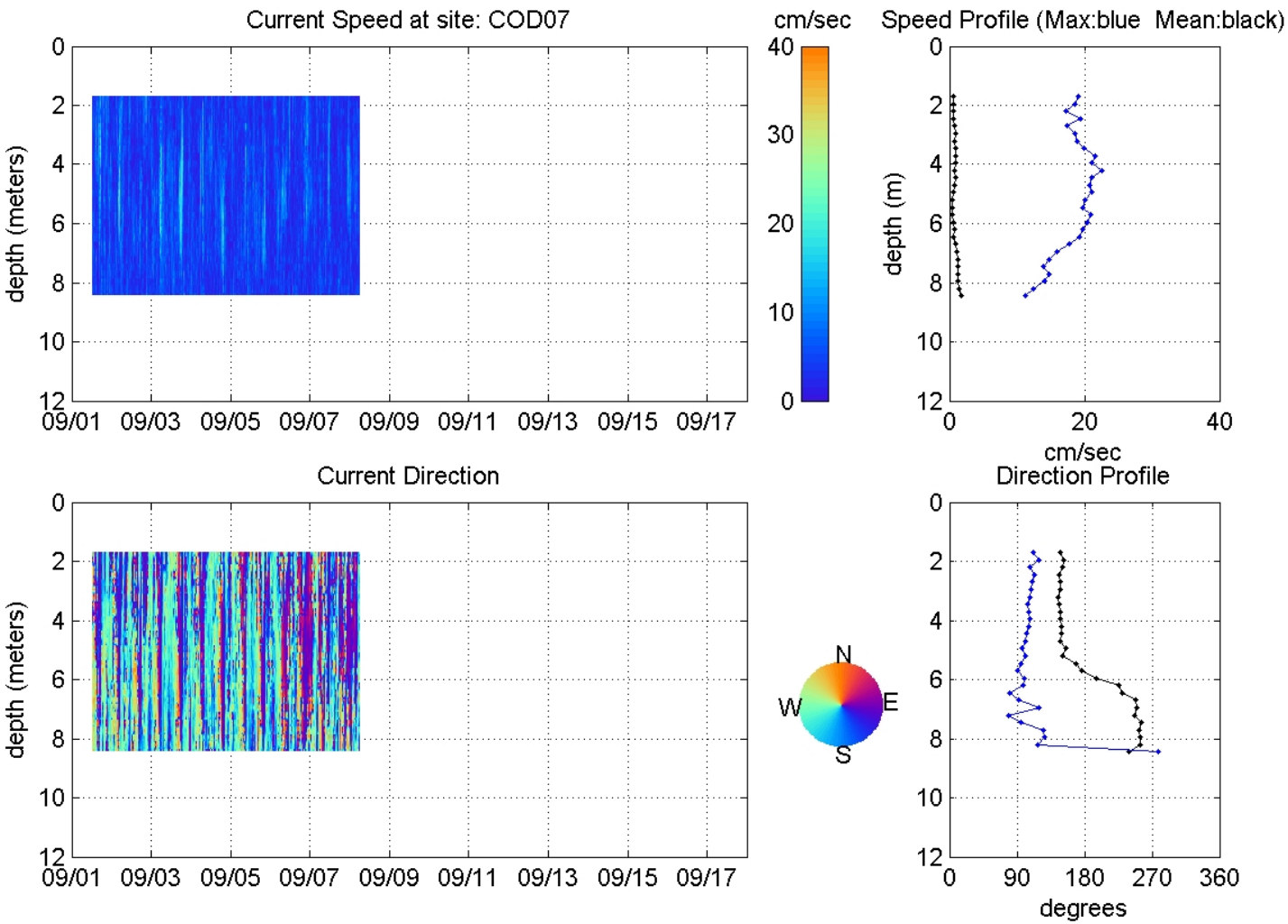


Figure 16: (Right) Color panels of current speed and direction at site COD07. (Left) vertical profiles of speed (upper) and direction (lower). Blue profiles represent the maximum speed and direction of the maximum speed. Black lines represent the mean speed and mean direction. **NOTE** near-bottom bins were found invalid; these data were removed from the analysis.

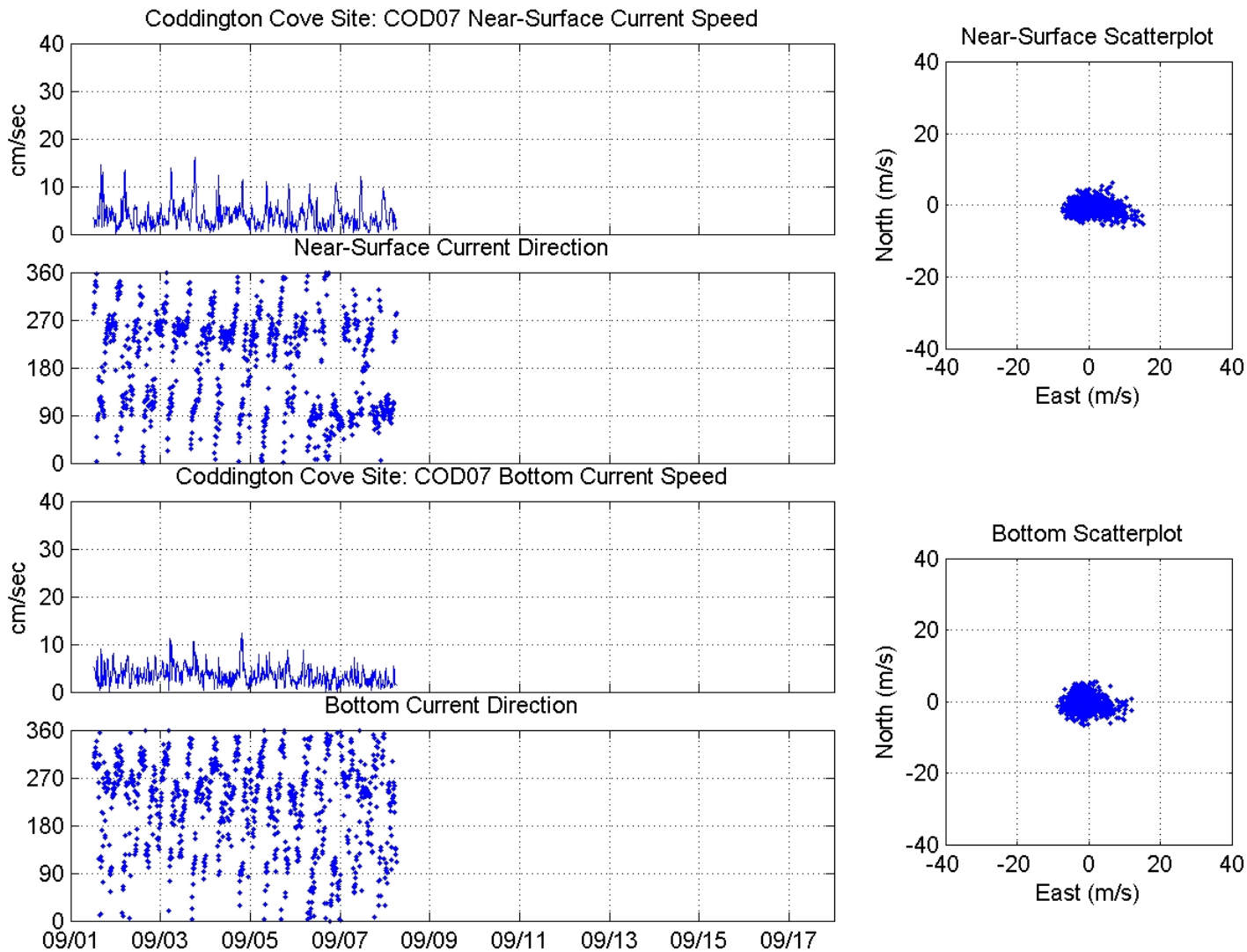


Figure 17: (Right) Time series of current speed and direction at site COD07. Near-surface currents are presented as the top two plots; near-bottom as the lower two plots. (Left) Scatterplots of near-surface (top) and near-bottom (lower) currents. Near-bottom currents were corrupted and edited out of all subsequent analyses.

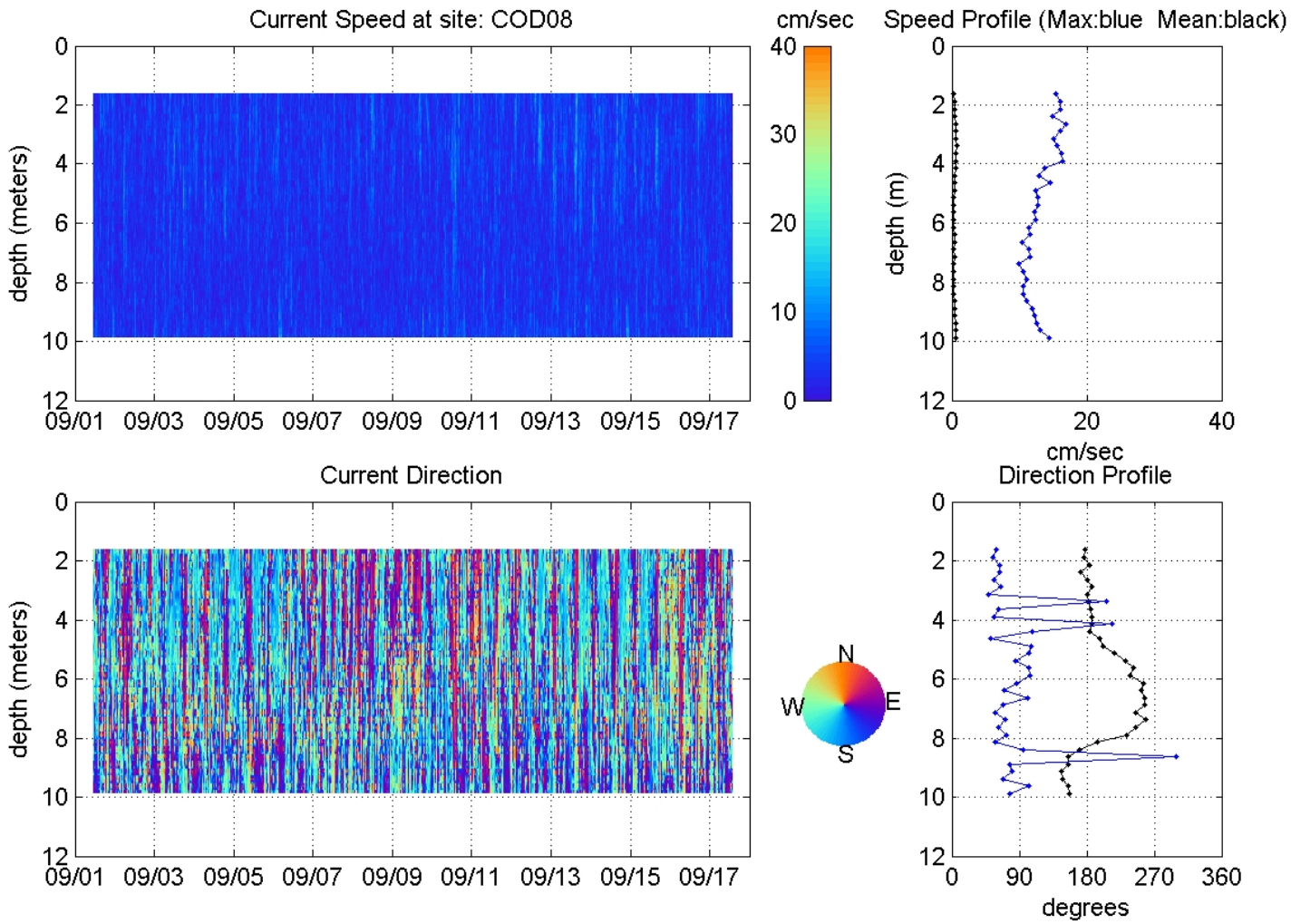


Figure 18: (Right) Color panels of current speed and direction at site COD08. (Left) vertical profiles of speed (upper) and direction (lower). Blue profiles represent the maximum speed and direction of the maximum speed. Black lines represent the mean speed and mean direction.

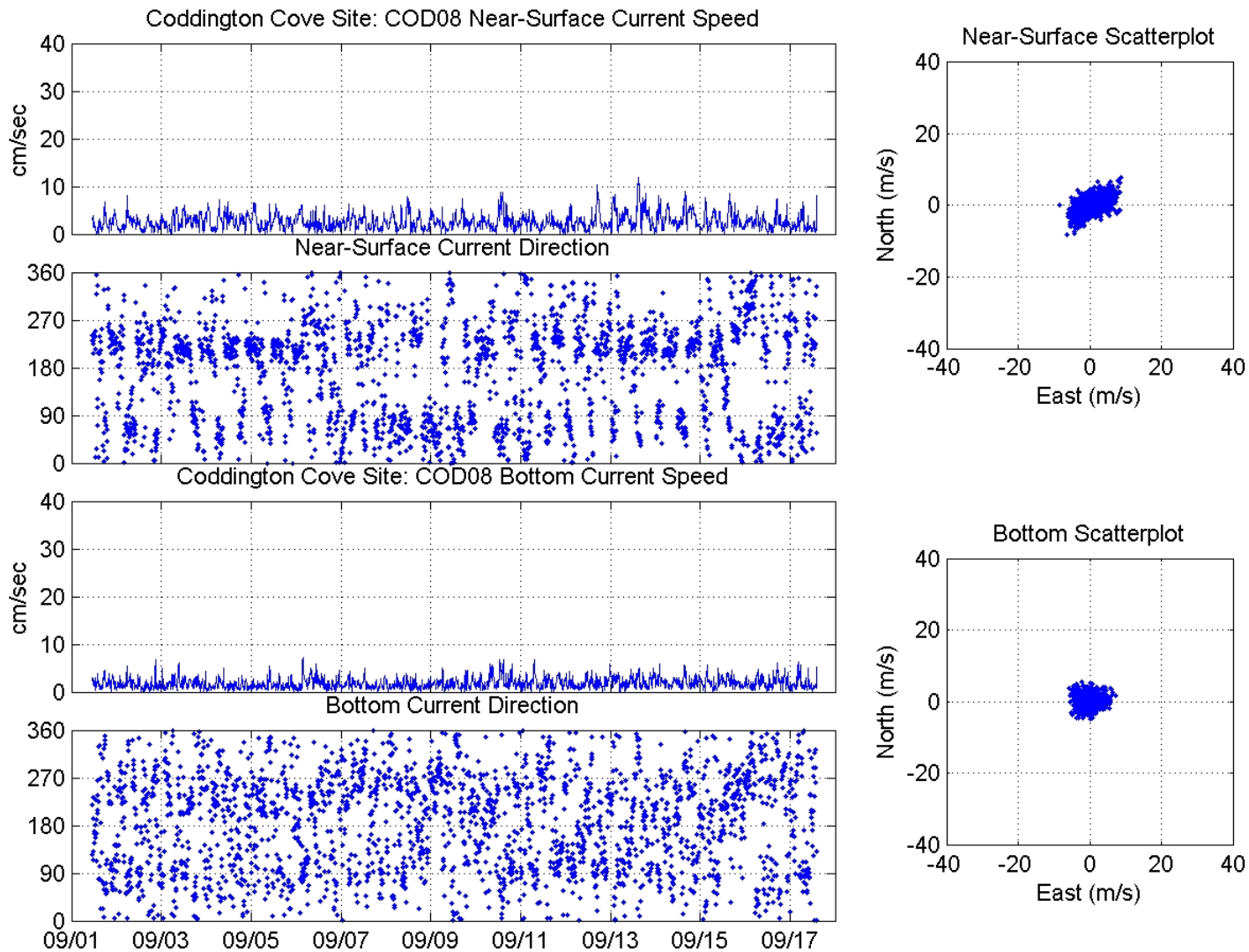


Figure 19: (Right) Time series of current speed and direction at site COD08. Near-surface currents are presented as the top two plots; near-bottom as the lower two plots. (Left) Scatterplots of near-surface (top) and near-bottom (lower) currents.

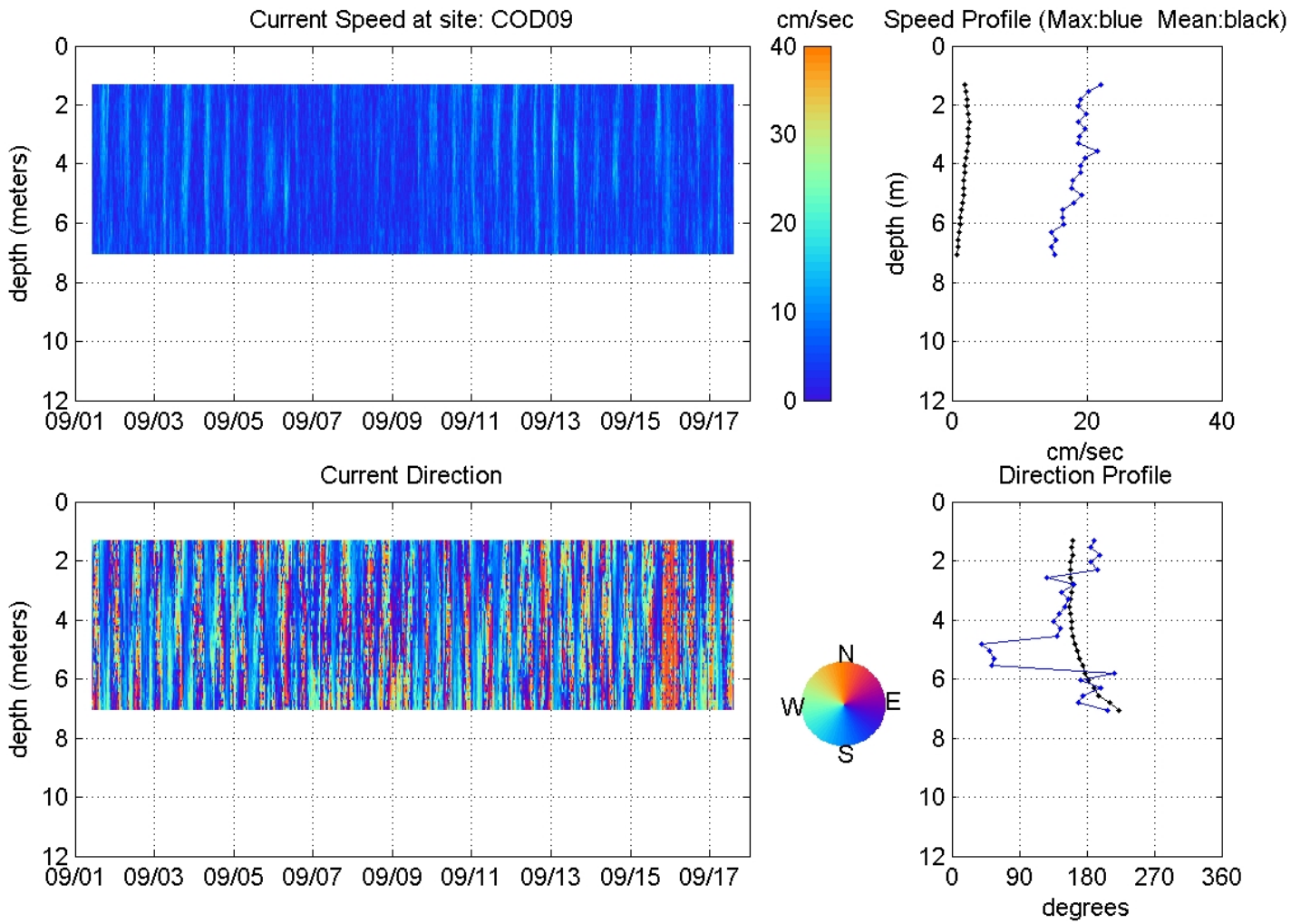


Figure 20: (Right) Color panels of current speed and direction at site COD09. (Left) vertical profiles of speed (upper) and direction (lower). Blue profiles represent the maximum speed and direction of the maximum speed. Black lines represent the mean speed and mean direction.

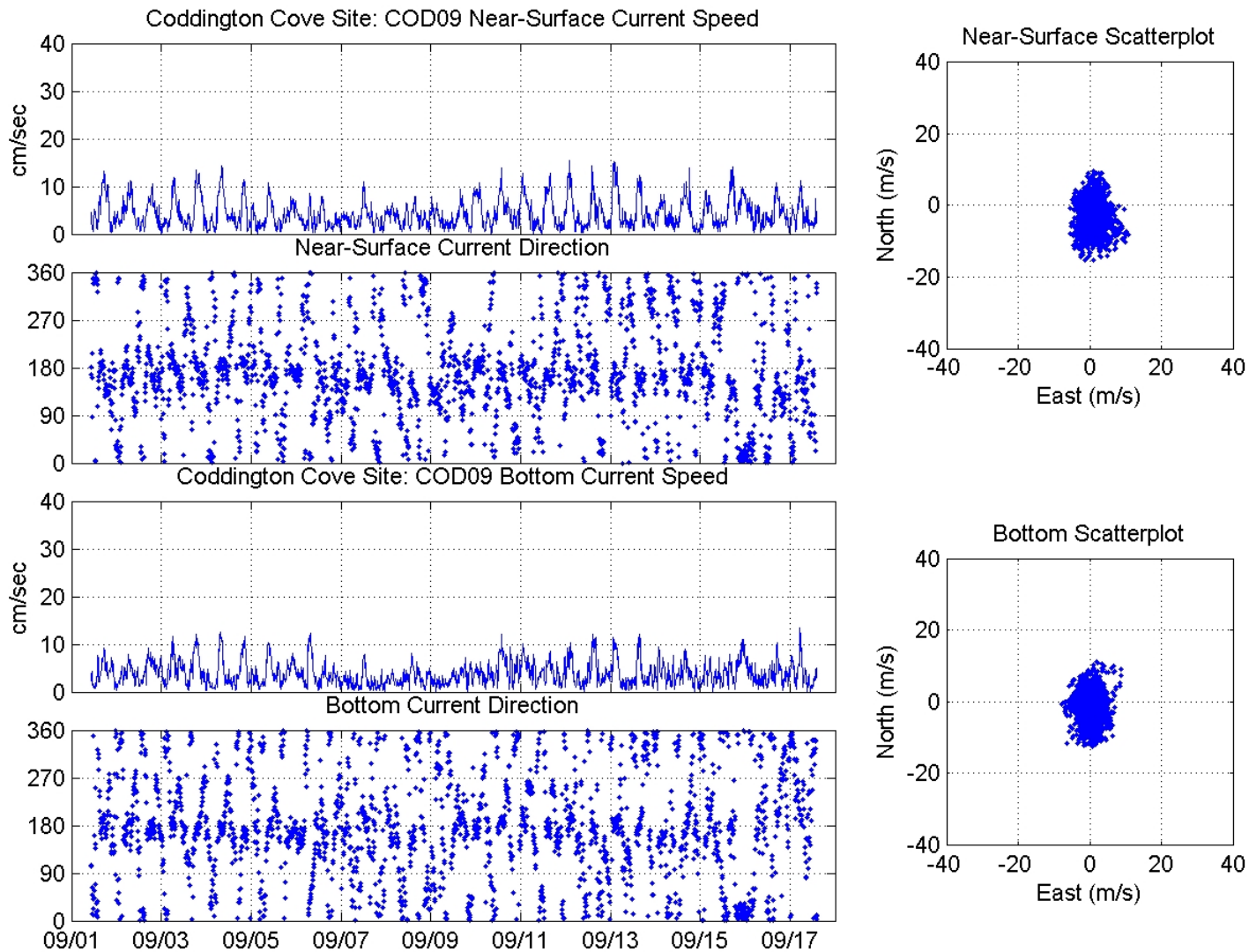


Figure 21: (Right) Time series of current speed and direction at site COD09. Near-surface currents are presented as the top two plots; near-bottom as the lower two plots. (Left) Scatterplots of near-surface (top) and near-bottom (lower) currents.

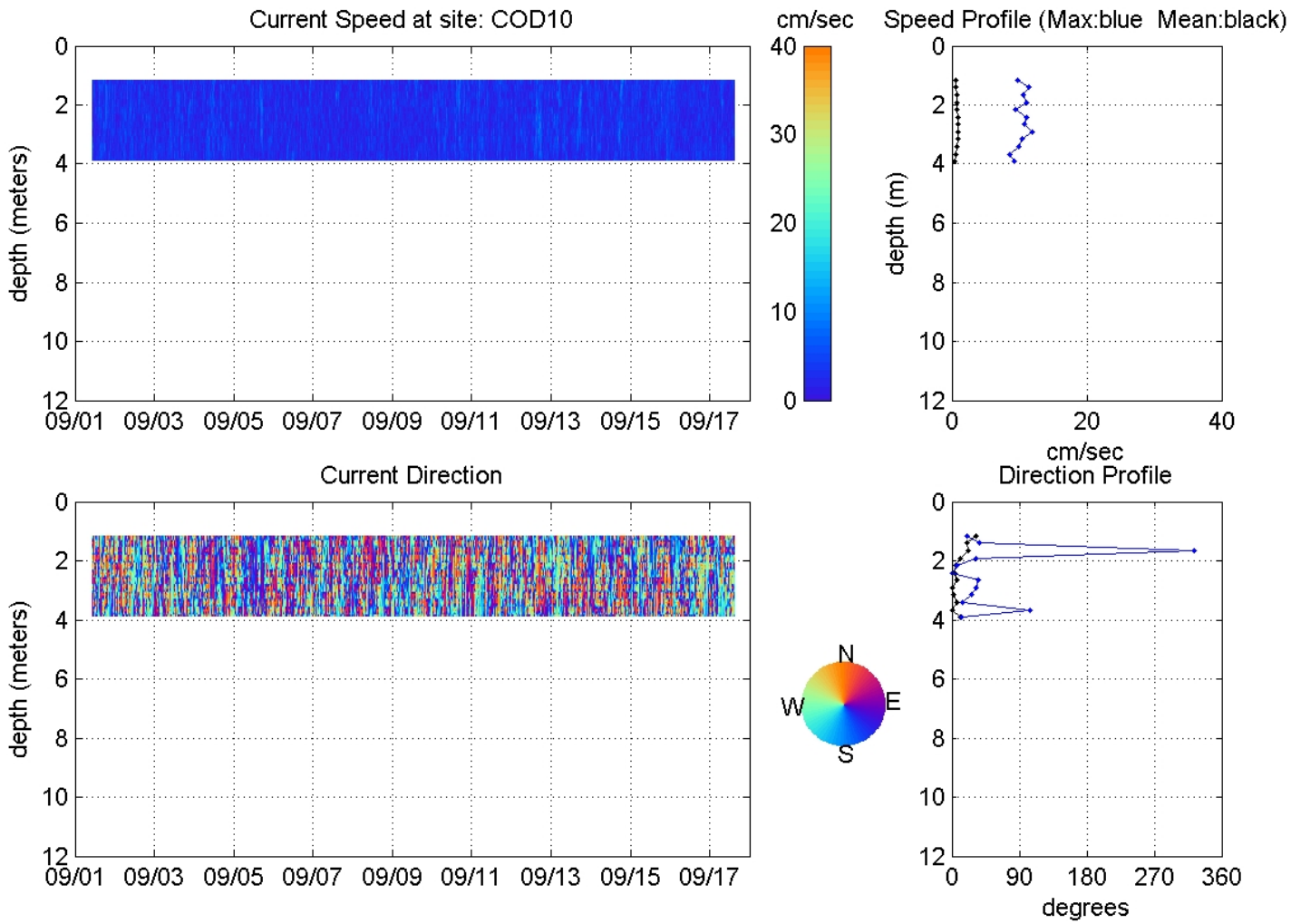


Figure 22: (Right) Color panels of current speed and direction at site COD10. (Left) vertical profiles of speed (upper) and direction (lower). Blue profiles represent the maximum speed and direction of the maximum speed. Black lines represent the mean speed and mean direction.

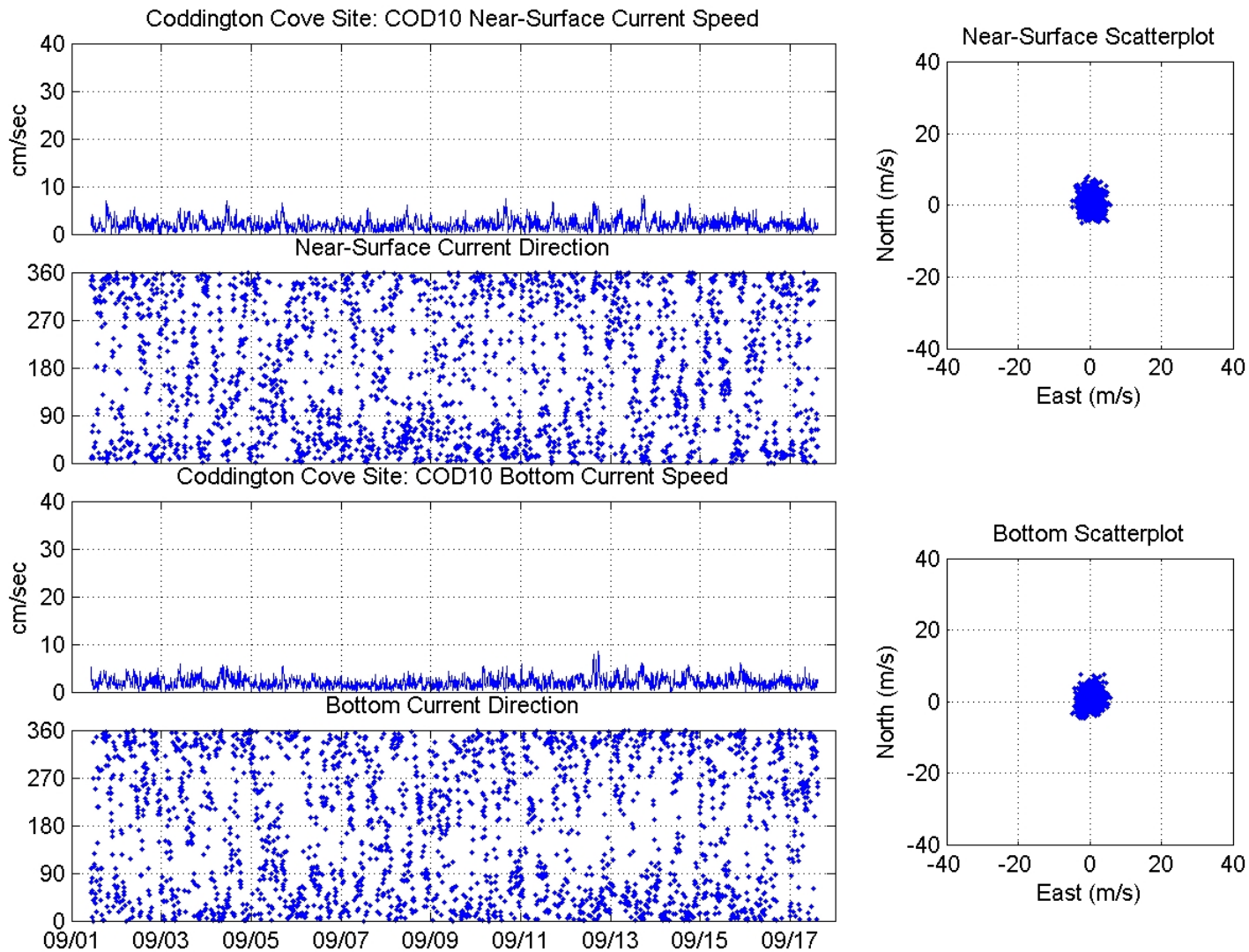


Figure 23: (Right) Time series of current speed and direction at site COD10. Near-surface currents are presented as the top two plots; near-bottom as the lower two plots. (Left) Scatterplots of near-surface (top) and near-bottom (lower) currents.

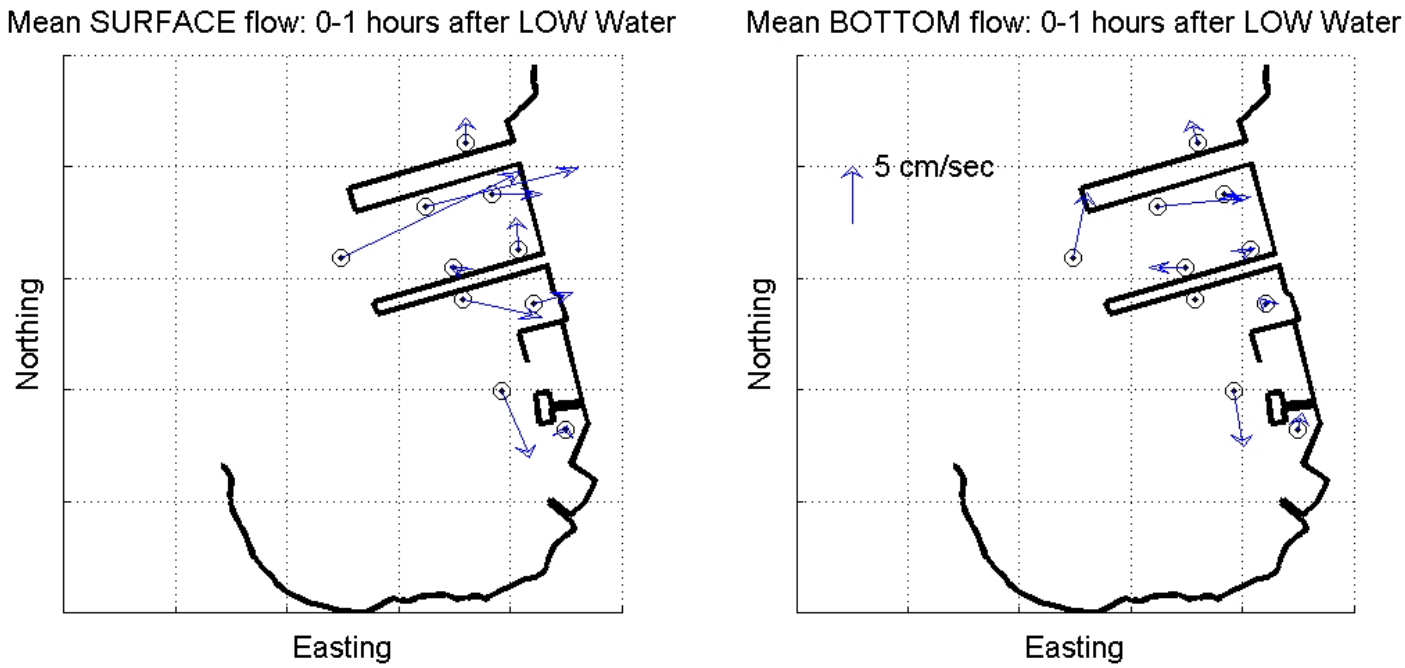


Figure 24: Mean flow vectors in Coddington Cove just after the time of low water. Near-surface flow (i.e. upper half of the water column) is shown to the left; near-bottom flow (i.e. lower half of the water column) to the right. These vectors resulted from the vector-average of measurements obtained 0-to-1 hours after low water for each tidal cycle over the ~16-day deployment. There appeared a strong rush of incoming flow just after the tide change.

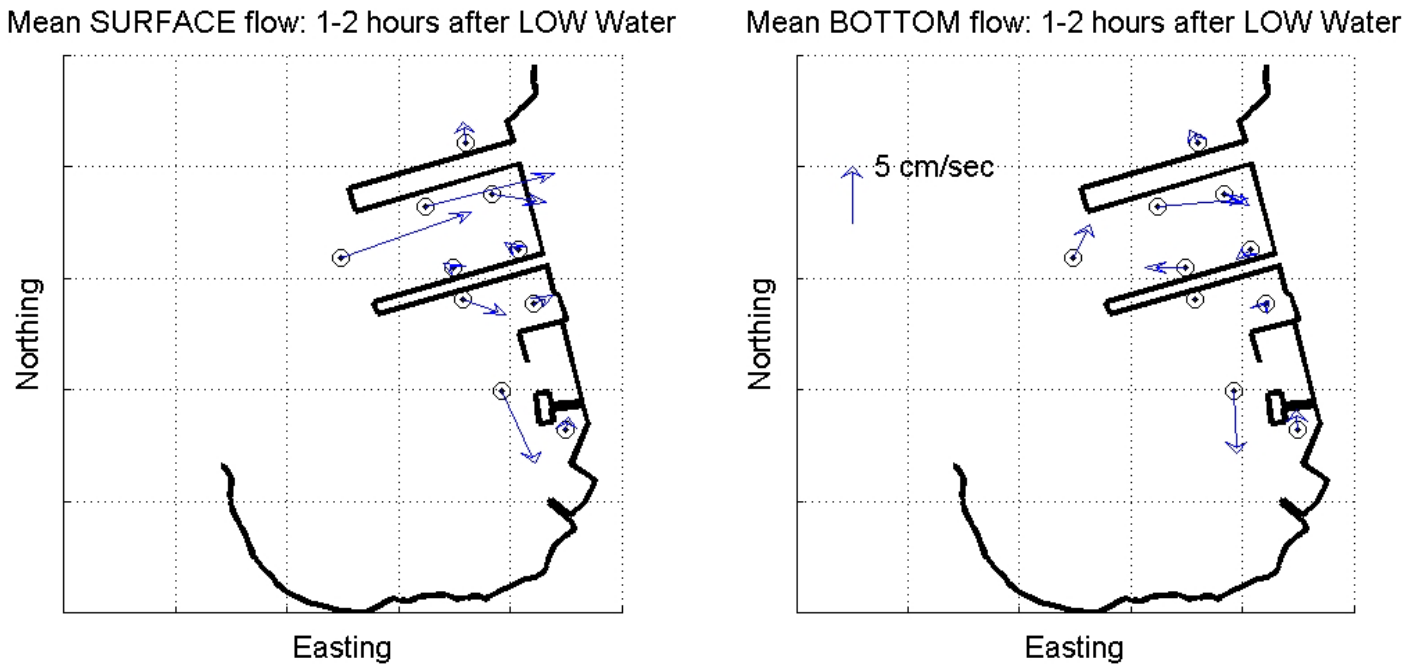


Figure 25: Mean flow vectors resulting from the vector-average of measurements 1-to-2 hours after low water for each tidal cycle over the ~16-day deployment.. Near-surface flow (i.e. upper half of the water column) is shown to the left; near-bottom flow (i.e. lower half of the water column) to the right. The strong rush of incoming flow after the tide change continues.

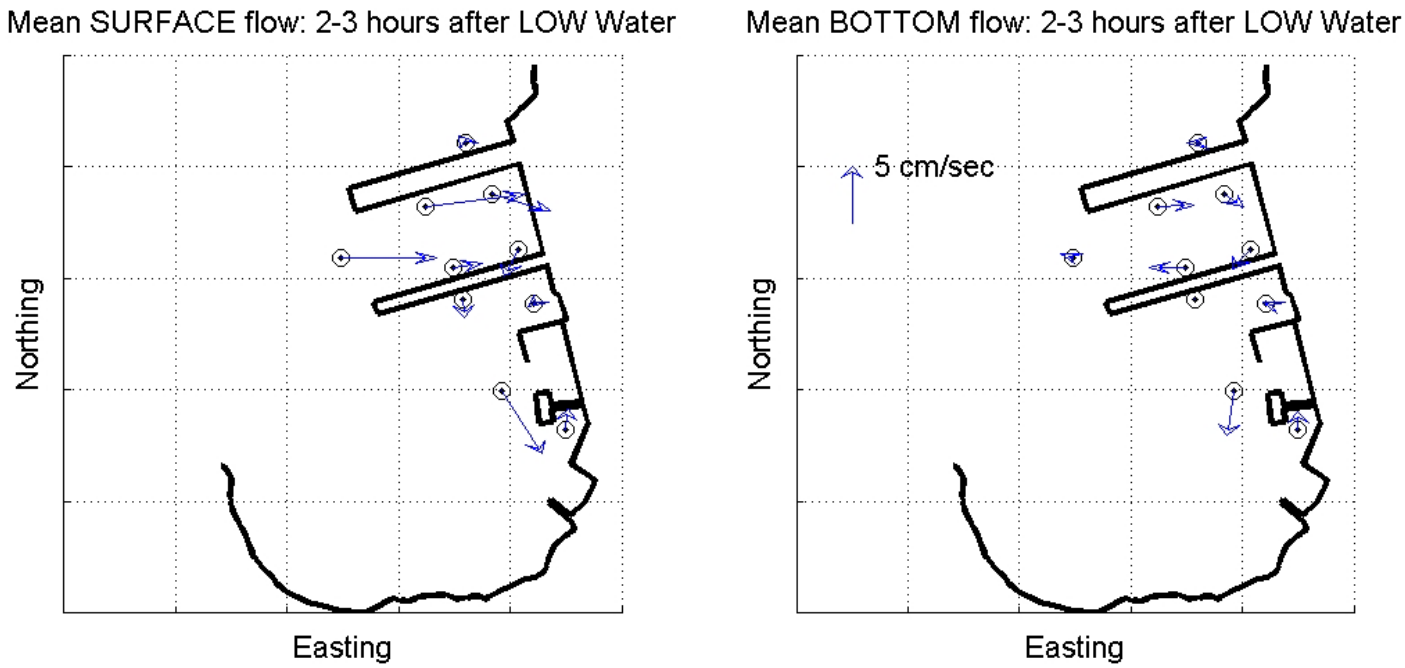


Figure 26: Mean flow vectors resulting from the vector-average of measurements 2-to-3 hours after low water for each tidal cycle over the ~16-day deployment.. Near-surface flow (i.e. upper half of the water column) is shown to the left; near-bottom flow (i.e. lower half of the water column) to the right. The strong rush of incoming flow after the tide change seems to slow.

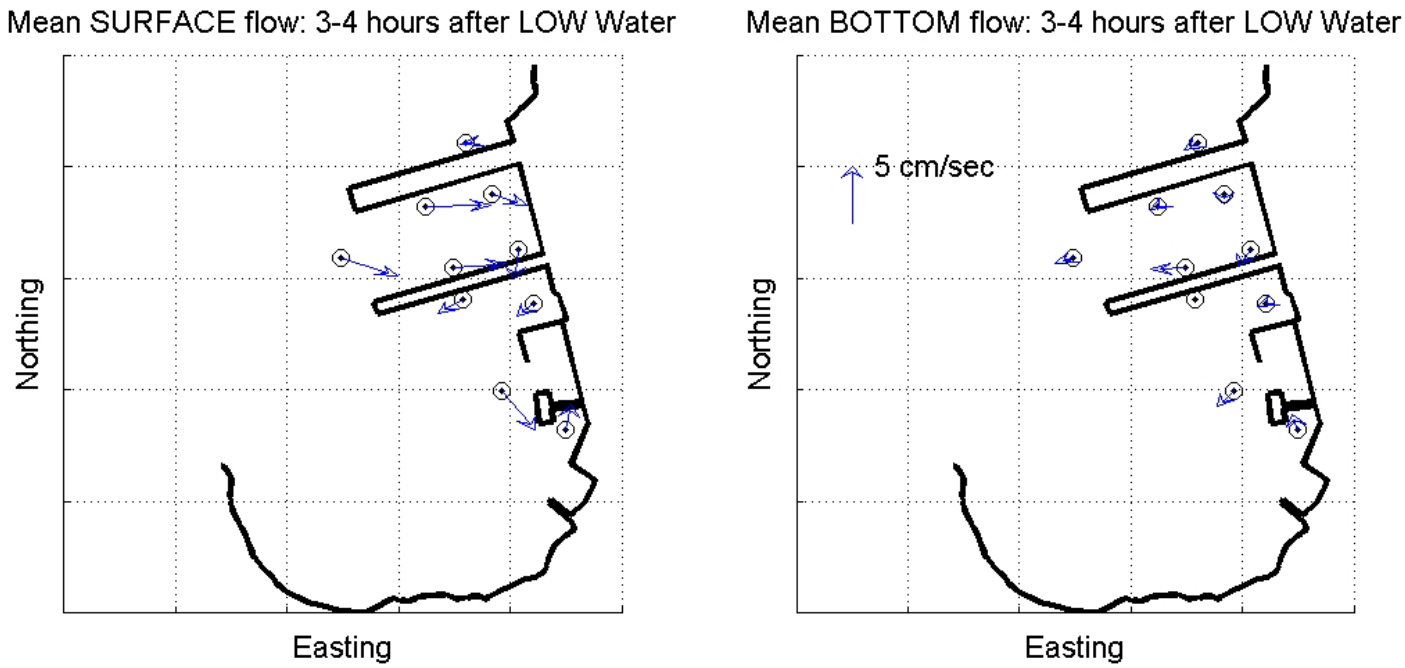


Figure 27: Mean flow vectors resulting from the vector-average of measurements 3-to-4 hours after low water for each tidal cycle over the ~16-day deployment.. Near-surface flow (i.e. upper half of the water column) is shown to the left; near-bottom flow (i.e. lower half of the water column) to the right. Incoming flows are slowing.

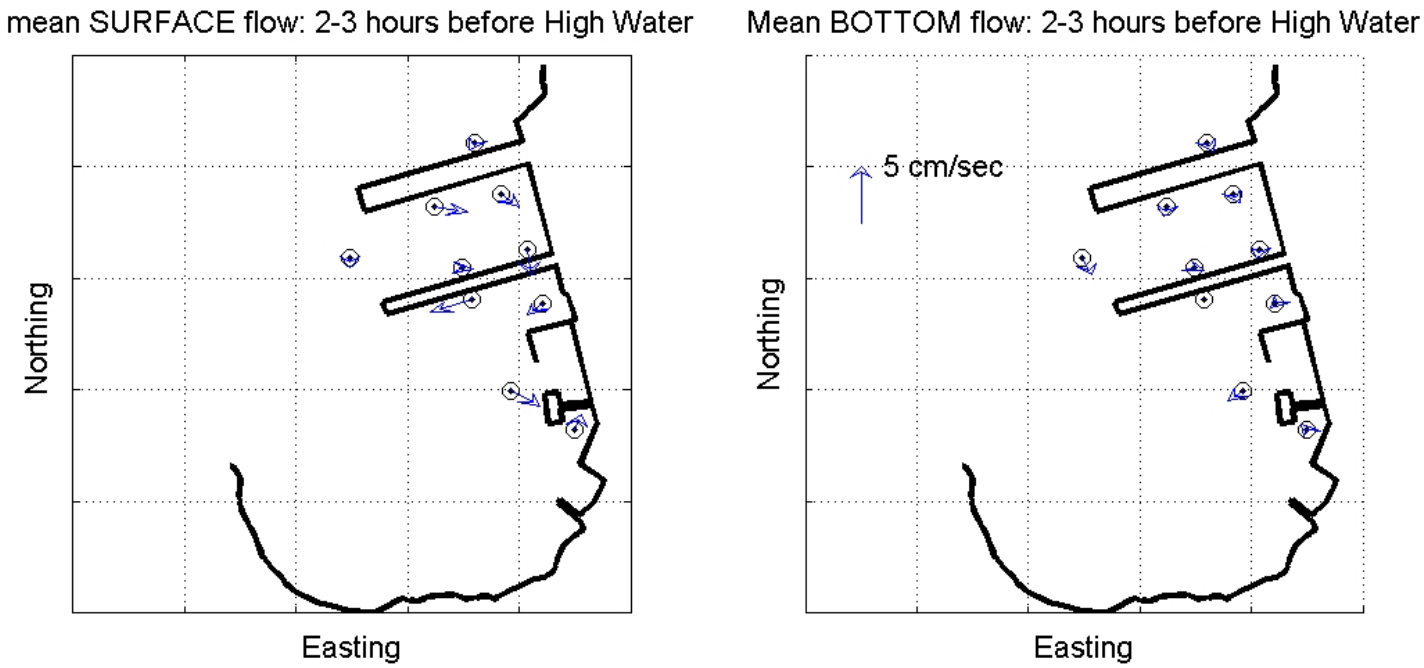


Figure 28: Mean flow vectors resulting from the vector-average of measurements 2-to-3 hours <u>before</u> high water for each tidal cycle over the ~16-day deployment.. Near-surface flow (i.e. upper half of the water column) is shown to the left; near-bottom flow (i.e. lower half of the water column) to the right. This appears to be the time of slack water, about midway between low and high water, an interesting result suggesting the tidal currents are in phase with tidal elevation (usually velocity and elevation are 90 degrees out of phase).

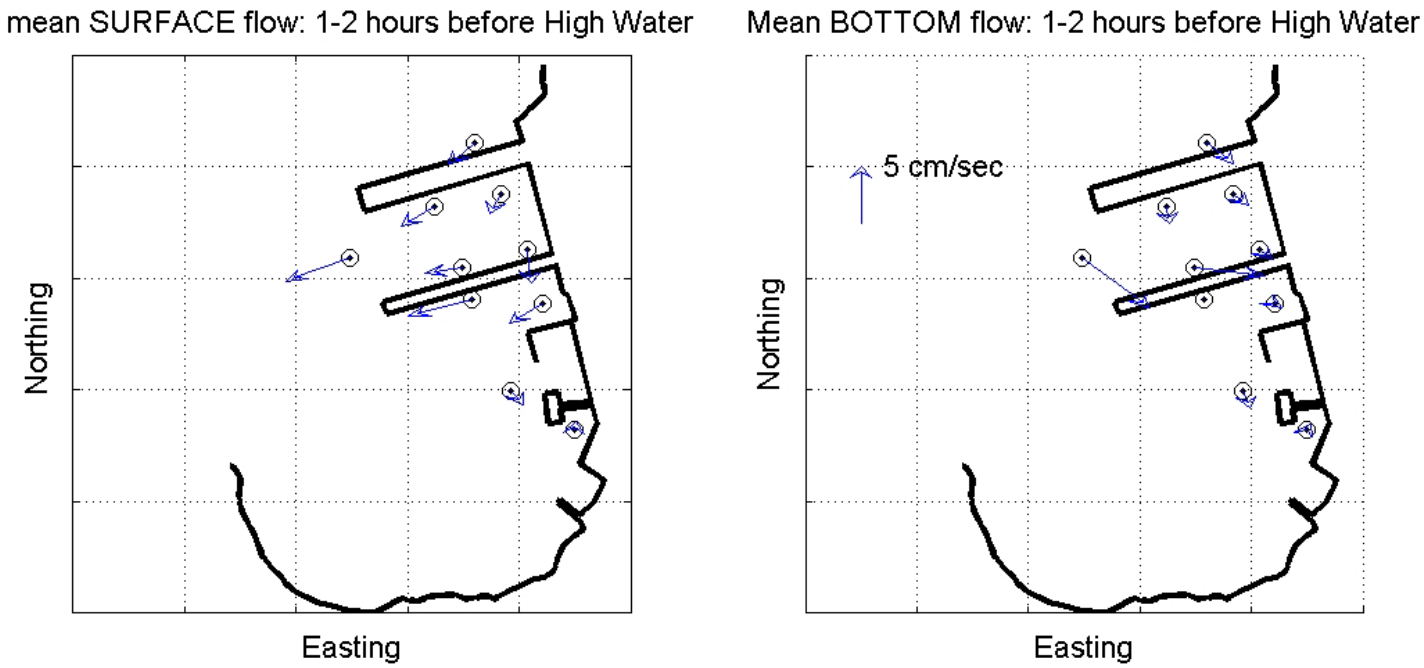


Figure 29: Mean flow vectors resulting from the vector-average of measurements 1-to-2 hours before high water for each tidal cycle over the ~16-day deployment.. Near-surface flow (i.e. upper half of the water column) is shown to the left; near-bottom flow (i.e. lower half of the water column) to the right. Near-surface flows at the stations suggest water is exiting from the Cove, even though the tide continues to rise.

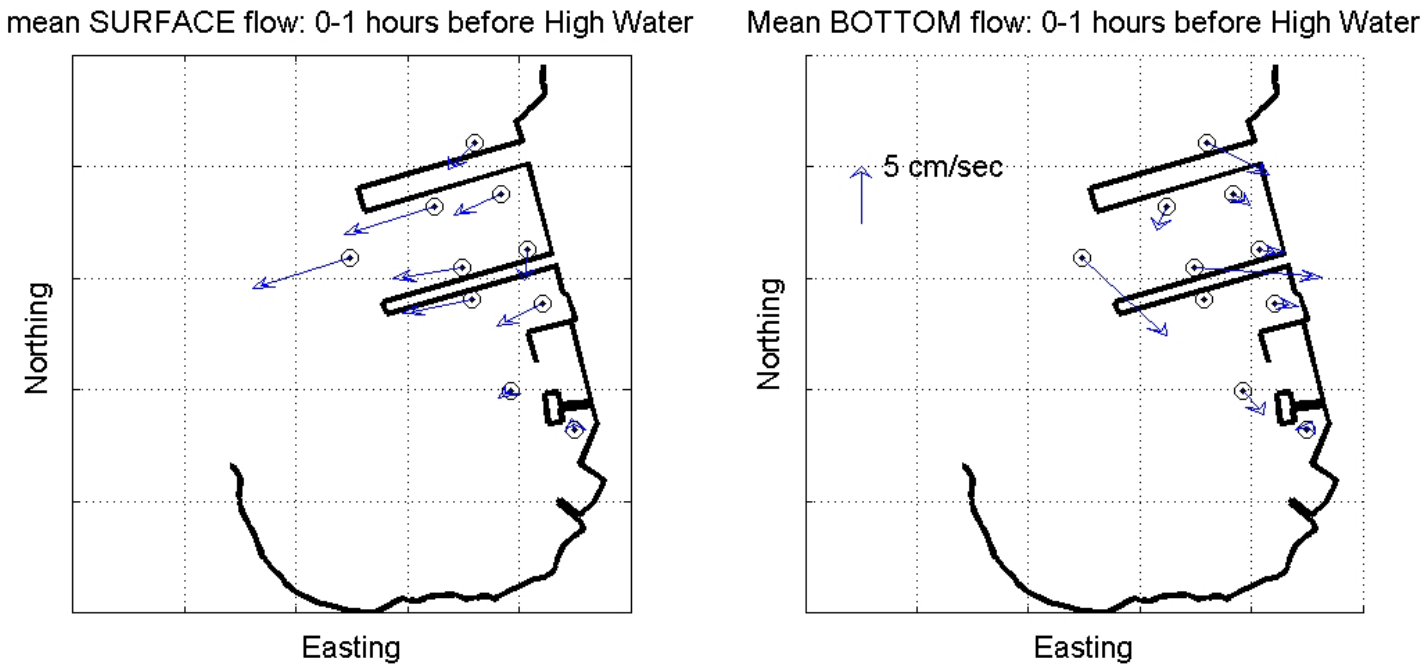


Figure 30: Mean flow vectors resulting from the vector-average of measurements 0-to-1 hour <u>before</u> high water for each tidal cycle over the ~16-day deployment.. Near-surface flow (i.e. upper half of the water column) is shown to the left; near-bottom flow (i.e. lower half of the water column) to the right. Near-surface flows at the stations suggest water is exiting from the Cove, even though the tide continues to rise.

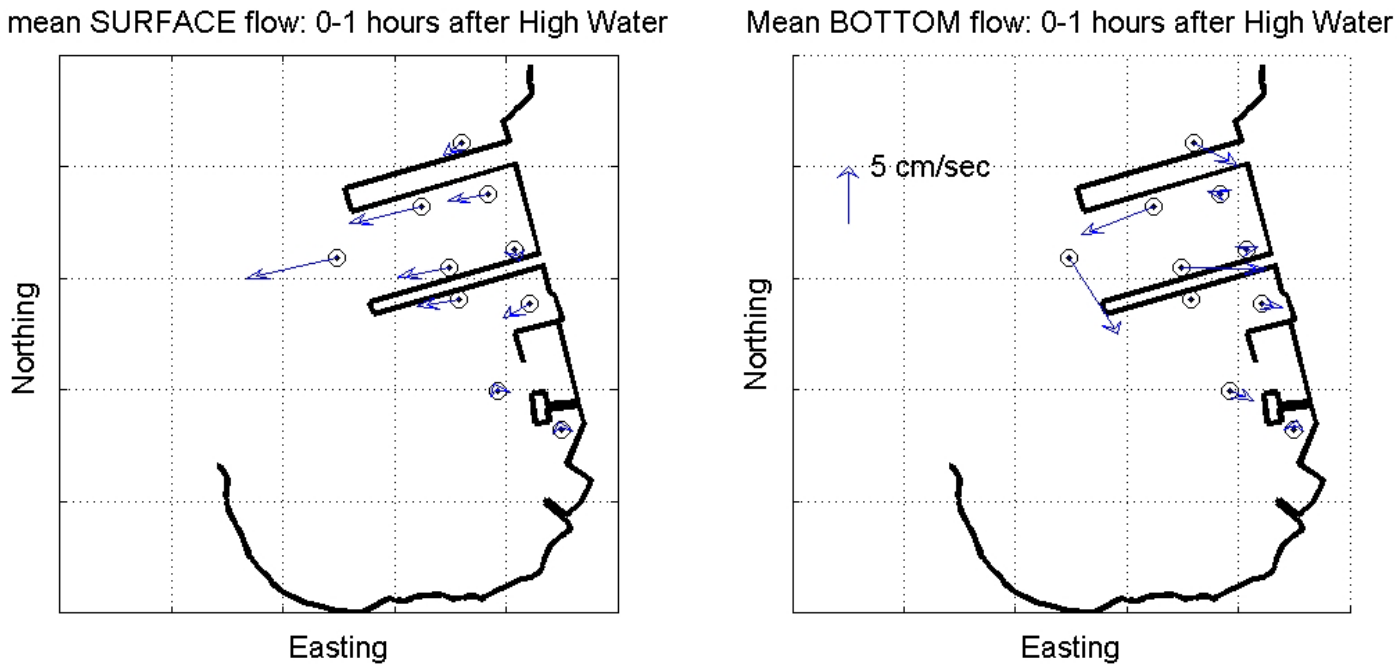


Figure 31: Mean flow vectors resulting from the vector-average of measurements 0-to-1 hour after high water for each tidal cycle over the ~16-day deployment.. Near-surface flow (i.e. upper half of the water column) is shown to the left; near-bottom flow (i.e. lower half of the water column) to the right. Near-surface flows at the stations suggest water is exiting from the Cove.

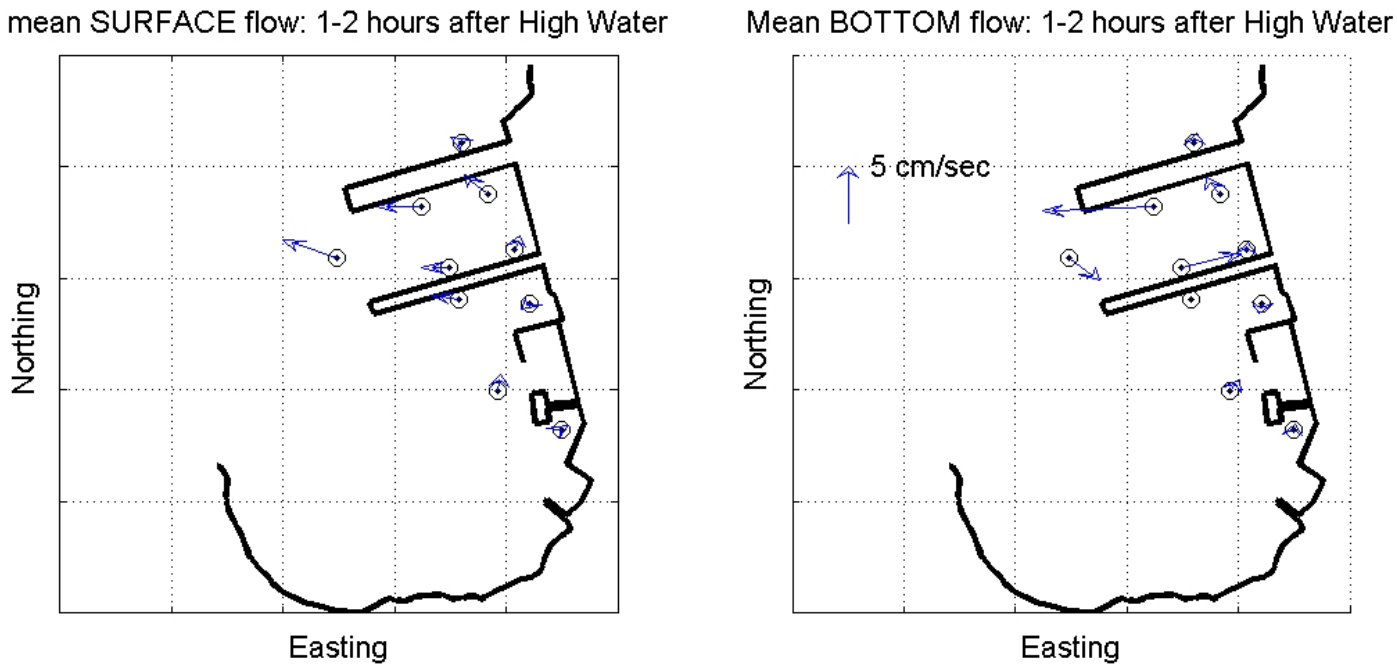


Figure 32: Mean flow vectors resulting from the vector-average of measurements 1-to-2 hours after high water for each tidal cycle over the ~16-day deployment.. Near-surface flow (i.e. upper half of the water column) is shown to the left; near-bottom flow (i.e. lower half of the water column) to the right. Westward flow is weakening.

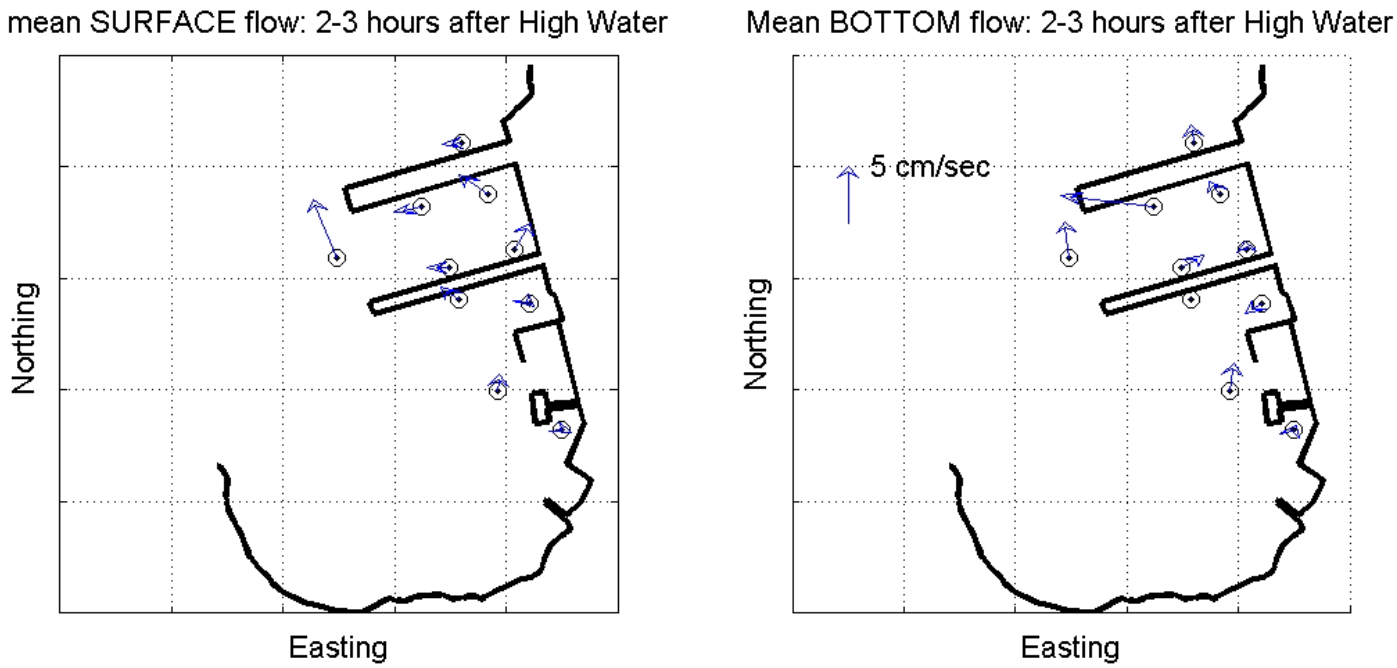


Figure 33: Mean flow vectors resulting from the vector-average of measurements 2-to-3 hours <u>after</u> high water for each tidal cycle over the ~16-day deployment.. Near-surface flow (i.e. upper half of the water column) is shown to the left; near-bottom flow (i.e. lower half of the water column) to the right.

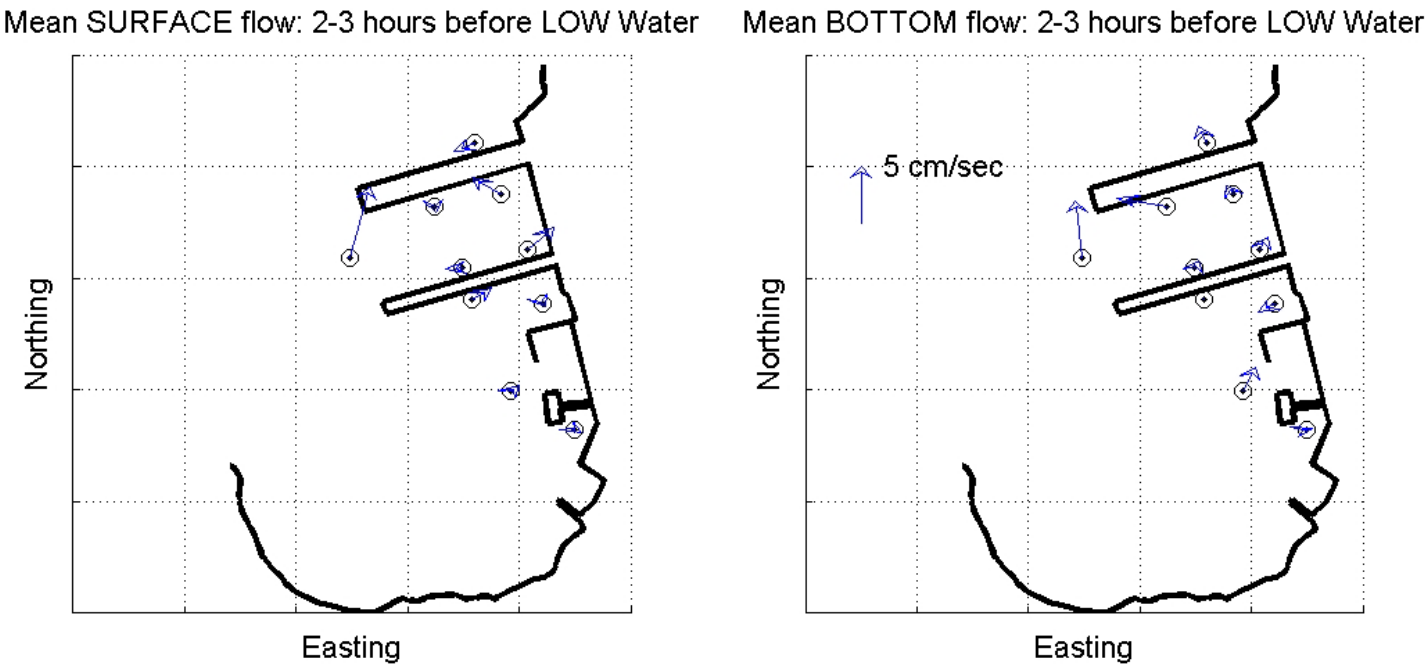


Figure 34: Mean flow vectors resulting from the vector-average of measurements 2-to-3 hours before low water for each tidal cycle over the ~16-day deployment.. Near-surface flow (i.e. upper half of the water column) is shown to the left; near-bottom flow (i.e. lower half of the water column) to the right.

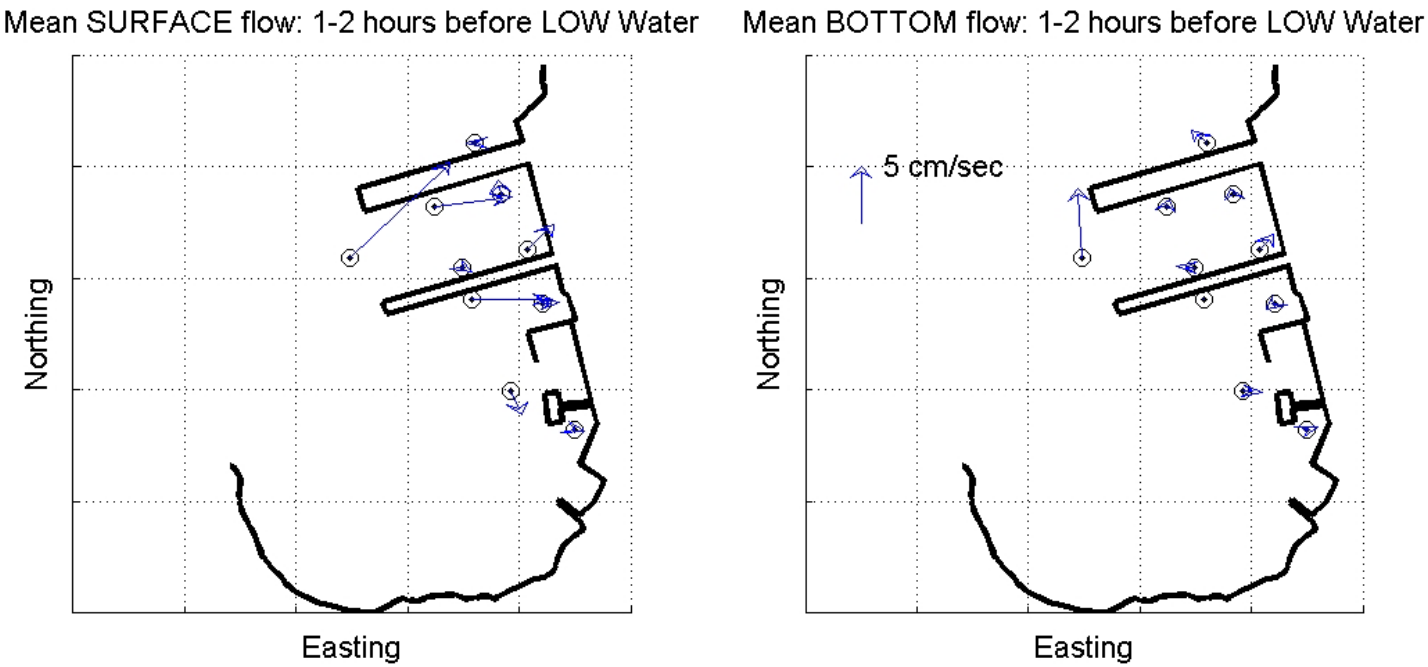


Figure 35: Mean flow vectors resulting from the vector-average of measurements 1-to-2 hours before low water for each tidal cycle over the ~16-day deployment.. Near-surface flow (i.e. upper half of the water column) is shown to the left; near-bottom flow (i.e. lower half of the water column) to the right. Flow seems to be generally eastward at many of the stations.

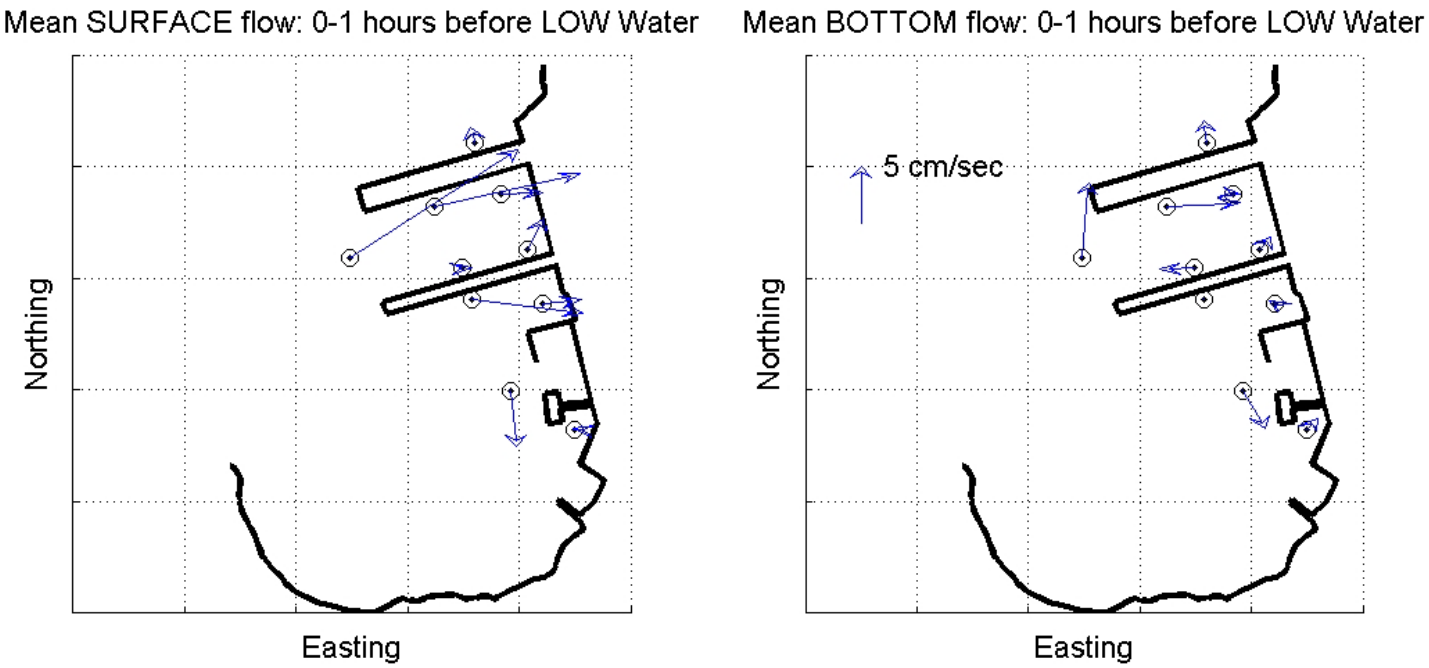


Figure 36: Mean flow vectors resulting from the vector-average of measurements 0-to-1 hours before low water for each tidal cycle over the ~16-day deployment.. Near-surface flow (i.e. upper half of the water column) is shown to the left; near-bottom flow (i.e. lower half of the water column) to the right. There seems to be a strong inflow towards the east/northeast during this stage of the tide.

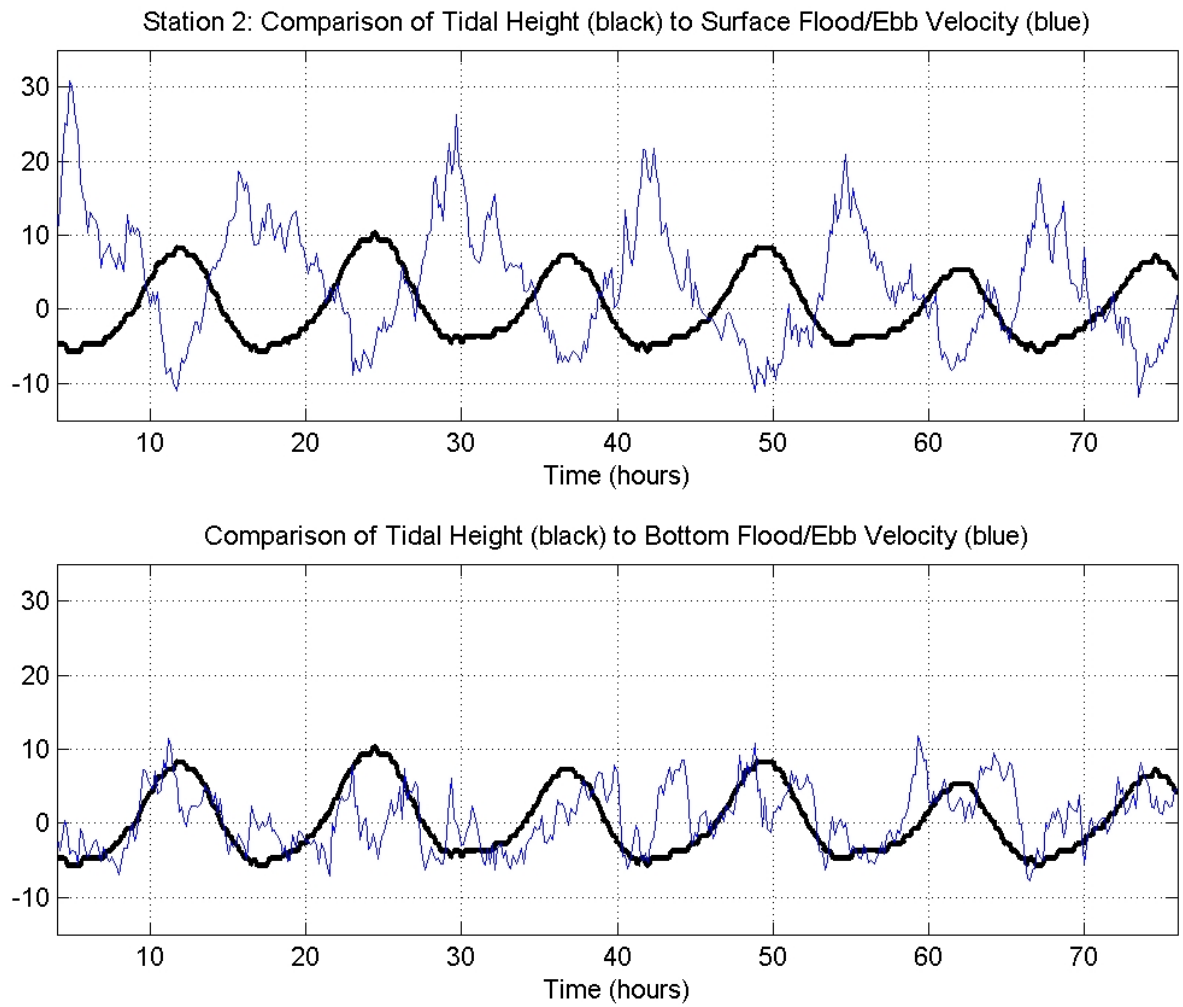


Figure 37: Relative phase between tidal elevations (black line) and near-surface tidal velocities (blue line, top plot) and near-bottom velocities (blue line, bottom plot) for a selected 3-day time period at Station 02. Tide height (in meters) was multiplied by 10 to better compare with velocity. Incoming flood velocities were of order ~20-30 cm/sec while out-going ebb velocities were of order 10 cm/sec. Near-surface velocities appeared by about 180 degrees out of phase with tidal elevations, with peak flood velocities occurring at low water and peak ebb velocities occurring at the time of high water. Near-bottom flows appeared to be in phase with elevation changes.

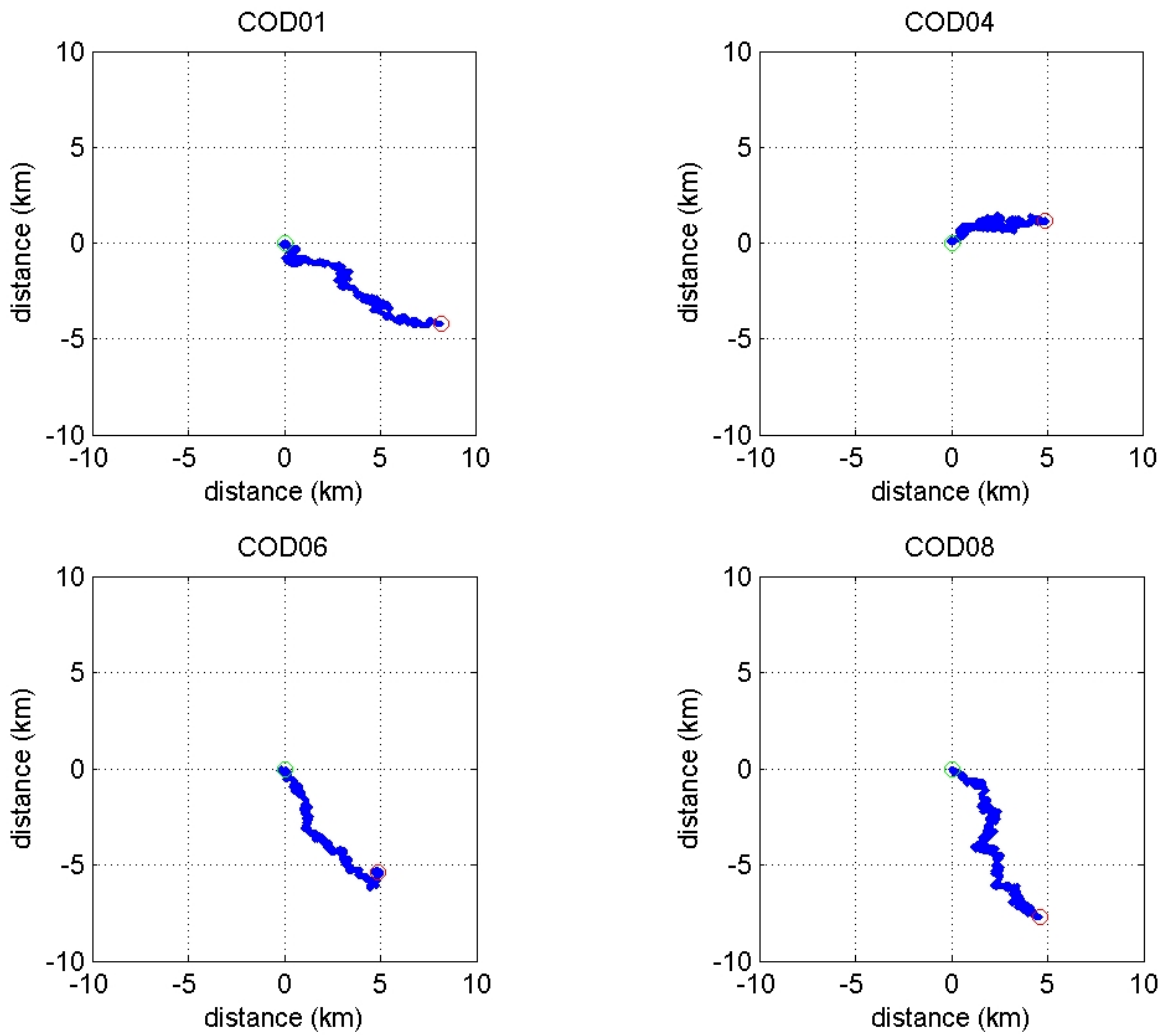


Figure 38: Progressive vector diagram for near-bottom flow at sites 1, 4, 6 and 8 (northern nearshore stations). These diagrams show the theoretical track of particles transported by bottom currents. The origin is located at (0,0) depicted by the green circle. The end point is depicted by the red circle. Net transport for these stations appears to be eastward or southeastward.

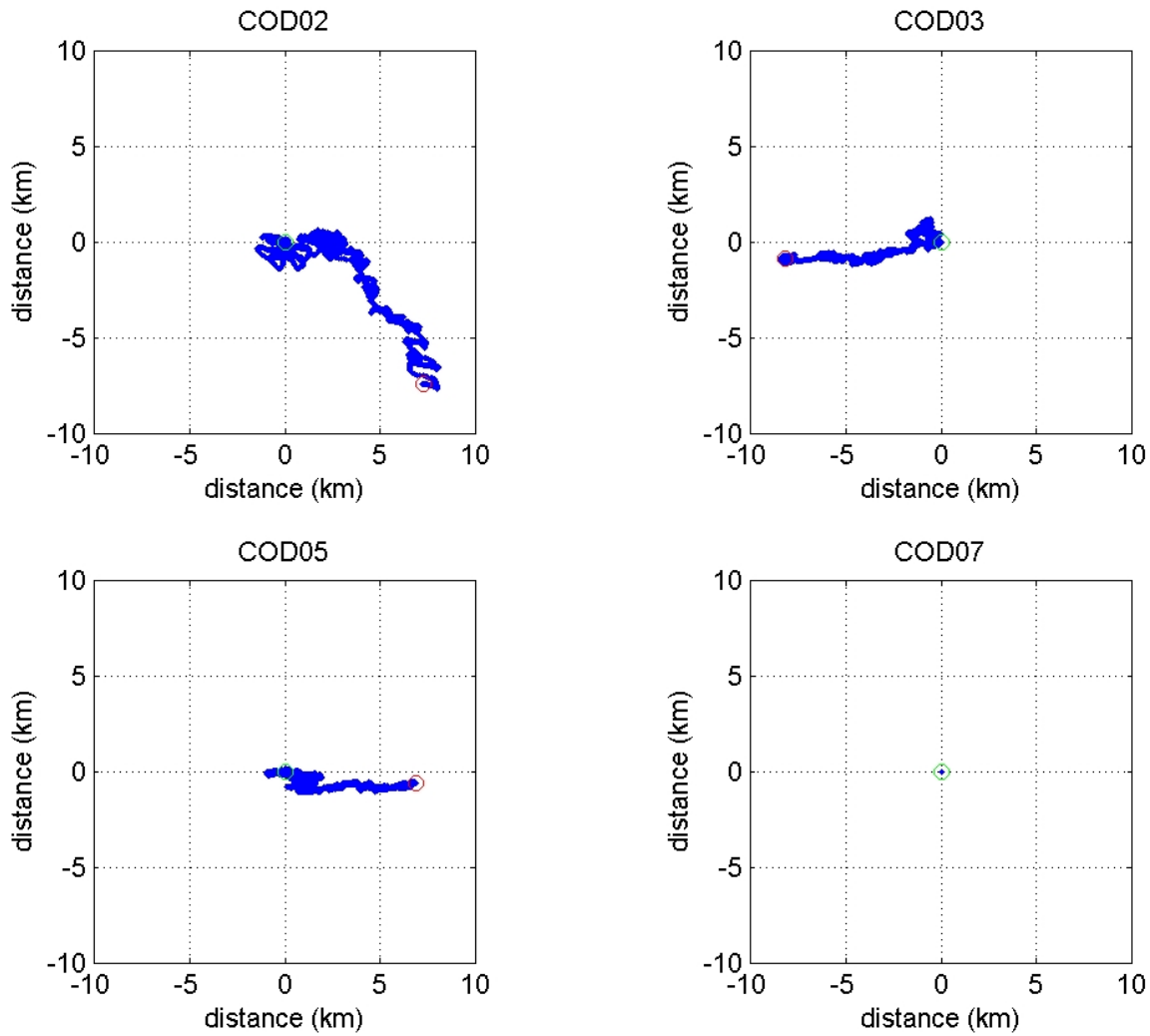


Figure 39: Progressive vector diagram for near-bottom flow at sites 2, 3, 5, and 7 (offshore stations). These diagrams show the theoretical track of particles transported by bottom currents. The origin is located at (0,0) depicted by the green circle. The end point is depicted by the red circle. Net transport for these stations appear to be eastward or southeastward. Bottom currents at Station 7 were invalid due to bias so not shown.

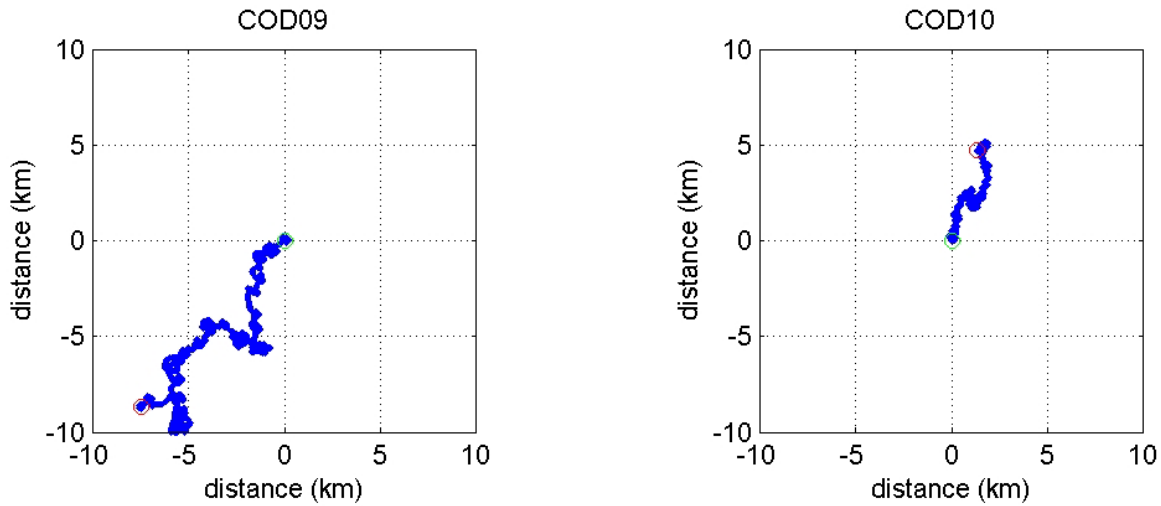


Figure 40: Progressive vector diagram for near-bottom flow at sites 9 and 10 (southern nearshore stations). These diagrams show the theoretical track of particles transported by bottom currents. The origin is located at (0,0) depicted by the green circle. The end point is depicted by the red circle. Net transport for station 09 was southwestward but Station 10 net transport was northward.

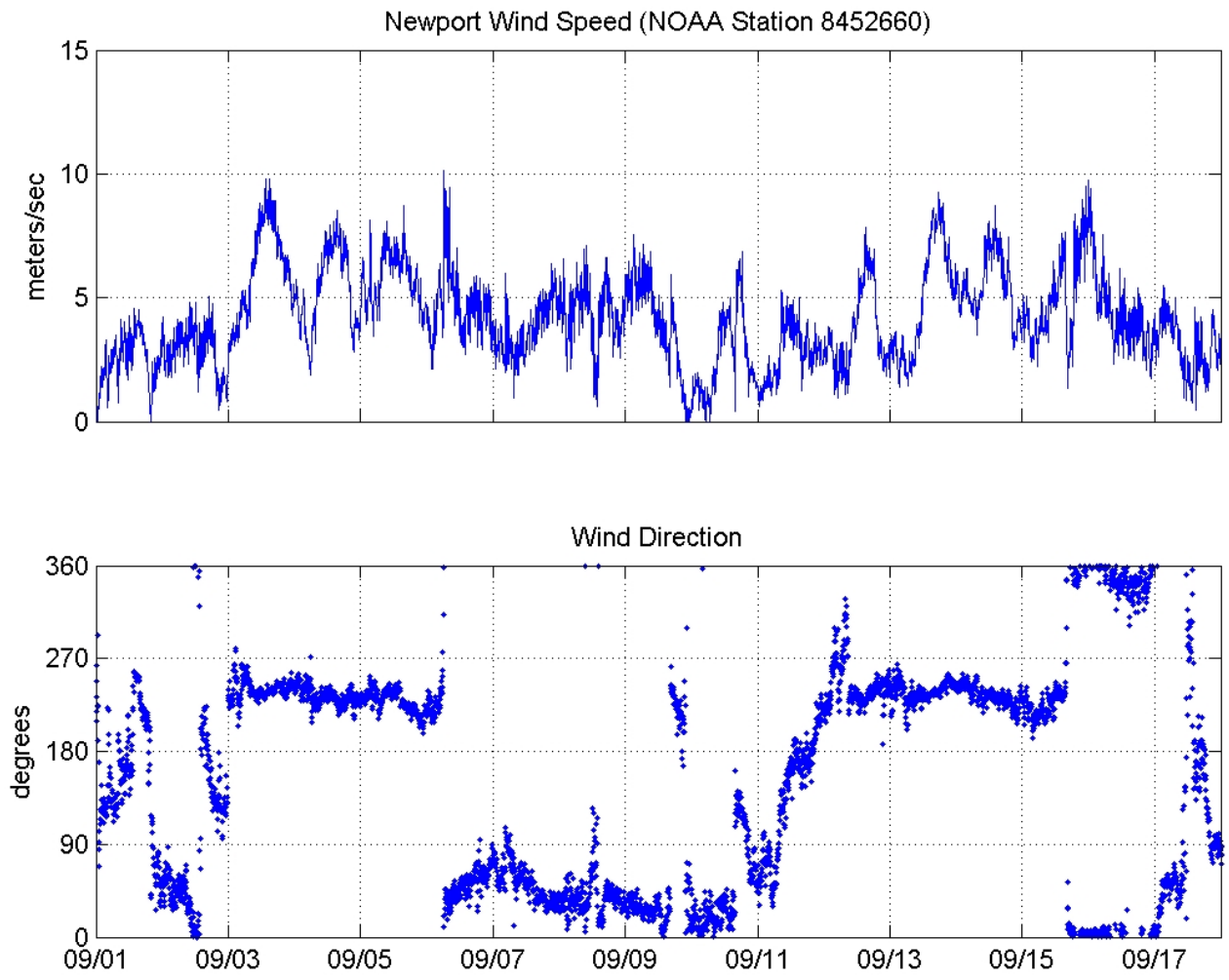


Figure 41: Wind speed and direction during the ADCP deployment (courtesy of NOAA PORTS system website http://tidesandcurrents.noaa.gov). Winds were from the northeast or southwest much of the time, rarely exceeding 10 m/s (~20 knots).

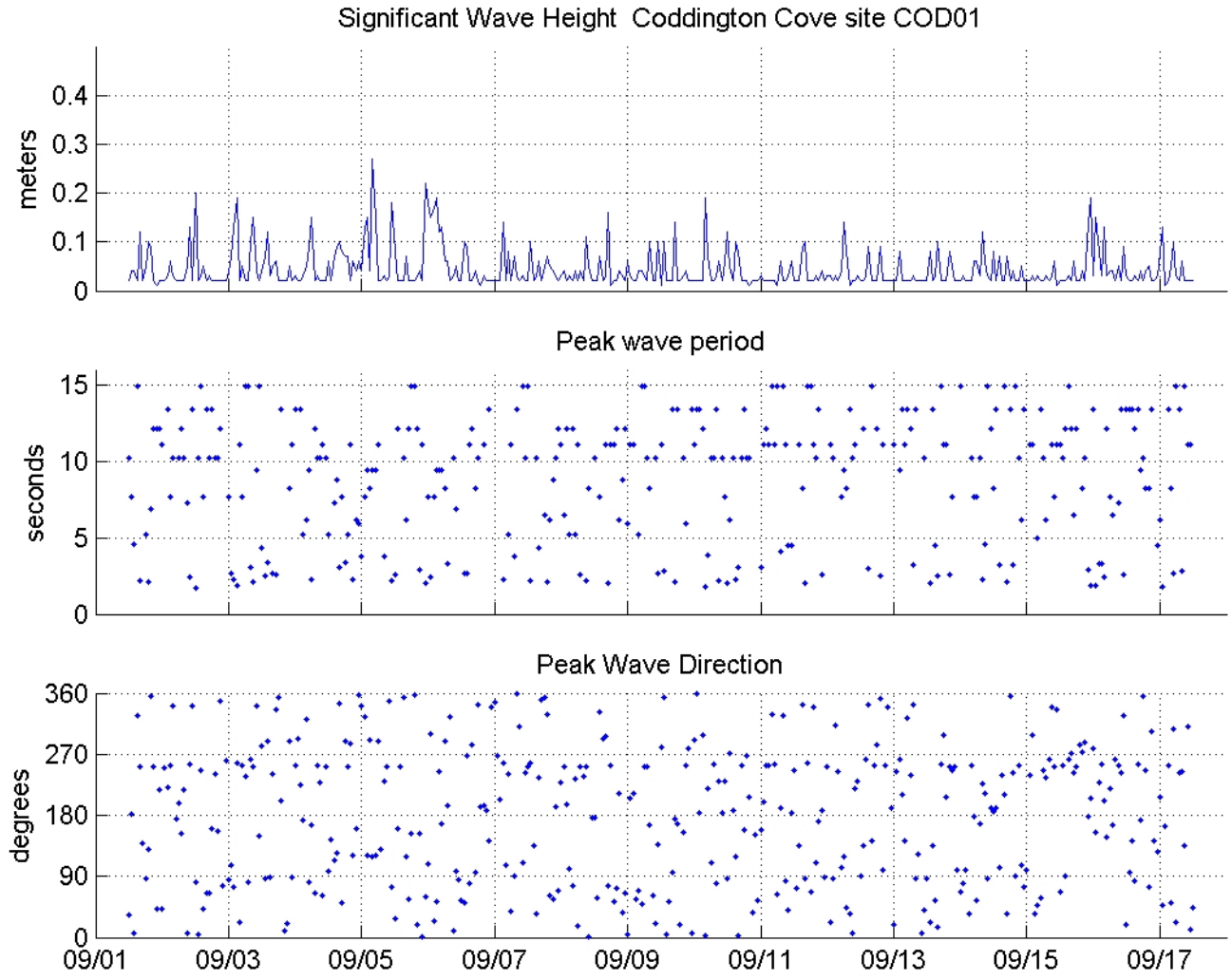


Figure 42: Significant wave height (top), peak wave period (middle) and peak wave direction (lower plot) for station COD01.

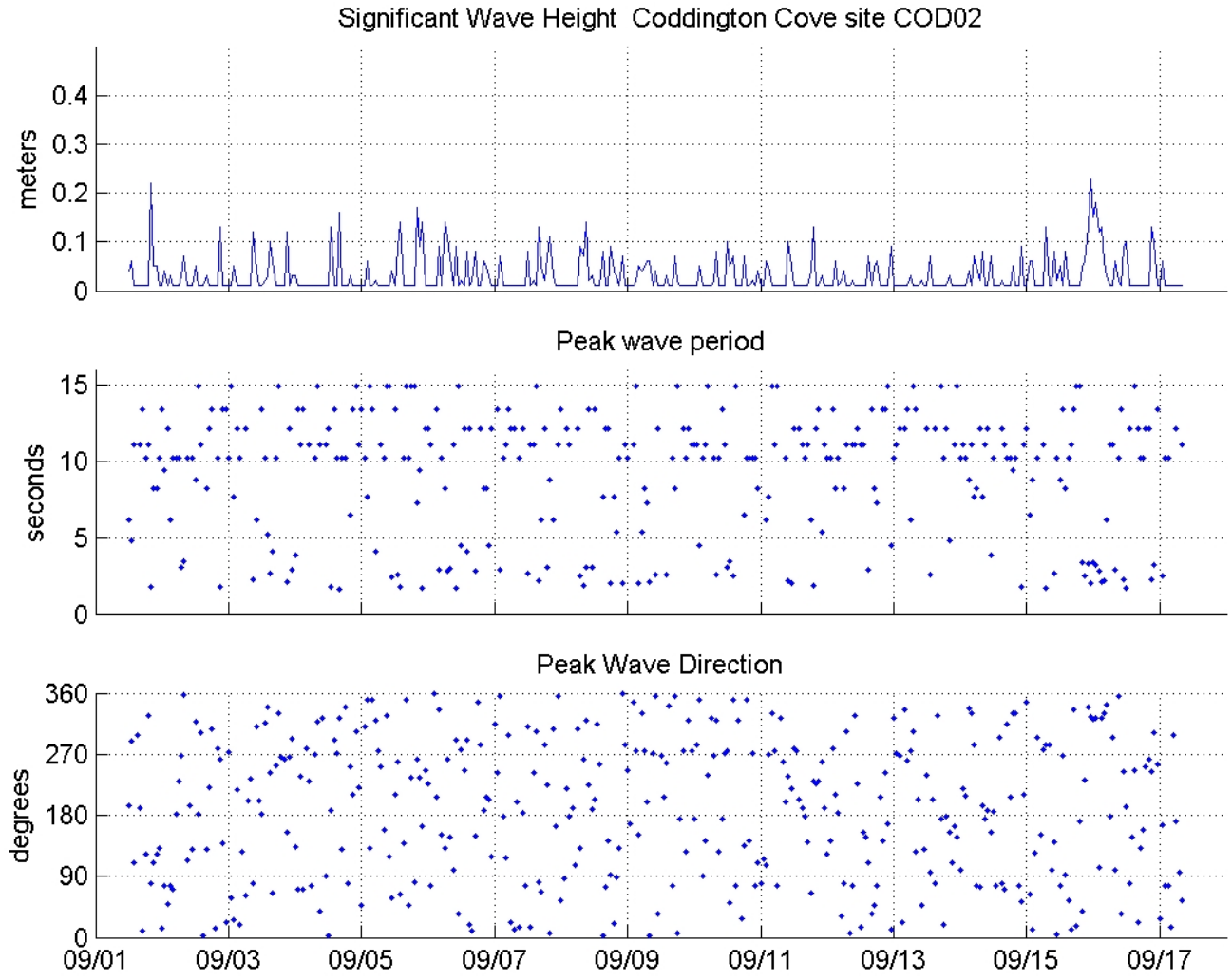


Figure 43: Significant wave height (top), peak wave period (middle) and peak wave direction (lower plot) for station COD02.

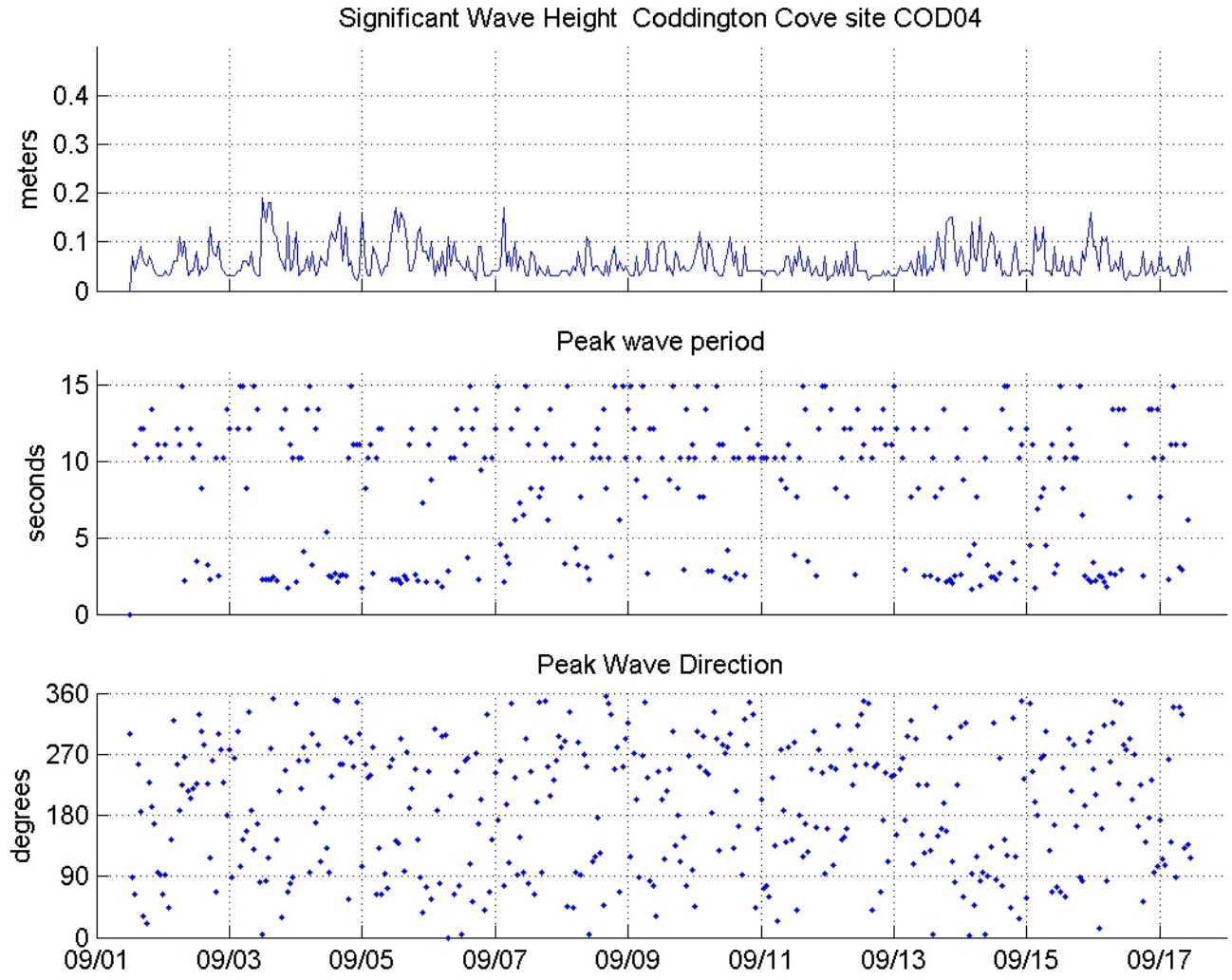


Figure 44: Significant wave height (top), peak wave period (middle) and peak wave direction (lower plot) for station COD04.

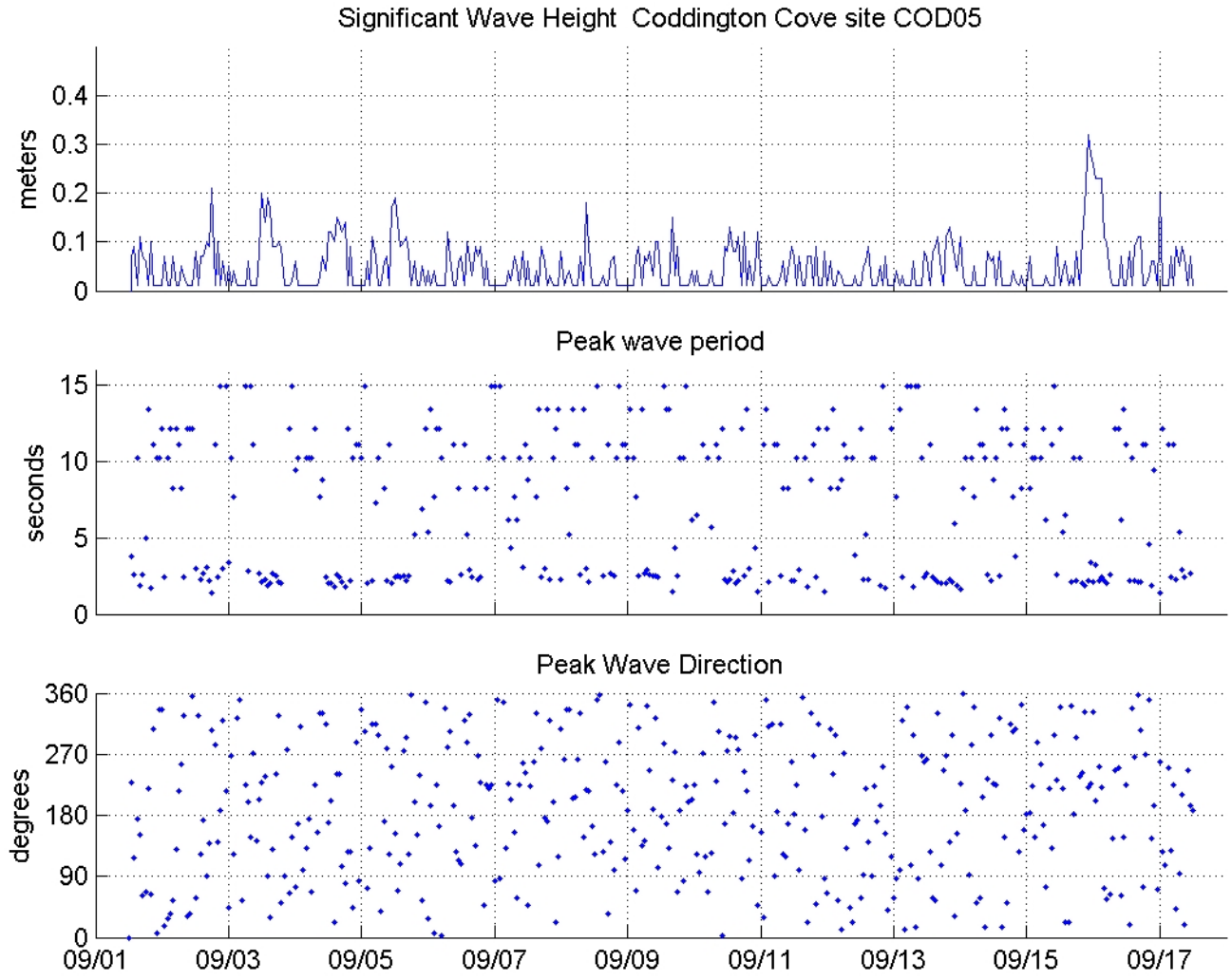


Figure 45: Significant wave height (top), peak wave period (middle) and peak wave direction (lower plot) for station COD05.

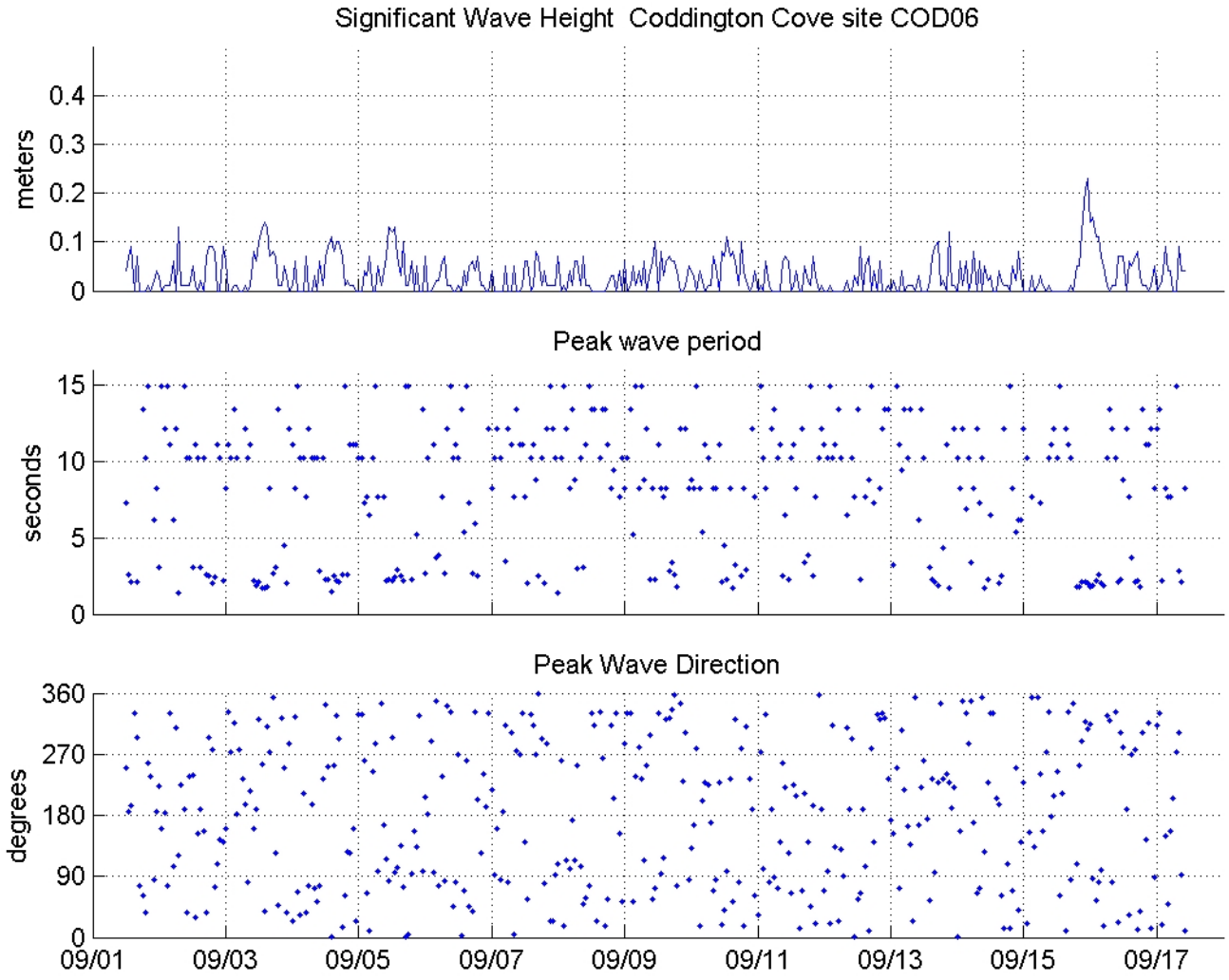


Figure 46: Significant wave height (top), peak wave period (middle) and peak wave direction (lower plot) for station COD06.

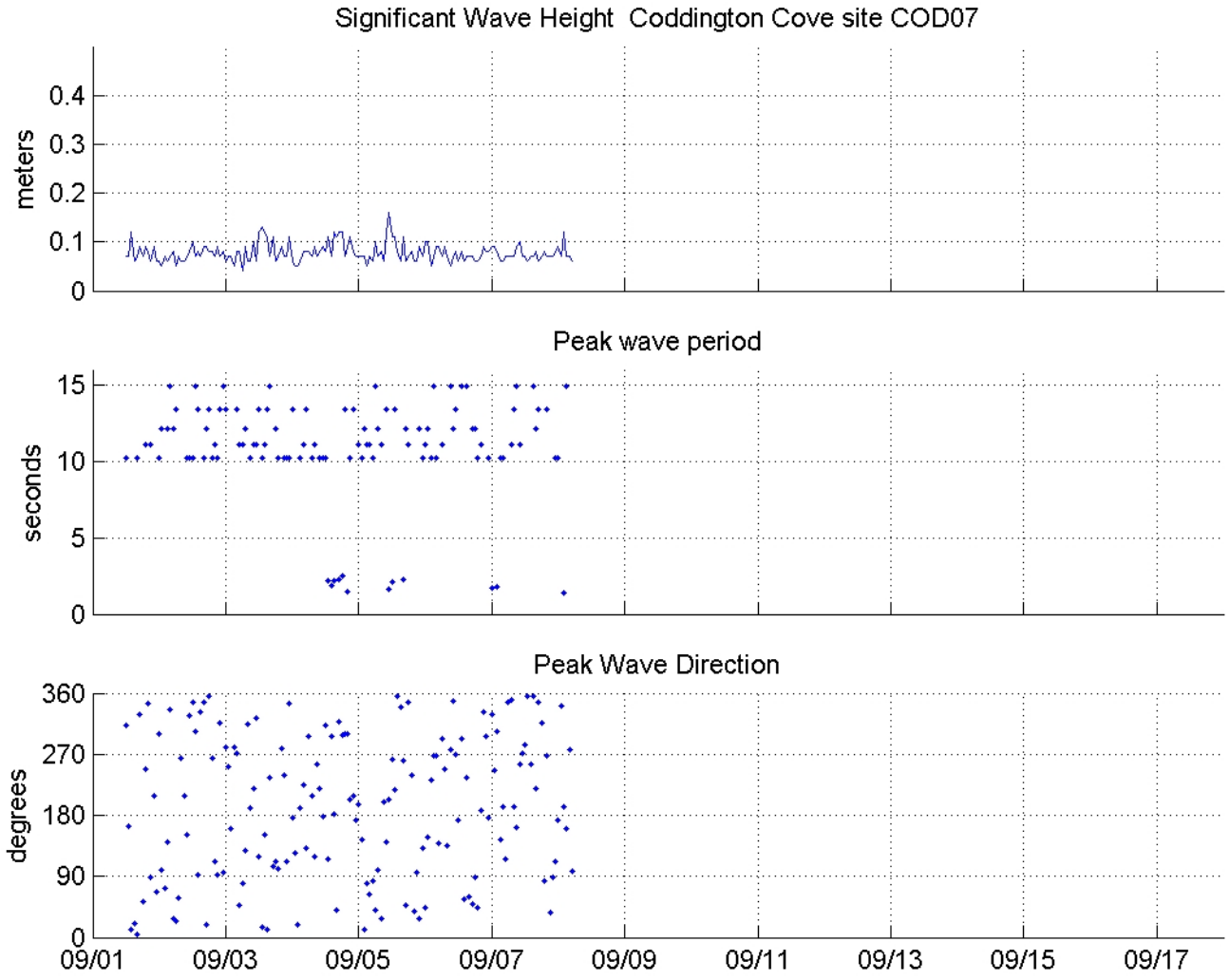


Figure 47: Significant wave height (top), peak wave period (middle) and peak wave direction (lower plot) for station COD07.

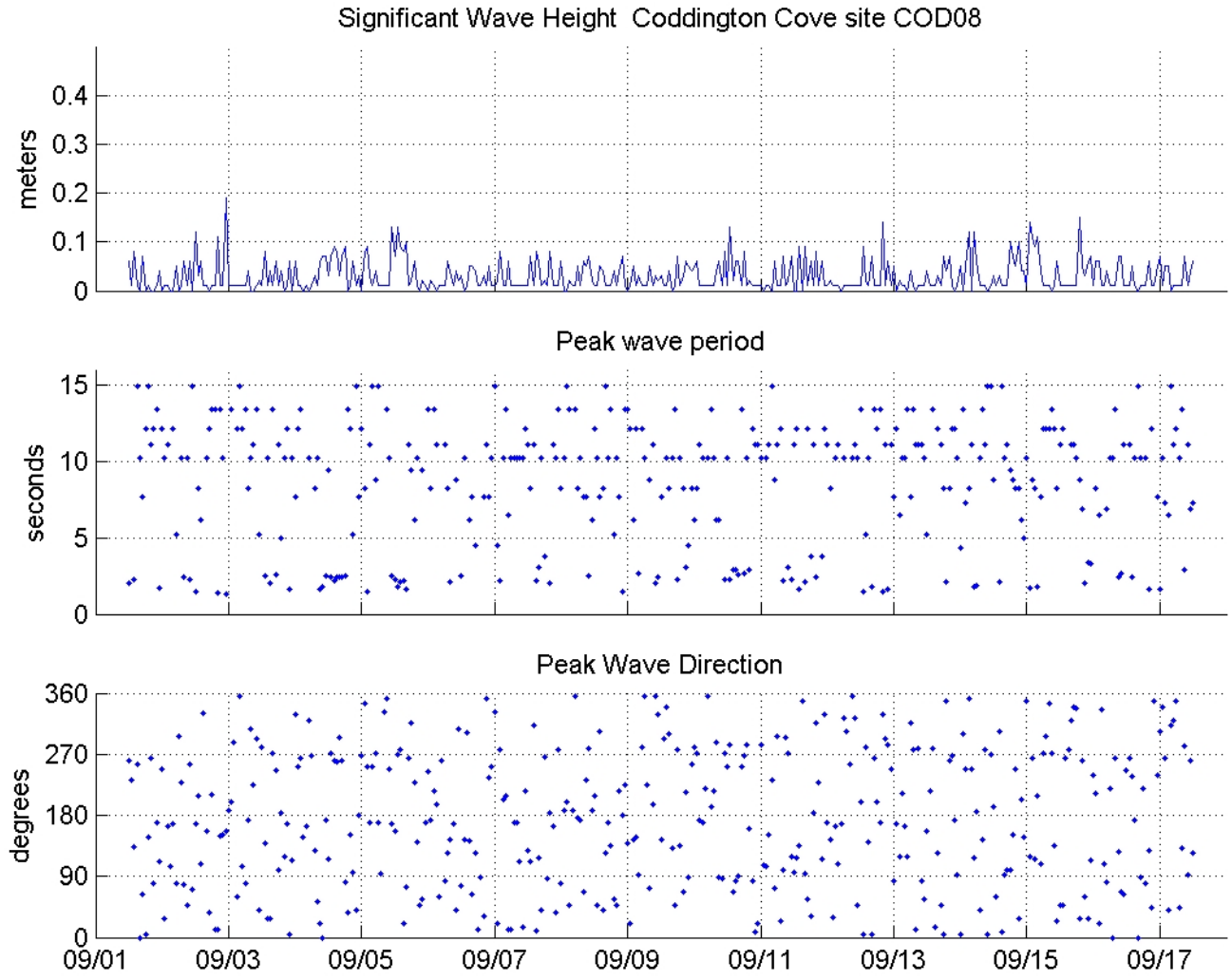


Figure 48: Significant wave height (top), peak wave period (middle) and peak wave direction (lower plot) for station COD08.

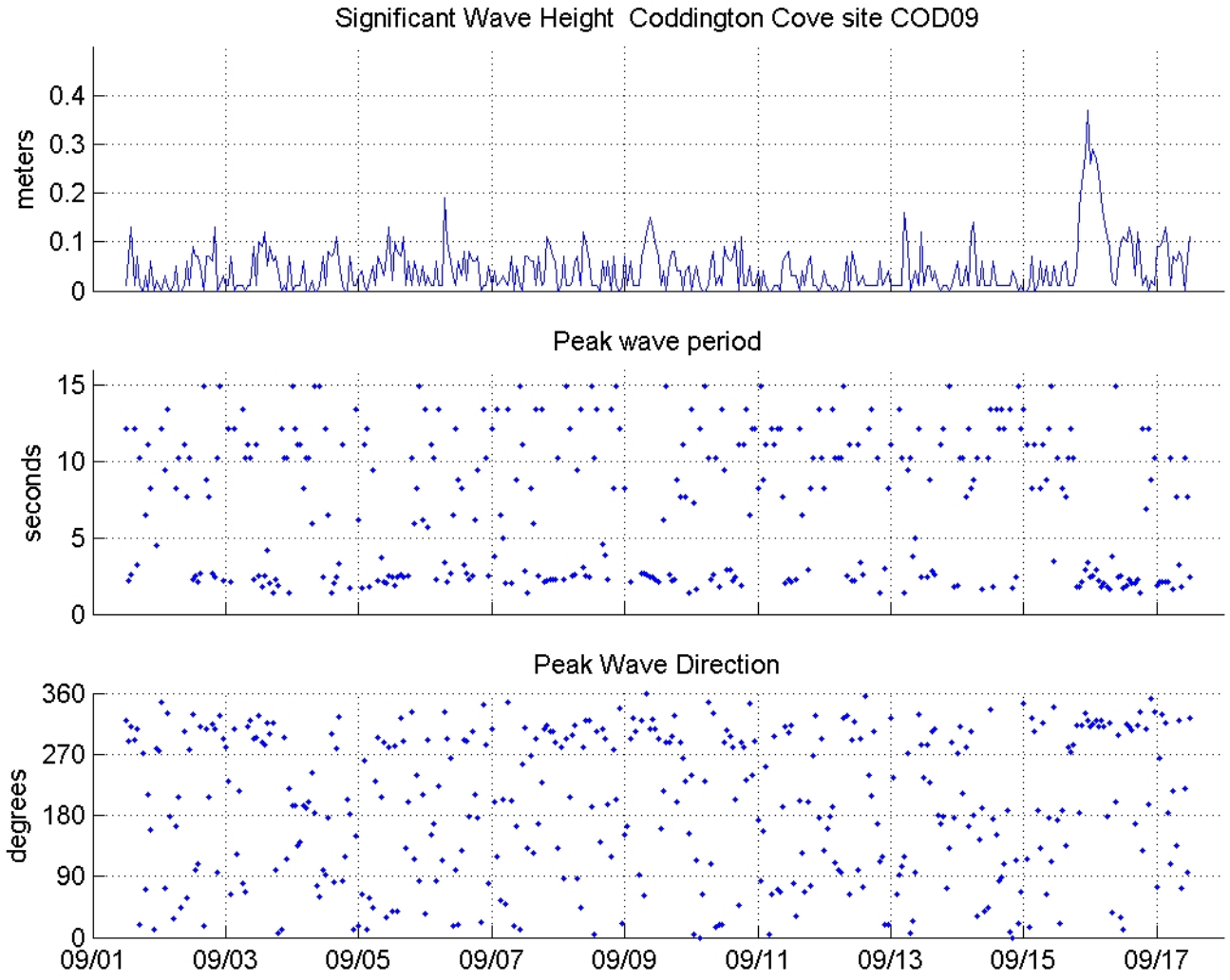


Figure 49: Significant wave height (top), peak wave period (middle) and peak wave direction (lower plot) for station COD09.

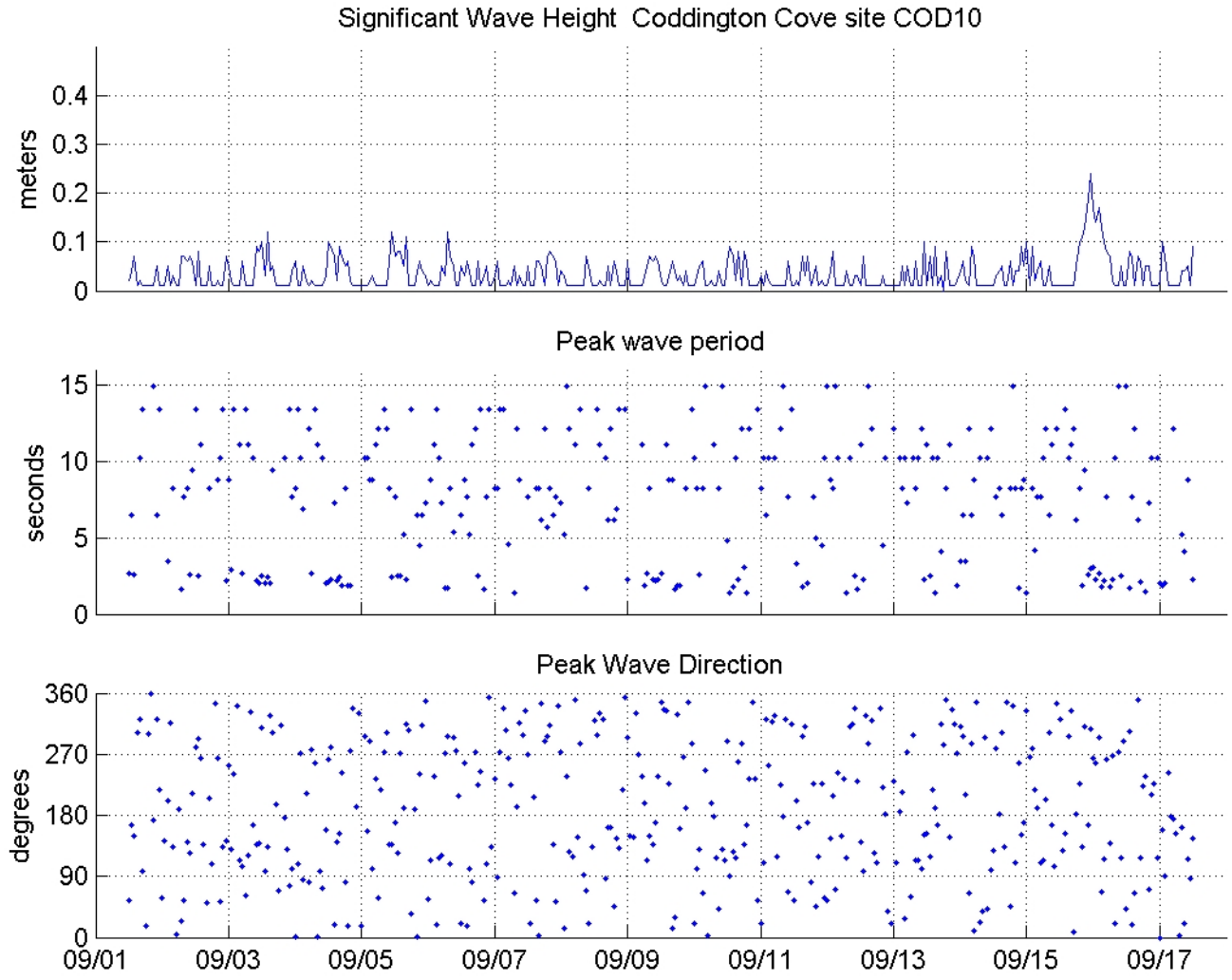


Figure 50: Significant wave height (top), peak wave period (middle) and peak wave direction (lower plot) for station COD10.

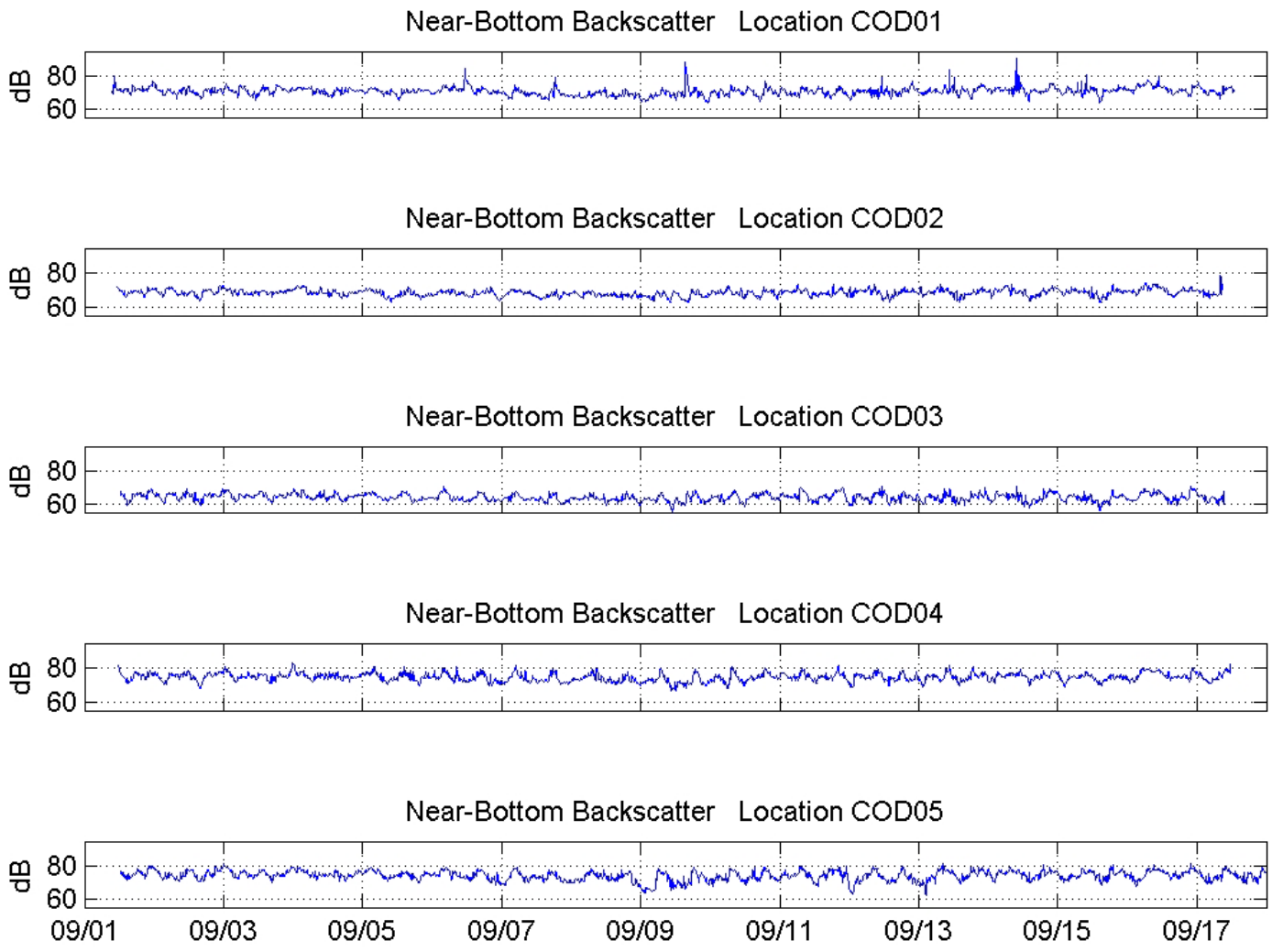


Figure 51: ADCP backscatter nearest the bottom at Sites 01 through 05. Correlation of backscatter to tides and wind events was not particularly strong, suggesting sediment re-suspension processes were weak during this time period.

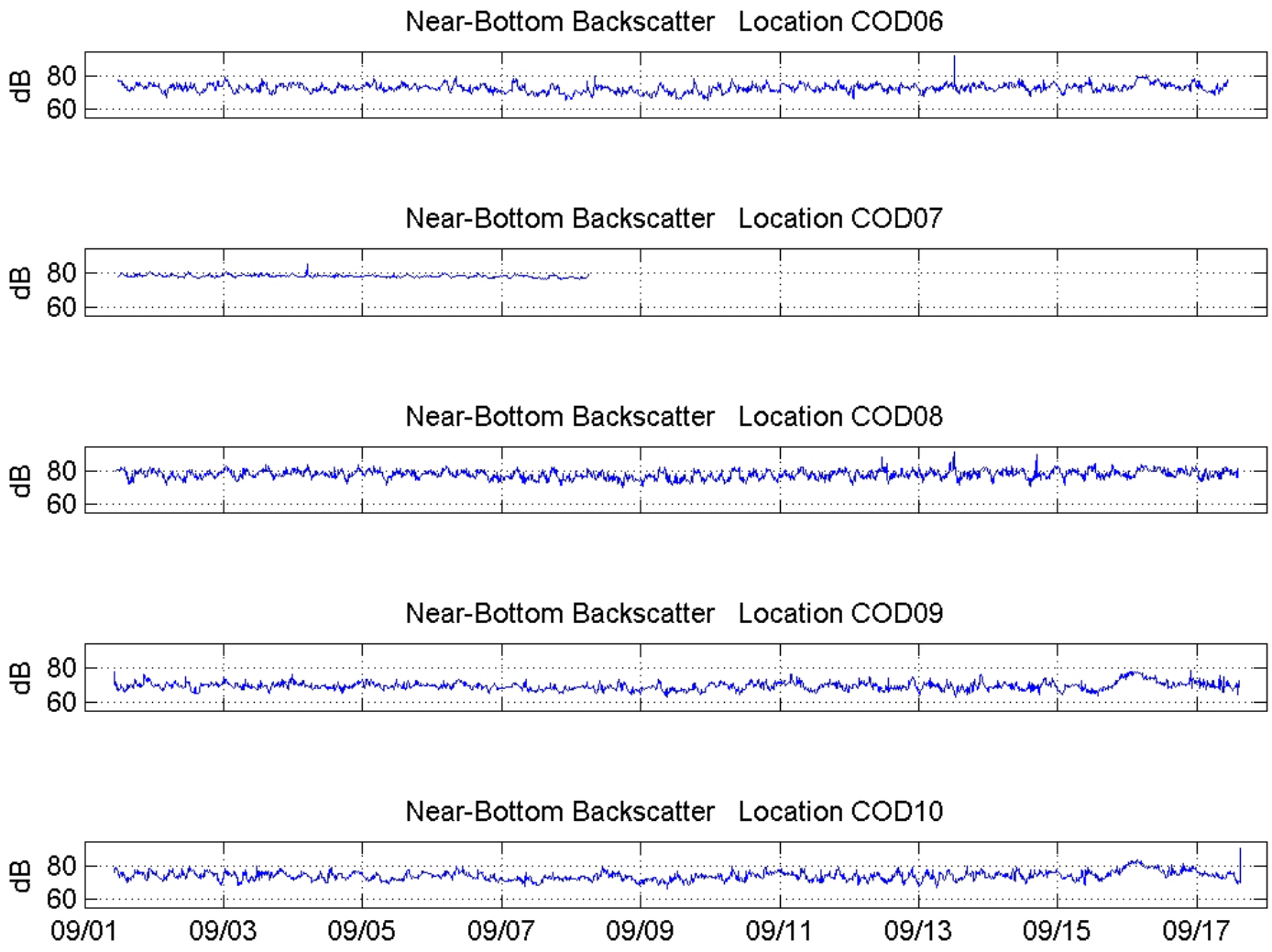


Figure 52: ADCP backscatter nearest the bottom at Sites 06 through 10. Location 09 and 10 showed some correlation to wind events, particularly strong north winds on September 16th.

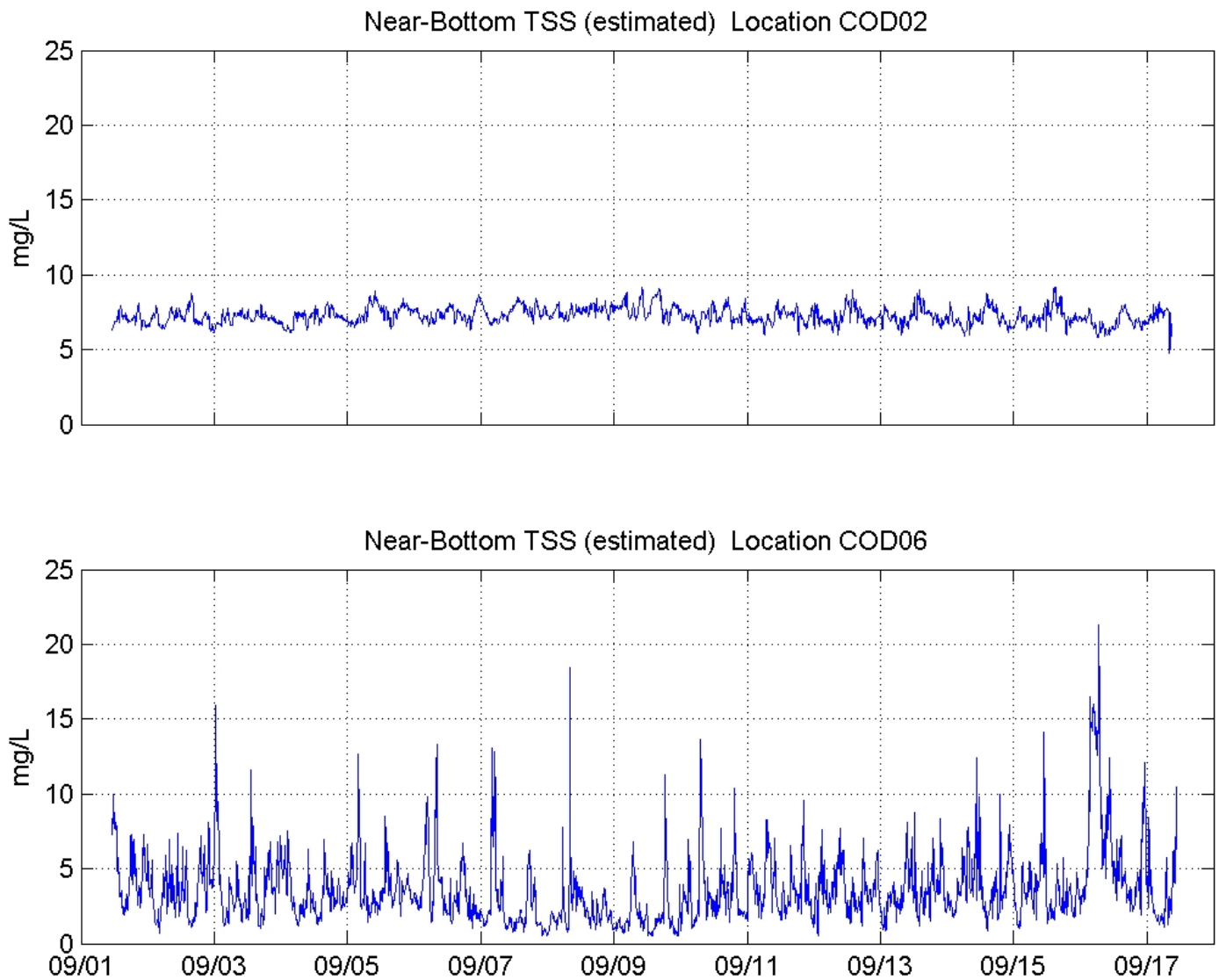


Figure 53: Total Suspended solid concentrations estimated from ADCP backscatter measurements at Locations COD02 and COD06. These were the only locations where the TSS-backscatter calibrations were reasonable. Variability at COD06 showed some dependence on wind events.

D-3 REPORT ON LEAD-210 ACCUMULATION RATES OF SEDIMENT CORES

Report on ^{210}Pb Accumulation Rates of Sediment Cores from Derecktor Shipyard Offshore Supplemental Sediment Investigation

by

Mead A. Allison, PhD
Independent Consultant**

14 February 2012

**** permanent position:**

Senior Research Scientist and Associate Director
Institute for Geophysics
University of Texas at Austin

INTRODUCTION/METHODS

The sample results were provided pre-analyzed by a commercial laboratory for total ^{210}Pb activity by alpha spectrometry. No information was made available to examine sample preparation or analytical procedures. The alpha method of conducting ^{210}Pb geochronology yields a total activity, which is a combination of particle-reactive ^{210}Pb that is adsorbed onto particle surfaces prior to their deposition at the accumulating (harbor) site. This is "excess" Pb and tends to be preferentially attached to clay mineral particles (clay and fine silt size classes) due to their cation exchange properties. A portion of the total measured activity is also "supported" Pb derived from *in situ* decay of ^{238}U and its daughters within the crystalline lattice structure of mineral grains. It is the downcore decay of the excess component that is utilized to calculate sediment accumulation rates by this method. Since supported level is not measured directly in the alpha method (as opposed to the gamma spectrometry method where the ^{226}Ra parent is measured to derive the supported Pb activities) it must be inferred and subtracted from the measured total activities provided. Normally this is done by coring and analyzing ^{210}Pb activity to depths where sediments are of such a great age that the vast majority of the excess component (only added at the sediment surface) above supported levels (continually produced at depth in the sediments) is gone. This is normally ~5 half-lives, which is about 3% of the original signal. Given the 22.3 y half-life of ^{210}Pb, this means analyzing sediments of greater than 100-125 year age. A series of activities measured in sediments greater than this age will give an activity where total = supported ^{210}Pb levels. In this harbor setting, many of the core records show a surficial harbor mud is replaced at depth with sandier pre-harbor deposition sediments and the surficial layer total activities are still declining at the contact (base of harbor layer is still less than 100-125 years in age). Two cores (GP07 and GP09) showed relatively low activities at the base of the sampled interval and no evidence of a contact with the pre-harbor mud layer from the core logs. The average of the basal samples from these two cores was used to derive a supported level of 0.25 dpm/g that was then applied to all the cores for calculations of sediment accumulation rate.

Sample data was provided as depths in inches and activities in picocuries/gram of sediment. These values were converted to metric depths (cm) and activities to decays per minute (dpm) per gram of sediment for convenience. Hence, results are reported in cm/y of accumulation.

RESULTS

The sediment accumulation rates calculated for each of the 10 core sites is listed in Table 1. Statistical errors and r^2 values are based on the best fit linear regression applied to the excess activity data points utilized in the calculation (shown in plots for each core below). Given that sample porosities were unavailable for these intervals, it was not possible to convert this linear sedimentation rate to a mass accumulation rate (g/cm^2/y). Variation in porosity of the sampled interval from site-to-site is a source of variability that impacts the inter-comparability of core accumulation over the entire field area. What follows is a description of the process and assumptions utilized for each of the core sites.

Table 1. Sediment accumulation rate from ^{210}Pb geochronology

Site Core #	R^2	Sediment Accumulation Rate (cm/y)	Rate Error (+/- 1 sd)	Comments
GP01	0.99	0.08	0.003	Rate represents a maximum
GP02	0.95	0.75	0.15	
GP03	0.89	0.18	0.09	Rate represents a maximum
GP04	0.56	2.05	3.51	Marginal correlation but rate "high"
GP05	0.74	0.35	0.60	Poor relationship, unreliable rate
GP06	0.58	2.23	3.37	Marginal correlation but rate "high"
GP07	0.98	0.45	0.05	Excellent profile
GP08	0.85	1.43	0.61	
GP09	0.95	0.14	0.04	Rate represents a maximum
GP10	0.66	0.27	0.15	Variable activity impacted correlation

GP01

The core description form provided with the samples indicates at least 4 major layers of distinct grain size in the sampled interval. As ^{210}Pb is preferentially adsorbed on clay mineral grains (the finest mud fraction), coarser grains are a dilutant in activity (add mass but no excess activity). Hence, core sites with variable grain size downcore often show variable excess ^{210}Pb—as this core does. The sample at 21 cm (third from top) had no excess activity (see Fig. 1a and b). To derive a sediment accumulation rate, it was necessary to assume this interval is the base of excess Pb present, and force the curve to a profile that includes this as the basal point. This yields a maximum rate of accumulation since the base of excess can actually exist anywhere in the interval between this point and the nearest one above. Higher values of total activity below this interval (Fig. 1a) are assumed to be a distinct grain size sediment with different supported ^{210}Pb activity.

GP02

The core description form provided with the samples indicates this is relatively homogenous harbor mud to the base of the sampled interval but does not reach supported levels. Excess Pb activity decreases steadily downcore, leading to a reliable accumulation rate.

GP03

The core description form provided with the samples indicates at least 2 major layers of distinct grain size in the sampled interval. The sample at 44 cm (third from top) had no excess activity (see Fig. 3a and b). To derive a sediment accumulation rate, it was necessary to assume this interval is the base of excess Pb present, and force the curve to a profile that includes this as the basal point. This method yields a maximum rate of accumulation since the base of excess can actually exist anywhere in the interval between this point and the nearest one above. Higher values of total activity below this interval (Fig. 3a) are assumed to be a distinct grain size sediment with different supported ^{210}Pb activity.

GP04

The core description form provided with the samples indicates this is relatively homogenous harbor mud to the base of the sampled interval but does not reach supported levels. Excess Pb activity also decreases in general downcore, but the correlation is statistically marginal (r^2=0.56) given only four intervals were analyzed. Another possible reason for variability in excess activity downcore at sites with high accumulation (cm/y) is non-steady state input of activities on particles deposited at the harbor floor. This can be produced by seasonal variability in ^{210}Pb fallout from the atmosphere but is normally "lost in the scatter" in settings where the accumulation rates are less than ~1 cm year.

GP05

The core description form provided with the samples indicates this is relatively homogenous harbor mud to the base of the sampled interval but does not reach supported levels. Excess Pb activity also decreases in general downcore, but the correlation is statistically marginal (r^2=0.56) given only four intervals are sampled. In order to yield a usable accumulation rate, it was necessary to omit the lowest interval, or it would have given a near infinite accumulation, hence, the results are <u>not quantitative</u> without further intervals being analyzed.

GP06

The core description form provided with the samples indicates this is relatively homogenous harbor mud to the base of the sampled interval but does not reach supported levels. Excess Pb activity also decreases in general downcore, but the correlation is statistically marginal (r^2=0.58) given only four intervals are sampled. Another possible reason for variability in excess activity downcore at sites with high accumulation (cm/y) is non-steady state input of activities on particles deposited at the harbor floor. This can be produced by seasonal variability in ^{210}Pb fallout from the atmosphere but is normally "lost in the scatter" in settings where the accumulation rates are less than ~1 cm year.

GP07

The core description form provided with the samples indicates this is relatively homogenous harbor mud to the base of the sampled interval, and the low total activities at the base suggest it is close to supported levels. Excess Pb activity decreases steadily downcore, leading to a reliable accumulation rate.

GP08

The core description form provided with the samples indicates at least 2 major layers of distinct grain size in the sampled interval. The two deepest intervals were below the core log indicator of a sandier layer composition, hence they were discarded and a rate calculated from the upper four

intervals. Excess Pb activity decreases steadily downcore, leading to a relatively reliable accumulation rate, albeit with significant error.

GP09

The core description form provided with the samples indicates this is relatively homogenous harbor mud to the base of the sampled interval, and the low total activities at the base suggest it is close to supported levels. To derive a sediment accumulation rate, it was necessary to assume the third interval is the base of excess Pb present, and force the curve to a profile that includes this as the basal point. This yields a maximum rate of accumulation since the base of excess can actually exist anywhere in the interval between this point and the nearest one above.

GP10

The core description form provided with the samples indicates at least 2 major layers of distinct grain size in the sampled interval. The sample at 55 cm (second from bottom) had no excess activity (see Fig. 3a and b). To derive a sediment accumulation rate, it was necessary to assume this interval is the base of excess Pb present, and force the curve to a profile that includes this as the basal point. This yields a maximum rate of accumulation since the base of excess can actually exist anywhere in the interval between this point and the nearest one above.

HARBOR SEDIMENTATION REGIME

While definitive conclusions cannot be made about the sedimentation trends in the study area because of the impact of dredging and ship-induced resuspension, it is clear that inshore (protected) areas tend to have high accumulation rates (e.g., greater than 0.6 cm/y; GP4, 6, 8, 9 and 10). Inshore areas exposed to wave fetch, and hence to bottom resuspension tend to be lower (e.g., GP1). Sites GP3, 5 and 7 directly under large ship anchorages display a variable rate from site-to-site (0.2-1 cm/y), likely due to the combination of human influences on sedimentation rates.

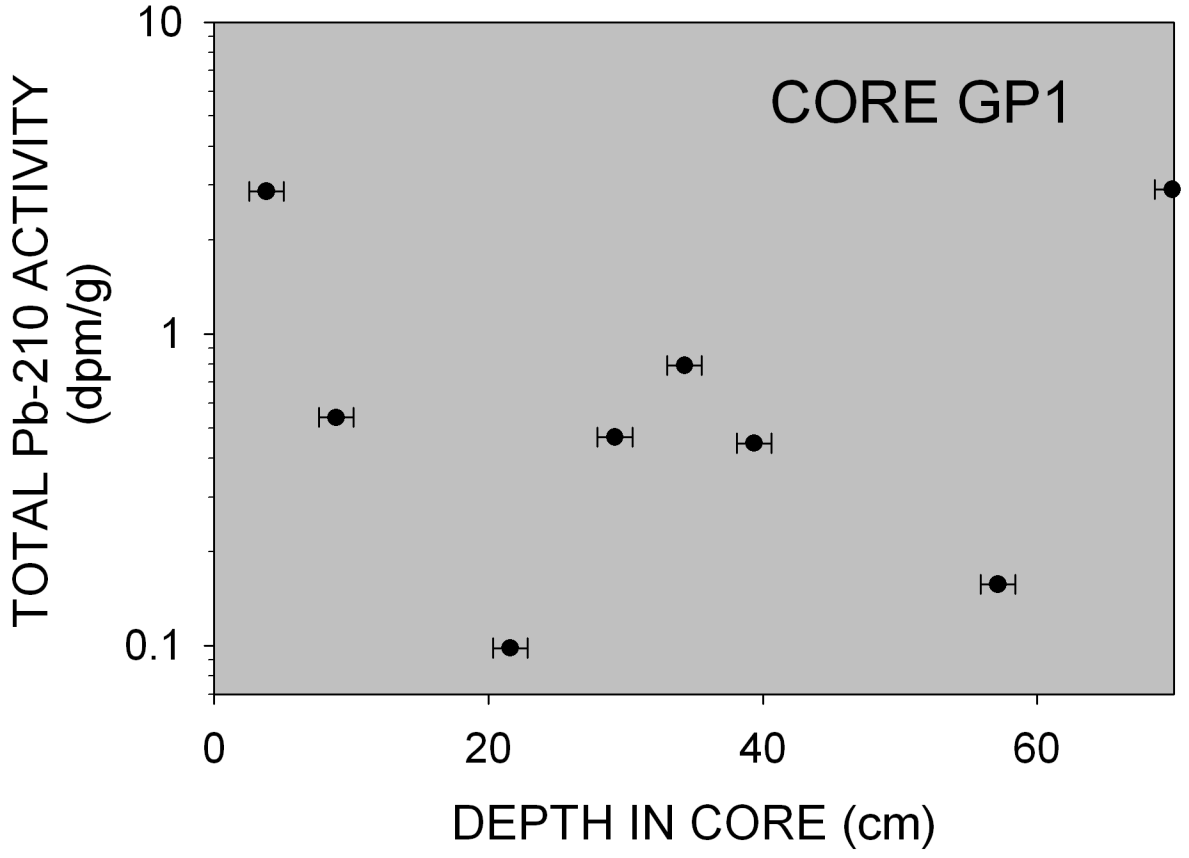


Figure 1a. Total ^{210}Pb activity downcore.

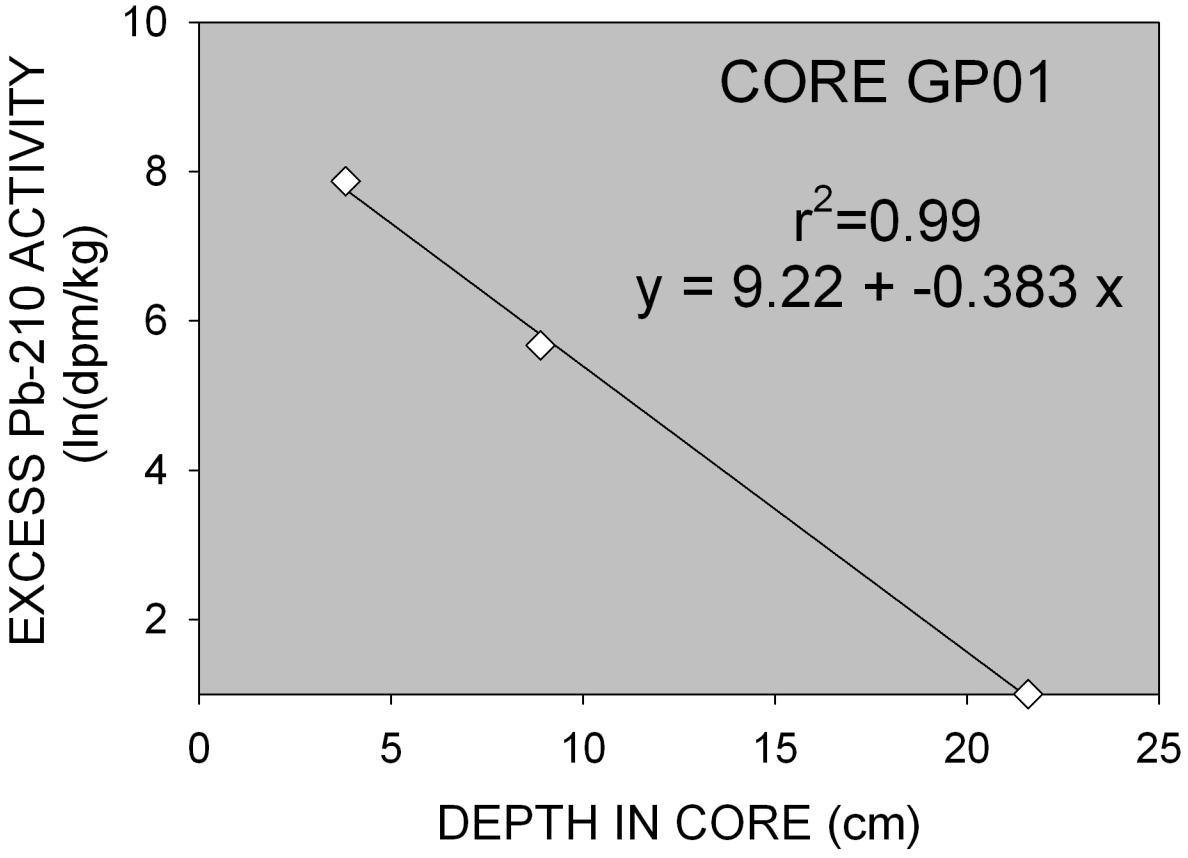


Figure 1b. Excess ^{210}Pb activity and best fit regression utilized for calculating sediment accumulation rate.

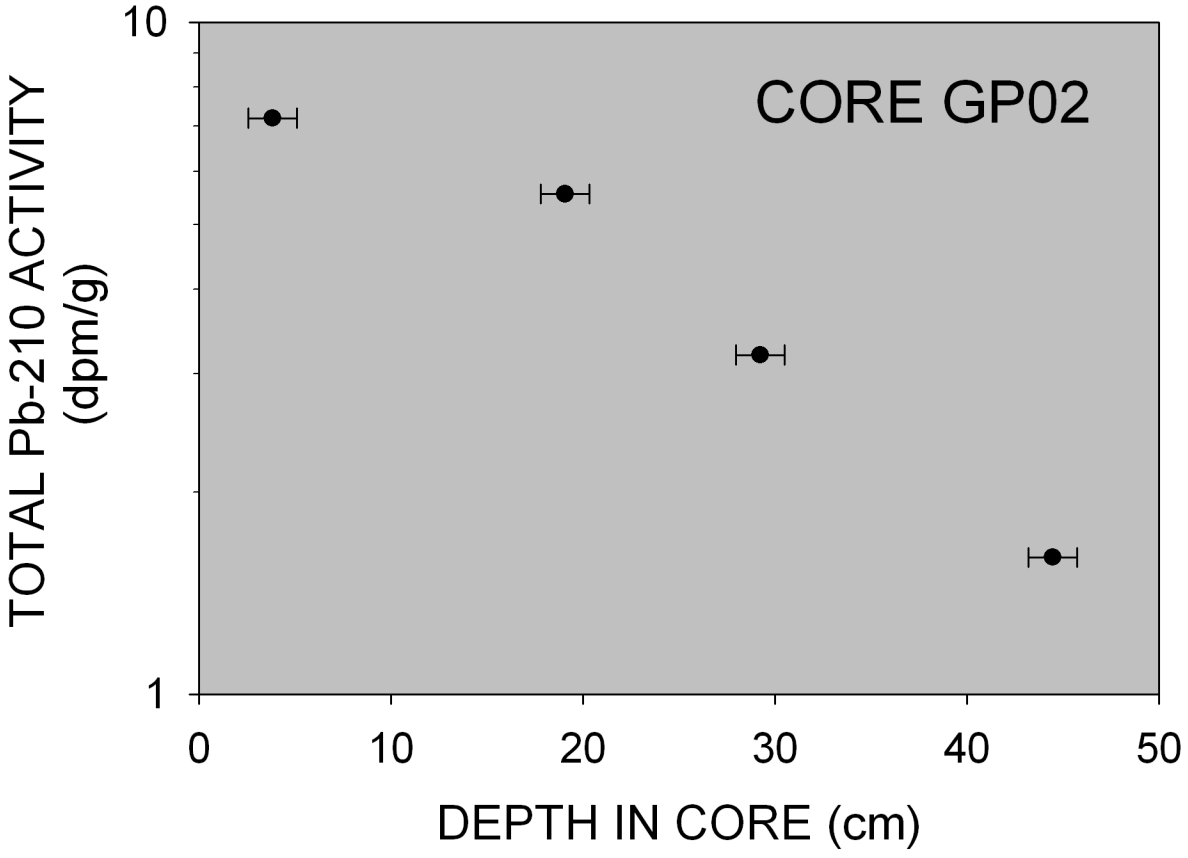


Figure 2a. Total ^{210}Pb activity downcore.

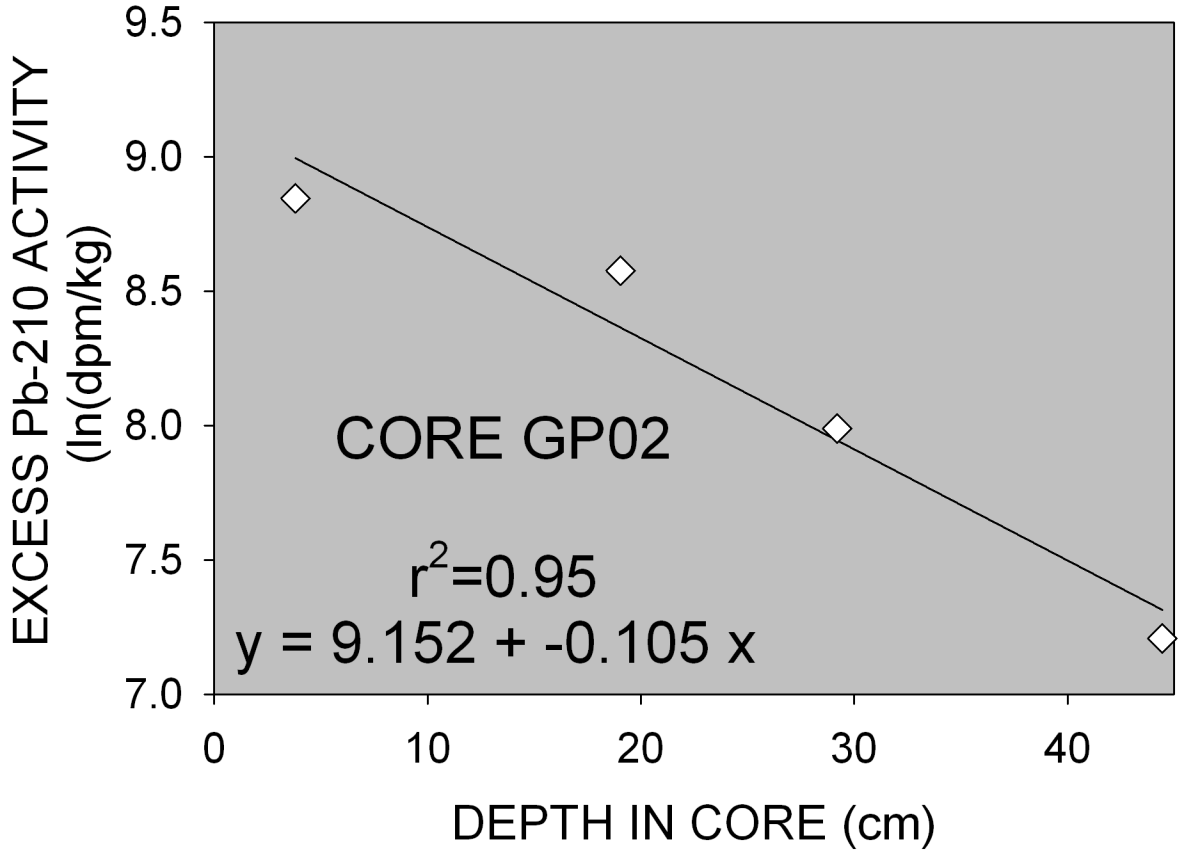


Figure 2b. Excess ^{210}Pb activity and best fit regression utilized for calculating sediment accumulation rate.

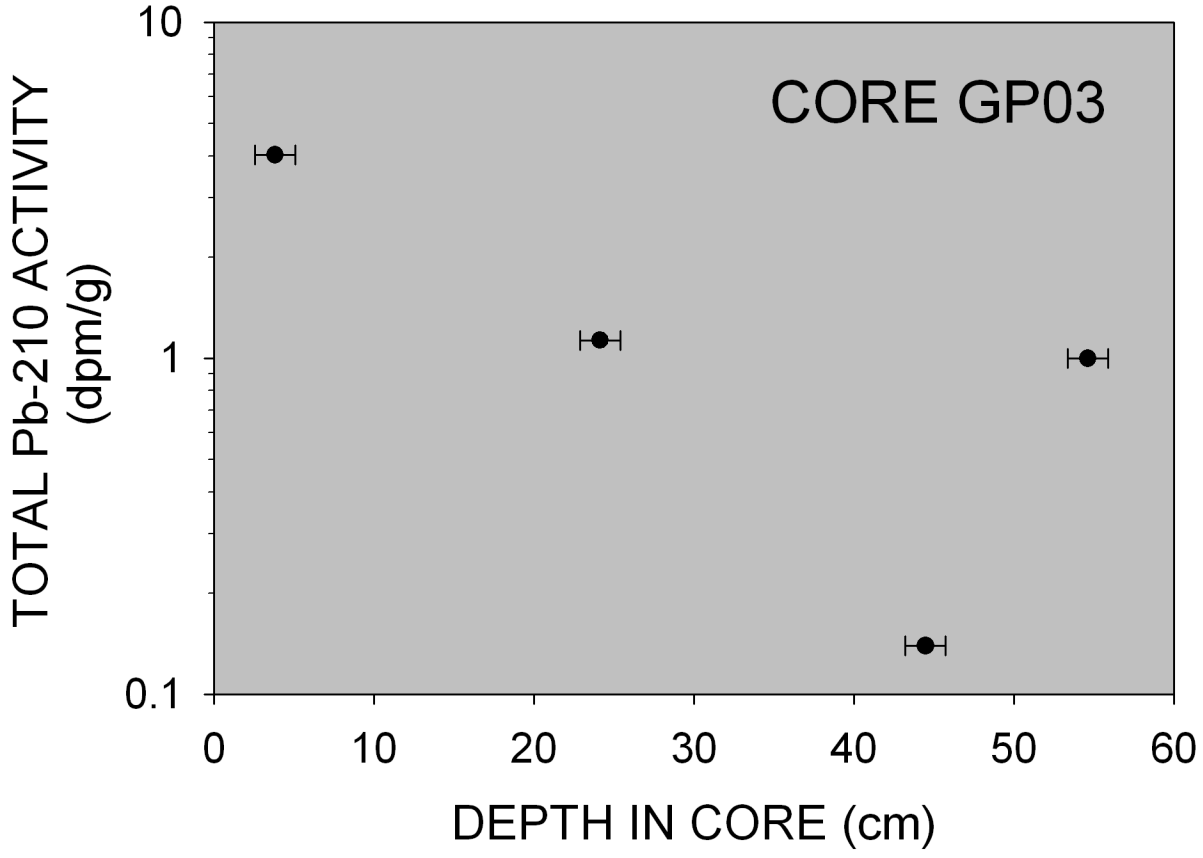


Figure 3a. Total ^{210}Pb activity downcore.

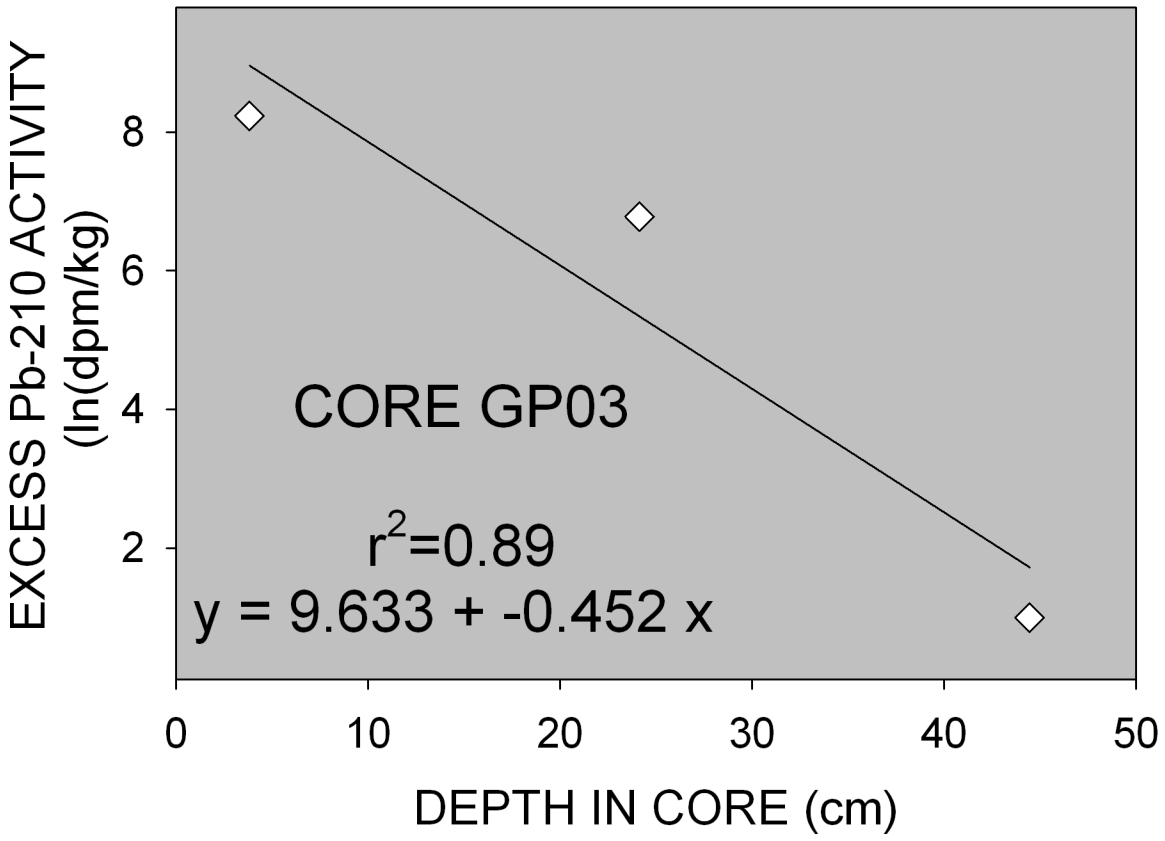


Figure 3b. Excess ^{210}Pb activity and best fit regression utilized for calculating sediment accumulation rate.

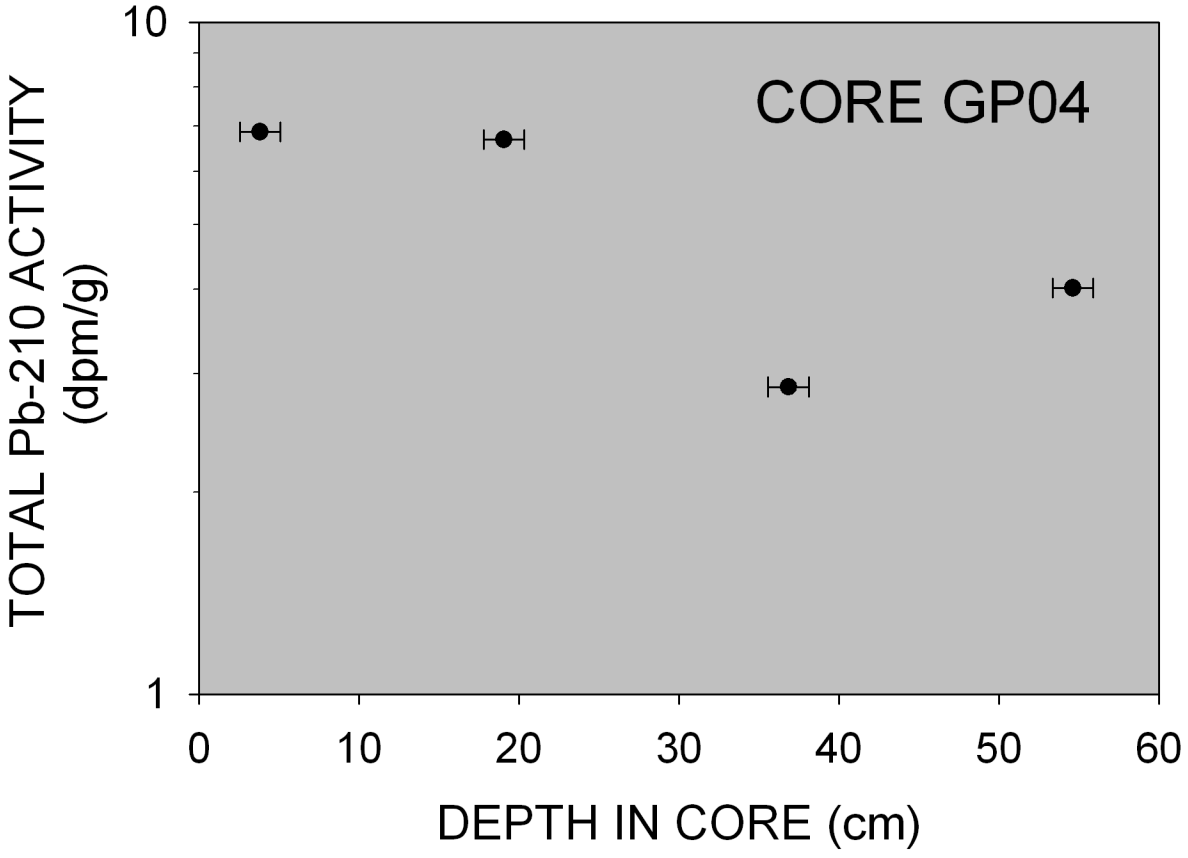


Figure 4a. Total ^{210}Pb activity downcore.

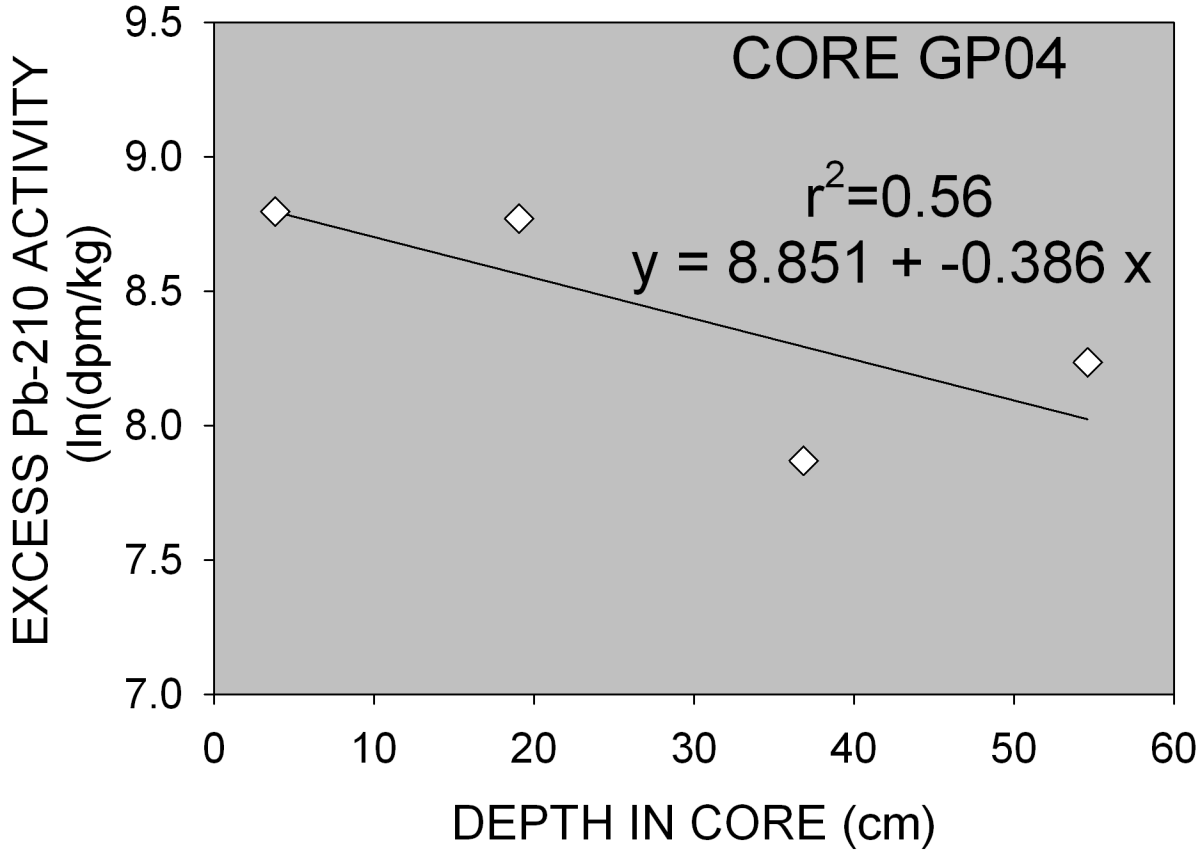


Figure 4b. Excess ^{210}Pb activity and best fit regression utilized for calculating sediment accumulation rate.

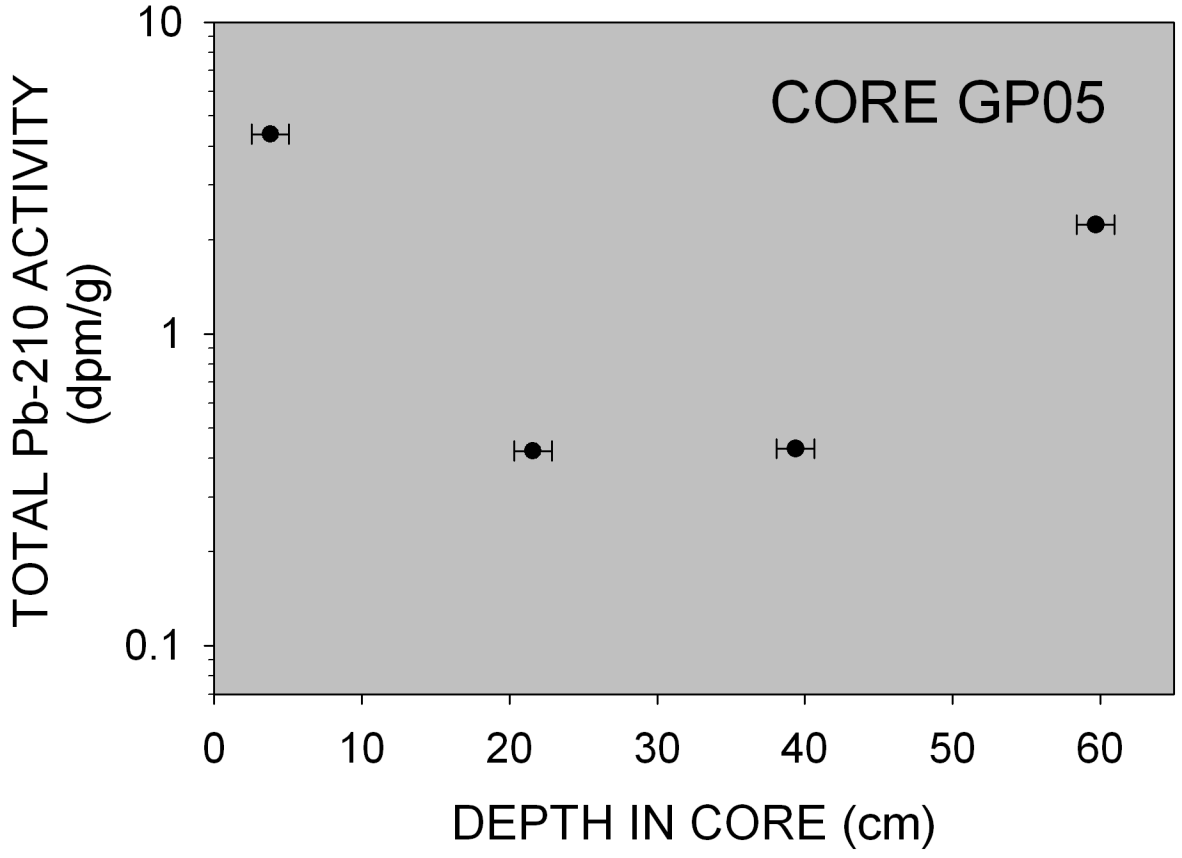


Figure 5a. Total ^{210}Pb activity downcore.

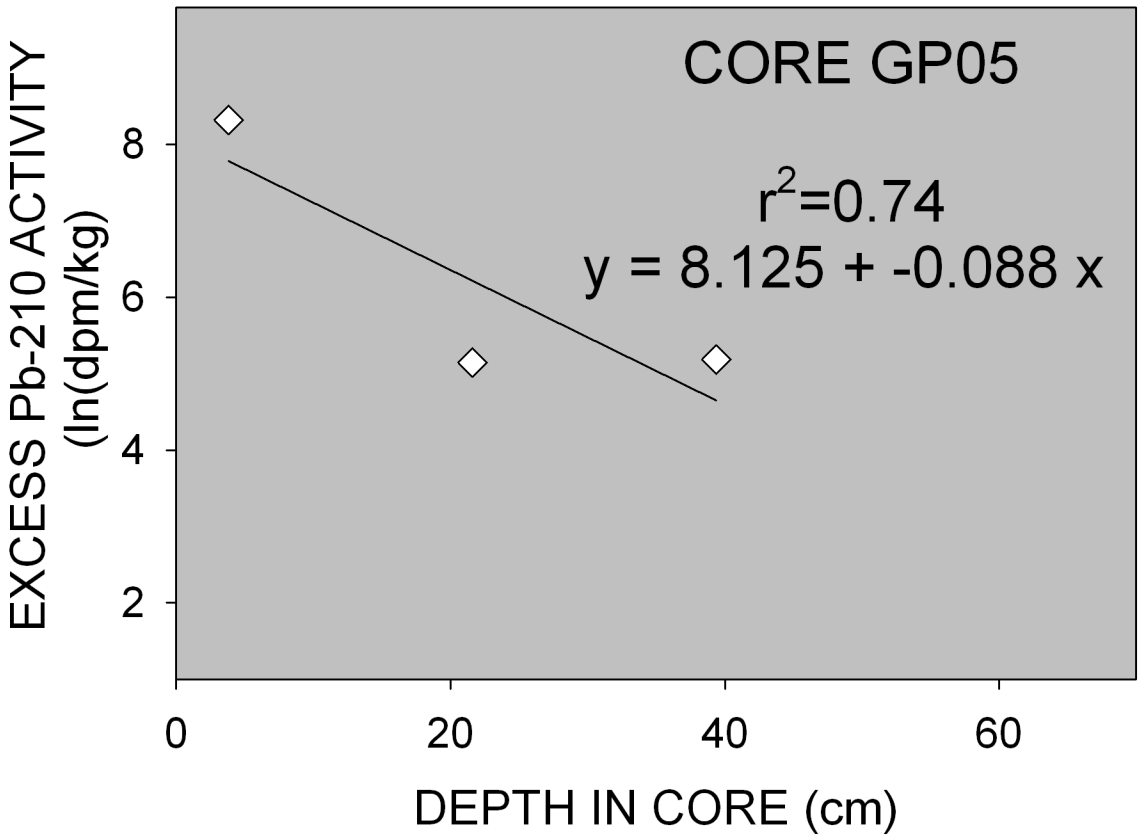


Figure 5b. Excess ^{210}Pb activity and best fit regression utilized for calculating sediment accumulation rate.

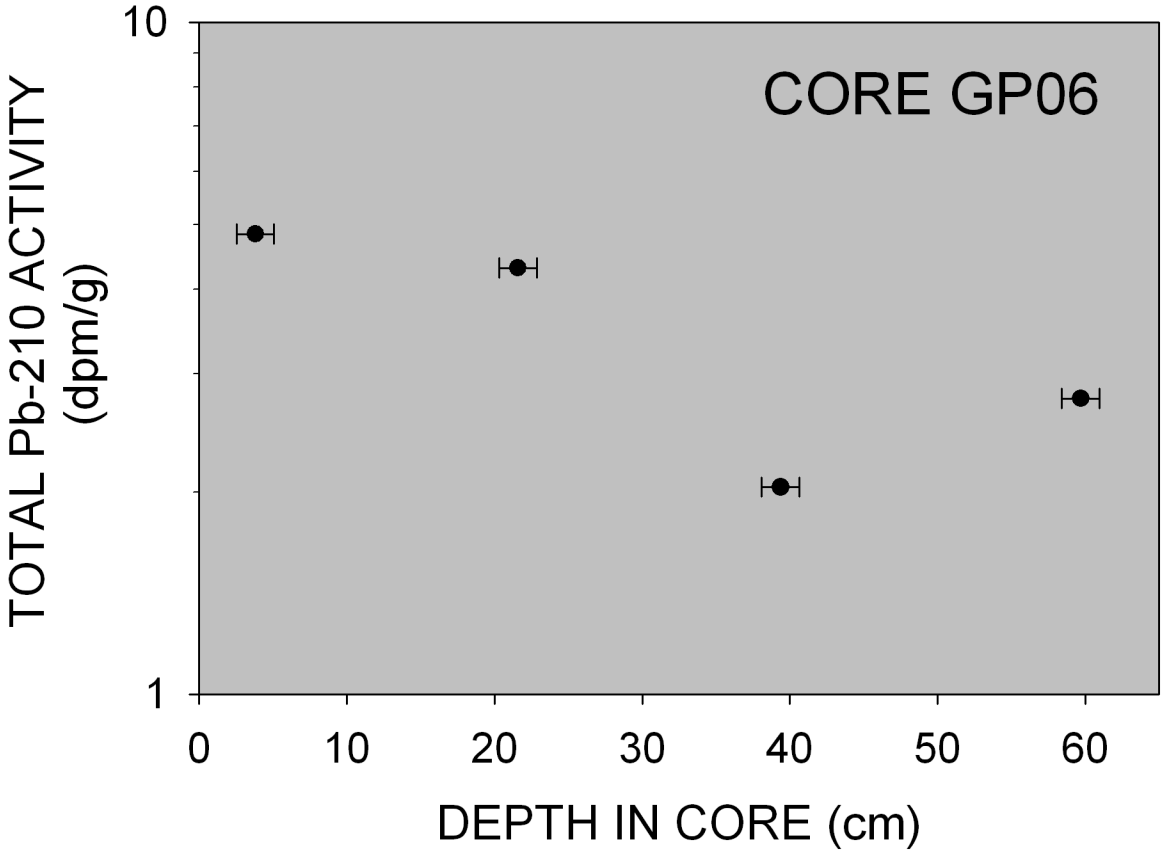


Figure 6a. Total ^{210}Pb activity downcore.

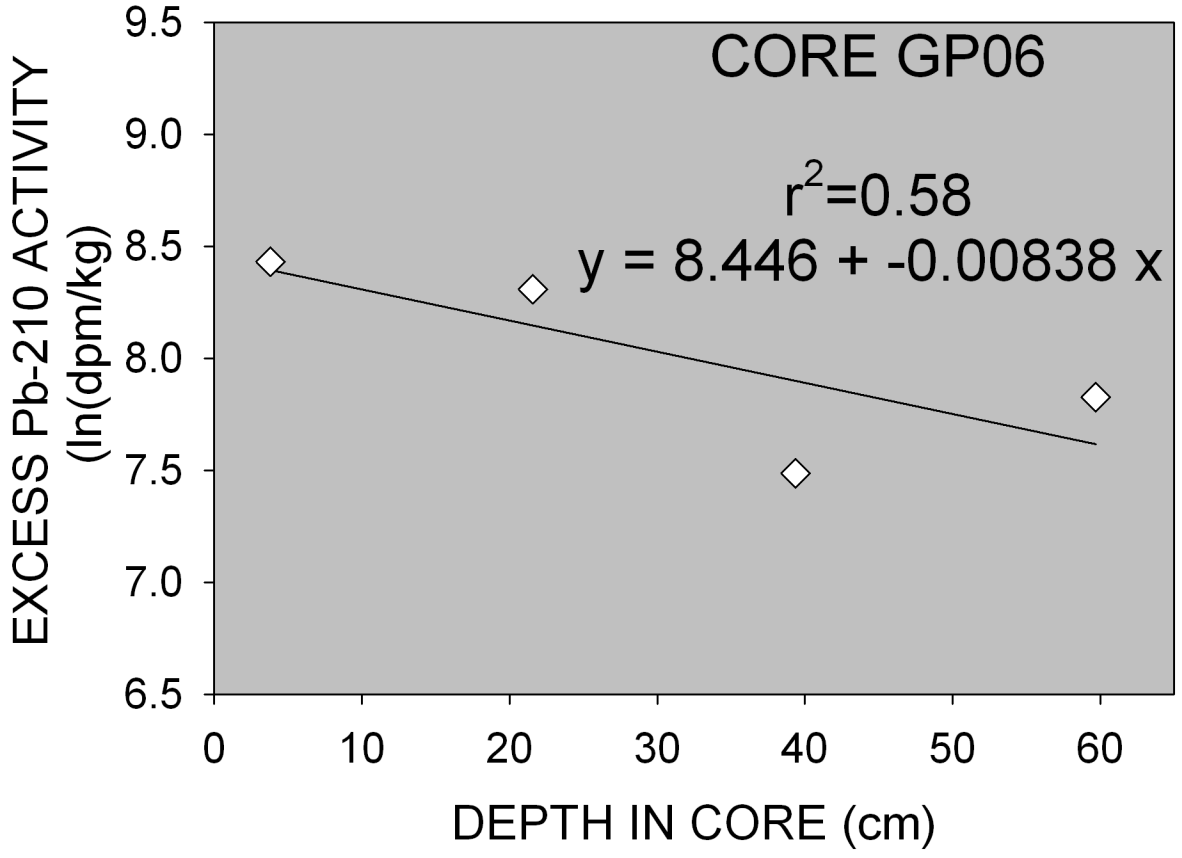


Figure 6b. Excess ^{210}Pb activity and best fit regression utilized for calculating sediment accumulation rate.

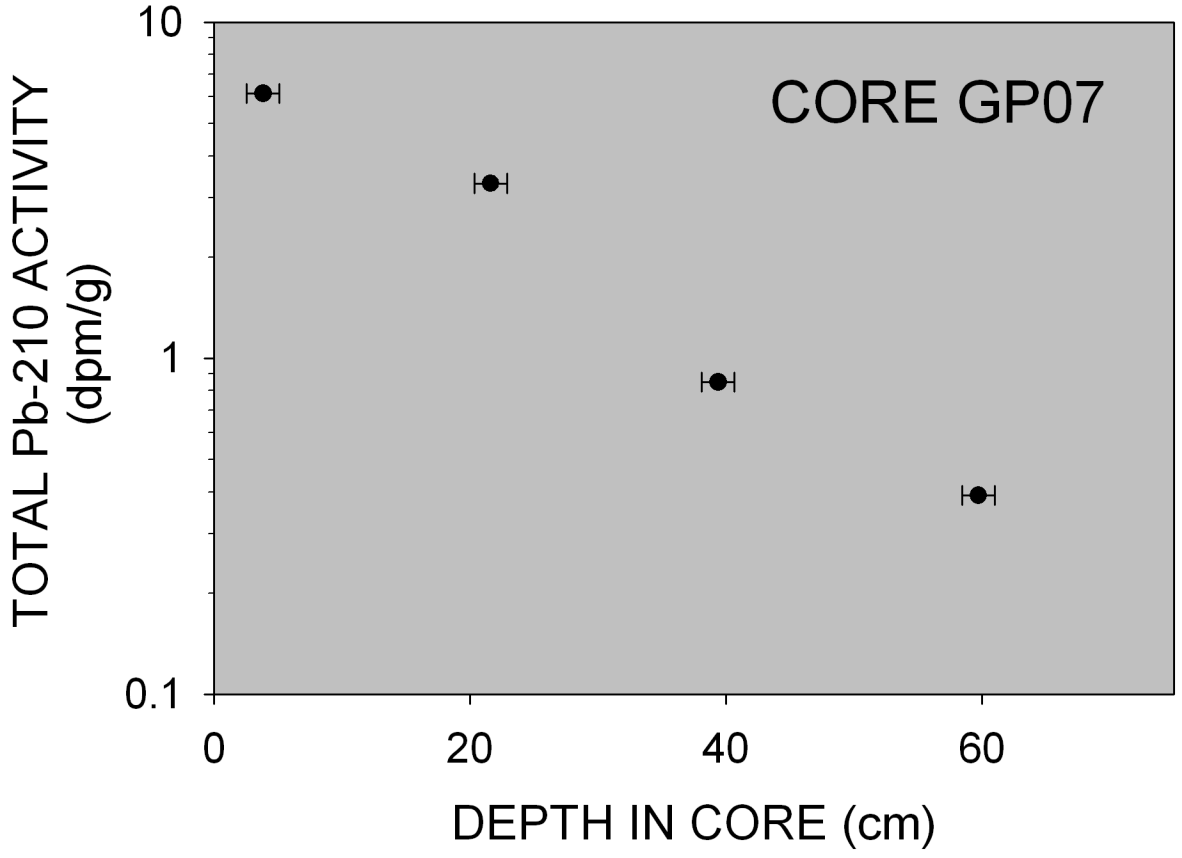


Figure 7a. Total ^{210}Pb activity downcore.

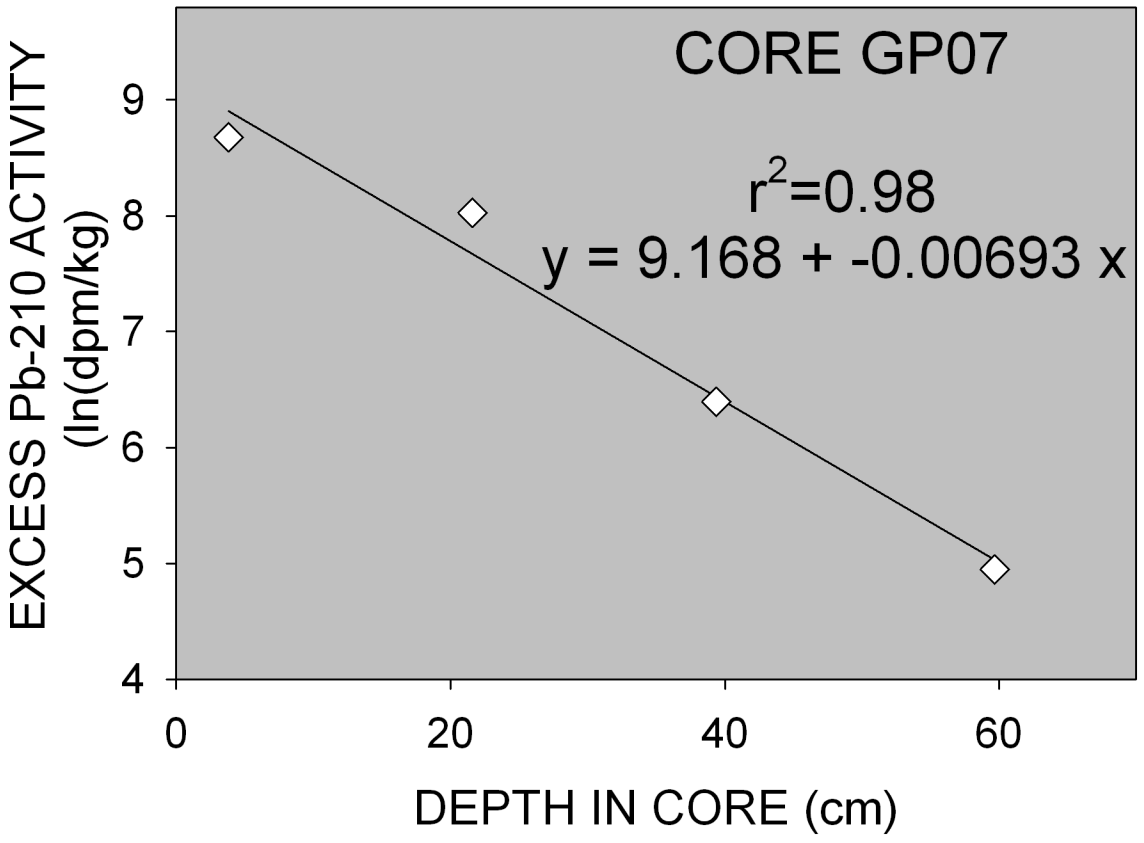


Figure 7b. Excess ^{210}Pb activity and best fit regression utilized for calculating sediment accumulation rate.

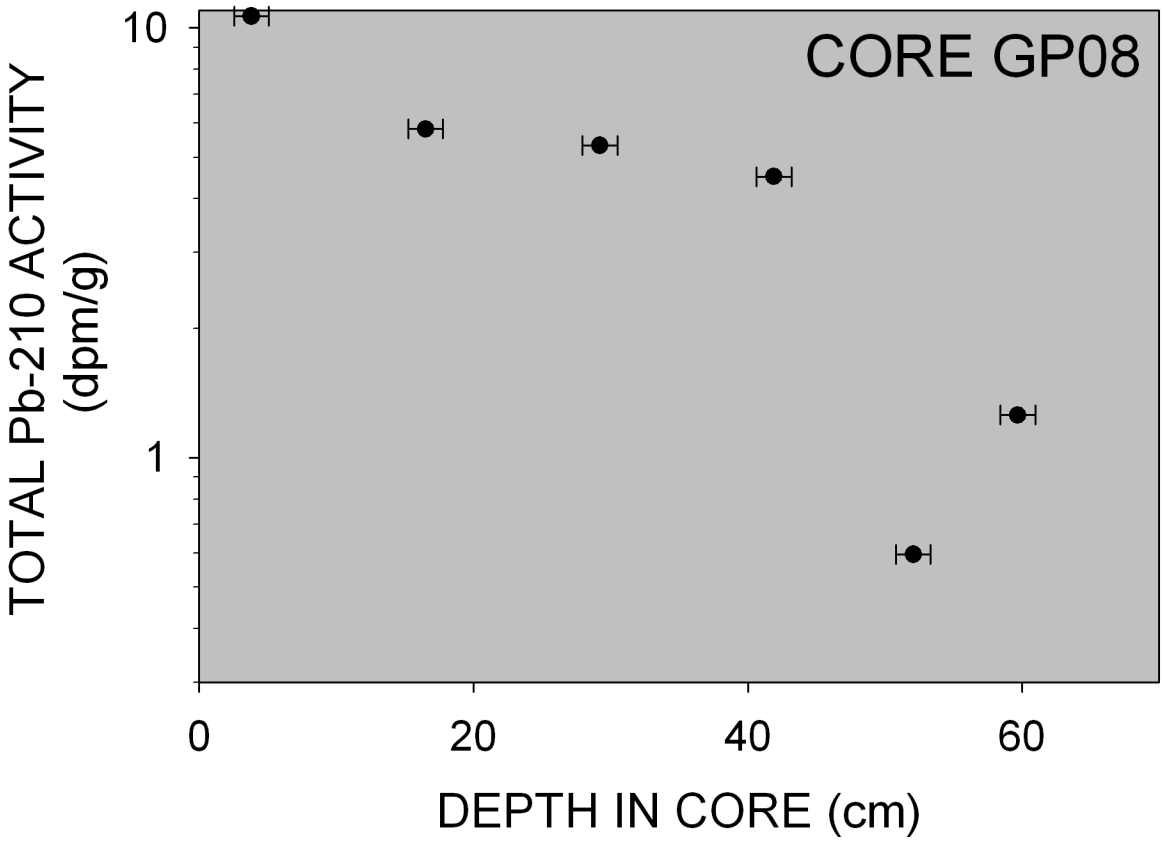


Figure 8a. Total ^{210}Pb activity downcore.

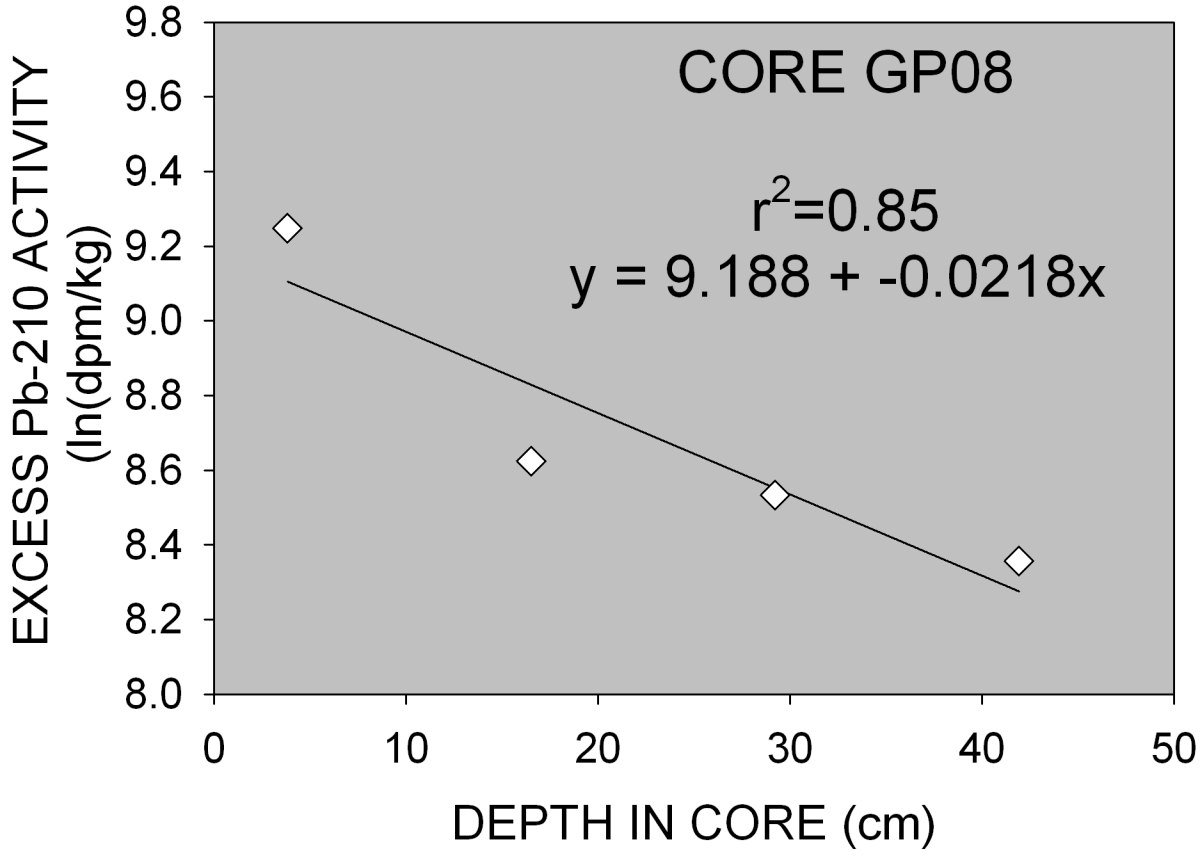


Figure 8b. Excess ^{210}Pb activity and best fit regression utilized for calculating sediment accumulation rate.

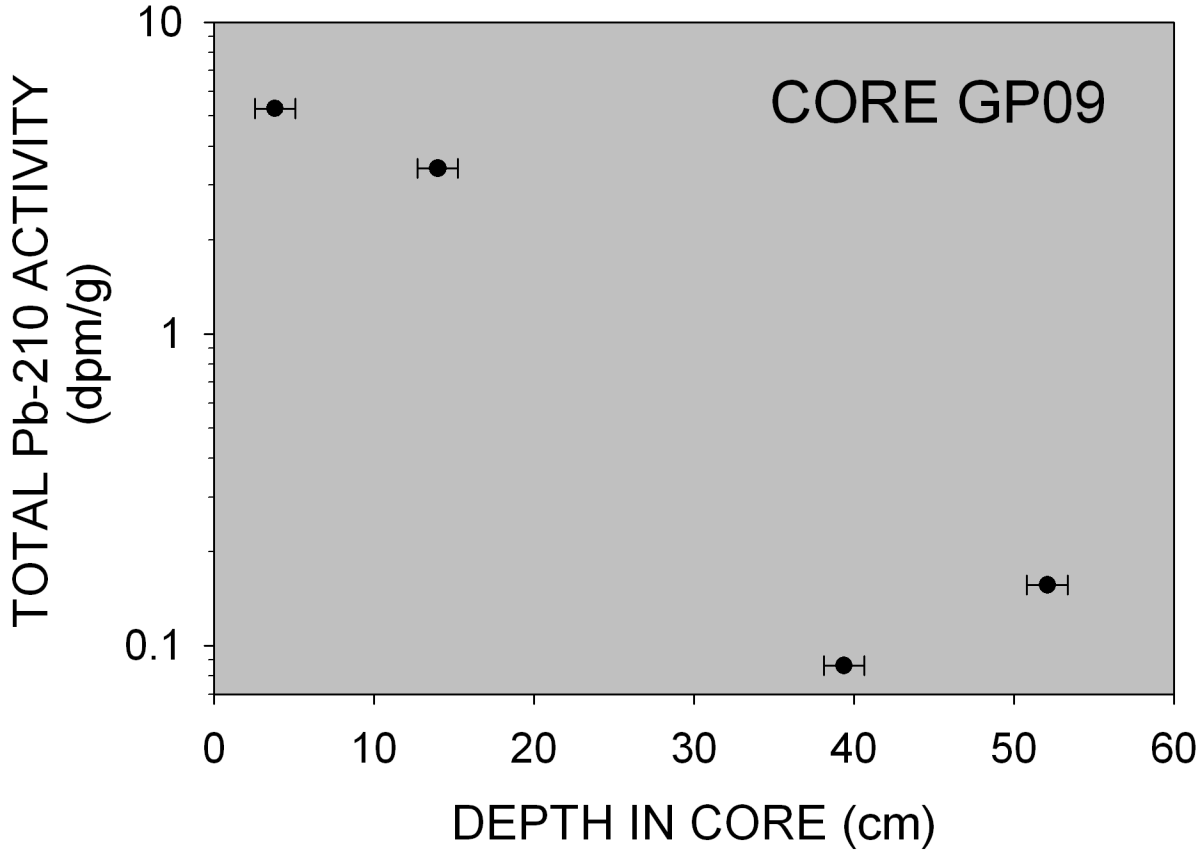


Figure 9a. Total ^{210}Pb activity downcore.

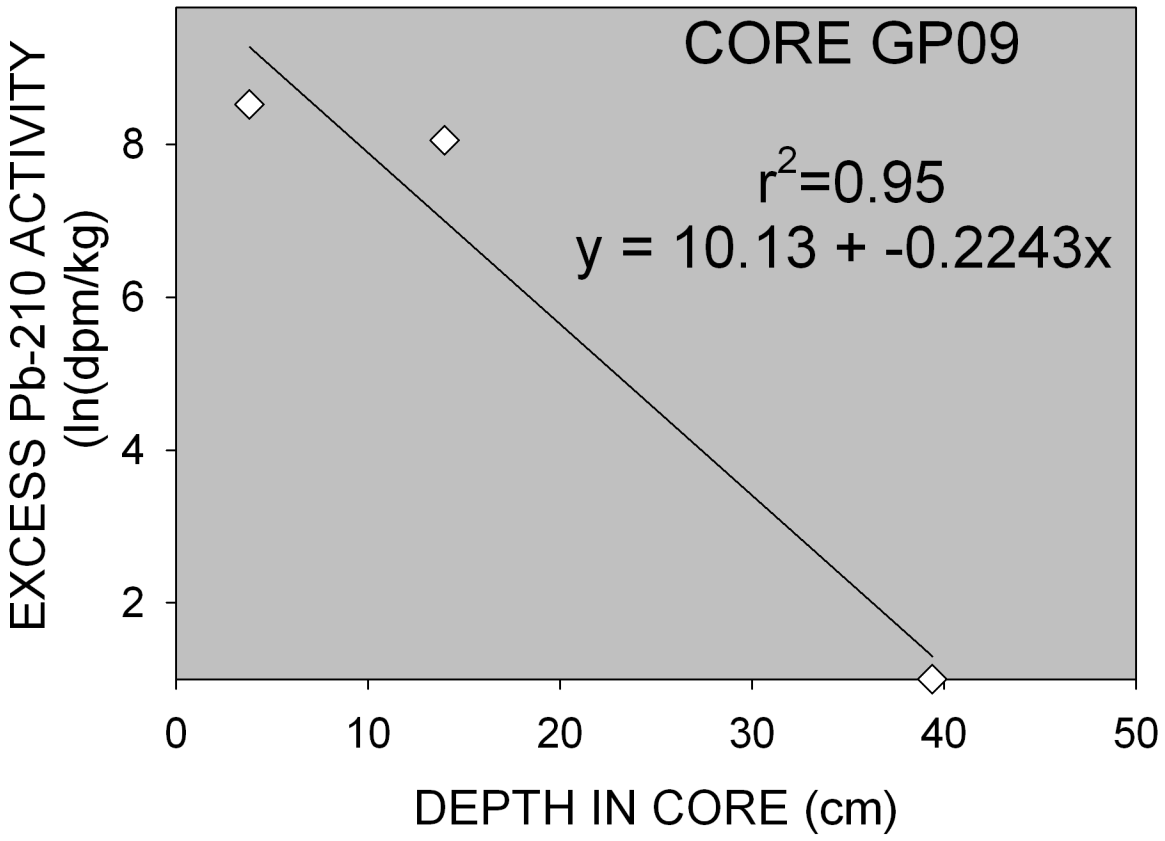


Figure 9b. Excess ^{210}Pb activity and best fit regression utilized for calculating sediment accumulation rate.

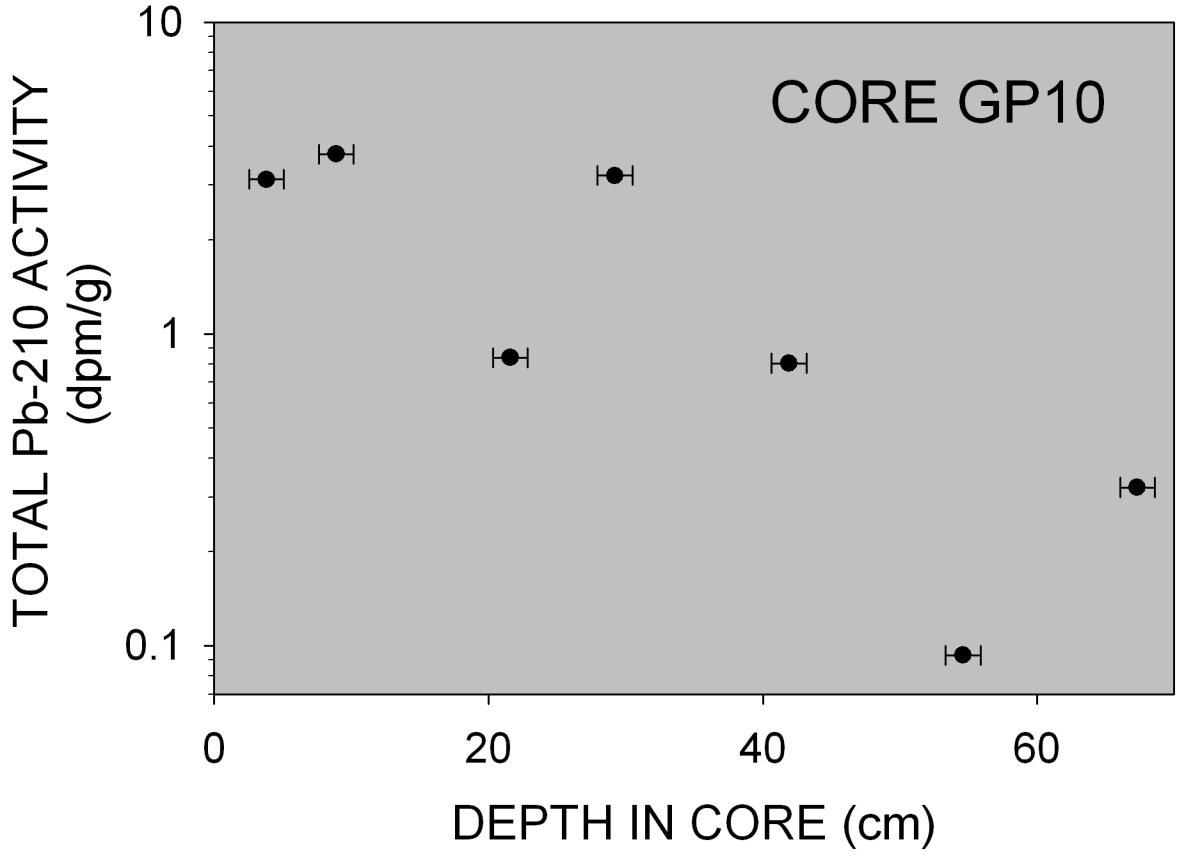


Figure 10a. Total ^{210}Pb activity downcore.

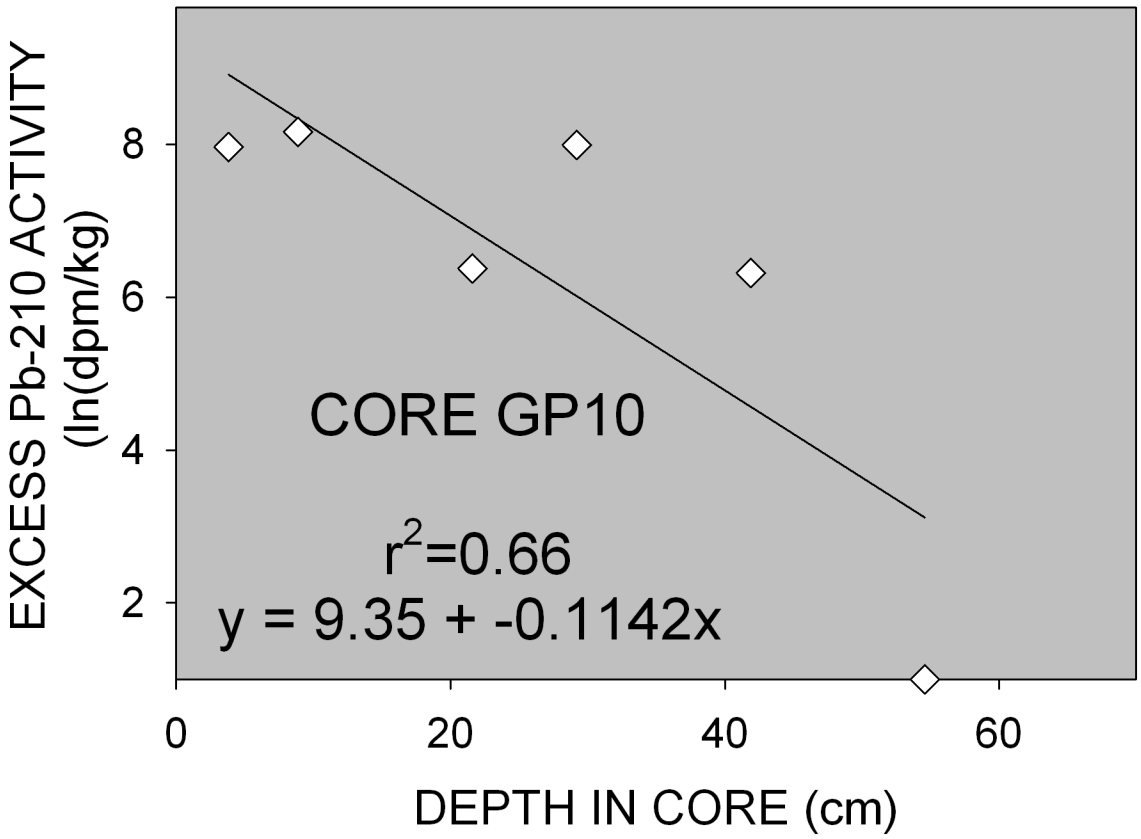


Figure 10b. Excess ^{210}Pb activity and best fit regression utilized for calculating sediment accumulation rate.

D-4 PROJECT TEAM MEETING NOTES AUGUST 16, 2012

MEETING NOTES

DISCUSSION OF REMEIDAL ALTERNATIVES (8/16/12)
SITE 19, FORMER DERECKTOR SHIPYARD
NAVSTA NEWPORT, NEWPORT RHODE ISLAND

PARTICIPANTS:

NAME	REPRESENTING
Dave Barclift	NAVFAC Atlantic
Pamela Crump	RIDEM
Ken Finkelstein	NOAA
Arun Gavaskar	NAVFAC Atlantic
John Galler (phone)	Tetra Tech, Inc.
Mike Horton	Tetra Tech, Inc.
Gary Jablonski	RIDEM
Winoma Johnson	NAVFAC Mid-Atlantic
Kymberlee Keckler	USEPA Region I
Greg Kemp	Mabbett & Assoc.
Ken Munney (phone)	US Fish and Wildlife
Bryan Olson	USEPA Region I
Stephen Parker	Tetra Tech, Inc.
Tim Reisch	NAVFAC Mid-Atlantic
Darlene Ward	NAVSTA Newport

ATTACHMENTS:

1. Proposed Agenda
2. Presentation Handout
3. Physical Data Figure

The meeting convened at 10:00 am

W. Johnson opened the meeting by thanking everyone for attending. She stated that the purpose of the meeting was to present updates on the current conditions of the site, present possible remedial alternatives and solicit input from the stakeholders, discuss any critical comments on the Supplemental Sediment investigation (SSI), and determine the next steps for developing the FS.

S. Parker led the presentation of SSI results and FS Alternatives that followed (Attachment 2).

Regarding Slide 5 (Technologies) B. Olson asked why the dredging technology was focused only on 1-foot depth. S. Parker replied that because the affected portions of the cove are a low energy environment and because there was clean, consolidated (erosion-resistant) sediment covering deeper sediment with elevated COC concentrations , there is a low risk of exposure to

COCs at depth. The EPA indicated disagreement that the cove has low enough energy to assure this condition. However, everyone agreed that there were two classes of data – one class (e.g., current velocity) related to the site conditions at the time of the SSI measurements and another class (e.g., isotope data) related to historical deposition rates over the last several years or decades. After some more discussion it was agreed that it would be best to save this discussion until after presentation of the remedial alternatives.

The topic of projected future use of the site was raised. W. Johnson and T. Reisch presented the information from documents that they had, namely that: the Navy has no mission for Derecktor Shipyard, future plans for the base do not show Pier 1 being present (it is planned for future, yet unscheduled demolition), and that there will be a weight restriction placed on Pier 2 by 2013. The Coast Guard is in the process of constructing new docking areas along the shoreline between Piers 1 and 2 and this waterfront will be the port location for their ocean buoy tenders. Pier 2 will be the port location for the Tiger Shark, a smaller USCG safety vessel. There will continue to be visiting ships berthed at Pier 2 periodically. At the end of the discussion it was clarified that the Navy's position is that remedial actions should be developed in line with the planned or projected future site use, as called for in CERCLA; the EPA took the position that remedial actions should be developed in line with potential future site use because the plans can always change.

Regarding Slide 10, the EPA requested that the Navy identify in the FS which alternative is their preferred alternative so the EPA will be able to better focus their time and reduce the number of comments. The Navy stated that the FS report is supposed to weigh all viable alternatives uniformly, but it could look into ways to make it evident which alternative they were leaning toward. To begin with, the Navy stated its position that all the alternatives (except Alternative 1, No Action) were selected to be protective of the receptors. EPA stated that their preference was for an alternative that included dredging. The Navy pointed out that Alternative 4 includes dredging and noted that in accordance with EPA's wishes, none of the alternatives had been framed as MNR alone. However, EPA's Sediment Guidance Document (2005) recognizes Enhanced MNR (thin cap), capping, and dredging as protective technologies and the Navy had evaluated all three.

Regarding Slide 11, the surface area weighted average concentration (SWAC) approach was explained in order to present to the group how the Navy determined which areas needed dredging. K. Keckler inquired about criteria that were used to select cells for action, S. Parker answered that it was dependent on COC concentration and location, with emphasis on addressing the highest concentrations first and then moving progressively to address lower concentrations. K. Keckler noted that because of this approach, there was some "hop scotching" of cells The Navy agreed, and explained that this was necessary for development of the alternatives, but it understands that once a dredging or capping plan is developed, it may include "overdredging" into some areas that were not selected in the alternative, simply for efficiency.

During discussion of the SSI chemical results it was noted that the results presented did not include zinc or copper. G. Kemp stated that the extent of contamination for these chemicals was not delineated during the SSI. EPA recalled that during development of the PRGs, copper and zinc were not retained as COCs because they were co-located with other COCs; they then stated that having zinc and copper as COCs should be reevaluated because chemical results from the SSI show that they are not fully co-located with other COCs everywhere within the site. During this and other discussions, EPA, RIDEM, NOAA, and USF&W stated their concern about elevated concentrations of zinc at a few locations where no remedial action was proposed. There was general agreement that the copper concentrations did not appear to merit concern, but that zinc concentrations needed to be further evaluated.

The Navy agreed to include zinc and copper in the SWAC calculation, but there was no PRG to compare results, which would be necessary for determining which areas would be included in the calculation. W. Johnson clarified that even if copper and zinc are included, the approach to the remedial alternatives wouldn't change; only the action areas might change based on those new results being added. Discussion from this point onwards centered on identifying what would be appropriate PRGs for copper and zinc. It was suggested that the team look at other marine sediment sites to see what their PRGs were. EPA also suggested that one approach could be that the Navy consider a concentration somewhere between the ERM and BPRG that was developed in the PRG document by SAIC. At the conclusion of the discussion the Navy agreed to use the BPRG as the initial criteria for conducting the SWAC calculation for copper and zinc, while other criteria were evaluated.

During discussion of the remedial alternatives, K. Munney noted that there were some differences between the interpolated results that were presented in the SSI and the grid approach that was shown in the presentation. S. Parker agreed and responded that the grid makes it easier to quantify action areas. G. Kemp stated that it may be beneficial to use a kriging interpolation method that considers contamination at depth. A. Gavaskar stated that various interpolation and contouring methods, including kriging, had already been tried with the SSI data, but did not provide any reasonable interpretation of the spotty data at this site (unlike other sites, such as Natick, where concentrations often tend to be spatially graded)

During discussion of the remedial alternatives, K. Munney suggested that a possible approach could be to divide the site into smaller decision units for the SWAC calculation, so it would be more specific to certain parts of the site. EPA suggested one possibility as three decision units (the areas associated with Pier 1, Pier 2 and the T-Wharf). D. Barclift reminded all that samples were not collected with the intention of creating decision units and they should not be used in that way. A. Gavaskar stated that there was no reason to create artificial decision units because the Navy was already using a very conservative approach that (a) had limited the SWAC calculations to cells that exceeded the PRG and (b) was addressing areas with the highest concentrations first, regardless of where they occurred (near Pier 1, Pier 2, or T-wharf). Dividing the site into smaller decision units based on certain site features (e.g., Pier 1) would have to include all contiguous cells associated with that feature, whether the cells exceeded the

PRG or not (as was done at Natick and other sites). It was also speculated that this approach would not necessarily make the evaluation more conservative. Eventually, the stakeholders agreed that development of smaller decision units was not an action item.

When discussing Slide 14, the EPA stated that they would like to see an alternative which would require no LUCs or monitoring at the end of the remedy. They indicated that this alternative would include addressing some of the contamination at depth because that would avoid having to impose LUCs. There were multiple approaches suggested by the entire group including dredging and not backfilling with a SWAC approach, dredging and backfilling at depth with a SWAC approach, modifying the SWAC approach to be a volumetric-weighted average concentration, instead of surface-weighted average. At the end of the discussion the Navy agreed to develop some new scenarios that might be used to develop a new Alternative 5. The goal of alternative 5 will be to create an alternative where no monitoring or LUCs will be necessary. The Navy agreed to work with the regulators as a team to develop a SWAC or volumetric approach.

With regard to Slide 14, K. Munney noted that the dots presented on the alternative figures really might represent two or more COCs with elevated concentrations at a location. Would the cumulative risk from such locations be greater? The Navy explained that SWACs were calculated separately for each COC, so whether there was one or more COCs in one cell was not an issue in identifying cells that need to be addressed. Also, the risk endpoint for each COC is different, so the cumulative risk from multiple COCs is not an additive process. K. Finkelstein also conducted a brief review of the data while the discussion was occurring and noted that while Ken M. was making a valid point, there did not appear to be any situations at the site where there was undue concentration of risk in post-remedy cells because of multiple COCs.

After a break for lunch, the group reconvened and final thoughts on the proposed alternatives were discussed. EPA reiterated their request for the Navy's preferred alternative. The Navy reiterated that while it considered all the alternatives (except Alternative 1, No Action) as protective, it would give serious consideration to Alternative 4 because EPA prefers it. The Navy noted that this the FS is still work in progress and the Navy will work with EPA and the State on an acceptable remedy.

The EPA also requested an alternative to dredge everything greater than PRGs as a high range of the alternatives, one that would balance the "no action" alternative. However, after discussion, it was understood that this request is really to discuss in the FS an alternative that does not require LUCs.

W. Johnson inquired about responses to comments on the Draft SSI Report. She particularly asked EPA for clarification on their letter, which had stated that the Navy did not need to respond if the comments were included in the report as an appendix to document, with a statement that EPA disagreed with some of the conclusion of the report. It was agreed that EPA, RIDEM and USFW did not require, nor would receive, responses to their comments. NOAA did request responses to comments.

At the end of the meeting W. Johnson asked if anyone had anything else to add, RIDEM stated that they concurred with EPA's comments during the meeting, and would like an alternative that has the fewest number of LUCs as possible that would restrict potential uses of Rhode Island's natural resources, for both environmental and economic reasons. They also stated that while EPA, NOAA and USF&W may find leaving COCs in sediment at levels 1 or 2 times the PRGs acceptable, RIDEM may find it unacceptable because of the development methods resulted in choosing multiples of the HI values as RPRGs.

W. Johnson thanked everyone and noted that there would be follow-up discussions to present the outcomes of the action items (below), though no schedule was presented. The meeting adjourned at 3:00 pm.

ACTION ITEMS

Navy:

- Update SWAC calculation to include Copper and Zinc concentrations where they are above the BPRG; this data should be presented to the team.
- Suggest PRGs for copper and zinc.
- Prepare an alternative (5) that will include no LUCs or monitoring.
- Correct Alternative 4 to show no LUCs in dredged areas.
- Provide a response to comments to NOAA.

EPA: (none)

RIDEM: (none)

NOAA: (none)

USFW: (none)

PRESENTATION OF REMEDIAL ALTERNATIVES

FEASIBILITY STUDY, Revision 1

Site 19, Former Derecktor Shipyard
Naval Station Newport,
Newport, RI

Presented By:
Tetra Tech, Inc.

NAVAL STATION NEWPORT

8-16-2012

Presentation of Remedial Alternatives
Objectives of the Meeting

- Updates and Current Conditions
- Presentation of Possible Remedial Alternatives to address COCs that exceed PRGs
- Receive input from the stakeholders
- Discuss critical comments to the SSI
- Determine next steps toward the FS

Presentation of Remedial Alternatives
Updates and Current Conditions

- Shoreline Improvement
- Disposition of the Ex-Saratoga
  - Departure is delayed by contracting actions
- Limitations on Piers
  - Pier 1 – No planned use. Demo program “paused” until 2013
  - Pier 2 – Weight handling operations cease October 2013
- Planned Use of the Site
  - USCG Ocean Buoy Tenders L: 225 feet, D: 13 Feet
  - USCG Tiger Shark L: 87 feet, D: 6 feet
  - Occasional visiting ships, NOAA
  - USCG Project Summer 2013
  - P-469 completion February 2013

NAVFAC Naval Facilities Engineering Command

TETRA TECH

Presentation of Remedial Alternatives
Technologies to be retained in the FS

- Following EPA's Contaminated Sediment Remediation Guidance for Hazardous Waste Sites the US Navy has evaluated the following remedial technologies to be included in the development of alternatives:
  - Natural Recovery
  - Monitored Natural Recovery (MNR)
  - Enhanced Natural Recovery (Thin Layer Cover)
  - In Situ Capping (Engineered Cap)
  - Dredging/Excavation
  - Implementation of Land Use Controls (LUCs)

- In-Situ treatment was not considered for this site

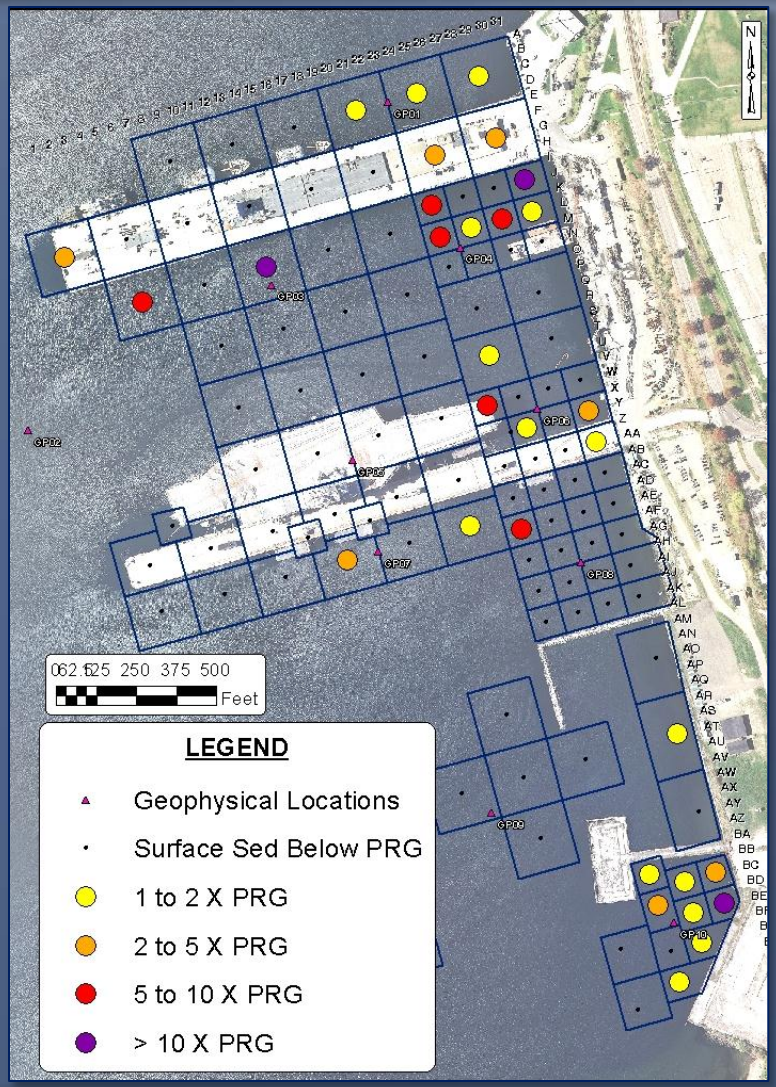
NAVFAC Naval Facilities Engineering Command

TETRA TECH

Presentation of Remedial Alternatives
Technologies

- **Natural Recovery –** reliance on natural processes to achieve PRGs in the long term by burial with clean sediment.
- **MNR** – Natural recovery with periodic assessment of bathymetry to identify changes over time, and periodic sampling at shallow depth intervals to measure contaminant concentrations and to document recovery.
- **Enhanced Natural Recovery** (thin layer cover) – placement of a 6 to 12 inch cover of clean sand that will reduce COC exposure to receptors and speed the natural recovery process. Thickness of cover will be determined by COC levels and depositional environment.
- **In-Situ Cap** – placement of an engineered cap that will serve to isolate contaminants from receptors, designed to withstand forces expected.
- **Dredging & Excavation** – excavate sediment to a depth of 1 foot with hydraulic or mechanical means and backfill with clean material.
- **LUCs** – prevent access by unauthorized persons through enforcement of existing security zone, minimize traffic by deep-draft vessels.

Presentation of Remedial Alternatives
Supplemental Sediment Investigation Results



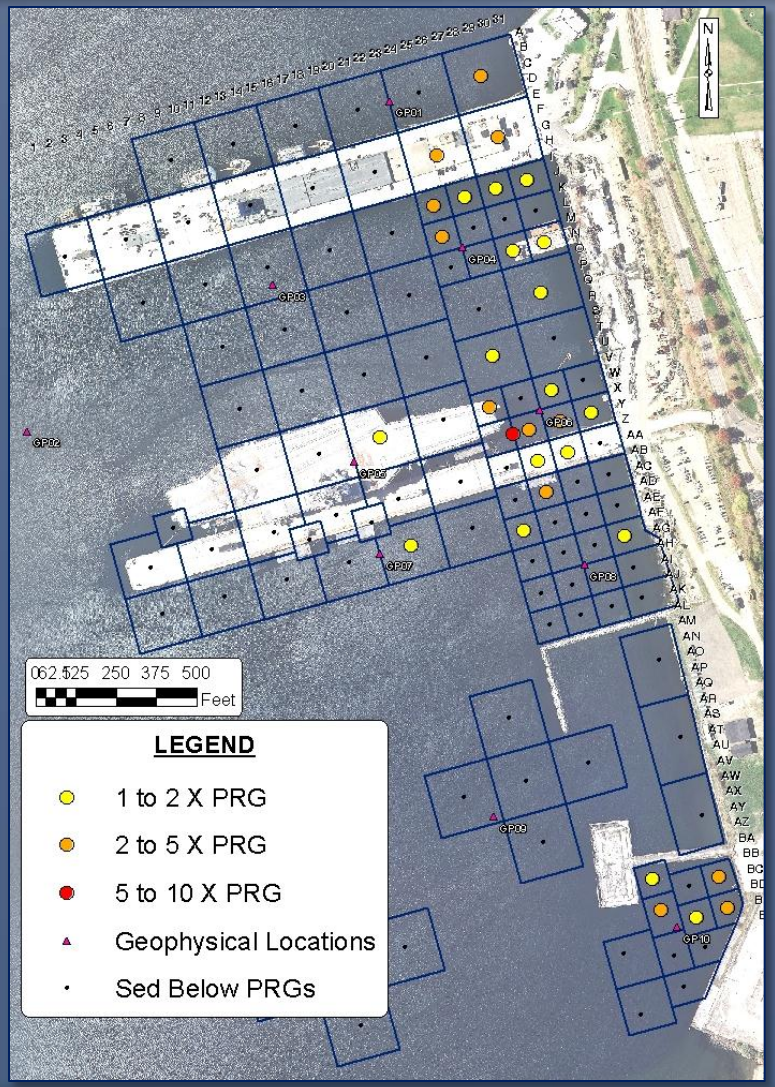
- Areas with COCs (PAHs, benzo(a)pyrene, PCBs, lead) exceeding PRGs in the 0 to 1 foot interval
- Colors indicate greatest extent of PRG exceedance per areas
  - Yellow: 1 to 2 X PRG
  - Orange: 2 to 5 X PRG
  - Red: 5 to 10 X PRG
  - Purple: > 10 X PRG

Link 1 - details on 0-1 foot interval

NAVFAC Naval Facilities Engineering Command

TETRA TECH

Presentation of Remedial Alternatives
Supplemental Sediment Investigation Results

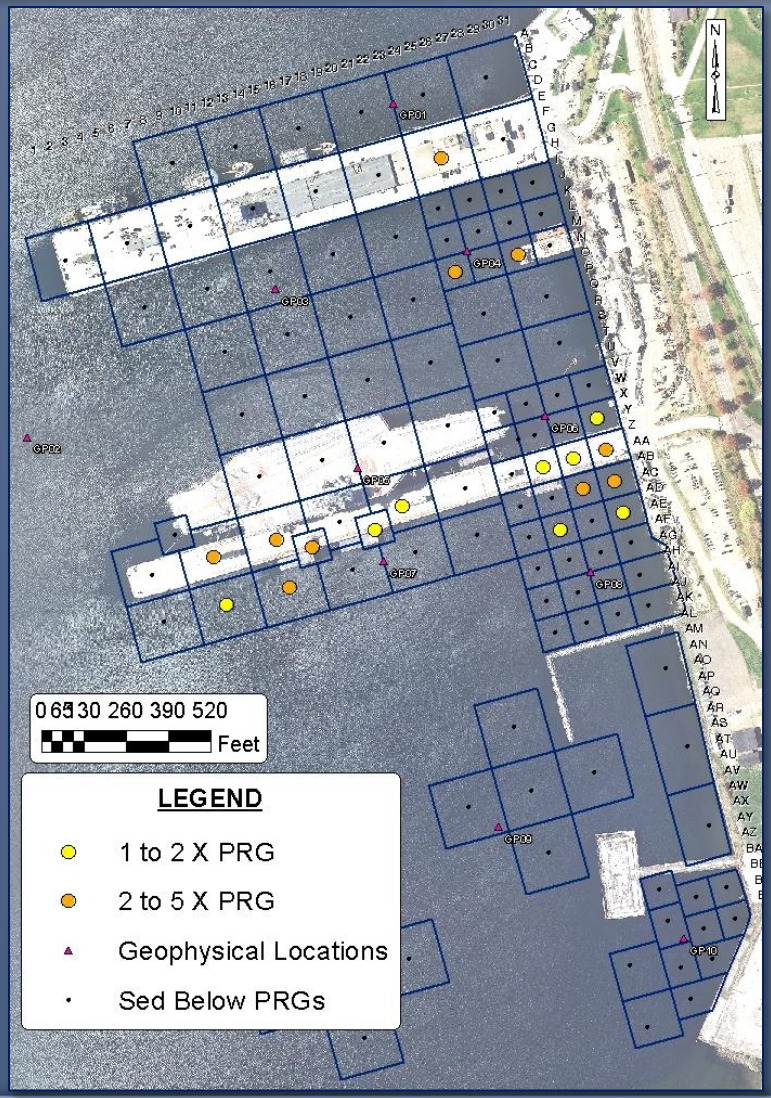


- Areas with COCs (PAHs, benzo(a)pyrene, PCBs, lead) exceeding PRGs in the 1 to 2 foot interval
- Colors indicate greatest extent of PRG exceedance per areas
  - Yellow: 1 to 2 X PRG
  - Orange: 2 to 5 X PRG
  - Red: 5 to 10 X PRG
  - Purple: > 10 X PRG

NAVFAC Naval Facilities Engineering Command

TETRA TECH

Presentation of Remedial Alternatives
Supplemental Sediment Investigation Results



- Areas with COCs (PAHs, benzo(a)pyrene, PCBs, lead) exceeding PRGs in the 2 to 4 foot interval
- Colors indicate greatest extent of PRG exceedance per areas
  - Yellow: 1 to 2 X PRG
  - Orange: 2 to 5 X PRG
  - Red: 5 to 10 X PRG
  - Purple: > 10 X PRG

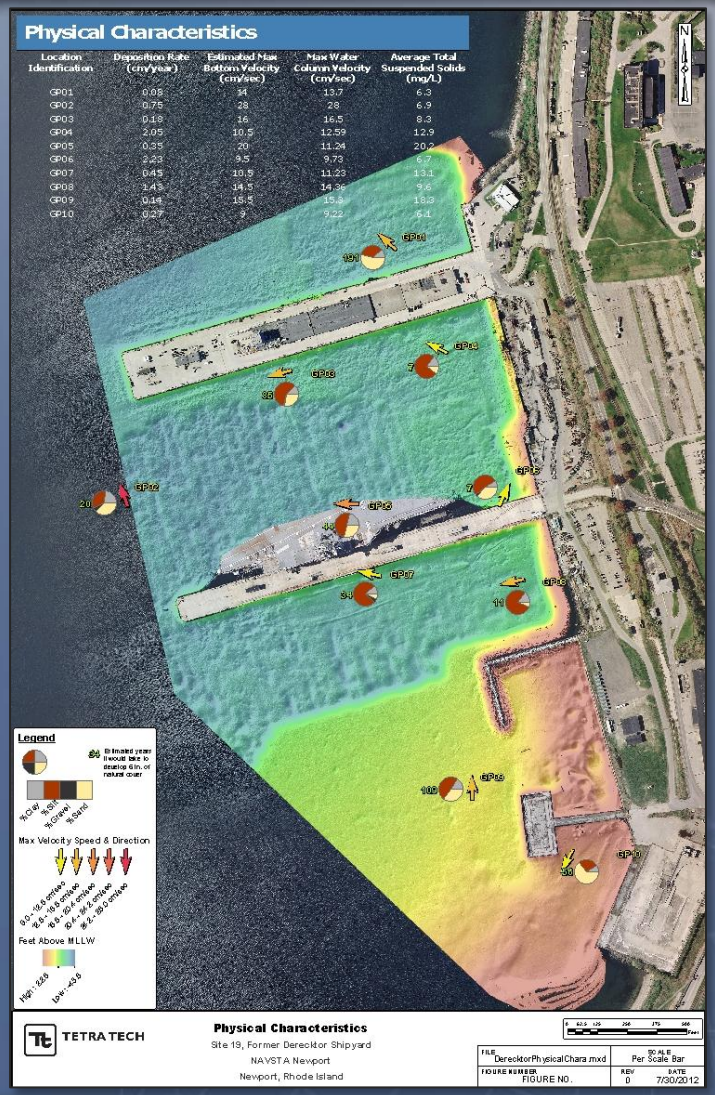
NAVFAC Naval Facilities Engineering Command

TETRA TECH

Presentation of Remedial Alternatives
Supplemental Sediment Investigation Results

- Deposition Rates ranged from 0.08 to 2.23 cm/year.
- Estimated Max Velocity rates ranged from 9 to 28 cm/sec.
- Silt was the dominant bottom material type at 7 locations, with sand being dominant at the remaining 3 locations.
- Clay was present from 0-1 feet at all locations in differing quantities.
- Sediment > 2 cm is highly consolidated and would require up to 3 times current velocity to disperse (ERDC).
- Draft of USCG ships is 13 feet, water depth >30 feet.
- No future traffic at Pier 1 planned.
- Ex Saratoga will be moved by tug, not under its own power.

See handout



Presentation of Remedial Alternatives
Alternatives Summary

Remedial Alternatives Includes:

- Alternative 1 – No Action
- Alternative 2 – Enhanced Natural Recovery at target areas* (thin layer cover) and Natural Recovery / LUCs.
- Alternative 3 – In Situ Cap at target areas* (engineered cap), Natural Recovery / LUCs.
- Alternative 4 – Dredge & Backfill (target areas)* with In-Situ Cap (under pier areas)*, Natural Recovery / LUCs.

* Target Areas selected through Surface Area - Weighted Average Concentration [SWAC] approach

Presentation of Remedial Alternatives
SWAC Approach for Alternatives 2-4

- The SWAC approach targets locations based on size and concentrations to achieve average COC concentrations below the PRGs within the group of locations that otherwise exceed PRGs.
- Used at many sediment sites for remedy development.
- Higher risk areas are subjected to more aggressive actions (enhanced MNR, In-Situ Capping, or dredging) so that average concentrations of the residuals are equal to or below PRGs.
- "The basis of the SWAC approach is that the exposure domain for receptors is broader than the small areas represented by individual samples, and so an average concentration of the exposure domain should be used" (IDEM and EPA Region 5, 2007)

$$SWAC = \frac{(area_1 \cdot conc_1) + (area_2 \cdot conc_2) \ldots + (area_\eta \cdot conc_\eta)}{area_1 + area_2 \ldots + area_\eta}$$

Parameter	PRG	Post-Action Concentration
PAHs	13,903 µg/kg	4,023 µg/kg
Benzo(a)pyrene	539 µg/kg	461 µg/kg
PCBs	1060 µg/kg	676 µg/kg
Lead	168 mg/kg	153 mg/kg

Link 2 - Other sites using SWAC

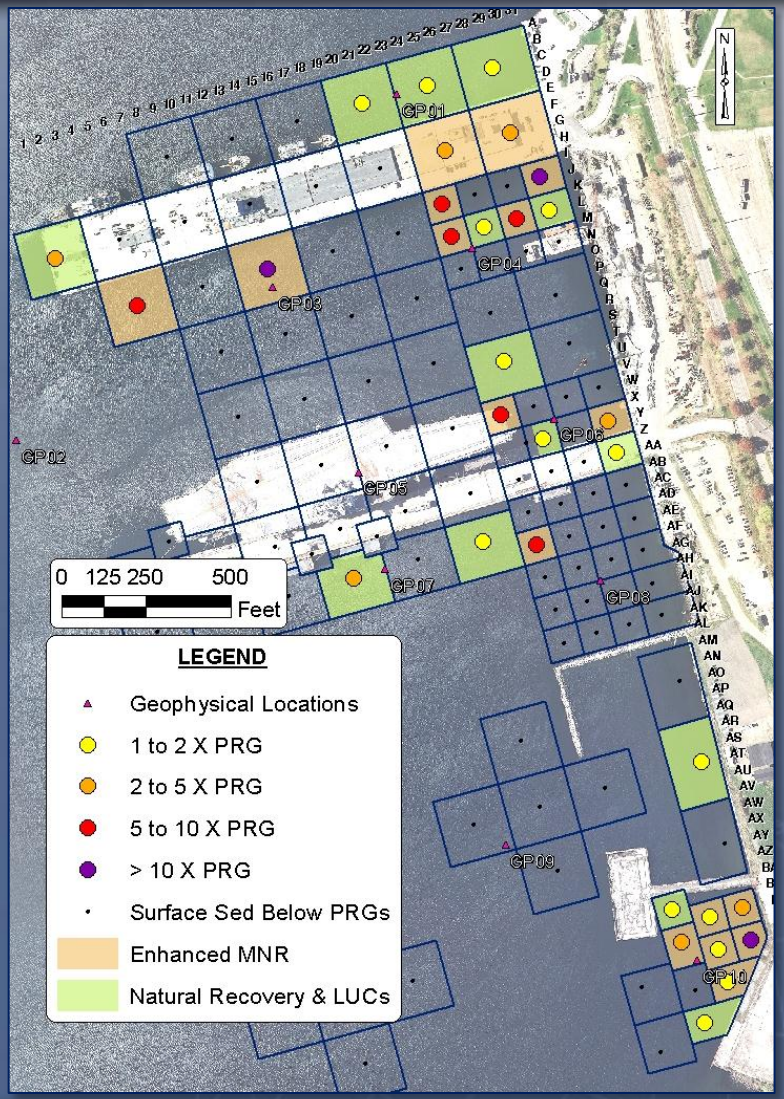
Link 3 – Details from Natick

NAVFAC Naval Facilities Engineering Command

TETRA TECH

Presentation of Remedial Alternatives
Alternative 2 – Enhanced Natural Recovery

- Placement of a thin layer cover at target areas to reduce SWAC across the entire site.
- Objective is to accelerate natural recovery by providing the equivalent of several years of deposition in target areas.
- Natural Recovery at all locations where PRG exceedances remain in surface sediment.
- Implement LUCs to prevent access by unauthorized persons and minimize traffic by deep-draft vessels
- Approximately 299,795 ft^2 will receive a thin layer cover
- Approximate cost $1.5M



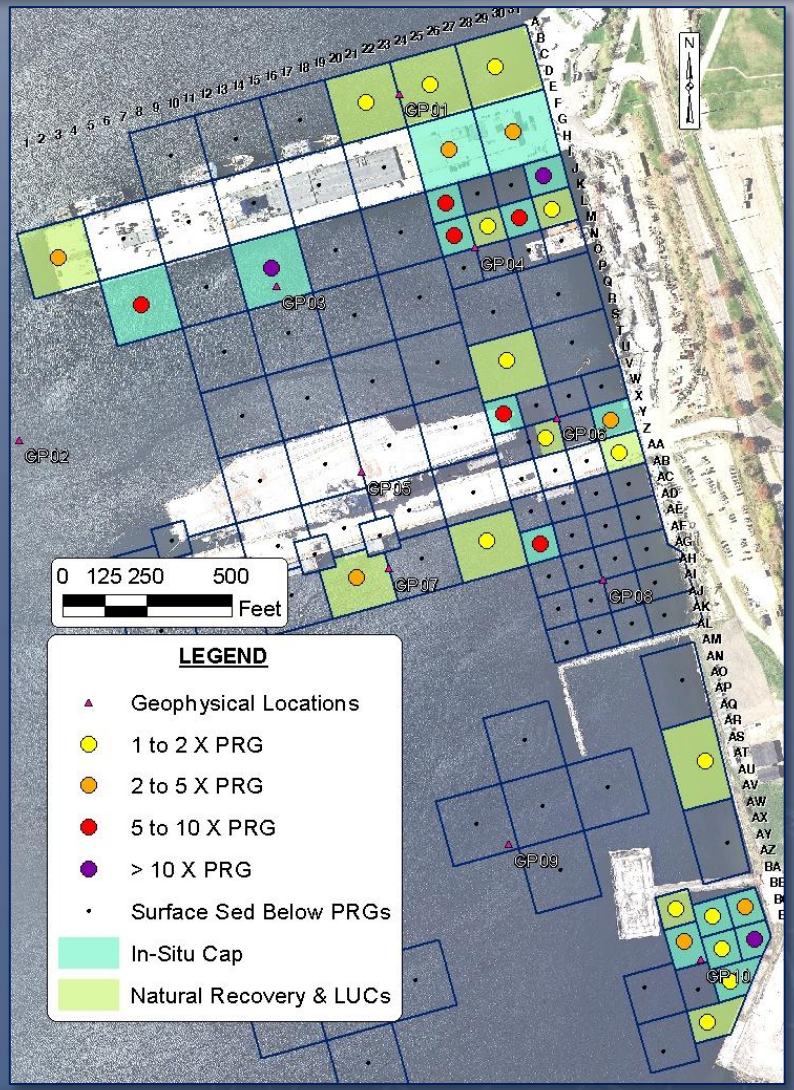
NAVFAC Naval Facilities Engineering Command

TETRA TECH

Presentation of Remedial Alternatives

Alternative 3 – In Situ Cap and Natural Recovery / LUCs

- Place an In-Situ Cap (engineered barrier) on selected areas based on SWAC.
- Natural Recovery and LUCs in areas where COCs remain in surface sediment at concentrations above PRGs.
- LUCs will be implemented as described in Alternative 2.
- Approximately 299,795 ft^2 will receive In-Situ Cap.
- Approximate Cost $3.4M



NAVFAC Naval Facilities Engineering Command

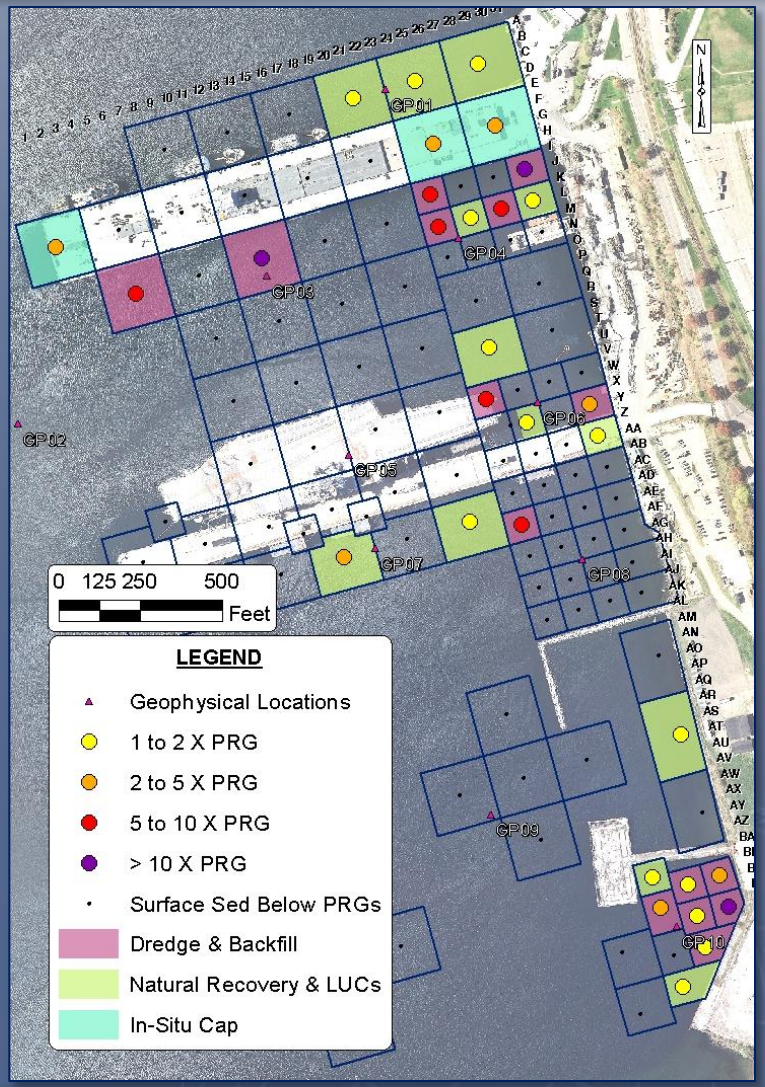
TETRA TECH

Presentation of Remedial Alternatives

Alternative 4 – Dredge and Backfill, In-Situ Cap, Natural Recovery LUCs

- Dredge areas selected on an SWAC basis to a depth of 1 foot and backfill with clean material.
- Placement of an In-Situ Cap over target areas beneath Pier 2.
- Natural Recovery and LUCs in areas where COCs remain in surface sediment at concentrations above PRGs
- LUCs will be implemented as described in Alternative 2.
- Approximately 8,006 yrd^3 of sediment will be dredged & backfilled, and approximately 123,576 ft^2 will receive an engineered cap.
- Approximate Cost $11.6M ($7.2M CAD)

Additional Discussion



NAVFAC Naval Facilities Engineering Command

TETRA TECH

Presentation of Remedial Alternatives
Dredging Technologies

TETRA TECH

D-5 REMEDIAL ALTERNATIVES PACKAGE OCTOBER 31, 2012

TETRA TECH

C-NAVY-10-12-5157W

October 31, 2012

Ms. Kymberlee Keckler
United States Environmental Protection Agency Region 1
5 Post Office Square, Suite 100
Boston, Massachusetts 02109-3912

Ms. Pamela Crump
Office of Waste Management
Rhode Island Department of Environmental Management
235 Promenade Street
Providence, Rhode Island 02908-5767

SUBJECT: Transmittal of Remedial Alternatives Package
Site 19, Former Derecktor Shipyard Marine Sediment
Naval Station Newport, Newport RI

Dear Ms. Keckler and Ms. Crump:

On behalf of Mr. Dominic O'Connor, US Navy NAVFAC, I am providing to you as attachments 1-5 summary information in regards to remedial alternatives for the marine sediment at Site 19, Former Robert E. Derecktor Shipyard, which is part of Naval Station Newport, and located in Newport and Middletown RI.

This material is being provided to you as the Navy's action following the meeting held on August 16, 2012 at which the findings of the Data Gaps Report for Marine Sediment (Tetra Tech, April, 2012) was discussed. At that time, four alternatives were presented, discussed, and clarified as described below:

- Alternative SD1 – No Action;
- Alternative SD2 – Enhanced Natural Recovery (thin layer cover) and institutional controls (ICs);
- Alternative SD3 – In-situ cap (engineered barrier) and ICs; and
- Alternative SD4 - Dredge and backfill target area surface sediment, with in-situ cap under Pier 2 to achieve surface weighted average concentrations, and ICs.

During these discussions, the Navy took as action to develop a fifth alternative (SD5) that would not be reliant on ICs, and would address deeper sediment present that exceeds PRGs. This alternative is presented as Attachment 1 (text description) and Attachment 2 (graphic).

Other action items were also taken by the Navy at the meeting. Attachment 3 presents a summary of zinc and copper in sediment at the site as compared to other published criteria and remediation goals. Attachment 4 presents conceptual cost estimates and conceptual plans for implementation of alternatives SD1 through SD5) (APEX, 10/29/12). Finally, Attachment 5 presents our notes from the August 16 meeting, revised in accordance with EPA comments received September 26, 2012 on our draft submittal.

In addition to these items above, under separate cover, the Navy has provided responses to comments from NOAA on the Draft Supplemental Sediment Investigation Report as agreed to at the August 16 meeting, and based on those responses the final report will be prepared and submitted. As agreed at the same meeting, comments from EPA and RIDEM on the draft report will be appended to the final report, but responses will not be prepared and revisions based on these comments will not be made.

Tetra Tech, Inc.
250 Andover Street, Suite 200, Wilmington, MA 01887-1048
Tel 978.474.8400 Fax 978.474.8499 www.tetratech.com

Based on the attached information, the Navy has developed estimated costs for the four alternatives that the Navy believes meet the protectiveness requirements for human health and the environment in accordance with the EPA Sediment Guidance (2005). These costs are summarized below:

Remedial Alternative Estimated Cost Summary

Alternative	Capital Costs[1]	Long Term Costs[2]	Total Estimate
SD2 – Enhanced Natural Recovery and ICs	$3,000,000	$1,900,000	$4,900,000
SD3 – In-Situ Cap and ICs	$4,800,000	$1,300,000	$6,100,000
SD4 – Dredge and backfill target area surface sediment, with In-Situ Cap Under Pier 2 to achieve surface weighted average concentrations, and ICs	$11,100,000	$1,300,000	$12,400,000
SD5 – Dredge and backfill target area sediment to achieve volume weighted average concentrations[3]	$17,400,000	$0	$17,400,000

[1]See Attachment 4 for cost basis, volumes, areas, conceptual approach
[2]Direct costs, no escalation
[3]Feasible only if sediment under Pier 2 can be successfully dredged; an outcome that appears very uncertain. SD5 is likely to result in considerable resuspension and collateral impacts.

At this point, the Navy proposes to incorporate this information into a revised FS, proposed plan and ROD for this site. If you have additional comments, please provide them prior to November 30 so we can continue to work toward our planned completion goals.

If you have any questions, please do not hesitate to contact me at 978-474-8434.

Very truly yours,

Stephen S. Parker, LSP
Project Manager

Enclosures

cc: D. Barclift, NAVFAC (w/encl.)
K. Finkelstein, NOAA (w/encl.)
A. Gavaskar, NAVFAC (w/encl.)
G. Glenn, Tetra Tech (w/o encl.)
W. Johnson, NAVFAC (w/encl.)
K. Munney, USF&W (w/encl.)
D. O'Connor NAVFAC (w/encl.)
P. Steinberg, Mabbett & Associates (2- w/encl.)
D. Ward, NAVSTA (w/encl.)
Site File (c/o Tetra Tech) (w/encl.)
File 112G02747-8.0 (w/encl.), 3.1 (w/o encl.)

Attachment 1
Development of Alternative SD5

Introduction

Based on the observations and discussions held at the meeting August 16, 2012, the Navy has developed an additional sediment remedial alternative, Alternative SD5, which evaluates the sediment based on a volume-weighted average approach. It is the Navy's understanding that achieving a volume-weighted average below PRGs would preclude the need for institutional controls (ICs), as the action would reduce the volume weighted average concentration across the site to values below PRGs for all COCs.

Background and Alternative SD4

As discussed on August 16, the primary goal of Alternative SD4 is to achieve a surface-weighted average goal equal to the PRG for all COCs in the surface sediment (the 0-1 foot depth interval). This would be accomplished using two remedial components: dredging and backfilling the excavation with clean substrate, and then installing a cover system over affected cells under Pier 2. Calculations provided during the meeting demonstrate that the post-dredging/backfill results would meet or be below PRGs. Further ICs for the open water areas would not be required and limited ICs would only be required to prevent disturbance of the cover area under Pier 2. Therefore, Alternative SD4 also results in a site that would not require ICs, except under Pier 2.

Alternative SD5

To develop Alternative SD5, the volume weighted average concentration (VWAC) was used similar to how the surface weighted average concentration (SWAC) was developed and used for Alternative SD4. Both the SWAC calculations used for Alternative SD4 and VWAC calculations used for Alternative SD5 are very conservative from a protectiveness standpoint because they use as a basis only those cells (Alternative SD4) or prisms (Alternative SD5) where the concentration of any COC is above the PRG. The VWAC calculations and their uses in Alternative SD5 are presented as follows:

1) Instead of using surface concentrations (in the top 1 foot of sediment) to select areas for calculation of a surface area weighted average, the average concentrations in each core (across the three sampled depths: 0-1, 1-2, and 2-4 ft) were used to develop a volume average concentration for each COC. If the volume average was above the PRG for any COC, the location represented by the core was selected for the volume average calculation. Each core

represents a 4-foot thick prism, or block, with a surface area of between 100'x100' and 200'x200' (see graphic).

Volume-Concentration for each 4-foot thick "prism" (VCp) was calculated below, where C = concentration in each cell (or sample or depth interval):

$$VCp = (C_{0\text{-}1ft} + C_{1\text{-}2ft} + (2 * C_{2\text{-}4ft})) / 4$$

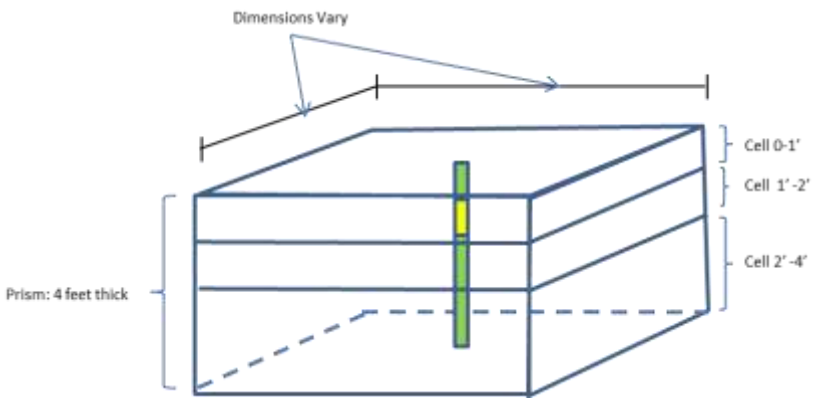


Figure 1 – Prisms which have average concentrations >PRGs are selected for volume average concentration calculation

2) The collection of the 4-foot thick prisms with average concentrations higher than the PRG makes up the "impacted site volume", which is used as a basis for the site volume weighted average concentration (VWAC) calculation. This prevents the clean locations from diluting the average concentration calculated in the next step.

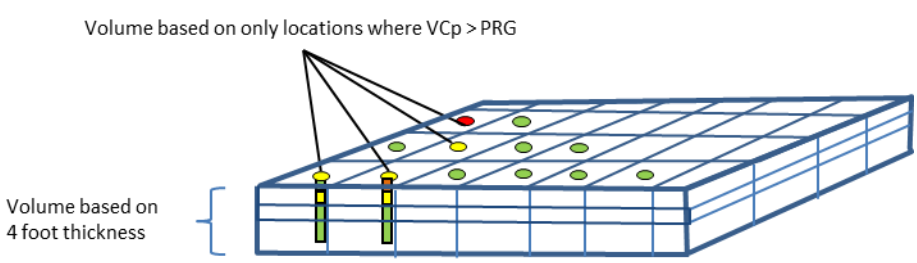


Figure 2 – Site volume average concentration is based on only locations where PRGs are exceeded in each prism

3) The calculation used to determine VWAC across the impacted portions of site is shown below, where: V=Volume of each 4-foot thick "prism" where any PRG was exceeded (see Step 2 above) and VCp is the volume-average concentration of each COC in that prism (Figure 2).

$$VWAC = [(V1 * VCp1) + (V2 * VCp2) + (V3 * VCp3)+\ldots+(Vn * VCpn)] / (V1+V2+V3+Vn)$$

4) Based on the calculation in #3 above, different dredging scenarios were simulated, in which dredged and backfilled cells were assigned a new concentration = 0 mg/kg. For example, if the top 1 foot cell in a prism was dredged and backfilled with clean sand, then the average concentration for that cell's surface sediment interval (0-1') was reduced to zero, and the average concentration for that prism was recalculated accordingly. If the top 2 feet of sediment in a prism was dredged, then the concentrations in the top two cells were reduced to zero. The VWAC for the target areas were recalculated at each step, and this process was continued until the VWAC for the entire impacted portions of the site were reduced below the PRG.

   As with the SWAC approach for the surface cells, the deeper cells with the highest concentrations were dredged first, regardless of where they were located. This ensures that higher concentration areas are addressed, regardless of which part of the site they are present in.

5) Using this approach, the following are the VWACs for the COCs (as well as Cu and Zn) calculated for the target areas of the site before and after implementation of SD5:

COCs and Cu, Zn	VWAC Prior to Remedial Action	RPRG	VWAC after Remedial Action under SD5
HMW PAHs (ug/kg)	23,679	13,903	9,075
Benzo(a)Pyrene (ug/kg)	1,284	539	527
Total PCBs (ug/kg)	3,209	1,060	381
Lead (mg/kg)	270	168	150
Zinc (mg/kg) (1)	250(2)	NA	235(2)
Copper (mg/kg)(1)	129(2)	NA	127(2)

(1) Not COCs, presented for illustrative purposes only.
(2) VWAC concentrations for zinc and copper reflect all concentrations measured at the site.

6) Alternative SD5 would result in the removal of approximately 14,300 CY (in-place volume) of sediment, and would result in a VWAC for all COCs below their associated PRGs. Including an

estimated 10,034 CY that would have to be over-dredged to access the targeted sediment and sidewall sloughing that is anticipated, the total volume of sediment that would have to be dredged is 24,334 CY. By comparison, in Alternative SD4, the in-place volume of sediment that would have to be dredged to meet a SWAC below all PRGs is 8,016 CY. Accounting for the over dredging that would be required to access this target volume, the total volume dredged in SD4 would be 14,016 CY.

In this manner, the VWAC is estimated in the same way as the SWAC developed for Alternative SD4. Whereas, the SWAC is calculated using concentrations in the 1-foot cells at the surface, the VWAC is calculated using the concentrations in the 4 foot-thick prisms. An important observation in Alternative SD5 is that there is no efficient way of achieving a VWAC below PRGs, without dredging the 4-foot thick prism associated with Cell G25 (under Pier 2).

Feasibility of Dredging Under the Piers

The Navy finds that dredging under the piers is not viable. Under Pier 2 lies a 4-foot thick prism associated with Cell G-25, and calculations show that achieving VWACs below PRGs for the action areas (same conservative approach as for SD4) would require that this prism be dredged to a depth of four feet. However, dredging under piers poses severe challenges with limited effectiveness and potential for collateral impacts. In one example method, target sediment under the pier would be mechanically dragged from under the pier (using a drag arm dredge) and then applying hydraulic dredging to the newly created pile. At the Harbor Island Superfund Site, Washington Department of Ecology observed that this method would create unacceptably high levels of sediment suspension, which would need to be controlled somehow (not clear how, as implementing silt curtains under the pier would be difficult). These challenges were discussed with dredging design consultants and engineers at the US Army Corps of Engineers as well as the private sector.

The dredging experts at the Corps suggested three different ways in which dredging could potentially be done under a pier (described in USEPA's email dated 9/4/12), but when contacted by the Navy the Corps did not know of any site that has actually implemented these concepts. Further research also indicates that dredging under the piers would have uncertain effectiveness, would lead to significant re-suspension, and involve very high costs.

The following information on dredging under a pier was compiled by the Navy for specific projects during this evaluation:

1. Harbor Island Site, WA - Lockheed Shipyard - Dredging under pier proposed in 1996 ROD. When difficulties became apparent during design, an ESD in 2002 was used to change the

remedy, so that the pier would be removed and enough of the sediment exposed would be dredged to allow a cap to be installed instead. The wooden pier at this site was easier to remove than would be the more solidly built pier at Derecktor. Dredging and capping the sediment under the (decommissioned) pier was completed in 2005. The following is quoted from the Memo to NRRB for Region X for the Harbor Island Superfund Site:

> "It was initially estimated that under-pier dredging would increase dredged sediment volume by about 10% and cost about five times as much as open-water dredging. However, after further evaluation it appears that under-pier dredging may increase sediment volume by as much as 20% and cost up to 10 times as much as open-water dredging. At such volumes and costs, under-pier dredging would significantly increase the costs of the selected remedy. In addition, it is uncertain how under-pier dredging will affect pier stability. To determine effects on pier stability, a structural analysis of the piers, will have to be conducted during remedial design. For these reasons, the extent of under-pier dredging, and its impact on the cost-effectiveness of the selected remedy, will be determined during remedial design after dredged sediment volumes, costs of under-pier dredging, and effects of dredging on pier stability are better known. If it is determined that under-pier dredging does not provide an environmental benefit in proportion to cost, or if pier stability is an issue, EPA may then consider other means of achieving the cleanup goals for under-pier sediments."

It was verified that the Lockheed portion of the Harbor Island Superfund Site was ultimately dredged only in open water areas, and capped in under-pier areas.

2. Harbor Island Site, WA - Todd Shipyard - Dredging under a pier was proposed in a 1996 ROD, but the difficulty was recognized in ROD, which said that the final remedy for the under-pier portion would be determined during remedial design. When challenges became evident, the Remedial Design abandoned the under-pier dredging and the site went on to implement a cap under the pier in 2007. The understanding was that dredging could still be done sometime in the future, whenever the pier was demolished.

3. San Diego Bay, CA - Shipyard sediment Site - A tentative Cleanup and Abatement Order (CAO) was signed by the San Diego Water Board on Sep 15, 2010 requiring that 15.2 acres of sediment be dredged. However, of these 15.2 acres, it identified 2.3 acres that were "inaccessible or under-pier areas", that would be remediated "by one or more methods other than dredging, most likely by sand cover".

4. Alameda Point, CA - Navy proposed capping under the wharf in the FS, but regulatory agencies insisted on dredging under it. When the dredging was conducted in 2012, they found large amounts of debris under the wharf, which clogged the intake and substantially slowed the hydraulic dredging process. Eventually divers were used for assistance and a special vessel was constructed for improved access, but the depth to which they could dredge was still limited. Target concentrations could not be achieved due to sediment migration and sloughing from surrounding areas as well as the simple problem of obstructions posed by the piles. A wharf stability analysis was also needed to show that the dredging was not affecting the integrity of the pilings. Overall, the project doubled in cost over initial high estimates, and did not go well, despite attempts to address various problems.

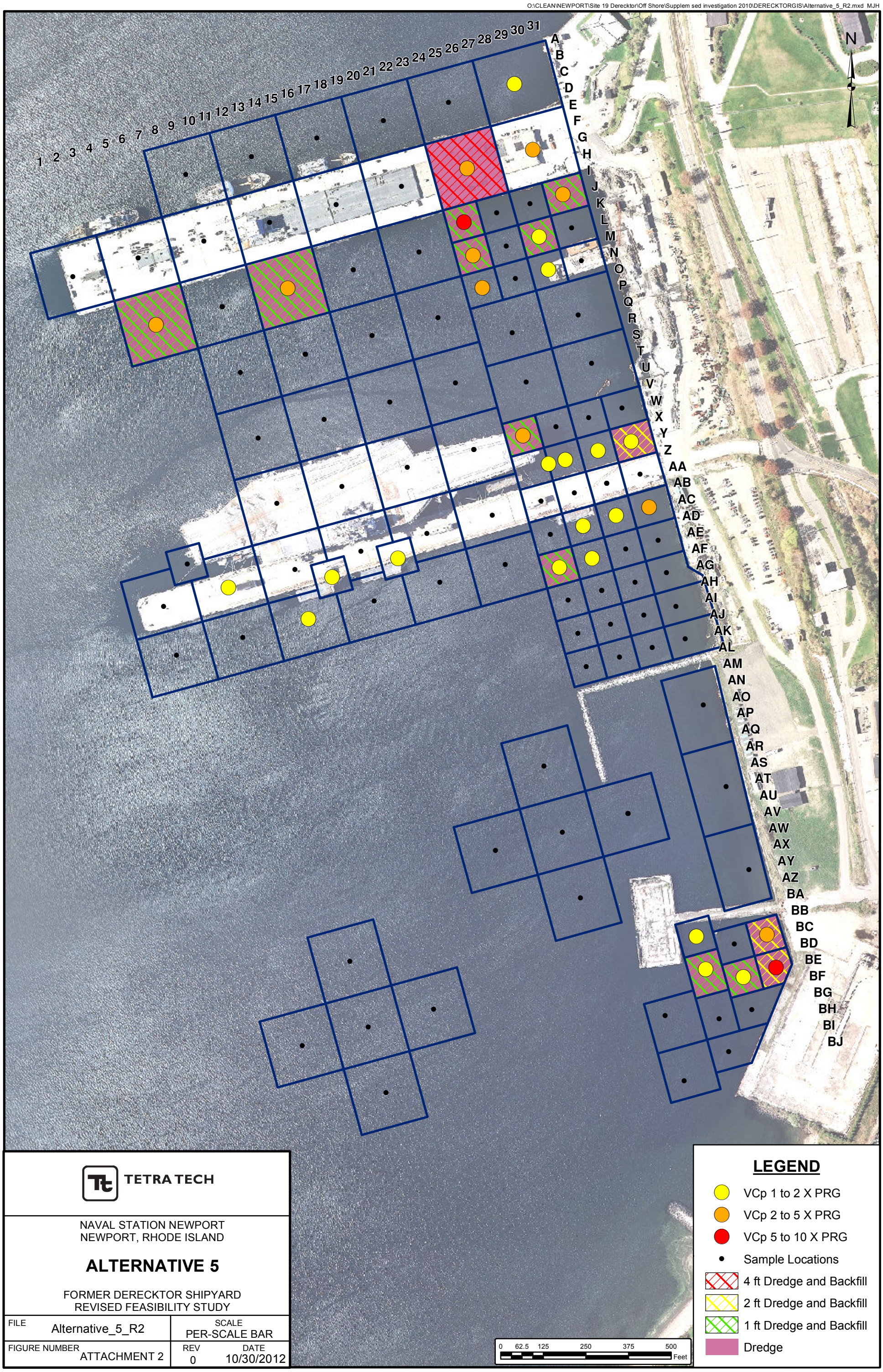
Finally, and most importantly, the structure of the pier must be considered. The Navy is seeking as-built drawings of the pilings seated for Pier 2 at NAVSTA Newport. A full evaluation of the structural stability

has not yet been conducted for under-pier dredging to be seriously considered. Some specifics can be seen in available utility drawings: Density of the piles is 10 feet on center, and piles are concrete and steel construction, 18 inches in diameter, leaving only 8.5 feet of clearance. Some piles have deteriorated to the point where the Navy has implemented weight handling restrictions on the pier. Although there are no “batter piles” (diagonal bracing on the pier sides) as are present at Pier 1, additional wooden piles and fixed fenders on the sides of the pier will provide additional hindrance to access underneath. In summary, the Navy finds that due to the water depth, the size of the area (200 feet x 200 feet), the density of the piles and the likely debris present; dredging under the piers is not a viable option at Derecktor.

Summary

The VWAC simulations show that Alternative SD5 would require much more effort and cost than Alternative SD4, regardless of how the dredging is accomplished. Successful dredging to four feet under Pier 2 is not viable and would likely result in collateral impacts (spreading, resuspension) that would be difficult to control. Alternatively, implementing the SWAC-based dredging proposed as part of Alternative SD4 would result in reduction of the VWAC in open water areas of the site to be close to the PRG for all COCs. Therefore, Alternative SD4 would result in a site that does not require any LUCs, except under Pier 2. Restrictions under the pier would not impact any planned uses of the open water areas.

O:\CLEAN\NEWPORT\Site 19 Derecktor\Off Shore\Supplem sed investigation 2010\DERECKTORGIS\Alternative_5_R2.mxd MJH



TETRA TECH

NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

ALTERNATIVE 5

FORMER DERECKTOR SHIPYARD
REVISED FEASIBILITY STUDY

FILE	SCALE	
Alternative_5_R2	PER-SCALE BAR	
FIGURE NUMBER	REV	DATE
ATTACHMENT 2	0	10/30/2012

Attachment 3
Evaluation of Zinc and Copper in Sediment

1. Introduction

Based on the human health and ecological risk assessments conducted for the site in 1996 and 1998 respectively, contaminants of potential concern (COPCs) were identified for marine sediment. Baseline PRGs (BPRGs) were developed for these COPCs and recommended PRGs (RPRGs) were derived from them. This document summarizes how two constituents, copper and zinc, were addressed in this process, and how new zinc and copper data collected in 2010 compare to these and other benchmark values.

2. Development of PRGs for Zinc and Copper

From the list of COPCs identified in the Ecological Risk Assessment (URI and SAIC, 1997), the applicable "limiting" contaminants of concern (limiting COCs) were identified as a part of the *Baseline* PRG (BPRG) development. Limiting COCs are generally identified as those that are the primary drivers of the unacceptable risks posed to each of the receptor groups. The limiting COCs are High Molecular Weight PAHs (HMW PAHs), benzo(a)anthracene, PCBs, and lead. For these limiting COCs, *Recommended* PRGs (RPRGs) were calculated (SAIC, 1998) as shown in Table 1.

The development of RPRGs addressed both anthropogenic contaminants and some uncertainties of the exposure assumptions (i.e. exposure areas for receptors).

Table 1: PRG Development for Site 19 Marine Sediment

COCs and Cu, ZN	BPRG	RPRG	Risk Endpoint
Lead	83.94 mg/kg	168 mg/kg	toxicity to aquatic organisms from exposure to suspended sediment
Benzo(a)pyrene	53.92 µg/kg	539 µg/kg	adverse human health effects from ingestion of shellfish
Total HMW PAHs	6,951 µg/kg	13,903 µg/kg	toxicity to aquatic organisms from exposure to bedded sediment
Total PCBs	530 µg/kg	1,060 µg/kg	toxicity to aquatic organisms from exposure to suspended sediment
Copper	73.74 mg/kg	None	toxicity to aquatic organisms from exposure to suspended sediment
Zinc	118.00 mg/kg	None	uptake by avian predators

mg/kg - milligrams per kilogram

µg/kg - micrograms per kilogram

The basis for the BPRGs and the reason why RPRGs were not required for copper and zinc are provided below:

2.1 Copper

The BPRG for copper is based on the likelihood for the copper to partition into water, and create a toxic effect to organisms. The effects testing conducted used sea urchin fertilization and development tests on water blended with sediment. The conclusion on copper from SAIC 1998 is provided as follows (parenthetic text is provided as explanation of terms):

> For copper, a TEV-HQ (threshold effects value - hazard quotient) = 1.76 at Station DSY31 was found based on a concentration of 5.1 µg/L (of copper) measured in the elutriate sample (the water supernatant separated after blending with sediment for toxicity testing). Following the methodology of RPRG translation from TEVs, the PRG-HQ=1 concentration of 74 µg/g (equal to 74 mg/kg) was calculated and the spatial implementation of the sediment PRG is presented (see Figure 3.3-4 of the PRG document). While several stations had sediment concentrations above the PRG, a number of these locations had non-detectable elutriate Cu concentrations such that it is clear that the predicted exceedences are erroneous. This is consistent with the fact that copper concentrations at DSY-27 and DSY-29 are not high; measured bulk concentrations were marginally above the ER-L and SEM-AVS was <5, indicating that metals, including copper, are not at concentrations high enough to contribute significantly to risk. The lack of measured copper in elutriates is also consistent with the low/nonbioavailable concentrations in sediments evaluated for the ERA. Two additional URI stations (DSY-2 and DSY-3) did have Cu concentrations in sediment higher than was observed for ERA locations, but the increase was marginal (less than two-fold) and hence aquatic biota would be presumed to be at minimal risk due to Cu in resuspended sediments. Hence the data demonstrate the copper is not a primary contributor to risk and thus retaining a PRG for remediation of sediments subject to resuspension is not recommended.

2.2 Zinc

The BPRG for Zinc is based on the likelihood for the zinc to be taken up by prey species (shellfish) and transferred to avian predators through the predator-prey relationship. This potential was measured through a bioaccumulation model presented in the Baseline Ecological Risk Assessment. The conclusion on zinc, along with other metals evaluated for exposure to avian predators from SAIC (1998) is provided as follows:

> In the marine ERA, generally intermediate risks to avian predators were assigned to stations DSY-28, DSY-29, and DSY-36, while slight risks were apparent elsewhere, including reference locations (SAIC 1997; Table 6.6-3). Although there is an apparent concordance between PRG exceedance and observed risk including areas represented by Station Pairs DSY-2/DSY-28 and DSY-3/DSY-29, implementation of remedial action based on this PRG does not appear warranted given the limitation of the conservative exposure assumptions in the ERA and subsequent conclusion that COCs in Coddington Cove do not likely pose an unacceptable risk to avian receptors (ERA Section 6.3). Thus despite the fact that PRGs were exceeded, the avian predator would have to spend its entire life feeding in the affected area for true risks to occur. This overly conservative

assumption leads to the recommendations that the PRGs for risk reduction for the avian aquatic exposure pathway metals not be adopted at this time except perhaps for purposes of monitoring to ensure continued lack of significant risks via food chain transfer from prey species to aquatic predators.

3. Summary of Other Information for Zinc and Copper

During the meeting held on August 16, 2012, there were a number of questions that were raised on the different toxicity values available for copper and zinc and how the current data and other Site PRGs compare to these values.

Based on those questions, a series of informational points were assembled comparing data from the site to toxicity data (Table 2). It has to be noted, however, that only a subset of samples collected during the 2011 supplemental sediment investigation at Site 19 were analyzed for zinc and copper. These were locations that were selected during the DQO process to target portions of the study area that could have received the highest levels of impact from zinc and copper sources during the operation of the former Derecktor Shipyard.

Table 2: Zinc and Copper, Site and Toxicity Data

Reference Information	Zinc (mg/kg)	Copper (mg/kg)
Site Data:		
Site Max used for Risk Assessment 1996	547	262
Site Max measured in Sediment assessment 2011	931	295
Surface weighted average concentration prior to RA (all cells)[1]	248	123
Volume weighted average concentration prior to RA (all prisms)[1]	250	129
Toxicity Data:		
ERL (NOAA)	150	34
ERM (NOAA)	410	210
TEL	124	18.7
PEL	271	108
AET (amphipod mortality 1988)	960	1300
AET (amphipod mortality 1994)	3,800	1300
AET (oyster abnormality 1986)	1,600	390
AET (echinoderm abnormality 1994)	460	390
T_{20}	94	32
T_{50}	240	94
T_{80}	640	280
Concentrations after Possible Remedial Actions:		
Surface weighted average concentration after Alternative SD4[1]	186	100
Volume weighted average concentration after Alternative SD5[1]	208	105

Notes:

1 – reflects inclusion of all concentrations of Cu and Zn measured
AET – Apparent Effects Threshold (Gries and Waldow, 1996)
TEL - Threshold Effects Level (MacDonald, 1994)
PEL - Probable Effects Level (MacDonald, 1994)
T_{20}, T_{50}, T_{80} - Chemical concentrations corresponding to a 20%, 50%, and 80% probability of observing sediment toxicity, respectively (EPA, 2005)

Additionally, previous executed RODs that include copper and zinc as COCs in marine sediment were researched, and PRGs that were found for those RODs are presented below:

Table 3: Zinc and Copper PRGs for Marine Sediment at Other Sites

Facility	Copper PRG	Zinc PRG
New London, Pier 1	270 ppm (ERM, amphipod; benthic invert)	410 ppm (ERM, amphipod, benthic invert)
Davisville, Site 9	NA	219 ppm (tern/shellfish food web modeling)
Brookhaven National Lab, Peconic River, NY	310 ppm (site-derived via invertebrate toxicity testing)	NA

4. Summary:

Based on the observed concentrations above, the previous application and consideration of zinc and copper in the conceptual site model, and the concentrations measured in 2010, the following points are noted:

- The copper in sediment is not very high compared to literature toxicity values and compared to PRGs established at other sites ranging from 270 mg/kg to 310 mg/kg in EPA Regions 1 and 2 (see Table 3).
- There are three locations that have elevated zinc in surface sediment as identified by NOAA, though average concentrations are not excessive compared to PRGs established at other sites ranging from 219 mg/kg to 410 mg/kg in EPA Regions 1 and 2 (see Table 3).
- In addition, implementation of the dredging that would be conducted in Alternative SD4 would reduce copper to a SWAC of 100 mg/kg, and zinc to a SWAC of 186 mg/kg. These post-remedy concentrations compare well with the benchmarks used in RODs at other sites.

Based on the information described in this summary, the Navy does not believe that the conclusions previously reached on the merits of not using copper or zinc as COCs for this site require revision.

5. References

MacDonald, D.D., 1994. Approach to the Assessment of Sediment Quality in Florida Coastal Waters Florida Department of Environmental Protection.

Gries, T.H., and K.H. Waldow. 1999. Progress Re-Evaluating Puget Sound Apparent Effects Thresholds (WETs), Volume I: 1994 Amphipod and Echinoderm Larval AETs. Draft Repoty. Washington State Department of Ecology. April.

EPA 2005. Predicting Toxicity to Amphipods from Sediment Chemistry. Office of Research and Development, National Center for Environmental Assessment. EPA/600/R-04/030. March.

SAIC, 1998. Final Preliminary Remediation Goals (PRGs) for Derecktor Shipyard/Coddington Cove. Science Applications International Corporation, 165 Dean Knauss Drive, Narragansett RI. November.

University of Rhode Island and SAIC, 1997. Final Derecktor Shipyard Marine Ecological Risk Assessment Report, Naval Education and Training Center, Newport RI. Science Applications International Corporation, and the University of Rhode Island Graduate School of Oceanography. May.

October 29, 2012

CONCEPTUAL COST ESTIMATES
FOR FIVE POTENTIAL REMEDIAL ALTERNATIVES
Former Derecktor Shipyard
Naval Station Newport, Newport, RI

Apex Companies, LLC (Apex) has prepared the following conceptual cost estimates associated with five (5) conceptual remedial alternatives to address impacted sediment at the Former Derecktor Shipyard at Naval Station Newport, Newport, RI.

The five alternatives are as follows:

- Alternative 1 – No Action.
- Alternative 2 – Cover/Capping of 1 Foot Over Select Areas. – This option has been referred to as Enhanced Natural Recovery. The cover for this option is assumed to be granular material.
- Alternative 3 – Cover/Capping of 2 Feet Over Select Areas. This option has been referred to as an "Engineered Barrier". At present, however, the composition of the cap is assumed to be the same as Alternative 2 (i.e. granular material).
- Alternative 4 – Dredge and Backfill Select Areas With In-Situ Capping in Select Areas.
- Alternative 5 – Dredge and Backfill Select Areas.

Apex has made the following assumptions in preparing its unit cost pricing in the following manner:

- **Elimination of CAD Cell Creation, and Passive Dewatering as Dredge Options:** It is Apex's understanding that the State of Rhode Island has indicated that CAD Cell disposal will not be acceptable in association with this work. Additionally, it is unlikely that the available space (approximately 3 acres) will be sufficient for passive dewatering of dredge spoils; therefore, only mechanical dewatering is currently included in cost estimates.
- **Potential Use of Mechanical Dredging Options:** Due to the need to utilize hydraulic dredging for some areas of the work (shallow areas and areas under the pier), it may not be feasible from a budgetary perspective to also conduct mechanical dredging simultaneously. Additionally, existing bathymetry indicates that the proposed dewatering site (see below) does not have sufficient draft adjacent to its bulkhead to allow for a scow to move adjacent to shore for the unloading of mechanical dredging spoils, which would hinder the use of mechanical dredging. Nevertheless, a tiered approach that integrates mechanical dredging into the dredging sequence may be necessary in order to address

potential debris that could hinder the functioning of hydraulic dredging equipment (see debris discussion below). In such an instance, mechanical dredges could be used to remove areas that have high quantities of debris into a scow, where the debris could be more easily segregated, and then material could be re-suspended and transported hydraulically to shore. For the purposes of this estimate, the mobilization and demobilization charges associated with both hydraulic and mechanical dredging have been included, and it is assumed that approximately 35% of the material would be dredged mechanically and then transferred onshore hydraulically.

- **Addition of Side-Slope Material Into Dredge Volumes:** Apex has included anticipated side-slope volumes into the total volumes for the dredge footprints. This information may vary somewhat when the full design is prepared; however, the updated volumes are more realistic compared to what volumes should be generated during construction.
- **Addition of Over-Capping Elevation Material**: Apex has added additional volume to capping materials in order to give the proposed contractor a margin of error for cap placement. This is typical for capping operations, as the contractor is not typically able to meet a capping elevation exactly.
- **Additional Costing Items For Hypothetical Under Pier Operations**: After reviewing the photos and plans for the areas under the piers, Apex believes that traditional hydraulic dredging would be unlikely to be successful under the piers, and that a diver-led suction dredge would most likely be needed. The suction dredge would be led by one to two divers that would be part of a three-diver crew. Additionally, there would be losses in efficiency for areas under the pier compared to traditional hydraulic dredging. These differences would also apply to capping and backfilling for under-pier locations.
- **Costing Items for Debris Removal:** Discussions with Tetra Tech have indicated that there is the potential for debris to be present under or adjacent to pier areas due to historic repair and operation activities at the piers. Apex's experience has indicated that debris levels in these locations may be substantial, and Apex has included costs for removal of a relatively substantial quantity of debris; however, the actual quantities cannot be known until the work proceeds and a more informed estimate would require a pre-design inspection. Methodology for debris removal may vary somewhat depending upon the Contractor's means and methods; however, for the purposes of this evaluation, Apex assumes that debris is removed via a drag-line (a submersible rake that gathers and removes debris from the water for decontamination and offsite disposal) prior to conducting hydraulic dredging operations and/or a screen (a grating that would cover the dredge scow such that debris would be caught in the screen and be shunted to the side for segregation, decontamination and offsite disposal) that would be used in association with mechanical dredging operations, as discussed above. Apex recommends a debris survey be conducted during the design process.

A summary of the volumetric and area assumptions utilized in the cost estimates, as well as a relatively detailed breakdown of these cost estimates is attached to this letter within **Table 1**.

Due to the conceptual level of this project to date, costs have been culled from past projects Apex has been associated with, including hydraulic dredging projects, that have included active dewatering components and projects that have had some component of off-site transportation and disposal. This cost estimate is a preliminary estimate for budgeting purposes only and is based

on the broad concepts available at this time. Apex has included costs for conducting multi-beam surveys to complete pre-dredge, post-dredge, and post-capping surveys within the dredge areas contemplated in each Alternative. The survey costs are intended to demonstrate that the correct dredge and/or capping elevations, relative to the existing elevations, are achieved, in order to satisfy the project team that the work was completed in accordance with plans and specifications. Please note that multi-beam surveys for areas beneath the piers will not be possible because of the interference of the concrete decking of the pier from allowing GPS systems to operate properly; for this area, a single beam survey system at known points set in advance of the survey would be utilized instead.

Water quality monitoring costs have also been included. The water quality monitoring consists of turbidity monitoring that takes place at multiple levels in the water column both up-current and down-current of the dredging or capping operation. It is currently assumed that monitoring would take place utilizing an optical back-scatter turbidity monitor. Monitoring is estimated to occur for the first three days of dredging, and twice weekly thereafter, based on project schedules predicated on an assumption of 100 cy/day for capping or dredging under piers and 500 cy/day for capping or dredging in open water.

Please note that, until a project such as this has gone through the bidding process, that cost estimates have a relatively high level of uncertainty. At present, Apex has included a 10% cost for engineering oversight of the project, and an overall 20% contingency in the final cost estimate within **Table 1**.

The following additional information is provided regarding the assumptions utilized in preparing the conceptual cost estimates:

Dredging Technologies Anticipated for Each Area

It is currently anticipated that areas under the piers will require a separate dredging technology than the areas that are not under existing piers, as outlined below:

Areas Not Under Piers

Prior to the start of dredging, debris removal will need to take place. Debris left in place could interfere with the efficiency of hydraulic dredging equipment (methods for debris removal are discussed above). This process could be lengthy, particularly if there is a significant quantity of debris, or if that debris is hidden below the surface of the ocean floor (again, the quantity will be confirmed during pre-design investigations).

Areas not currently under existing piers will likely utilize hydraulic dredging, which utilizes a cutting head to mix dredge material with water, which is then pumped to a dewatering location. The dredge runs along the bottom of the dredge area, and is connected to a barge which contains other support equipment. The dredge material is mixed with up to 10 times its volume in liquid, creating a slurry that can be pumped long distances, but must be dewatered prior to disposal. If the proposed dewatering location is far away, booster pumps may be needed to transport the dredge slurry to the dewatering location.

Should it be found that a large proportion of debris exists within the dredge material, it is possible that a combination of mechanical dredging (to remove the material and sort debris) plus hydraulic dredging (to transport the material to shore for dewatering) may be utilized. In that case, subsequent to initial mechanical dredging of the material into a scow, the material will be re-suspended within the scow and transported hydraulically to shore to the dewatering area.

Capping or backfill for open water areas could be completed in a number of different ways, and the methodology would likely be left open for the Contractor. Nevertheless, methodologies including: gravity-fed tremie pipe placement, release of material from slow-moving scows or barges, hydraulic washing of coarse sand from a flat-topped barge, or hydraulic transport via pipeline with baffle plate or sand box (or other type) for energy dissipation, could be considered for capping or backfill of material in open water.

Areas Under Piers

This task will be similar to that outlined above for areas not under piers; however, Apex has assumed that removal of debris from under the pier will be significantly more difficult, because no overhead crane can be utilized to remove material, which will complicate the debris removal process and increase the cost (methods for debris removal are discussed above).

Apex presumes that areas under existing piers will be unlikely to easily utilize hydraulic dredging; as a result, it is likely that suction dredging (or a specialized hydraulic dredge) will be used. To ensure that the area is dredged thoroughly, it is likely that a team of divers will be needed to guide the suction dredge (or specialized hydraulic dredge) as the material is removed. This will be of particular importance between the pilings. It is likely that a suction dredge will also run at a significantly reduced output, which will also result in increased cost.

Similar to the hydraulic dredge described earlier, the suction dredge will likely pump material to the dewatering location. Some suction dredges claim that they do not mix the material with as much water as a hydraulic dredge would, which would save on dewatering costs, but would increase the cost to transport the material to the dewatering area (if it cannot be pumped as easily). Again, if the proposed dewatering location is far away, booster pumps may be needed to transport the dredge slurry to the dewatering location.

Capping for areas under the piers would likely be conducted utilizing the hydraulic methods (likely with pipeline and energy dissipation) listed above. Apex anticipates that coarse capping material would be transported to the nearest location via barge or scow. This material would be then transported hydraulically to the capping location by suspending the material and pumping it to the end of a pipe at the capping location. This work would likely be conducted at a significantly slower rate than that of placement in open water areas. The mechanics for placement of material are not dissimilar to those associated with removal, in that they involve mixing the materials into a slurry and transporting them some distance for placement via piping.

Overdredge and Side-Slopes

When designing a dredge project, it is necessary to grant a contractor an "over-dredge", which is a depth beyond the target dredge depth that the contractor may be paid. "Over-dredge" depths are typically 1 foot, which would double the volume generated from a 1 foot dredge cut, as proposed within the presentation. However, contractors typically do not ultimately collect the whole over-dredge; therefore, Apex has assumed ¾ of a foot of over-dredge in its volumetric calculations to be conservative.

Typically, as one dredges a location, the side slopes slough into the excavation and need to be removed as well. Material typically ranges in the type of side-slope that it will retain underwater. The side-slope ranges from approximately 1H:6V to 1H:3V, depending on the material. Apex has assumed that the material to be dredged will likely hold to a 1H:5V (although this information will need to be confirmed later in the design process). Apex has assumed that capping material (which is likely to be sandy), will retain a steeper side slope (1H:3V) (although, again, this information will need to be confirmed later in the design process).

Dewatering Technologies Anticipated

Once the slurry reaches the dewatering location, Apex presumes that mechanical dewatering equipment will be utilized to remove the water. The water may need to be treated prior to discharge. Typical mechanical dewatering equipment could include a belt press, hydrocyclone, or other technology. Often, a polymer is added to speed coagulation of the material to increase the efficiency of mechanical dewatering.

Sedimentation Controls

Apex's experience in association with jobs such as this are that sedimentation controls may not be necessary if only hydraulic and suction dredging are utilized. Hydraulic and suction dredging relies on negative pressure to capture the dredge material that is generated during the dredging process. As a result, these dredging methodologies are unlikely to generate significant quantities of turbidity that may impact or degrade water quality. Therefore, there may be a reasonable argument that would indicate that sedimentation controls associated with dredging may not be necessary, and that a monitoring program may be adequate to maintain reasonable turbidity levels surrounding the dredge areas, with the use of sedimentation controls to be implemented if turbidity levels exceeded a designated threshold.

However, if mechanical dredging is utilized and/or turbidity controls associated with dredging are required by USEPA, Apex presumes that such controls could be utilized within the targeted dredge areas (although some areas may be more costly to implement than others). Silt curtains would likely be the most reasonable alternative to control potential siltation. Silt curtains are produced in lengths from 3 feet to up to 100 feet; however, documentation of historic use of silt curtains indicate that they have been most typically utilized within water depths of 25 feet of water or less. Use of silt curtains within deeper water is possible; however, the silt curtains become increasingly vulnerable to the force of currents, which can displace the curtains or otherwise impair their effectiveness. To resist currents, the curtains can either be anchored in place, or attached to temporary sheet piling that may be driven for the purposes of holding the silt curtains in place. As the curtains get longer, or are implemented in more atypical

configurations, additional controls could be required; often the full extent of necessary controls will not be known until construction begins. For the purposes of the cost estimates provided herein, it is assumed that temporary sheet piling would be utilized at the corners and at one location along the length of the curtain on each sied to hold the curtains in place. Under the pier, silt curtains could be attached to the pilings in such a way as to isolate the dredge areas under consideration; however, the implementation of silt curtains under the piers poses significant additional challenges to ensure their effectiveness, not only due to the logistics involved in confirming proper installation, but also due to the challenges posed by regular inspections to determine whether the silt curtains are performing as anticipated.

Typically, the bottom of the silt curtains hang above the bottom of the ocean floor, to prevent the tidal variation from dragging the bottom of the curtain into (and out of) impacted sediment, which would generate turbidity, rather than reducing it. The bottom of the silt curtains may also be weighted to ensure that the curtains hang do their design depths.

The cost estimate assumes that two 200 ft X 200 ft areas are surrounded by silt curtains. Dredging and/or capping underneath the piers is anticipated to be significantly slower than the work that is completed in open water; as a result, the work under the pier may take place simultaneously as the work in open water; hence the need for two sets of silt curtains.

Laydown Area

Apex currently assumes that the three (3) acres of waterfront immediately north of the T-Wharf will be available for laydown and dewatering. If additional space were available, it could result in lower costs for the project by allowing passive dewatering as a possibility. Apex presumes that this area will be available for the contractor to set up equipment and trailers, stage materials, and stockpile dredge spoils and capping materials. An area immediately adjacent to the shoreline will minimize the distance that the slurry will need to be pumped over land, while allowing the dewatering fluids to be discharged back into the ocean post-treatment (assuming a NPDES permit for such discharge may be obtained from USEPA).

Although the three (3) acre area north of the T-Wharf is a good location for dewatering, the best location would likely be on the piers themselves. The piers themselves would allow for short distances for dewatering operation, as locations closest to the dredge areas could be used to stage materials and dewater dredge spoils. The piers would also theoretically allow for mechanical dredging without supplemental hydraulic transport, as they have sufficient draft adjacent to them to allow scows to unload. It is Apex's current understanding that these locations are unavailable due to weight handling restrictions that currently exist. Nevertheless, if it has not been conducted recently, an assessment of the existing loading capacity of the piers may be worthwhile and may generate some cost savings if it shows that some use of the piers for the purposes of assisting the contractor is a viable possibility.

Please also note that the costs provided are capital costs and that long-term operating costs are not included in the summary.

Transportation and Disposal

As access to the facility is likely to include security access and frequent inspections for trucks that are delivering equipment, delivering materials, or transporting dredge spoils offsite for disposal, Apex has included additional budget intended to compensate for this extra effort that will be required of contractors.

The pricing currently provided by Apex anticipates that the material will be transported to a Subtitle C landfill in New York by road. Please note that transportation and disposal costs listed herein assume that material can be disposed within a Subtitle C landfill, does not fail TCLP, and is determined to be non-hazardous. If any of these assumptions should prove to be untrue, the final costs may change from those shown.

Attachments: Table 1

TABLE 1

Table 1: Capital Cost Estimates for Alternatives

Assumptions/ Cost Estimate Line Items for Costing Purposes	Alternative				
	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Assumptions					
MNR Monitoring Costs (Acres)	0	8.7	8.7	0	0
Dredge Volume (Cubic Yards)	0	0	0	14,016	15,627
Dredge Under Pier (Cubic Yards)	0	0	0	0	8,708
Backfill Volume (Cubic Yards)	0	0	0	14,016	15,627
Backfill Under Pier (Cubic Yards)	0	0	0	0	8,708
Capping (Cubic Yards)	0	10,868	22,732	0	0
Capping Under Piers (Cubic Yards)	0	4,273	8,794	6,590	0
Debris Removal (Tons)	0	0	0	2,138	2,138
Debris Removal Under Pier (Tons)	0	0	0	0	450
Enhanced MNR Capping (CY)	0	0	0	0	0
Offsite Transportation and Disposal (CY)	0	0	0	14,016	24,336
Non MNR Monitoring (Acres)	15.4	6.7	6.7	0	0
Cost Estimate Line Items					
Mobilization/ Demobilization	$ -	$ 500,000	$ 500,000	$ 1,175,000	$ 1,175,000
Silt Curtain Purchase and Management	$ -	$ 150,000	$ 150,000	$ 150,000	$ 150,000
Mechanical Dredging	$ -	$ -	$ -	$ 294,340	$ 328,174
Capping	$ -	$ 641,221	$ 1,341,179	$ -	$ -
Capping Under Piers	$ -	$ 570,391	$ 1,174,009	$ 879,814	$ -
Debris Removal (Tons)	$ -	$ -	$ -	$ 641,250	$ 641,250
Debris Removal Under Pier (Tons)	$ -	$ -	$ -	$ -	450,000
Hydraulic Dredging - Mechanical Dewatering	$ -	$ -	$ -	$ 537,521	$ 599,308
Suction Dreding Under Piers - Mech. Dewater	$ -	$ -	$ -	$ -	$ 1,162,563
Backfill	$ -	$ -	$ -	$ 826,956	$ 922,012
Backfill Under Piers	$ -	$ -	$ -	$ -	$ 1,162,563
Enhanced MNR Capping	$ -	$ -	$ -	$ -	$ -
Offsite Disposal	$ -	$ -	$ -	$ 3,504,051	$ 6,083,912
Multi-Beam Bathymetric Survey	$ -	$ 270,000	$ 270,000	$ 234,000	$ 234,000
Single-Beam Bathymetric Surveys Under Pier	$ -	$ 60,000	$ 40,000	$ 60,000	$ 30,000
Water Quality Monitoring	$ -	$ 71,962	$ 140,904	$ 129,469	$ 244,176
Construction Oversight (10%)	$ -	$ 226,357.41	$ 361,609.26	$ 843,240.16	$ 1,318,295.57
Contingency (20%)	$ -	$ 497,986.30	$ 795,540.37	$ 1,855,128.35	$ 2,900,250.25
Total Estimated Costs:	$ -	$ 2,987,918	$ 4,773,242	$ 11,130,770	$ 17,401,501

Notes:
1). Costs are for Capital Costs only. Future operation and maintenance costs not included.
2). Higher end range of potential unit costs utilized to create the cost estimates listed above due to preliminary nature of cost estimate.
3). Hydraulic dredging numbers include 0.75 foot overdredge.
4). Updated costs include side-slopes on a 1V:5H slope for dredging and on a 1V:3H slope for capping.
4). Alternative 1 - No Action.
5). Alternative 2 - Cover/Capping of 1 Foot Over Select Areas.
6). Alternative 3 - Cover/Capping of 2 Feet Over Select Areas.
7). Alternative 4 - Dredge and Backfill Select Areas With In-Situ Capping In Select Areas
8). Alternative 5 - Dredge and Backfill Select Areas
9). Disposal cost assumes material can be disposed within Subtitle C landfill, does not fail TCLP, and is determined to be non-hazardous.
10). Engineering and permitting costs not included.
11). Assumes 1.5 tons per cubic yard of sediment.
12). Assumes only mechanical dewatering of sediment due to potential space restrictions at facility.
13). Assumes that up to 35% of the material will be dredged mechanically, and that material would be transported to shore hydraulically.
14). Assumes debris is removed via screen (for mechanically dredged material) or via drag line (performed pre-dredge for hydraulic/suction dredging).
15). Assumes water quality monitoring occurs 3 times in the first week of construction, and two times per week thereafter.
16). Assumes rate of 100 cy/day for areas under pier (capping or dredging) and 500 cy/day for areas not under pier (capping or dredging).
17). Silt curtain purchase and management assumes that sufficient silt curtains are utilized to surround one 200 ft X 200 ft area under the pier and one 200 ft X 200 ft area not underneath the pier.

MEETING NOTES

DISCUSSION OF REMEIDAL ALTERNATIVES (8/16/12)
SITE 19, FORMER DERECKTOR SHIPYARD
NAVSTA NEWPORT, NEWPORT RHODE ISLAND

PARTICIPANTS:

NAME	REPRESENTING
Dave Barclift	NAVFAC Atlantic
Pamela Crump	RIDEM
Ken Finkelstein	NOAA
Arun Gavaskar	NAVFAC Atlantic
John Galler (phone)	Tetra Tech, Inc.
Mike Horton	Tetra Tech, Inc.
Gary Jablonski	RIDEM
Winoma Johnson	NAVFAC Mid-Atlantic
Kymberlee Keckler	USEPA Region I
Greg Kemp	Mabbett & Assoc.
Ken Munney (phone)	US Fish and Wildlife
Bryan Olson	USEPA Region I
Stephen Parker	Tetra Tech, Inc.
Tim Reisch	NAVFAC Mid-Atlantic
Darlene Ward	NAVSTA Newport

ATTACHMENTS:

1. Proposed Agenda
2. Presentation Handout
3. Physical Data Figure

The meeting convened at 10:00 am

W. Johnson opened the meeting by thanking everyone for attending. She stated that the purpose of the meeting was to present updates on the current conditions of the site, present possible remedial alternatives and solicit input from the stakeholders, discuss any critical comments on the Supplemental Sediment investigation (SSI), and determine the next steps for developing the FS.

S. Parker led the presentation of SSI results and FS Alternatives that followed (Attachment 2).

Regarding Slide 5 (Technologies) B. Olson asked why the dredging technology was focused only on 1-foot depth. S. Parker replied that because the affected portions of the cove are a low energy environment and because there was clean, consolidated (erosion-resistant) sediment covering deeper sediment with elevated COC concentrations , there is a low risk of exposure to

COCs at depth. The EPA indicated disagreement that the cove has low enough energy to assure this condition. However, everyone ~~agreed~~ recognized that there were two classes of data – one class (e.g., current velocity) related to the site conditions at the time of the SSI measurements and another class (e.g., isotope data) related to historical deposition rates over the last several years or decades. After some more discussion it was agreed that it would be best to save this discussion until after presentation of the remedial alternatives.

The topic of projected future use of the site was raised. W. Johnson and T. Reisch presented the information from documents that they had, namely that: the Navy has no mission for Derecktor Shipyard, future plans for the base do not show Pier 1 being present (it is planned for future, yet unscheduled demolition), and that there will be a weight restriction placed on Pier 2 by 2013. The Coast Guard is in the process of constructing new docking areas along the shoreline between Piers 1 and 2 and this waterfront will be the port location for their ocean buoy tenders. Pier 2 will be the port location for the Tiger Shark, a smaller USCG safety vessel. There will continue to be visiting ships berthed at Pier 2 periodically. At the end of the discussion it was clarified that the Navy's position is that remedial actions should be developed in line with the planned or projected future site use, as called for in CERCLA; the EPA took the position that remedial actions should be developed in line with potential future site use because the plans can always change.

Regarding Slide 10, the EPA requested that the Navy identify in the FS which alternative is their preferred alternative so the EPA will be able to better focus their time and reduce the number of comments. The Navy stated that the FS report is supposed to weigh all viable alternatives uniformly, but it could look into ways to make it evident which alternative they were leaning toward. To begin with, the Navy stated its position that all the alternatives (except Alternative 1, No Action) were selected to be protective of the receptors. EPA stated that their preference was for an alternative that included dredging. The Navy pointed out that Alternative 4 includes dredging and noted that in accordance with EPA's wishes, none of the alternatives had been framed as MNR alone. However, EPA's Sediment Guidance Document (2005) recognizes Enhanced MNR (thin cap), capping, and dredging as protective technologies and the Navy had evaluated all three. EPA stated that enhanced MNR relies on the same mechanisms as MNR so took issue with the Navy's statements that enhanced MNR was a protective viable remedy.

Regarding Slide 11, the surface area weighted average concentration (SWAC) approach was explained in order to present to the group how the Navy determined which areas needed dredging. K. Keckler inquired about criteria that were used to select cells for action, S. Parker answered that it was dependent on COC concentration and location, with emphasis on addressing the highest concentrations first and then moving progressively to address lower concentrations. K. Keckler noted that because of this approach, there was some "hop scotching" of cells The Navy agreed, and explained that this was necessary for development of the alternatives, but it understands that once a dredging or capping plan is developed, it may include "overdredging" into some areas that were not selected in the alternative, simply for efficiency.

During discussion of the SSI chemical results it was noted that the results presented did not include zinc or copper. G. Kemp stated that the extent of contamination for these chemicals was not delineated during the SSI. EPA recalled that during development of the PRGs, copper and zinc were not retained as COCs because they were co-located with other COCs; they then stated that having zinc and copper as COCs should be reevaluated because chemical results from the SSI show that they are not fully co-located with other COCs everywhere within the site. During this and other discussions, EPA, RIDEM, NOAA, and USF&W stated their concern about elevated concentrations of zinc at a few locations where no remedial action was proposed. There was general agreement that the copper concentrations did not appear to merit concern, but that zinc concentrations needed to be further evaluated. EPA requested that the Navy also retain the copper PRG. The Navy agreed to look further at both.

The Navy agreed to include zinc and copper in the SWAC calculation, but there was no PRG to compare results, which would be necessary for determining which areas would be included in the calculation. W. Johnson clarified that even if copper and zinc are included, the approach to the remedial alternatives wouldn't change; only the action areas might change based on those new results being added. Discussion from this point onwards centered on identifying what would be appropriate PRGs for copper and zinc. It was suggested that the team look at other marine sediment sites to see what their PRGs were. EPA also suggested that one approach could be that the Navy consider a concentration somewhere between the ERM and BPRG that was developed in the PRG document by SAIC. At the conclusion of the discussion the Navy agreed to use the BPRG as the initial criteria for conducting the SWAC calculation for copper and zinc, while other criteria were evaluated.

During discussion of the remedial alternatives, K. Munney noted that there were some differences between the interpolated results that were presented in the SSI and the grid approach that was shown in the presentation. S. Parker agreed and responded that the grid makes it easier to quantify action areas. G. Kemp stated that it may be beneficial to use a kriging interpolation method that considers contamination at depth. A. Gavaskar stated that various interpolation and contouring methods, including kriging, had already been tried with the SSI data, but did not provide any reasonable interpretation of the spotty data at this site (unlike other sites, such as Natick, where concentrations often tend to be spatially graded)

During discussion of the remedial alternatives, K. Munney suggested that a possible approach could be to divide the site into smaller decision units for the SWAC calculation, so it would be more specific to certain parts of the site. EPA suggested one possibility as three decision units (the areas associated with Pier 1, Pier 2 and the T-Wharf). D. Barclift reminded all that samples were not collected with the intention of creating decision units and they should not be used in that way. A. Gavaskar stated that there was no reason to create artificial decision units because the Navy was already using a very conservative approach that (a) had limited the SWAC calculations to cells that exceeded the PRG and (b) was addressing areas with the highest concentrations first, regardless of where they occurred (near Pier 1, Pier 2, or T-wharf). Dividing the site into smaller decision units based on certain site features (e.g., Pier 1) would

have to include all contiguous cells associated with that feature, whether the cells exceeded the PRG or not (as was done at Natick and other sites). It was also speculated that this approach would not necessarily make the evaluation more conservative. ~~Eventually, the stakeholders agreed that development of smaller decision units was not an action item.~~ EPA suggested that the Navy evaluate the data several ways and present it to the team for discussion at a later date.

When discussing Slide 14, the EPA stated that they would like to see an alternative which would require no LUCs or monitoring at the end of the remedy. They indicated that this alternative would include addressing some of the contamination at depth because that would avoid having to impose LUCs. There were multiple approaches suggested by the entire group including dredging and not backfilling with a SWAC approach, dredging and backfilling at depth with a SWAC approach, modifying the SWAC approach to be a volumetric-weighted average concentration, instead of surface-weighted average. At the end of the discussion the Navy agreed to develop some new scenarios that might be used to develop a new Alternative 5. The goal of alternative 5 will be to create an alternative where no monitoring or LUCs will be necessary. The Navy agreed to work with the regulators as a team to develop a SWAC or volumetric approach.

With regard to Slide 14, K. Munney noted that the dots presented on the alternative figures really might represent two or more COCs with elevated concentrations at a location. Would the cumulative risk from such locations be greater? The Navy explained that SWACs were calculated separately for each COC, so whether there was one or more COCs in one cell was not an issue in identifying cells that need to be addressed. Also, the risk endpoint for each COC is different, so the cumulative risk from multiple COCs is not an additive process. K. Finkelstein also conducted a brief review of the data while the discussion was occurring and noted that while Ken M. was making a valid point, there did not appear to be any situations at the site where there was undue concentration of risk in post-remedy cells because of multiple COCs.

After a break for lunch, the group reconvened and final thoughts on the proposed alternatives were discussed. EPA reiterated their request for the Navy's preferred alternative. The Navy reiterated that while it considered all the alternatives (except Alternative 1, No Action) as protective, it would give serious consideration to Alternative 4 because EPA and RIDEM prefers it. The Navy noted that the FS is still work in progress and the Navy will work with EPA and the State on an acceptable remedy.

The EPA also requested an alternative to dredge everything greater than PRGs as a high range of the alternatives, one that would balance the "no action" alternative. However, after discussion, it was understood that this request is really to discuss in the FS an alternative that does not require LUCs. It was subsequently agreed that an Alternative SD5 would be developed to have an alternative that would not be reliant on LUCs.

W. Johnson inquired about responses to comments on the Draft SSI Report. She particularly asked EPA for clarification on their letter, which had stated that the Navy did not need to respond if the comments were included in the report as an appendix to document, with a

statement that EPA disagreed with some of the conclusion of the report. It was agreed that EPA, RIDEM and USFW did not require, nor would receive, responses to their comments. NOAA did request responses to comments.

At the end of the meeting W. Johnson asked if anyone had anything else to add, RIDEM stated that they concurred with EPA's comments during the meeting, and would like an alternative that has the fewest number of LUCs as possible that would restrict potential uses of Rhode Island's natural resources, for both environmental and economic reasons. G. Jablonski stated that the RIDEM would prefer remedial alternatives that do not include limits to future use, because these could limit the resources of the State (economic resources as well as natural resources). RIDEM also stated that while EPA, NOAA and USF&W may find leaving COCs in sediment at levels 1 or 2 times the PRGs acceptable, RIDEM may find it unacceptable because of the development methods that resulted in choosing multiples of the HI values as RPRGs.

W. Johnson thanked everyone and noted that there would be follow-up discussions to present the outcomes of the action items (below), though no schedule was presented. The meeting adjourned at 3:00 pm.

ACTION ITEMS

Navy:

- Update SWAC calculation to include Copper and Zinc concentrations where they are above the BPRG; this data should be presented to the team.
- Suggest PRGs for copper and zinc.
- Prepare an alternative (5) that will include no LUCs or monitoring.
- Correct Alternative 4 to show no LUCs in dredged areas.
- Provide a response to comments to NOAA.

EPA: (none)

RIDEM: (none)

NOAA: (none)

USFW: (none)

D-6 PROJECT TEAM MEETING NOTES JANUARY 3, 2013

MEETING NOTES

DISCUSSION OF REMEIDAL ALTERNATIVES
SITE 19, FORMER DERECKTOR SHIPYARD
NAVSTA NEWPORT, NEWPORT RHODE ISLAND
JANUARY 3, 2013 HAMPTON INN, MIDDLETOWN RI

PARTICIPANTS:

NAME	REPRESENTING
Dave Barclift	NAVFAC Atlantic
Ken Finkelstein	NOAA
Joe Foran	TME (Facilitator)
Arun Gavaskar	NAVFAC Atlantic
Mike Horton	Tetra Tech Inc.
Bart Hoskins	EPA Region I
Mark Kaufman	Resolution, LLC
Kymberlee Keckler	EPA Region I
Greg Kemp	Mabbett & Assoc. (phone)
Pamela Crump	RIDEM
Chet Meyers	Apex Companies, LLC
Deb Moore	NAVSTA Newport – Partial
Ken Munney	US Fish and Wildlife (phone-partial)
Dominick O'Connor	NAVFAC Mid-Atlantic
Stephen Parker	Tetra Tech Inc.
Darlene Ward	NAVSTA Newport – Partial

ATTACHMENTS:

1. Agenda
2. Presentation/Handout

MINUTES:

The meeting convened at 10:10 am

Joe Foran opened the meeting by introducing himself and describing his role as the facilitator. The participants of the meeting then each introduced themselves and then Steve Parker began the presentation.

Steve Parker stated that the purpose of the meeting was to understand the process of calculating the Surface area Weighted Average Concentration (SWAC) and Volume Weighted Average Concentration (VWAC), to determine which alternatives will be selected for inclusion in the Feasibility Study (FS), and then discuss which alternative should be described in the proposed plan.

During presentation of Slide 5 the EPA questioned the second bullet that stated "EPA sediment guidance (2005) and Navy consider all three alternatives (2, 3, and 4) protective". This prompted a discussion regarding the protectiveness of alternatives 2 and 3 (enhanced natural recovery and capping). The Navy stated that the active alternatives (alternatives 2, 3, and 4) presented all offered protection to the receptors, though this protection is provided at varied levels among the alternatives. Therefore, the Navy thought that all of them should be included, and not rejected from the FS altogether. The EPA stated that they understand that a range of alternatives needs to be included in the FS but that they do not agree that alternatives 2 and 3 would be acceptable for selection because EPA does not agree that one round of sediment transport and physical data is enough to demonstrate that Alternative 2 is protective.

A second point raised during the presentation of Slide 5 was that RIDEM prefers alternatives that would not limit the potential reuse of the site (no institutional controls). RIDEM indicated that they view alternatives 2 and 3 as requiring restrictions on the use of the port, which they would not agree to.

NOAA stated that if an alternative has no chance of being selected it should not be included in the FS. After further discussion it was agreed that alternatives 2 and 3 would be included in the FS, but were not preferred remedies, given EPA's preference for a remedy that included some dredging and RIDEM's preference for fewer institutional controls (ICs).

During presentation of Slide 7 NOAA brought up an idea of separating the site into decision units (around Pier1, Pier 2, and the T-Wharf). This developed into a discussion about the calculation of SWAC, and how it was conducted. The Navy clarified that because the SWAC only utilizes data from samples where a PRG exceedance was detected, it is a very conservative approach. Bart Hoskins and the Navy both pointed out that for a relatively smaller site like this one, from a population risk standpoint, the proposed averaging method was acceptable. The Navy also emphasized another advantage that the higher-concentration cells would be dredged first, regardless of where they were located, before going on to dredge lesser concentrated cells. RIDEM questioned whether one COC would get averaged out if it occurred in fewer cells than other COCs. The Navy explained that with each COC, the SWAC calculation was restarted with a new group of cells that exceeded the PRG for that COC only, so that all COCs received the same conservative treatment. EPA and RIDEM acknowledged that this SWAC calculation method is a conservative approach. EPA stated that the SWAC/VWAC approach was acceptable for development of alternatives. EPA and RIDEM ultimately agreed that splitting the site into decision units would not be necessary. RIDEM recognized that while NOAA's original suggestion was interesting, their ultimate goal was the elimination of ICs at the site and if that could be accomplished without the use of smaller decision units, then that would be acceptable.

Slide 11 prompted discussion regarding different SWAC/VWAC concentrations that might be achieved after implementation of Alternatives 4 or 5. Particularly highlighted was the fact that Alternative 4 achieves PRGs on both the SWAC and VWAC basis for all COCs, except for a slight exceedance of the PRG for benzo(a)pyrene on a VWAC basis. The VWAC exceedance of benzo(a)pyrene was driven by higher concentrations in a relatively-large volume prism (G-25) under Pier 2. The Navy questioned

whether the much higher projected cost of Alternative 5 (~ $30M) versus Alternative 4 ($11 M) was worthwhile, especially when benzo(a)pyrene in the sediment may not even be a site-operations related release, but rather a result of non-point source urban runoff. The only IC that the Navy envisions with Alternative 4 is the need to exercise caution that underlying sediment is appropriately handled when demolishing Pier 2. No ICs would be required in the open water area and no limitations on ship size or ship traffic would be necessary. K. Finkelstein (NOAA) stated that he did not see value in pursuing Alternative 5 because of the much increased cost for the effort to reduce concentrations of benzo(a)pyrene by only a minimal amount. He also stated such expenditure might have much more value in a restoration role, as might be identified in a Natural Resource Damage (NRD) claim. EPA eventually stated that it saw both Alternatives 4 and 5 as protective. RIDEM stated that they highly value an option without ICs, upon which the Navy replied that Alternative 4 comes very close to that point. There would be no ICs in open water areas and there would be no practical restrictions on use of the Pier or the cove.

Slide 13 prompted a discussion regarding dredging beneath Pier 2. Chet Meyers (Apex) reviewed some of the uncertainties and difficulties that would be inherent with dredging beneath Pier 2 which explained the large price range associated with that option. The Navy emphasized that when the cost of dredging under piers at both Alameda and New London are extrapolated to the higher volume of sediment present at Derecktor, the cost of dredging under the pier alone is likely to be at the upper end of the presented cost range. In fact, Derecktor presents more degrees of difficulty in dredging under the pier than New London or Alameda (greater water depth, very little overhead clearance under the pier, smaller clearance between pilings, etc.) that would make dredging here even costlier. RIDEM asked what the Navy's best projection of cost for Alternative 5 is. Navy replied that its projected cost of Alternative 5 is $30 M, including $11 to 12M in the open water areas (similar to Alternative 4) and $18M for the under pier portion.

Slide 18 prompted discussion on including Alternative 5 in the FS. The EPA stated that it should be included in the FS to have a full range of alternatives, although they agreed that Alternative 4 appeared to be adequately protective. The Navy agreed to include Alternative 5 in the FS but stated that its preference for the proposed plan is Alternative 4. RIDEM again noted its preference for the site to become as IC-free as possible and that would indicate Alternative 5. The Navy reiterated that Alternative 4 includes very minimal ICs, these would not hinder operations of the port or ship traffic. They would be triggered only if and when Pier 2 was demolished, so that precautions could be taken to ensure that the sediment underneath was appropriately handled. The Navy reminded the participants that Alternative 4 achieves SWACs for all COCs, VWAC for three of the COCs, comes very close on the fourth COC, and will include installation of a cover (engineered barrier) for the cells under the pier. The ICs would not restrict the use of the pier or the cove in any way.

Discussion following the presentation covered a few smaller topics:

- <u>Need for backfill when a dredged area has no subsurface contamination</u>: The EPA stated that removing the need for backfill could equate to a significant cost savings that should be accounted for in the FS. The Navy supported the decision to not use backfill in areas without subsurface contamination, but believes that it is a decision to be made during the design phase and that cost savings would be minimal relative to the total cost of the action. The Navy's current plan is to backfill all dredged areas, so that the sediment surface is returned to grade as much as possible

with the surrounding sediment and to ensure that SWACs are met as designed, without the need for post-dredging monitoring.

- Completing the FS and PRAP simultaneously: It was proposed that the PRAP and the FS be provided at the same time so that the team would know which alternative the Navy is suggesting while they review the FS. Ultimately the team decided that a Revised Draft FS would be submitted to EPA and RIDEM by 3/30/2013, and the PRAP would be submitted on its FFA date in May. The Navy stated that they intend to propose Alternative 4, with a projected cost of $11M, in the PRAP.

- Elevated concentrations of Zinc: NOAA stated a concern that without a PRG for zinc, three locations (K05, W17, and BB26) with particularly elevated zinc concentrations would remain after dredging. RIDEM expressed similar concern. The Navy explained that one location (K05) was already identified for dredging because of exceedances of a different COC (lead), and that another location would be partially remedied due to over-dredging during the action. The resulting SWAC concentrations for zinc were reviewed from the October 31 memorandum along with ERL and ERM values. NOAA then stated that this would be acceptable, given that only one elevated zinc concentration would not be addressed by dredging (W17). Also, NOAA recognized that these three cells were particularly elevated only in comparison to baseline PRGs. When compared to final PRGs developed at other New England sites (and the ERM values), they are not particularly elevated. EPA stated that the October 31, 2012 submittal sufficiently described zinc as not a concern at the site. RIDEM stated that they would provide their position on zinc after consulting their risk assessor.

- Tributyltin: EPA asked if further tributyltin analysis should be conducted during future sampling efforts. After some discussion, the team decided that the results reported during the SSI indicate that tributyltin is not a concern at the Derecktor Shipyard Site.

The meeting concluded at 2:30 PM.

ACTION ITEMS:

At the conclusion of the meeting, Joe Foran reviewed the action items that were identified. These were reviewed and agreed by all parties as stated below:

1. **RIDEM** will evaluate and report back to the team with their position on the zinc concentrations that will remain after the remedial actions are taken. RIDEM will have a response to the team by 1/11/2013.
2. **EPA and RIDEM** to discuss Alternatives 4 and 5 offline and provide feedback to the team by 1/14/2013.
3. **Navy** to distribute draft meeting minutes by 1/10/2013.
4. **Navy** to submit Revised FS by 3/30/2013.

PROPOSED MEETING AGENDA (REVISED)

Site 19 Former Robert E. Derecktor Shipyard

Remedial Alternatives for Revised FS and Proposed Plan

JANUARY 3, 2013, 10 AM - 2 PM

Hampton Inn, Middletown RI

1. Purpose of meeting - 10 min

2. Summary of previous meeting, and follow up

    Review of previous meeting and Package sent 10/31/12 45 min

    New Alternative 5: 15 min

    Area and Volume Averaging Calculations, Various Alternatives - 20 min

BREAK – one hour

3. Summary of alternatives that we are proposing for the FS - 30 min

4. Anticipated Regulatory concerns / Navy response / future use of the property – 45 min

PROPOSED REMEDIAL ALTERNATIVES

FEASIBILITY STUDY, Revision 1

Site 19, Former Derecktor Shipyard
Naval Station Newport,
Newport, RI

Presented By:
Tetra Tech, Inc.

NAVAL STATION NEWPORT

January 3, 2013

Proposed Remedial Alternatives

Meeting Objectives (AGENDA)

1. Purpose of Meeting
2. Review previous discussions and follow-up
   - Review of alternatives presented at the August meeting
   - Present follow-up on action items, (reference package sent 10/31/12)

Break

3. Summary of alternatives proposed for Site 19 FS
4. Discuss regulatory concerns, future use of the property

2. August Meeting Review

- Just a reminder:
  - Benzo(a)pyrene PRG = 539 ug/kg to protect human health *(ingestion of shellfish)*
  - Total HMW PAHs PRG = 13,903 ug/kg to protect amphipods in *bedded sediment*
  - Total PCBs PRG = 1,060 ug/kg to protect aquatic invertebrates from *suspended sediment*
  - Lead PRG = 168 mg/kg to protect aquatic invertebrates from *suspended sediment*

2. Future use of the Property

- No planned future use of Pier 1
- Pier 2 to be used by the USCG Tiger Shark and occasionally by a NOAA research vessel (both small, shallow-draft vessels)

USCG Tigershark, Draft 6 feet

NOAA H.B. Bigelow, Draft 19 feet

- Ship traffic to the "Marginal Wharf" is expected to be limited to Coast Guard buoy tenders (draft 11-13 feet).
- Both piers are identified for demolition at some undetermined point in the future
- No funds are programmed for demolition

USCG Juniper, Draft 13 feet

2. August Meeting Review

- Preliminary Alternatives 1 through 4 were discussed:
  1. No Action - $0
  2. Enhanced Natural Recovery (Thin Layer Cover), LUCs - $3.M*
  3. Cover in Place (engineered barrier), LUCs - $4.8M*
  4. Surface dredging & backfill (open water), cover & LUCs under Pier 2 - $11.6M*

- EPA sediment guidance (2005) and Navy consider all three alternatives (2, 3, and 4) protective.
- Navy agreed to evaluate an alternative that eliminates all LUCs
- Navy deferred to EPA wishes that the final remedy include some dredging.

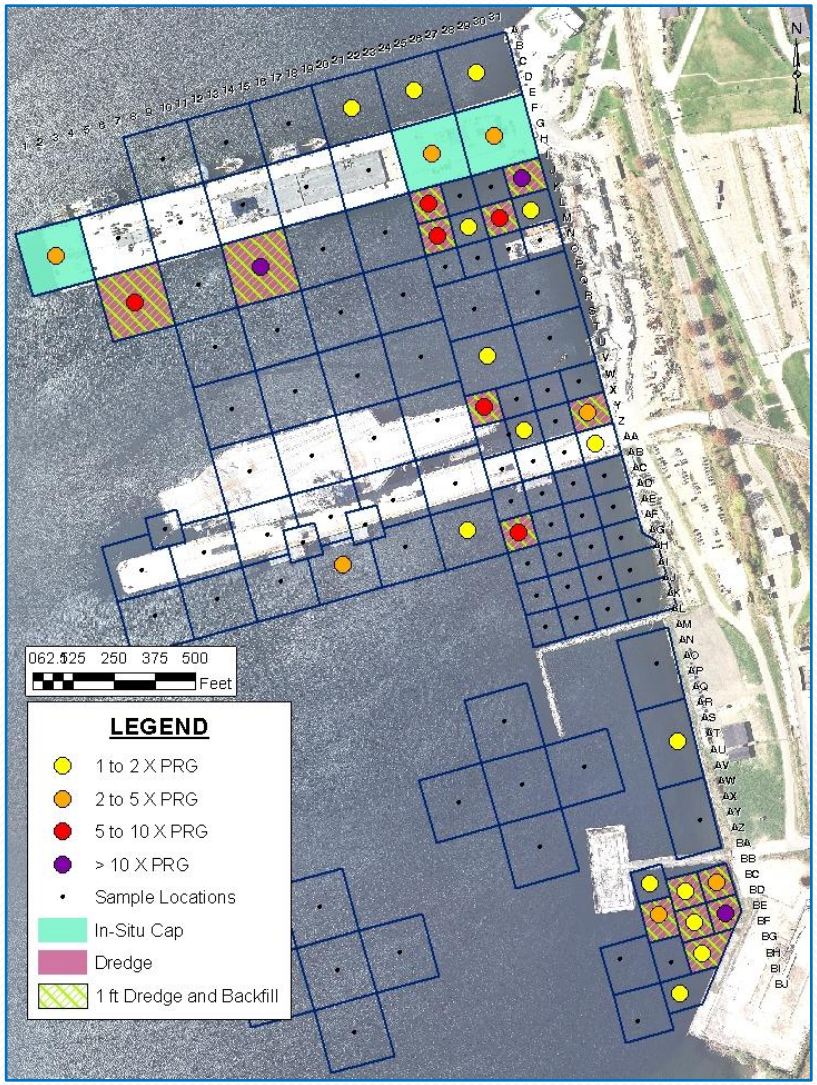
*** Costs have been updated to include over dredge and sloughing**

2. August Meeting Review

- Alternatives above were based on a calculated Surface-Weighted Average Concentration (SWAC), similar to approach taken by EPA at other New England sites, such as New Bedford Harbor and Natick.
- Calculations projected acceptable resulting concentrations after the implementation of Alternative 4.
- The Navy agreed to develop an additional Alternative that would potentially eliminate a need for LUCs for all four COCs, using a volume-weighted average concentration that includes deeper sediment (**Alternative 5, distributed 10/31/12**).
- The Navy agreed to include zinc in the SWAC calculations so the team could see the site-wide concentration under Alternative 4.

2. August Meeting Review: Summary of Alternative 4

- Conservative approach –
  - Only considers areas where PRGs are exceeded
  - Dredge areas with highest concentrations first, until SWAC falls below PRG.
  - Dredge to a depth of 1 foot and backfill with clean material.
- Placement of an In-Situ Cap (2 ft.) over target areas beneath Pier 2.
- LUCs will be implemented <u>beneath Pier 2 only</u> to protect the capped area from disturbance.
  - LUCs apply only to demolition and dredging associated with Pier 2 and not to ship movement.



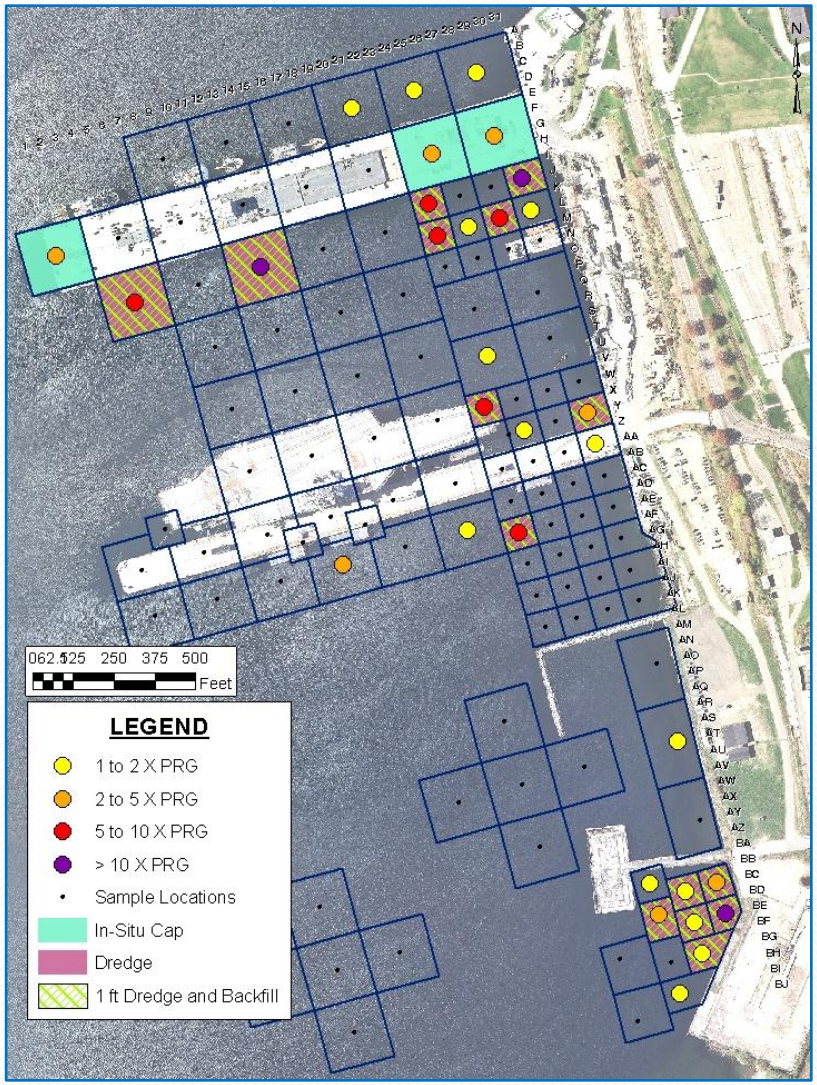
2. August Meeting Review: Summary of Alternative 4 (cont.)

- Conservative VWAC calculations show that dredging of surface cells reduces all COCs below PRGs, except benzo(a)pyrene, which comes close.* This is because most of the more contaminated cells are at the surface.

- Approximately 14,000* yrd^3 of sediment will be dredged & backfilled, and approximately 123,576 ft^2 will receive an engineered cap.

- Approximate Cost $11.6M*

*** Clarified & updated from 8/16/12**

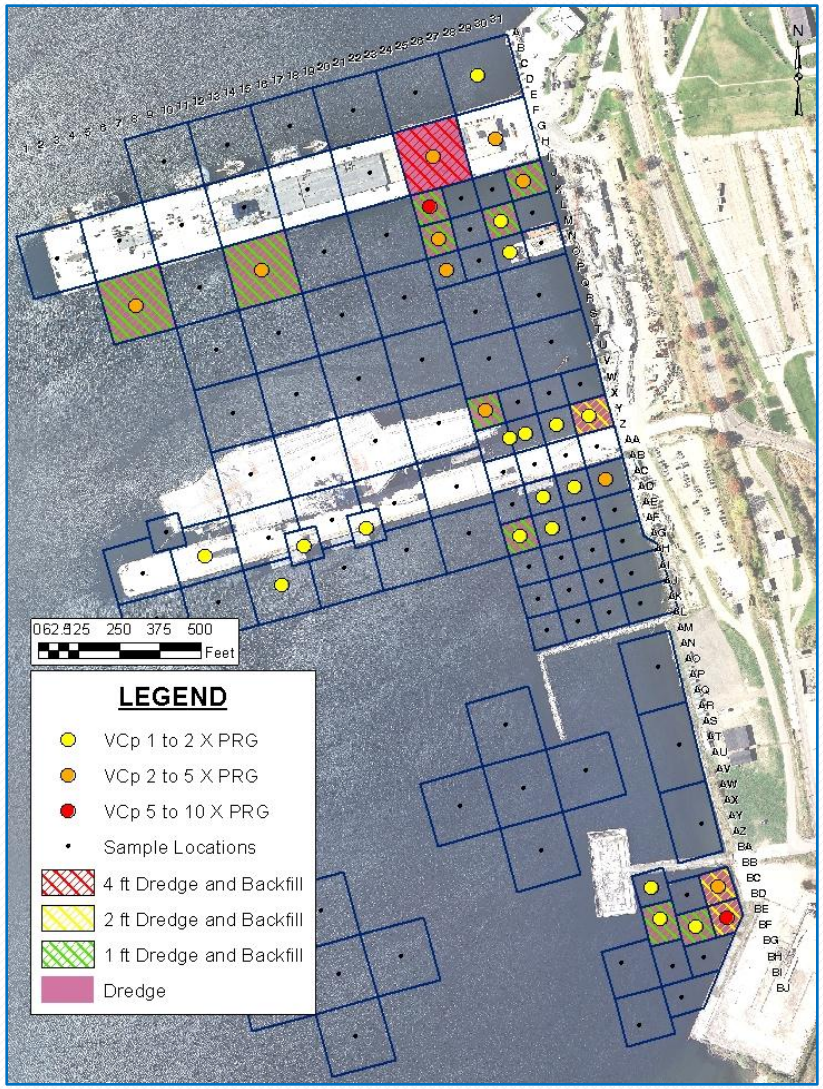


2. August Meeting Follow-up: Alt. 4 - Performance Monitoring

- Bathymetric survey of dredging cells
  - Pre-dredge
  - Post-dredging & pre-backfill – verify depth of dredge effort
  - Post-backfill – verify backfill to grade
- Bathymetric survey of covered cells under pier
  - Pre-cover
  - Post-cover
- Inventory of dredged material, backfill, cap material
  - Dredged volume, CY (and tons) and dewatered volume, CY (and tons)
  - Backfill volume, CY (and tons)
  - Cap material, CY (and tons)
- Confirmatory chemical sampling is not anticipated given use of clean backfill material and clean cover

2. Follow-up: Summary of New Alternative 5

- Dredge areas selected on a VWAC basis to the depth determined necessary by the VWAC calculation.
- LUCs would not be necessary in open water areas or under pier after the remedial action for any of the four COCs.
- This alternative would dredge approximately 24,000 cubic yards of sediment (including ~10,000 Cy under Pier 2, primarily for benzopyrene).
- Approximate cost $18M to $30M.



2. Follow up: Resulting COC Concentrations, Various Scenarios

SCENARIO	Benzo(a)pyrene (µg/kg)	Total HMW PAHs (µg/kg)	Total PCBs (µg/kg)	Lead (mg/kg)
PRG	*539*	*13,903*	*1,060*	*168*
Alt 1 No Action - **SWAC**	1,415	32,465	6,286	522
Alt 1 No Action - **VWAC**	1,284	23,679	3,209	271
Alt 1 No Action -**VWAC** (whole contiguous study area)	232	3,199	190	77
Alternative 4 – **SWAC**	461	4,025	675	112
Alternative 4 – **VWAC**	805	12,905	381	161
Alternative 5 – **VWAC**	527	9,075	381	150

Moving from Alt 4 to Alt 5 achieves a B(a)P decrease of 278 ug/kg, at an additional cost of up to $19 M

- Alternative 4 would remove 14,000 cubic yards of sediment, place approximately 6,600 cubic yards of cover material, and is estimated to cost approximately $11.6 M (dredge volume includes over-dredging & sloughing).
- Alternative 5 would remove 24,000 cubic yards of sediment, and cost approximately $18 M to $30M (dredge volume includes over-dredging & sloughing).
- Red text indicates average exceedance of PRG noted.

Surface Weighted Average Concentration (SWAC) and Volume Weighted Average Concentration (VWAC)

- Explanation of SWAC

SCc= Sample Concentration representing a "cell", which is the measured conc. at the surface interval

$$SWAC = \frac{[(S1*SCc1)+(S2*SCc2)+\ldots(Sn*SCcn)]}{(S1+S2+\ldots Sn)}$$

SWAC is based on only surface samples where SCc > PRG

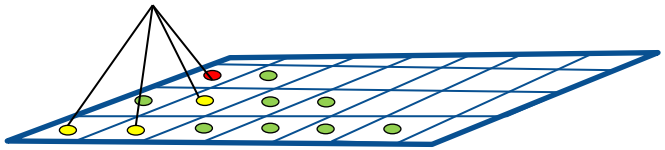


Figure 1 – Site SWAC is based on only locations where PRGs are exceeded in surface sample (surface samples are 0-1 foot).

For SWAC, S is the surface area of the cell, but addresses the top foot since that is the interval of the surface sample.

- Explanation of VWAC

VCp = Volume Concentration of a "prism", which is the average conc. of all samples in the core, and where one core represents the three dimensional block or "prism"
If VCp > any PRG, then the prism is included in the VWAC calculation.

$$VWAC = \frac{[(V1*VCp1)+(V2*VCp2)+\ldots(Vn*VCpn)]}{(V1+V2+\ldots Vn)}$$

For VWAC, V is based on the depth of the core and surface dimensions of the prism.

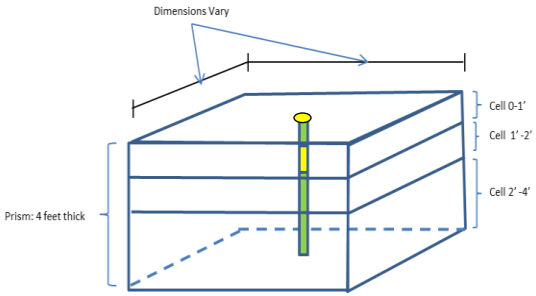


Figure 1 - Calculate VCp

VWAC is based on only locations where VCp > PRG

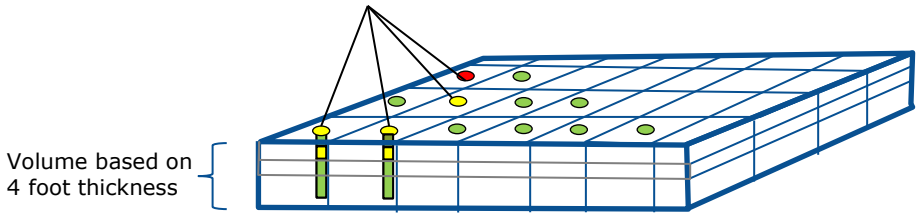


Figure 2 – Site volume average concentration is based on only locations where PRGs are exceeded in each prism

2. Follow up - USACE Input

- USACE provided ideas on how areas under the pier could potentially be dredged, but when contacted, did not know of any sites where these ideas had been implemented.
- Some of the proposed methods could spread contaminants into surrounding areas: Washington Department of Ecology has expressed reservations at Harbor Island Site.
  - E.g., horizontally dragging sediment (raking) from under a pier to open water area and then dredging it could lead to spreading contamination.

- Derecktor, Pier 2 Challenges
  - Pilings are only 10 feet apart on center, allowing clearance of only 8 feet between piles.
  - Overhead clearance (deck to water) is 3-6 feet depending on tide.
  - Water depth is estimated between 17 and 24 feet.

2. Follow up - Experience at Other Sites Dredging Under Piers

- San Diego Bay, CA - Shipyard sediment Site

  A tentative Cleanup and Abatement Order (CAO) was signed by the San Diego Water Board on Sep 15, 2010 requiring that 15.2 acres of sediment be dredged. However, of these 15.2 acres, it identified 2.3 acres that were "inaccessible or under-pier areas", that would be remediated "by one or more methods other than dredging, most likely by sand cover".

- Harbor Island Site, WA - Todd Shipyard

  Dredging under pier proposed in 1996 ROD, but difficulty was recognized in ROD, which said that final remedy for the under-pier portion would be determined in remedial design. Remedial Design abandoned under-pier dredging and site implemented a cap under the pier in 2007.

- Harbor Island Site, WA - Lockheed Shipyard

  Dredging under pier proposed in 1996 ROD. When difficulties became apparent, ESD in 2002 required that the pier be removed and enough of the sediment exposed be dredged, so that a cap could be left in place. Wooden pier at this site was easier and cheaper to remove than concrete pier at Derecktor. Completed in 2005.

2. Follow up - Dredging under Piers: Alameda Point Summary

- Dredging was not done under the pier. Spacing between pilings would not allow equipment to go in.
- Dredging was performed under the wharf road, where a "white-water raft" was rigged with pumps and hoses and floated under the wharf.
- Divers were utilized to maneuver the hydraulic vacuum hose in the sediment (not enough overhead clearance to operate barge-mounted hydraulic dredge, such as hanging ladder).
- Significant problems with debris initially led to work stoppages.
- But eventually, it was the use of divers and the resulting slow production rate that led to a high cost of operation
- 2,745 CY of sediment dredged from under wharf at a cost of ~ $4.5M.

2. Follow up - Alameda Point in Relation to Derecktor Shipyard

- DERECKTOR:
  - Under Alternative 5 approximately 10,000 CY of sediment needs to be dredged to 4 feet in G25 alone under Pier 2. This would cost ~$18M.
  - Cost could be even higher than the proportional increase because Alameda was dredged in water depth less than 10 ft. Beyond 10 feet, unit costs are higher because it entails even slower production rate, greater diver safety issues, etc. Depths under Pier 2 at cell G25 is expected to be 17 – 24 feet.
  - At Alameda, the pilings under the wharf had a spacing of between 13 to 15 ft. The Derecktor Pier has 8 foot spacing.
  - Note that only benzo(a)pyrene drives the need to dredge under the piers (based on VWAC) and this COC could be associated with other non-point sources.

Open Discussion and Break

Break

3. Summary of Alternatives proposed for Revised FS

- Alternative 1 – No Action - $0
- Alternative 2 – Enhanced Natural Recovery – $3 M
  - Placement of a thin layer cover on target areas to reduce exposure based on the SWAC across the entire site.
  - Implement LUCs to prevent access to the site by unauthorized persons and limit ship traffic from deep draft vessels.
- Alternative 3 – In Situ Cap and LUCs – $4.8 M
  - Place an In Situ Cap (engineered barrier) on target areas to reduce the SWAC across the entire site.
  - Implement LUCs to prevent access to the site by unauthorized persons and limit ship traffic from deep draft vessels.
- Alternative 4 – Dredge Target Open Water Areas, Cover Under Pier 2. - $11.1 M
  - Dredge target open water areas to meet PRGs on a SWAC basis.
  - Place an In Situ Cap (engineered barrier) on target areas under Pier 2 to meet PRGs on a SWAC basis and reduce exposure to benzo(a)pyrene.
  - Resulting VWAC will be below PRGs with the exception of benzo(a)pyrene, which is close.
  - Implement LUCs to prevent disruption of the cap under Pier 2 without controls.

4. A Look Ahead

- Navy endorses Alternative 4:
  - Meets PRGs under a conservative SWAC approach.
  - Meets or comes close to meeting PRGs under a conservative VWAC approach.
  - Less disruptive and has less potential for contaminant redistribution than Alternative 5, where dredging under pier could be messy.
  - Fits the planned future use of the site and can be altered if use changes (demolition of the Piers).
  - Balances effectiveness and cost against benefit.
  - Satisfies future use concerns, although at a higher cost

4. Regulatory Concerns

- Open Discussion

D-7 PROJECT TEAM MEETING NOTES OCTOBER 23, 2013

MEETING NOTES

DISCUSSION OF REMEDIAL ALTERNATIVES (10/23/13)
SITE 19, FORMER DERECKTOR SHIPYARD
NAVSTA NEWPORT, NEWPORT RHODE ISLAND

PARTICIPANTS:

NAME	REPRESENTING
Chau Vu	USEPA
Dave Barclift (phone)	NAVFAC LANT
James Forrelli	Tetra Tech, Inc
Joe Foran	TME
Mike Horton	Tetra Tech, Inc.
Bart Hoskins	USEPA
Lynne Jennings	USEPA
Kymberlee Keckler	USEPA
Greg Kemp	Mabbett & Assoc.
Pamela Crump	RIDEM
Chet Meyers	Apex Companies, LLC
Dominic O'Connor	NAVFAC Mid Lant
Stephen Parker	Tetra Tech, Inc.
Darlene Ward (phone)	NAVSTA Newport

ATTACHMENTS:

1. Agenda
2. Presentation Handout (with resolutions)
3. Dredge area list
4. Summary Issues Handout

The meeting convened at 10:15 am

The meeting opened with a request from EPA to modify the meeting agenda by first discussing the development of a new alternative, and then work out additional issues. This was agreed.

Tetra Tech began the presentation with an explanation of the SWAC and VWAC calculations to refresh the participant's memories. K. Keckler stated that EPA considers backfill a cover and any alternative that includes dredging and backfill will require monitoring (annual chemistry sampling, and possible bathymetry). P. Crump stated that RIDEM does not support calling backfill a cover because that would require LUCs.

At the completion of the SWAC and VWAC calculations explanation and some discussion of the current remedial alternatives the discussion turned towards development of a new remedial alternative:

EPA stated that they were OK with capping beneath piers as part of the selected remedial alternative. After RIDEM expressed some concern regarding demolition or renovation of the pier, the Navy confirmed that the cap would be maintained, or contamination addressed if demolition or renovation of the pier were to occur. This language would be included in the ROD and LUC document.

Tetra Tech opened up the SWAC/VWAC calculation spreadsheet that has been used to project SWACs and VWACs after dredging each area where PRGs were exceeded. This spreadsheet projected SWACs, VWACs, and costs for scenarios both with and without backfill. The team started with the dredging plan as described in the most recent iteration of Alternative 4 (provided to meeting participants) as a base. The team then went through the exercise of testing various dredging scenarios to see what the projected SWACs and VWACs would be with and without backfill.

During this exercise the EPA and RIDEM stated that VWAC should not be a goal if the SWAC calculations (without backfill) project COC concentrations to reach levels within a range of what could be expected after dredging. The team then focused on developing an alternative based solely on achieving SWACs < PRG without backfill.

During the development of the alternative there was discussion regarding the Coast Guard shoreline redevelopment project and how that might effect this remedial action. The EPA suggested that it might be appropriate to remove cell Y30 from the calculation because the Coast Guard will likely dredge this area. The Navy explained that it would be difficult at best to attempt to coordinate with the Coast Guard project, and that it would be better to proceed without regards to the USCG project; primarily because the Coast Guard dredge area only encompasses half of this cell. EPA and RIDEM suggested that the Coast Guard project be described in the FS and there should be a statement indicating that the Navy will ensure that dredging in the Former Derecktor Shipyard, for both the Coast Guard project and this remedial action, would be conducted in accordance with the Superfund remedy.

After some additional discussion, and manipulation of the spreadsheet the team agreed to include a new alternative (SD5) based on the following:

- Demonstration of meeting PRGs will be based on SWAC calculation only.
- Dredged cells will not be backfilled.
- Cells to be dredged will include:
  - Dredge to 1 foot: AE24, J24, J30, K05, K13, L28, and W24.
  - Dredge to 2 feet: BB26, BC30, BD26, BE30, C29, L24, Y25, Y26, Y28, and Y30.
- LUCs and monitoring will be limited to cells G29 and G25 under Pier 2.

- Construction or renovation at or under Pier 2 (including demolition) will accommodate protection or removal of the capped sediment under Pier 2. The ROD and FS will include this language.
- It was recognized that the projected lead SWAC does not meet the PRG of 168, it comes close at 184 mg/kg, which is acceptable as a risk-management point to both EPA and RIDEM (acceptable for achieving RAOs).

(The above was written as a consensus statement and reviewed by all parties, to which all were in agreement)

Once the elements of this alternative had been agreed to, the EPA indicated that they had a previous comment requesting that historic data (samples collected prior to 2010) be used in the SWAC and VWAC calculations. The Navy stated that due to the fact that intervals previously sampled were different (0-2 cm in 1993, 0-6 inches in 1997, and varied intervals in 2004), it would be incorrect to include those concentrations in the model where intervals were 0 to 1 foot, 1 to 2 feet, and 2 to 4 feet. The EPA agreed with the Navy's justification for not including historic data.

11:50 – 1300: Break

13:00 Discussion of major issues of concern (based on EPA and RIDEM comments to the Draft FS) using the summary handout.

1. <u>Asbestos:</u>

   S. Parker stated that the Naval Station reported that all the asbestos pipe lagging under the piers had been removed. The EPA stated that they were not aware that ACM had been removed from beneath Piers 1 and 2. The Navy agreed to find the documentation to support this and provide it to the EPA.

   The EPA stated that they would like to see all ARARs that they identified regarding asbestos in their comments included in the FS (CAA, NESHAPs, etc.). The Navy agreed to do this with regards to dredge material removed from the site. EPA also suggested that language be included in the FS that states "there is a potential for the presence of asbestos in the sediment, and dredge spoils should be handled accordingly". This was also agreed to.

   Lastly, the LUC boundary for asbestos was discussed. EPA stated initially that they would expect LUCs throughout the entire cove to prevent bringing sediment to the surface (worst case scenario) since there is no data to prove that asbestos hasn't migrated and isn't present at levels that may pose risk. RIDEM stated that they will not support a

remedy where LUCs prohibit use of the site. The Navy suggested that an LUC could be instituted for the entire site but it would only state that any dredging that may occur would have to be done so with the possibility that asbestos is present in the sediment; there would be no additional restrictions (i.e. anchoring, fishing). The discussion continued revolving around the following points:

- EPA requested some type of documentation (qualitative or quantitative) that would show that under a worst case scenario there is no risk to human health from sediment exposure. The Navy stated that it would not be productive to perform a risk assessment to measure risk to incidental exposure (sediment adhering to anchors, traps, fishing gear etc.) when asbestos was reported in only subsurface samples in one location under Pier 1 at a maximum concentration of 2%.
- Additional sampling was recommended by the EPA to show that asbestos has not migrated from beneath the pier. The Navy stated that sampling would only provide asbestos concentrations for the site at the time of sample collection; since the area beneath the pier is not being dredged that asbestos could still migrate, and the Navy does not wish to perform future monitoring due to the presence of asbestos.
- It was suggested that the asbestos LUCs be addressed through risk management with the information that the team already has because the anchoring and fishing scenarios don't seem likely to pose an actual potential for exposure.

After lengthy discussion the team agreed to the following:

- An asbestos LUC would be implemented beneath Pier 1 to assure that any sediment removed from this area during dredging, future construction, or demolition would be tested and handled with appropriate consideration to the possibility that there is asbestos within it.
- An Asbestos LUC would be implemented throughout the entire site that would ensure any dredge spoils would be managed in accordance with the ARARs that are presented in the FS to address the possible presence of ACM in the sediment.
- The Navy will prepare a draft justification as to why the LUCs are acceptable without further sampling or risk assessment. The justification will be based on the likely impact area directly beneath the source (the pipes beneath the pier) the concentrations found in that area, the behavior of asbestos in water, and the likelihood for this material to migrate and be deposited at a concentration greater than 1% away from the pier. This material will be provided in advance of the revised FS.

2. <u>Backfill:</u>

(See morning discussions). It was suggested that all discussion of the VWAC be removed from the FS, and that a monitoring component be added to alternatives that

include backfill. To clarify, the existing alternative SD4 will remain in the FS, and it will be set up to meet SWAC with backfill (this will differentiate it from the new alternative SD5). SD4 will not be developed to meet the VWAC < PRGs, only SWAC < PRGs.

3. Calculations:

   The EPA had concerns that historic sediment data were not included in the calculations. Per the discussion described above, it was agreed to not include historic data in the calculations.

4. MNR or EMNR:

   EPA requested that if Alternative 2 is to remain in the FS the uncertainties described in their comments should be included in the discussion. The Navy agreed, and will provide such language in advance of the revised FS.

5. Cap Concerns:

   The team agreed to address the cited concerns with armoring, slope stability etc. during design.

6. Cost:

   The team agreed to dismiss outstanding comments regarding methodology and assumptions made for FS cost estimates.

7. PRGs and RAOs:

   The EPA stated that their main issues were that a HQ of 10 was used to select a clean-up goal for benzo(a)pyrene, and that the PRG document was not transparent enough.

   Tetra Tech explained that the reason for the PRG-HQ of 10 for benzo(a)pyrene was in an effort to not identify the entire site as exceeding criteria, and because a background value could not be agreed upon during PRG development. Figure 3.3-12 of the PRG document (Appendix B of the FS) presents the results where exceedances would exist if the PRG-HQ of 1, between 1 and 10, and greater than 10 were used. It shows that if a HQ between 1 and 10 were selected the entire cove would have exceeded, but PRG-HQ = 10 only locations historically identified as potential release areas exceed. The PRG-HQ of 10 presents a much more realistic scenario because it is unlikely that benzo(a)pyrene levels throughout the entire cove are entirely site related. The protocol for determining risk was not changed, it was used to determine a site specific clean-up level. The EPA also requested that the PRG document be updated to show the calculations and assumptions used. The Navy agreed to provide an explanation regarding the adoption of a PRG-HQ of 10 for benzo(a)pyrene in the FS, but did not recommend or agree to revision of the PRG document.

8. Confirmatory Sampling:

There was discussion about resampling of dredged areas, and use of new concentrations and combine that data with SSI (2010) data from un-dredged cells to calculate a new site-wide surface area average to determine if RAOs have been achieved. The discussion on confirmatory sampling was tabled.

9. Recontamination:

   The EPA clarified that their intent is to state for the record that there is concern that storm water outfalls could potentially contribute to recontamination of the marine sediment after the remedy is complete. The Navy stated that they understand their concern, but noted that the drains are managed under the NAVSTA Newport Storm Water Management Permit.

10. LEDPA:

    The project team agreed to identify the new Alternative 5 as the LEDPA.

11. Design Concerns:

    The EPA indicated concerns regarding the design of the cap under Pier 2 that is part of Alternatives 4 and 5. The project team agreed to address this issue during the remedial design.

12. HHRA:

    The EPA stated that there were concerns regarding the age of the HHRA. Specifically, they are concerned that updates to the guidance should be reviewed as they would during a 5 year review because the document was so old, rather than wait until the 5 year review period. This would not change the remedy or PRGs, it should just describe how it differs from the original HHRA in response to guidance updates. Three areas need update:

    - Shellfish ingestion rates
    - Early Life Stage Exposure to Mutagenic Compounds
    - Risk-based PRG development

    The Navy agreed to provide a separate summary paper to assess the updates cited in the EPA's comments and explain if these updates would change the risk at the site.

13. 100-year Storm:

    The EPA requested that the FS state that all caps will be designed to withstand the force of a 100 year storm. The Navy agreed to identify this in the FS as a design parameter at appropriate places.

14. LUCs, ICs:

    See morning discussion. EPA stated that this is not a concern for the development of the new alternative SD5.

15. Habitat Concerns:

    The EPA was concerned that material used for capping or backfilling under specific alternatives would result in the loss of habitat. The Navy agreed to state in the FS that cap material will be as similar as possible to the current conditions, within engineering constraints. This will be further addressed during the remedial design.

16. Alternative Comparisons:

    EPA requested that Table ES-1 be updated to use terms like "partially meets overall protection and reduces overall risk". The Navy agreed to update the table and make changes throughout the FS as appropriate.

17. ARARs:

    The project team agreed to table discussion on ARARs and finalize them during finalization of the FS.

One topic that was not covered in the summary list but was identified in the 9/30/13 letter from EPA: The EPA stated concern that there is presently not enough (geotechnical) data to support the design of a cap for the east end of Pier 2. The project team agreed to address this concern during the remedial design.

Action Items:

Navy:

- Include mention of the Coast Guard project in the FS to state that the Navy will ensure that all work being conducted is consistent with the Superfund remedy.
- Submit asbestos removal documentation for areas beneath Piers 1 & 2 to the EPA and RIDEM.
- Characterize asbestos risk in paragraph form for inclusion into the FS. A draft will be submitted to EPA and RIDEM via email.
- Add chemical monitoring to backfill areas under Alternative 4.
- Propose list of uncertainties regarding Alternative 2 for inclusion in the FS where appropriate. Update Table ES-1. Submit draft to EPA and RIDEM via email.
- Prepare a justification for the use of a HQ of 10 for benzo(a)pyrene for inclusion in the FS and ROD. Submit draft to EPA and RIDEM via email.
- Prepare a review of the HHRA with regards to updates to the guidance. Submit to EPA and RIDEM via email, and update the FS with this information as appropriate.

- Email SWAC/VWAC spreadsheet in Excel format to EPA and RIDEM **(completed 10/24/13)**.

EPA:

- Check with attorney to prepare a revised list of ARARs relating to asbestos and submit to the project team.

RIDEM: No Action Items were identified for RIDEM.

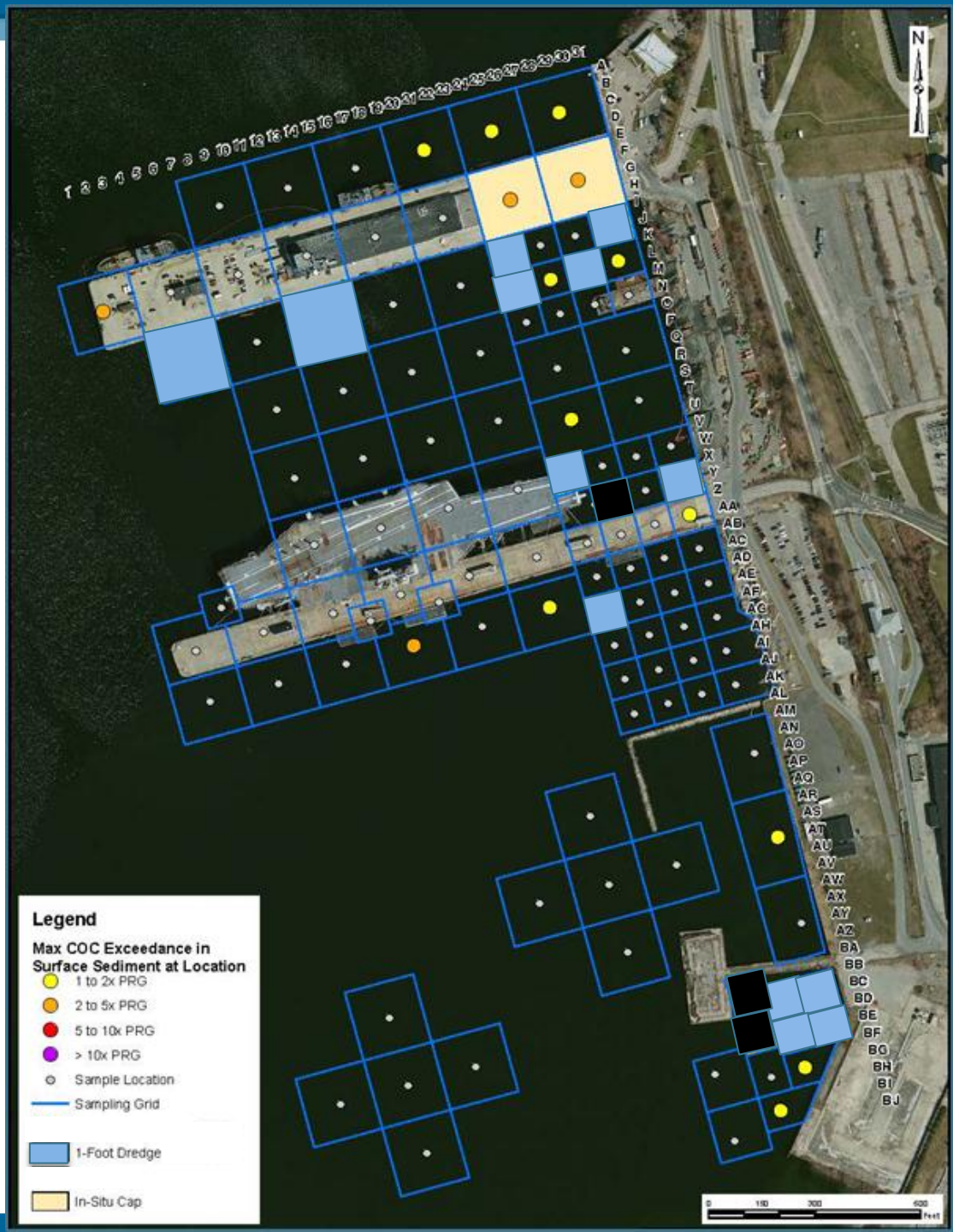
TETRA TECH

Visual of revised SD4

Dredge to 1 foot, backfill to grade

Cover under pier 2

Initial calculations show 7,098 CY in- place sediment dredged & backfilled, at a cost of $12M



TETRA TECH

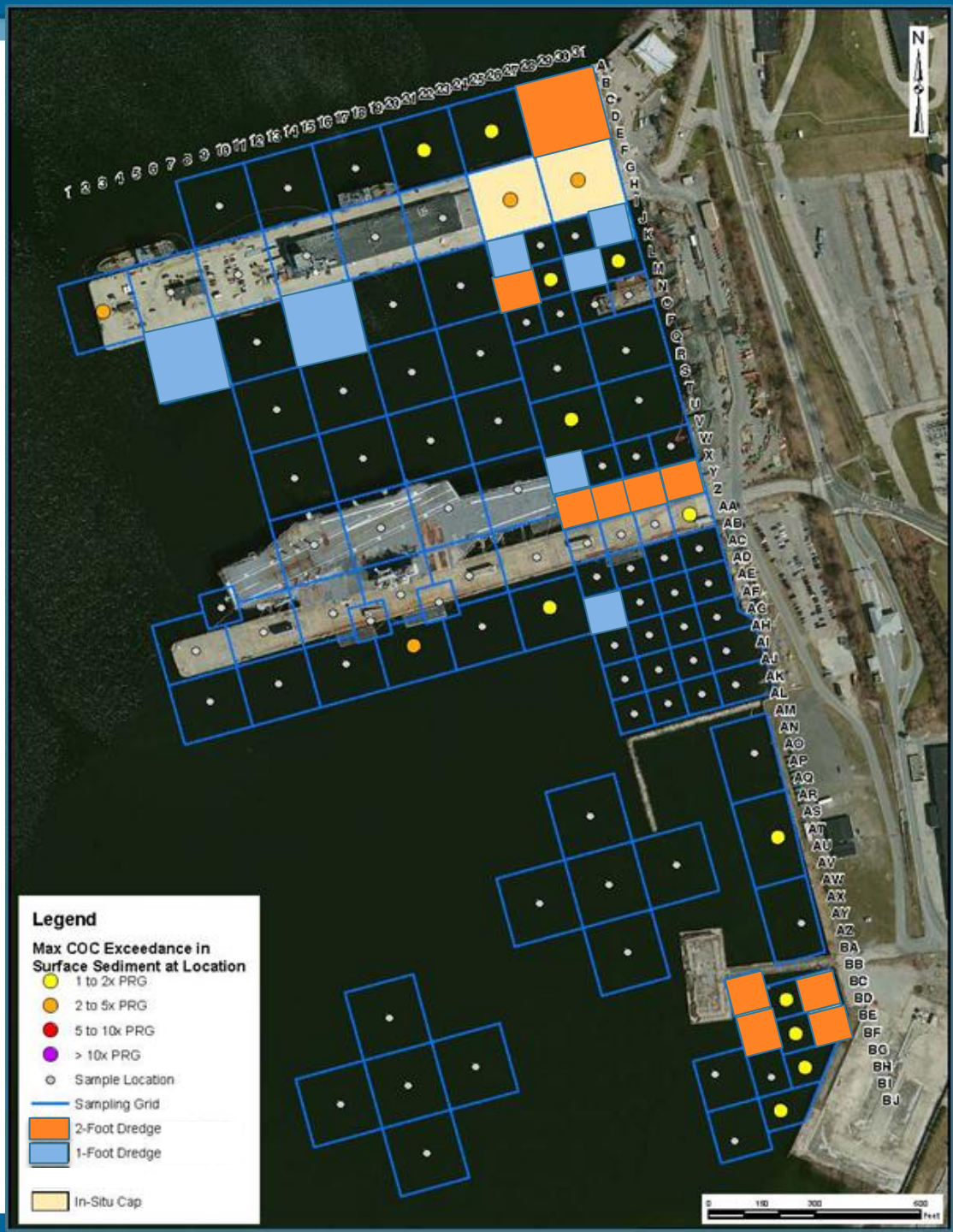
Visual of new SD5

Dredge to 2 feet, no backfill

Dredge to 1 foot, no backfill

Cover under pier 2

Initial calculations show 14,479 CY in-place sediment dredged & backfilled, at a cost of $16.5M



D-8 DEVELOPMENT OF SURFACE-AREA WEIGHTED AVERAGE CONCENTRATION (SWAC) CALCULATIONS

APPENDIX D-8

SWAC Example Calculations

The SWAC (utilized for development of Alternatives that address exposure to the surface one foot of sediment) was calculated for each COC separately by first identifying each cell where the PRG was exceeded. Each of the cells where PRGs were exceeded was then included in the SWAC calculation for that COC. The SWAC calculation is as follows:

$$SWAC = \frac{(conc_1 * area_1)+(conc_2 * area_2)\ldots+(conc_n + area_n)}{area_1 + area_2 \ldots + area_n}$$

Where:
conc = surface interval concentration of the COC in question
area = the area of the cell that the sample represents (presented on Figure D7-A)

This calculation was completed for each COC separately to ensure that if the COC was not exceeded in a particular cell, that concentration would not be included in the calculation (this is the most conservative approach when averaging).

For a simplistic example, SWAC concentrations of two COCs for a theoretical site represented by four samples are presented below:

Where four samples S1 through S4 represent the whole site:

S1 = 1200 µg/kg PCBs, and 100 mg/kg lead, and represents 300 square feet of surface sediment

S2 = 500 µg/kg PCBs, and 800 mg/kg lead, and represents 200 square feet of surface sediment

S3 = 1300 µg/kg PCBs and 300 mg/kg lead and represents 250 square feet of surface sediment

S4 = 100 µg/kg PCBs and 50 mg/kg lead, and represents 200 square feet of surface sediment

And:

The PCB PRG = 1,060 µg/kg

The Lead PRG = 168 mg/kg

Conservative SWACs for lead and PCBs are calculated as follows:

$$SWAC_{PCBs} = \frac{(1200*300)+(1300*250)}{300+250} = 1245\ \mu g/kg$$

$$SWAC_{Lead} = \frac{(800*200)+(300*250)}{200+250} = 522\ mg/kg$$

In the above example, the SWAC for lead is calculated using only the results from S2 and S3, and the SWAC for PCBs is calculated using S1 and S3 because they are the only results exceeding the PRG. The “clean” results and data from S4 are not included in either calculation, even though the receptor would be as equally exposed to that area as the others. This approach provides a theoretical decision unit for each COC individually that is highly conservative both in baseline and in post-remedy calculations.

To determine which areas to address in order to reduce SWAC for each COC at this example site, the highest concentration is removed from the equation, and replaced with a null value, simulating either excavation of the sediment represented by that sample and backfilling the area with clean sand (eliminating the material), or covering the area with a cap (eliminating the exposure). The calculation is then run again to determine if the SWAC is below the PRG. To continue the above example, S3 has been dredged and backfilled to address SWAC for PCBs, and S2 has been dredged and backfilled to address SWAC for lead, and the new SWACs are calculated as follows:

$$SWAC_{PCB\ (post\ dredge)} = \frac{(1200*300)+(0*250)}{300+250} = 645\ \mu g/kg$$

$$SWAC_{Lead\ (post\ dredge)} = \frac{(0*200)+(300*250)}{200+250} = 167\ mg/kg$$

This example shows that by remediating sediment in two locations, the SWACs for both lead and PCBs, and thus the exposure concentrations for the two conservative theoretical decision units, have been reduced to below PRGs.

A more realistic approach may be to include all the data from the study or from actual decision units based on physical boundaries. However, in so doing, the baseline area average concentrations would all be below PRGs, indicating a no-action remedy for the site. Using the example site above, this calculation is presented below (only PCBs are presented below):

$$SWAC_{PCBs} = \frac{(1200*300)+(500*200)+(1300*250)+(100*200)}{300+200+250+200} = 847\ \mu g/kg$$

To avoid mathematical dilution of COC concentrations, it is determined that the use of SWAC calculation on a location specific basis as opposed to the whole site basis is appropriate for achieving goals based on exposure for a surface remedy, including thin layer cover, capping, and surface dredging, with backfill.

Baseline Concentrations

The concentrations of COCs compared to PRGs based on the SWAC and VWAC calculations for baseline conditions (pre-remediation) were conducted for the site using results from SSI samples that exceeded PRGs; and a summary is provided below:

Scenario	Benzo(a)pyrene (µg/kg)	Total HMW PAHs (µg/kg)	Total PCBs (µg/kg)	Lead (mg/kg)
PRG	*539*	*13,903*	*1,060*	*168*
Baseline SWAC (no action)	1,415	32,465	6,286	522

SWAC Calculations For Remedial Alternatives

The areas requiring remedial action to reduce the baseline SWACs to below PRG are presented on Figure D8-A. The tables that follow present the list of cells included in the SWAC calculation for each COC, and the resulting post-remediation SWAC calculations. Alternative 1, which is a no action alternative presents the calculation for the baseline (since no action would result in the same condition as is currently present). The calculations for the other alternatives present the resulting SWACs after those alternatives are completed based on the currently available data. Using the approach described in this section, the grid cells with the highest concentrations of each COC would be remediated first, regardless of which part of the site they are located, and the average concentration for the assemblage of areas for each COC is reduced to below the PRG accordingly.

Alternative 1

CELL/INTERVAL	CONCENTRATION	AREA (SF)	CONC.*AREA
BENZO(A)PYRENE (µg/kg)			
AD13-0012	1300	32408	42130400
AT30-0012	890	38193	33991770
BB26-0012	930	10028	9326040
BC28-0012	790	9987	7889730
BC30-0012	1200	9467	11360400
BD26-0012	1260	12449	15685740
BE28-0012	610	9950	6069500
BE30-0012	9000	8944	80496000
BG28-0012	810	12334	9990540
BI26-0012	580	14714	8534120
C25-0012	840	40000	33600000
C29-0012	620	43818	27167160
G25-0012	1200	40000	48000000
G29-0012	1600	43574	69718400
J30-0012	8800	11630	102344000
L24-0012	580	10000	5800000
L26-0012	670	10000	6700000
L30-0012	930	11586	10774980
Y26-0012	900	7246	6521400
Y30-0012	1100	11677	12844700
	SUM:	388005	548944880

SWAC (548,944,880/388,005)= 1,414.8 µg/kg

CELL/INTERVAL	CONCENTRATION	AREA (SF)	CONC.*AREA
HIGH MOLECULAR WEIGHT PAHs (µg/kg)			
AD13-0012	17300	32408	560658400
BB26-0012	16400	10028	164459200
BC30-0012	14100	9467	133484700
BD26 -0012	16600	12449	206653400
BE30-0012	117000	8944	1046448000
G25-0012	15000	40000	600000000
G29-0012	17300	43574	753830200
J30-0012	188000	11630	2186440000
Y30-0012	18900	11677	220695300
	SUM:	180177	5872669200

SWAC (5,872,669,200/180,177) = 32,593.9 µg/kg

CELL/INTERVAL	CONCENTRATION	AREA (SF)	CONC.*AREA
PCBs (µg/kg)			
AA30-0012	1880	11658	21917040
J24-0012	1200	10000	12000000
K13-0012	17000	40000	680000000
L24-0012	1710	10000	17100000
L26-0012	1800	10000	18000000
L28-0012	3600	10000	36000000
T25-0012	1500	34788	52182000
W24-0012	2050	10000	20500000
	SUM:	136446	857699040

SWAC (857,699,040/136,446) = 6,286.0 µg/kg

CELL/INTERVAL	CONCENTRATION	AREA (SF)	CONC.*AREA
Lead (mg/kg)			
AD21-0012	200	34800	6960000
AE24-0012	1020	10000	10200000
BE30-0012	173	8944	1547312
C21-0012	320	40000	12800000
C25-0012	198	40000	7920000
C29-0012	209	43818	9157962
G01-0012	368	40000	14720000
J24-0012	1100	10000	11000000
K05-0012	1410	40000	56400000
K13-0012	598	40000	23920000
L24-0012	884	10000	8840000
L26-0012	324	10000	3240000
L28-0012	876	10000	8760000
W24-0012	904	10000	9040000
Y30-0012	256	11677	2989312
	SUM:	359239	187494586

SWAC (187,494,586/359,239) = 521.9 mg/kg

Alternatives 2 and 3 – The foot print for Alternatives 2 and 3 are identical and SWACs were calculated to be the same.

CELL/INTERVAL	CONCENTRATION	AREA (SF)	CONC.*AREA
BENZO(A)PYRENE (µg/kg)			
AD13-0012	1300	32408	42130400
AT30-0012	890	38193	33991770
BB26-0012	930	10028	9326040
BC28 cap/cover	0	9987	0
BC30 cap/cover	0	9467	0
BD26 cap/cover	0	12449	0
BE28 cap/cover	0	9950	0
BE30 cap/cover	0	8944	0
BG28 cap/cover	0	12334	0
BI26-0012	580	14714	8534120
C25-0012	840	40000	33600000
C29-0012	620	43818	27167160
G25 cap/cover	0	40000	0
G29 cap/cover	0	43574	0
J30 cap/cover	0	11630	0
L24 cap/cover	0	10000	0
L26-0012	670	10000	6700000
L30-0012	930	11586	10774980
Y26-0012	900	7246	6521400
Y30 cap/cover	0	11677	0
	SUM:	388005	178745870

SWAC (178,745,870/388,005) = 460.7 µg/kg

CELL/INTERVAL	CONCENTRATION	AREA (SF)	CONC.*AREA
HIGH MOLECULAR WEIGHT PAHs (µg/kg)			
AD13-0012	17300	32408	560658400
BB26-0012	16400	10028	164459200
BC30 cap/cover	0	9467	0
BD26 cap/cover	0	12449	0
BE30 cap/cover	0	8944	0
G25 cap/cover	0	40000	0
G29 cap/cover	0	43574	0
J30 cap/cover	0	11630	0
Y30 cap/cover	0	11677	0
	SUM:	180177	725117600

SWAC (725,117,600/180,177) = 4,024.5 µg/kg

CELL/INTERVAL	CONCENTRATION	AREA (SF)	CONC.*AREA
PCBs (µg/kg)			
AA30-0012	1880	11658	21917040
J24 cap/cover	0	10000	0
K13 cap/cover	0	40000	0
L24 cap/cover	0	10000	0
L26-0012	1800	10000	18000000
L28 cap/cover	0	10000	0
T25-0012	1500	34788	52182000
W24 cap/cover	0	10000	0
	SUM:	136446	92099040

SWAC (92,099,040/136,446) = 675.0 µg/kg

CELL/INTERVAL	CONCENTRATION	AREA (SF)	CONC.*AREA
Lead (mg/kg)			
AD21-0012	200	34800	6960000
AE24 cap/cover	0	10000	0
BE30 cap/cover	0	8944	0
C21-0012	320	40000	12800000
C25-0012	198	40000	7920000
C29-0012	209	43818	9157962
G01-0012	368	40000	14720000
J24 cap/cover	0	10000	0
K05 cap/cover	0	40000	0
K13 cap/cover	0	40000	0
L24 cap/cover	0	10000	0
L26-0012	324	10000	3240000
L28 cap/cover	0	10000	0
W24 cap/cover	0	10000	0
Y30 cap/cover	0	11677	0
	SUM:	359239	54797962

SWAC (54,797,962/359,239) = 152.5 mg/kg

Alternative 4

CELL/INTERVAL	CONCENTRATION	AREA (SF)	CONC.*AREA
BENZO(A)PYRENE (µg/kg)			
AD13-0012	1300	32408	42130400
AT30-0012	890	38193	33991770
BB26-0012	930	10028	9326040
BC28 backfill	0	9987	0
BC30 backfill	0	9467	0
BD26-0012	1260	12449	15685740
BE28 backfill	0	9950	0
BE30 backfill	0	8944	0
BG28-0012	810	12334	9990540
BI26-0012	580	14714	8534120
C25-0012	840	40000	33600000
C29-0012	620	43818	27167160
G25 capped area	0	40000	0
G29 capped area	0	43574	0
J30 backfill	0	11630	0
L24 backfill	0	10000	0
L26-0012	670	10000	6700000
L30-0012	930	11586	10774980
Y26-0012	900	7246	6521400
Y30 backfill	0	11677	0
	SUM:	388005	204422150

SWAC (204,422,150/388,005) = 526.9 µg/kg

CELL/INTERVAL	CONCENTRATION	AREA (SF)	CONC.*AREA
HIGH MOLECULAR WEIGHT PAHs (µg/kg)			
AD13-0012	17300	32408	560658400
BB26-0012	16400	10028	164459200
BC30 backfill	0	9467	0
BD26-0012	16600	12449	206653400
BE30 backfill	0	8944	0
G25 capped area	0	40000	0
G29 capped area	0	43574	0
J30 backfill	0	11630	0
Y30 backfill	0	11677	0
	SUM:	180177	931771000

SWAC (931,771,000/180,177) = 5,171.4 µg/kg

CELL/INTERVAL	CONCENTRATION	AREA (SF)	CONC.*AREA
PCBs (µg/kg)			
AA30-0012	1880	11658	21917040
J24 backfill	0	10000	0
K13 backfill	0	40000	0
L24 backfill	0	10000	0
L26-0012	1800	10000	18000000
L28 backfill	0	10000	0
T25-0012	1500	34788	52182000
W24 backfill	0	10000	0
	SUM:	136446	92099040

SWAC (920,990,040/136,446) = 675.0 µg/kg

CELL/INTERVAL	CONCENTRATION	AREA (SF)	CONC.*AREA
Lead (mg/kg)			
AD21-0012	200	34800	6960000
AE24 backfill	0	10000	0
BE30 backfill	0	8944	0
C21-0012	320	40000	12800000
C25-0012	198	40000	7920000
C29-0012	209	43818	9157962
G01-0012	368	40000	14720000
J24 backfill	0	10000	0
K05 backfill	0	40000	0
K13 backfill	0	40000	0
L24 backfill	0	10000	0
L26-0012	324	10000	3240000
L28 backfill	0	10000	0
W24 backfill	0	10000	0
Y30 backfill	0	11677	0
	SUM:	359239	54797962

SWAC (54,797,962/539,239) = 152.5 mg/kg

Alternative 5

CELL/INTERVAL	CONCENTRATION	AREA (SF)	CONC.*AREA
BENZO(A)PYRENE (µg/kg)			
AD13-0012	1300	32408	42130400
AT30-0012	890	38193	33991770
BB26-2448	300	10028	3008400
BC28-0012	790	9987	7889730
BC30-2448	690	9467	6532230
BD26-2448	120	12449	1493880
BE28-0012	610	9950	6069500
BE30-2448	250	8944	2236000
BG28-0012	810	12334	9990540
BI26-0012	580	14714	8534120
C25-0012	840	40000	33600000
C29-2448	84	43818	3680712
G25 surface cap	0	40000	0
G29 surface cap	0	43574	0
J30-1224	580	11630	6745400
L24-2448	41	10000	410000
L26-0012	670	10000	6700000
L30-0012	930	11586	10774980
Y26-2448	370	7246	2681020
Y30 below sample depth	0	11677	0
	SUM:	388005	186468682

SWAC (186,468,682/388,005) = 480.6 µg/kg

CELL/INTERVAL	CONCENTRATION	AREA (SF)	CONC.*AREA
HIGH MOLECULAR WEIGHT PAHs (µg/kg)			
AD13-0012	17300	32408	560658400
BB26-2448	4030	10028	40412840
BC30-2448	8760	9467	82930920
BD26-2448	1530	12449	19046970
BE30-2448	3620	8944	32377280
G25 surface cap	0	40000	0
G29 surface cap	0	43574	0
J30-1224	12400	11630	144212000
Y30 below sample depth	0	11677	0
	SUM:	180177	879638410

SWAC (879,638,410/180,177) = 4,882.1 µg/kg

CELL/INTERVAL	CONCENTRATION	AREA (SF)	CONC.*AREA
PCBs (µg/kg)			
AA30-0012	1880	11658	21917040
J24-1224	400	10000	4000000
K13-1224	66	40000	2640000
L24-2448	6	10000	60000
L26-0012	1800	10000	18000000
L28-1224	115	10000	1150000
T25-0012	1500	34788	52182000
W24-1224	1130	10000	11300000
	SUM:	136446	111249040

SWAC (111,249,040/136,446) = 815.3 µg/kg

CELL/INTERVAL	CONCENTRATION	AREA (SF)	CONC.*AREA
Lead (mg/kg)			
AD21-0012	200	34800	6960000
AE24-1224	198	10000	1980000
BE30-2448	9.5	8944	84968
C21-0012	320	40000	12800000
C25-0012	198	40000	7920000
C29-2448	11.7	43818	512670.6
G01-0012	368	40000	14720000
J24-1224	610	10000	6100000
K05-1224	5.3	40000	212000
K13-1224	168	40000	6720000
L24-2448	20.8	10000	208000
L26-0012	324	10000	3240000
L28-1224	85.5	10000	855000
W24-1224	577	10000	5770000
Y30 below sample depth	0	11677	0
	SUM:	359239	68082638.6

SWAC (68,082,638/359,239) = 189.5 mg/kg

D-9 ASBESTOS UNDER PIERS 1 AND 2

Introduction

The following summary was prepared to describe the nature and behavior of asbestos-containing thermal system insulation that was released to the seafloor, relative to potential for human exposure to that asbestos by a future worker or fisherman. This summary was prepared at the request of the USEPA and RIDEM at the technical meeting held 10-23-13 in regards to Site 19 (former Robert E. Derecktor Shipyard) at Naval Station Newport, Newport RI.

Release of Asbestos to the Marine Environment at Site 19:

Between 2005 and 2009, records indicate that pipe insulation assumed to contain asbestos (ACM) was released from piping under Pier 1 as pieces falling from the pipes or as sections of piping falling after deterioration of pipe hangars. Diver inspections were conducted and it was determined that the material under water (approximately 15-30 feet in depth) had deteriorated substantially rendering the ACM as not recoverable.

Surveys in 2007 and 2008 found:

- Majority of abandoned steam line (still hanging) under Pier 1 was in poor condition and missing more than 75% of insulation.
- Limited but unrecoverable insulation on limited portions of piping on the seafloor under Pier 1.
- Steam piping under Pier 2 was in better condition than that under Pier 1.

EPA Commented during review of the Site 19 Feasibility Study that asbestos contamination in sediment should be managed under CERCLA. EPA stated that the FS should identify asbestos as a contaminant of concern and address asbestos similar to the Blackburn and Union Record of Decision for the sediment component of that remedy.

The Navy noted that the asbestos in the Blackburn and Union site was a process waste, disposed of in ponds and posing high potential for exposure in the pond shallows. After looking further into this example site, it was noted that the action level for asbestos in sediment at that site was “less than 1%”: Activity-based sampling of the soil indicated that a removal based on 1% asbestos would be protective of human health, and these results were assumed to be representative of sediment since activity-based sampling cannot be done for sediment. The cleanup level for both soil and sediment was set as “<1%”, and the ROD stated that less than 1% would not contribute to a cumulative ILCR >1E-4 through dust inhalation pathway.

Regulatory Standards:

A soil cleanup standard of 1% has a basis of consistency with standards set by NESHAPs as well as the Asbestos Hazard Emergency Response Act (AHERA), which defines asbestos-containing material (ACM) and asbestos containing building material (ACBM) as materials containing asbestos at concentrations of 1% or more by weight, as determined by polarized light microscopy (PLM). While some states enforce criteria for asbestos in soil there are no known regulatory standards for asbestos in sediment.

Acceptable concentrations of asbestos in ambient air are not established by law, but an acceptable standard for clearance testing after asbestos abatement in indoor air is 0.01 total fibers per cubic centimeter (f/cc) in the ambient air within the work area. There is no relationship between the 1% standard of asbestos within solid material to the air benchmark of 0.01 f/cc, these are independent values that are specific to the different media.

Asbestos in drinking water is regulated by the safe drinking water act, which establishes a maximum contaminant level (MCL) of 7 million fibers per liter (MFL), or 7,000 fibers per cubic centimeter of water. This MCL is based on health effects that can result from the ingestion of water containing asbestos derived from natural sources, mine waste or asbestos-cement water supply piping, which was utilized in construction of some urban water supply systems.

Nature and Behavior of Asbestos Released to the Environment:

Asbestos-containing pipe insulation was typically manufactured as block or paper material sized specifically for the piping it would be attached to. In either case, the mined asbestos (a mineral fiber) was reduced and blended with other materials such as cellulose or magnesium and a binding agent and then formed into its end product. So-called “Aircell” insulation resembles corrugated cardboard though the mix of the pulp making the product would be typically 65-75% chrysotile asbestos mixed with cellulose. “Mag”, or white block insulation was higher grade for higher temperature applications, and could contain up to 85% or more amosite asbestos, blended with other mineral components such as magnesium silicate. In both cases, the formed insulation was typically attached to the pipe with metal bands and wrapped with a cloth (canvas) or paper jacket. Asbestos containing insulation for piping elbows, joints, and valves typically was formed from a chrysotile-based plaster built up around the fitting and sometimes wrapped with cloth jacket while wet. In most applications, the binder was a water soluble material. As a result, asbestos removal programs are made safer through the use of simple wetting agents such as water or amended water to break down the binder and prevent dust from becoming airborne.

Asbestos pipe insulation placed or allowed to fall into standing water would initially repel the water, but within minutes, the binding agents would begin to break down, allowing water to seep within the insulation. After the material is soaked in water for more than 24 hours, the binder would be completely broken down leaving a mass not

unlike wet paper or paste. In the case of a pipe falling into standing water with insulation still on it and encased in its original canvas jacket, the insulation would break down to a pudding-like mass, retained only by the cloth wrapping. Once the cloth had become compromised by rot, or torn by abrasions, there would be nothing to hold what was once the ACM to the pipe and the fibers would be subject to dispersion with even the lowest perceptible water flow.

Asbestos pipe insulation released to the sea floor under the Piers at Derecktor shipyard would likely only be recoverable within days of its release. Diver surveys dispatched after the release of piping from the pier in 2007 and 2008 noted piping with no insulation, as well as insulation deteriorating. In one report, a diver observed a piece of what was identified as ACM, but while attempting to recover a sample, it disintegrated into the water column. This survey noted that mechanical breakdown of the ACM was ongoing and deemed it unrecoverable. These observations are consistent with the relatively fast breakdown of the binder, the slower deterioration of the cloth jacket and the eventual dispersion of the ACM into the ocean water.

With no binder to retain the asbestos as a solid material, the asbestos fibers would be released as mineral fibers to the water column if even the lowest energy was encountered. Rapid marine growth over a well – jacketed section of piping & ACM could, in theory, act to retain the asbestos fibers into the sediment and incorporate them into the subsurface matrix over time.

In a more energetic aquatic environment, asbestos fibers would be subject to fast dispersion with water flow. This is because smaller asbestos fibers have very little mass, and do not even settle out of the air, staying airborne for hours or even days in closed environments. Once suspended in the water, these smaller fibers would travel with other suspended solids.

Removal of asbestos from water is accomplished through coagulation and filtration, however, capture efficiency for filtration systems for single fibers is low; removal is enhanced 10-fold or more by incorporating fibers into flocculent prior to filtration. Removal of chrysotile fibers in water filtration to levels near detection limits (typically 10^5-10^6 fibers/L) is possible with specialized treatments to increase capture efficiency (Bales, et. al. 1984). Removal of asbestos fibers from water used in decontamination is typically conducted with by passing water through a 5 micron filter, typically enforceable by State regulations for abatement actions (Kaplan, undated).

<u>Current Conditions under Pier 1</u>

Core sediment samples were collected from ten stations under Pier 1 during 2010 from depths of 0-1 foot, 1-2 feet, and 2-4 feet. This area was sampled because it was deemed the most likely to be the most heavily impacted, being directly under the ACM released. In all locations under Pier 1, samples were analyzed for asbestos fibers using a soil

analytical method. In the 27 samples collected, asbestos fibers were not found above 1% (by weight) with the exception of 2: at one station, asbestos fibers were reported at 2% in the sample from 1-2 feet below the sediment surface and in the sample from 2-4 feet below the sediment surface.

Potential for Exposure at Site 19

Two potential exposures routes for Asbestos in sediment at Site 19 have been suggested by EPA and RIDEM: Exposure through handling sediment during a dredging action, and inadvertent exposure by persons encountering incidental quantities of sediment brought from the seafloor to the surface.

For dredging exposures, the sediment containing asbestos fibers at concentrations greater than 1% would assumed to be brought to the surface from under Pier 1 (presumably during demolition of the pier), allowed to dry, and then become airborne during handling. This potential exposure can easily be minimized through engineering controls to 1) sample waste generated to confirm presence of asbestos fibers, 2) retain certain amount of moisture to prevent dust generation during handling and 3) use proper disposal processes and locations where adequate controls will remain.

For incidental exposures, there is less likelihood for exposures to actually take place. In order for the asbestos under more than 10 feet of water under pier 1, and under more than one foot below the sediment surface to provide an exposure potential for humans, an unusual series of events would have to occur. Qualitative modeling could project a potential for exposure with some gross assumptions, as follows:

1. The first foot of sediment under the pier (where there is relatively low water energy) would have to be stripped from the underlying sediment containing the sediment where asbestos fibers were found at 2%.
2. The sediment containing asbestos fibers at 2% would have to be shifted without dispersal to one side of the pier, where it could be encountered by a receptor. A 50% dispersal would result in a total concentration of 1% asbestos in the surface sediment in the new location. To be conservative, one would have to assume all the sediment >2% under the pier is located to one other grid cell next to the pier without dispersal or loss of concentration.
3. The shifted sediment with asbestos fibers would have to all settle out of the water within a brief time period prior to the residual water current moving them to another location, a behavior that is not expected. Settling behavior of this sediment has not been tested.
4. A receptor (i.e. industrial port worker) would inadvertently drag some sediment onto a cable, chain, anchor or other piece of equipment, and it would have to be assumed that this sediment would not be rinsed off into the water, as is common practice.

5. The receptor would allow the sediment to dry on the equipment, disturb it after drying and respire the dust.

The expected behavior of asbestos fibers entrained in water or sediment does not indicate that the above sequence is likely. The probability of the above sequence of high energy events to occur without dispersion (loss) of the asbestos fibers within the water or in the air is improbable. Energy required to move sediment to an area where it could be encountered would likely reduce the source concentration to a value not expected to pose a risk for exposure.

References:

(Bales, et al 1984) Roger C. (1984) *Surface chemical and physical behavior of chrysotile asbestos in natural waters and water treatment.* California Institute of Technology , Pasadena, CA. (Unpublished)

Kaplan, undated) Unregulated Disposal of Asbestos Contaminated Shower Water Effluent: A Question of Public Health Risk. David E. Kaplan
http://www.mesothelioma.us/pages/additional-information/articles-for-patients/

FLI Environmental

Final Clearance Inspection Checklist

Client: MCC CONST

Date: 11/04/11

Address: U.S. NAVAL STATION - PIER 2

Project #: 11-1987

Address: NEWPORT, RI

Time: 7:45AM

Asbestos Contractor: GREEN ENV.

Negative Pressure: Yes (No) - NA

Containment Area: NA

Poly Sheeting in Place: Yes (No) - NA

Decon Type: 3 STAGE

Full Containment: Yes (No) - NA

Work Area Size:

Glovebag Removal: (Yes) No

List Materials and Quantities Abated

Material	Quantity
PIPE INS./COATINGS	3340 LF

Certification

The work area outlined above has been inspected by the Asbestos Abatement Project Supervisor and Project Monitor and has passed the visual inspection criteria of no visible debris.

	Name	Signature	License #
Project Monitor:	FRANK N. BALAGTAS	Frank N. Balagtas	AM400049
Supervisor:	Arcadio C Mesa	Arcadio C Mesa	MC9416H490

Air Sampling Data:

Total # of Samples: NA

Pass / Fail

Sample #	Location	F/cc		Sample #	Location	F/cc

Additional Notes:

WENT DOWN UNDER PIER WITH GREEN ENV. ON FLOATS AND CONDUCTED VISUAL INSPECTION ON PIPES, ALL PIPE INS. WAS REMOVED UNDER SCOPE OF WORK

Notes on the
Pier II Pile Repairs and ACM Removal

General Information:

Contract: N40085-10-D-9430 DO# 0002

Pier 2 Pile Repairs and Asbestos Containing Materials (ACM) Removal at Naval Station Newport, Newport, Rhode Island

Navy PM:

Brian Sneed (401) 841-1709 brian.s.sneed@navy.mil

General Contractor:

D-F Joint Venture
22121 Princeton Circle
Frankfort, IL 60423-8509

Asbestos Project Designer:

Richard K. Bowen RI DoH Lic.# AAC-0784-PD Exp: 11/27/2011

Asbestos Contractor:

Green Environmental Inc LAC-246 Exp: 11/19/2011
120 Longwater Drive
Norwell, MA 02061

Waste Transporter:

Dynamic Waste Systems Inc. Need property address – Not PO Box
PO Box 346
Essex, MA 02929
978-768-7195

Disposal Site:

Turnkey Landfill – Waste Management
97 Rochester Neck Rd.
Rochester, NH 03829
POC: Steve Durand 800-847-5303 603-330-2111

Review:

UFGS:

Review of re-submitted plan: D-F Transmittal #15 08/02/2011

Answers to Navy's Questions/Concerns:

1. OK
2. Advise your contractor that whatever level of respiratory protection cited in the approved plan, MUST be obliged by all their abatement subs. Currently the Plan call for PAPR.
3. It is a Navy specification to the PRIME contractor. See UFGS 02 83 16.00 20 § 3.2.7 Air Sampling.

ORDER FOR SUPPLIES OR SERVICES

1. CONTRACT/PURCH. ORDER/ AGREEMENT NO.	2. DELIVERY ORDER/ CALL NO.	3. DATE OF ORDER/CALL (YYYYMMMDD)	4. REQ./PURCH. REQUEST NO.	5. PRIORITY
N40085-10-D-9430	0002	2011 Apr 27	ACQR1935199	DO-C2

6. ISSUED BY CODE N40085
NAVFAC MID ATLANTIC
NORTHEAST IPT
9742 MARYLAND AVENUE
BLDG Z-144
NORFOLK VA 23511

7. ADMINISTERED BY *(if other than 6)* CODE N40085
NAVFAC MID ATLANTIC
PWD NEWPORT
BLDG 1SIMONPIETRI DRIVE
NAVAL STATION NEWPORT
NEWPORT RI 02841-1712

8. DELIVERY FOB
[X] DESTINATION
[ ] OTHER
(See Schedule if other)

9. CONTRACTOR CODE 62XV6 FACILITY
NAME AND ADDRESS
D-F JOINT VENTURE
22121 PRINCETON CIR
FRANKFORT IL 60423-8509

10. DELIVER TO FOB POINT BY (Date) *(YYYYMMMDD)*
SEE SCHEDULE

11. MARK IF BUSINESS IS
[ ] SMALL
[ ] SMALL DISADVANTAGED
[ ] WOMEN-OWNED

12. DISCOUNT TERMS

13. MAIL INVOICES TO THE ADDRESS IN BLOCK
See Item 7

14. SHIP TO CODE
SEE SCHEDULE

15. PAYMENT WILL BE MADE BY CODE N68732
DFAS-CLEVELAND NORFOLK ACCOUNTS PAYABLE
P.O. BOX 998022
CLEVELAND OH 44199

MARK ALL PACKAGES AND PAPERS WITH IDENTIFICATION NUMBERS IN BLOCKS 1 AND 2.

16. TYPE OF ORDER

DELIVERY/ CALL	X	This delivery order/call is issued on another Government agency or in accordance with and subject to terms and conditions of above numbered contract.
PURCHASE		Reference your quote dated Furnish the following on terms specified herein. REF:

ACCEPTANCE. THE CONTRACTOR HEREBY ACCEPTS THE OFFER REPRESENTED BY THE NUMBERED PURCHASE ORDER AS IT MAY PREVIOUSLY HAVE BEEN OR IS NOW MODIFIED, SUBJECT TO ALL OF THE TERMS AND CONDITIONS SET FORTH, AND AGREES TO PERFORM THE SAME.

NAME OF CONTRACTOR | SIGNATURE | TYPED NAME AND TITLE | DATE SIGNED *(YYYYMMMDD)*

[X] If this box is marked, supplier must sign Acceptance and return the following number of copies: 1

17. ACCOUNTING AND APPROPRIATION DATA/ LOCAL USE
See Schedule

18. ITEM NO.	19. SCHEDULE OF SUPPLIES/ SERVICES	20. QUANTITY ORDERED/ ACCEPTED*	21. UNIT	22. UNIT PRICE	23. AMOUNT
	SEE SCHEDULE				

** If quantity accepted by the Government is same as quantity ordered, indicate by X. If different, enter actual quantity accepted below quantity ordered and encircle.*

24. UNITED STATES OF AMERICA
TEL:
EMAIL:
BY: E. Elizabeth Cole 4/27/11
CONTRACTING / ORDERING OFFICER

25. TOTAL $989,800.00
26. DIFFERENCES

27a. QUANTITY IN COLUMN 20 HAS BEEN
[ ] INSPECTED [ ] RECEIVED [ ] ACCEPTED, AND CONFORMS TO THE CONTRACT EXCEPT AS NOTED

b. SIGNATURE OF AUTHORIZED GOVERNMENT REPRESENTATIVE | c. DATE *(YYYYMMMDD)* | d. PRINTED NAME AND TITLE OF AUTHORIZED GOVERNMENT REPRESENTATIVE

e. MAILING ADDRESS OF AUTHORIZED GOVERNMENT REPRESENTATIVE

28. SHIP NO. | 29. DO VOUCHER NO. | 30. INITIALS

f. TELEPHONE NUMBER | g. E-MAIL ADDRESS

[ ] PARTIAL
[ ] FINAL

32. PAID BY

33. AMOUNT VERIFIED CORRECT FOR

36. I certify this account is correct and proper for payment.

a. DATE *(YYYYMMMDD)* | b. SIGNATURE AND TITLE OF CERTIFYING OFFICER

31. PAYMENT
[ ] COMPLETE
[ ] PARTIAL
[ ] FINAL

34. CHECK NUMBER

35. BILL OF LADING NO.

37. RECEIVED AT	38. RECEIVED BY	39. DATE RECEIVED *(YYYYMMMDD)*	40. TOTAL CONTAINERS	41. S/R ACCOUNT NO.	42. S/R VOUCHER NO.

1.00 INTRODUCTION

1.10 PROJECT AUTHORIZATION

This report presents the results of an Asbestos Assessment of Pier II conducted by GZA GeoEnvironmental, Inc. (GZA) for the Naval Facilities Engineering Command (NAVFAC), Facilities Engineering and Acquisition Division, c/o TranSystems (Client) for Contract: N40085-08-D-2117 Task Order: X006. The project is located at Pier II, U.S. Naval Station Newport, in Newport, Rhode Island (the Site -"Pier"). Authorization to proceed on this project was granted in accordance with GZA's proposal dated December 14, 2009 and is subject to the Terms and Conditions of Engagement and Limitations referenced therein. This report is subject to modification if subsequent information is developed by GZA or any other party.

1.20 PROJECT OBJECTIVE

The objective of this Asbestos Assessment was to assess the presence, location, and quantity of asbestos-containing materials (ACMs) associated with utility pipes located on the underside of the Pier. This assessment will assist in the design of abatement activities and project design associated with the anticipated renovation and/or demolition of the structure.

1.30 SCOPE OF SERVICES

GZA's survey of the Pier was completed in general accordance with the following:

- United States Environmental Protection Agency (USEPA), Guidelines for Controlling Friable Asbestos-Containing Materials in Buildings, Office of Pesticides and Toxic Substances, EPA Report Number 560/5-85-024, June 1985;
- the Navy's "Scope of Work for Performing Asbestos, Lead, PCB's and Mercury Surveys for Demolition and Renovation Designs," LANTDIV version 3.0 (06/99); and
- GZA's proposal for services.

GZA's scope of services consisted of the following activities:

- A visual evaluation of accessible areas beneath the Pier by USEPA-accredited and licensed Asbestos Inspectors to locate, estimate, sample, and assess those materials suspected to contain asbestos. Note that the scope of work was limited to an asbestos study of utility pipes located beneath the Pier. Although topside structures and utility pits were not included in the scope of work, piping that extended from topside beneath the Pier was assessed.
- Review of available drawings, specifications, and descriptions.

- An interview with facility representatives regarding their knowledge of asbestos materials.
- Asbestos bulk sampling of representative materials.
- Analysis of the asbestos bulk samples at a National Voluntary Laboratory Accreditation Program (NVLAP) and licensed laboratory using polarized light microscopy with dispersion staining (PLM/DS), and visual estimation of resulting asbestos concentrations.
- A review of the asbestos inspection findings, sampling protocols, and laboratory results.
- Preparation of this report of our findings.

Site history and certain information on features were obtained from the following sources as part of this assessment:

- Naval Facilities Engineering Service Center, East Coast Detachment, drawings and descriptions;
- Naval Facilities Engineering Command (NAVFAC) Environmental personnel;
- NAVFAC historical drawings;
- Appledore Marine Engineering, Inc. drawings;
- Asbestos Survey Pier II Report prepared in September 2008 by Watermark Engineering;
- Record drawings, specifications, and descriptions from NAVSTA's Public Works Department;
- Department of Defense Construction Criteria Manual, (DOD 4270.1-M);
- Tom Smith, Asbestos Control Manager Naval Station Newport;
- Ms. Cornelia Mueller, Environmental Scientist, Installation Restoration and Contract Support;
- Ms. Janet Fahy, Parsons Team Construction Manager;
- Navy dockside, port operations, piermaster personnel (LTJG Chris Widhalm, Mr. Marshall Burkhart, Mr. Gerald Sciegel, and Mr. Gary Moniz);
- Charter Environmental personnel (Mr. David Durham/Forman and Mr. Bob Johnson/Project Manager).

This report presents GZA's field observations, results, and opinions, and is subject to modification if subsequent information is developed by GZA or any other party. (Note that the scope of work did not include lead paint or other building-related hazardous materials.) This report has been prepared in accordance with the limitations presented in Section 6.00 and Appendix A.

1.40 LOCATION

Pier II is located at the northern portion of the U.S. Naval Station Newport, in Newport,

Rhode Island. It is situated to the north of Pier I and west of Defense Highway. The Pier extends into the Coddington Cove portion of Narragansett Bay in a westerly direction from the wharf; refer to the attached *Locus Plan*, Figure 1.

1.50 DESCRIPTION AND HISTORY OF STRUCTURE

The Pier is a waterfront structure utilized for berthing of Naval and Coast Guard vessels. It is a concrete, steel, and wood structure measuring approximately 1,572 feet long by 200 feet wide; refer to the attached *Asbestos Sampling Location Plans*:

- Pier II – East Utility Lines, Figure 2-East;
- Pier II – Middle Utility Lines, Figure 2-Middle; and
- Pier II – West Utility Lines, Figure 2-West.

The topside structures of the Pier include Building Nos. 68, 69, 70, and 71. The Pier was reportedly constructed in circa-1956 (i.e., 54 years old). According to historical drawings reviewed, the following renovations and rehabilitations occurred to utilities:

1964 - electrical;
1978 - drainage, electrical, and heat tracers;
1979 - fuel oil pipeline bents on the northern side;
1984 - wastewater collection pump station, electrical, heat trace system;
1991 - sewer line repairs; and
1996 - berthing utilities.

The September 2008 *Asbestos Survey Pier II Report* prepared by Watermark Engineering (Watermark) consisted of a limited asbestos inspection beneath Pier II. The asbestos inspection was completed on behalf of Watermark by Mystic Air Quality Consultants, Inc. of Groton, Connecticut. The report indicated that the piping systems appeared to have been recently replaced based on the types of construction materials observed. Specifically, pipe coverings constructed of PVC protective coverings and/or rubberized coatings were observed. These newer piping systems were not sampled based upon the newer construction and non-suspect materials observed. Access to some pipes was limited due to the tides and height of the pipes from the water surface. A total of 14 samples were analyzed by polarized light microscopy with dispersion staining. According to the Bulk Asbestos Sample Analysis Report, Asbestos Containing Suspect Materials Roster, and Chain-of-Custody, ACM was identified in:

- black Tar-like, brown fibers in tar paper located "Pier I / Pier II under foam, 12-inch pipe / 30-inch pipe;" and
- black Tar-like, brown fibers in tar paper located "Pier II 24-inch south pipe."

2.00 SURVEY

The purpose of GZA's Site reconnaissance was to make surficial observations for suspected asbestos-containing materials. GZA Project Managers, Mark Burbelo and Timothy Downey, USEPA-accredited and licensed asbestos inspectors, and Brian Balukonis assessed the Site during the week of February 1, 2010 and March 8, 2010.

A Site-Specific Health, Safety, and Accident Prevention Plan was developed for the project based on NAVFAC's cold water requirements. Personnel were equipped with protective clothing, personal floatation devices (PFDs), communication, and other personal protection equipment. The vessel was equipped with safety equipment according to Coast Guard regulations. A safety briefing with port operations was conducted daily prior to the start of work.

2.10 OBSERVATIONS SUMMARY

As indicated, the scope of the observations was focused on utility pipes located beneath the Pier. An initial survey was conducted to acquaint the inspectors with the Pier and to assess the types, locations, and extent of utility pipes. A more extensive survey was then conducted, at which time the utility lines were visually evaluated for the presence of thermal system insulation such as corrugated paper, fibrous chalky mixtures, or plaster-like coatings. Observations were documented and approximately 290 digital photographs were obtained of the underside of the Pier structure. Fifty-six selected photographs are included in Appendix B.

Detailed drawings were prepared that identified Pier structure features, pile number and row designations, relative location of the utility pipes, assumed or suspected specific utility names (based on markings and drawings), outside diameter of the pipes, and sample locations.

As shown on the *Asbestos Sampling Location Plans*, Figure 2, utilities consisted of both active and inactive piping lines identified as:

- steam and condensate;
- sanitary sewer;
- potable water;
- fire suppression;
- fuel oil; and
- electrical.

The CAD drawings were based on available documents and actual field measurements. As shown on the attached photographs, some of the utility lines and hangers exhibited deterioration.

3.00 ASBESTOS SURVEY

Asbestos-containing materials (ACMs) are commonly used in older construction materials. Federal regulations require an asbestos survey prior to any renovation, alteration, and repair or demolition project that will disturb building materials. Asbestos-containing products are still available today and are often used in the form of tars, sealants, caulks, and coatings.

3.10 ASBESTOS SURVEY METHODOLOGY

Procedures for locating and identifying ACMs were based on guidelines published by the USEPA *Guidelines for Controlling Friable Asbestos-Containing Materials in Buildings, Office of Pesticides and Toxic Substances*, EPA Report Number 560/5-85-024, June 1985. Areas were assessed for the presence of suspect surface coatings that may have been applied for fireproofing, acoustical, waterproofing, or thermal insulation purposes. An assessment of suspect miscellaneous ACMs was conducted.

3.20 INACCESSIBLE AREAS

Although GZA's intent was to conduct a thorough survey of the Site, it is important to note that we cannot guarantee that all asbestos within the surveyed areas has been identified, particularly since the Pier and most of the utility lines are currently active. In addition, ACMs have frequently been used in areas where detection is difficult until renovation, demolition, and/or asbestos abatement work begins and allows access to these remote areas. Where access to portions of the Site was unavailable or limited, GZA has provided an opinion as to the likely presence of asbestos containing materials consistent with the information available.

3.30 ASBESTOS BULK SAMPLING PROTOCOL

Suspect ACM includes installed building materials that were pre-formed (i.e., manufactured off-Site) or were prepared and installed on-Site and are known to potentially contain asbestos. The number of asbestos bulk samples typically collected depends on the type of identified suspect material. According to the USEPA/AHERA regulation, materials may be classified as surfacing (e.g., plaster), thermal (i.e., pipe insulation), or miscellaneous (e.g., vinyl tiles). The number of samples required increases as the potential for either a non-uniform mixture or poor asbestos distribution in the material increases.

As previously indicted, the Pier is a concrete, steel, and wood structure. The survey did not include any topside buildings, therefore, no building roofs, ceilings, walls, or floors were sampled. The results of the visual asbestos survey of the utilities beneath the pier indicated that no readily apparent evidence of sprayed-on fireproofing materials was observed in the areas that were accessible. For the purposes of this evaluation, materials which were considered non-suspect and were not assessed or sampled if observed included concrete, metal, plastics, rubber, synthetic foam, glass, ceramics, and wood.

The results of the visual asbestos survey indicated that thermal system insulation (TSI), i.e., suspected asbestos-containing pipe insulation, was observed at the pipe elbows of 8-inch utility pipes that extended in a north-south direction; see survey results below. An apparent transite of fiberglass pipe was observed at the bulkhead; refer to Photograph P-3.

Bulk sampling was conducted of the TSI, various types of suspect ACMs, and also of representative utility coverings. A total of 161 bulk samples of utility materials were obtained during the field survey for laboratory analysis of asbestos content. These representative materials included:

- tar and felt papers;
- tar and asphalt coatings;
- rubber coatings;
- protective coatings (unspecified);
- fibrous insulations;
- wools;
- fibrous meshes;
- glue dabs;
- caulkings;
- adhesives;
- mastics;
- rubbers with mastic;
- plastics with mastic; and
- foams with mastic.

Samples were placed in airtight, tight-sealing plastic bags. The sample bags were then wet wiped of visible debris, assigned an identification number, and shipped for laboratory analysis following chain-of-custody protocol.

3.40 ASBESTOS SURVEY RESULTS

Samples were analyzed by ProScience Analytical Services, Inc., of Woburn Massachusetts using polarized light microscopy with dispersion staining (PLM/DS) in accordance with EPA Method 600/R-93/116. A copy of the Asbestos Analytical Laboratory Reports are provided in Appendix C along with the corresponding chain-of-custody documentations.

Based on the results of analytical laboratory testing, asbestos concentrations were detected in 27 samples. The following asbestos-containing materials (ACMs) were identified:

Field ID / Location, Description, Sampled date	% ACM
A-27, 8", White Fiber @ Elbow, 3/8/10	10
A-43, 8", White Fibrous Powder @ Elbow, 3/9/10	40
A-73, 8", White Fibrous @ Elbow, 3/8/10	70
A-89, 8", White Fibrous @ Elbow, 3/8/10	70
A-128, 8", N-S, Black Asphalt Pipe Elbow, white fibrous insulation, 2/5/10	40
A-103, 8", N-S, Black Asphalt Pipe Elbow, white fibrous insulation, 2/5/10	50
D-2, 16"/18", Black Tar on Valve Plastic Pipe, 3/10/10	10
D-2, 18", Tar outer covering on metal, 2/4/10	20
G-43, 8", Black Tar on Paper, 3/9/10	20
G-103, 8", Black Tar on Pipe, 3/9/10	20
I-128, 8", Tar on Paper -Tan Paper Cover, 3/9/10	10
J-127, 8", Black Tar paper with tan backing, 2/5/10	5
N-38, 8", Black tar inner layer on metal pipe, 2/5/10	10
N-38, 8", Grayish-white paper on inner metal pipe, 2/5/10	20
N-38/43, 8", Black outer tar paper, 2/4/10	10
O-27, 8", N-S, Black Asphalt Pipe Elbow, white fibrous insulation, 2/5/10	10
P-2, 13", Tar Coated Inner Layer, 3/9/10	20
P-3, 18", Black Tar Paper Outer Layer, 2/1/10	20
P-18, 18", Black Tar Paper Inner Layer, 2/1/10	15
P-36, 18", Black Tar Inner coating on metal, 2/1/10	10
P-53, 18", Black Tar Innermost coating on steel, 2/1/10	20
P-53, 18", Black Tar Paper Inner Layer, 2/1/10	Trace
P-73, 8", N-S, Black Asphalt Pipe Elbow, white fibrous insulation, 2/5/10	30
P-93, 18", Tar Paper Inner asphalt coating, 2/1/10	10
P-109, 18", Black Inner Tar on Metal Pipe, 3/10/10	10
P-128, 18", Black Tar on metal pipe, 2/1/10	20
P-152, 14", Black Inner Tar on Metal Pipe, 3/10/10	30

Asbestos concentrations were not detected in any of the remaining 134 samples above the regulatory criteria of 1%.

5.00 RECOMMENDATIONS

Prior to conducting demolition/renovation activities that may impact the confirmed ACM, a Rhode Island-licensed asbestos abatement contractor must be retained to remove the ACM. Since the identified ACM is currently in generally good condition, it is recommended that the material be maintained in place under an Operations and Maintenance Plan until any renovation/demolition activities which may impact the materials are planned.

GZA recommends that following the initial phase of renovation/demolition, the inspector who performed this assessment be notified to conduct a supplemental inspection to identify any suspect ACM that may have been obscured or restricted during the assessment. Care should be taken not to disturb material identified as asbestos prior to or during renovation/demolition work.

5.00 QUALIFICATIONS AND LIMITATIONS

Environmental Professional Qualifications are attached in Appendix D. GZA's assessment was performed in accordance with generally accepted practices of other consultants undertaking similar studies at the same time and in the same geographical area, and GZA observed the degree of care and skill generally exercised by other consultants under similar circumstances and conditions. GZA's findings and conclusions must be considered not as scientific certainties, but rather as our professional opinions concerning the significance of the limited data gathered during the course of the assessment. No other warranty, express or implied, is made. This report is also subject to the specific limitations contained in Appendix A.

This study and report have been prepared for the Client, its successors and assigns, solely for use as an asbestos assessment to the extent set forth in our proposal. GZA's aggregate Liability to all parties who may come to rely upon the report is limited to the amount set forth in the Terms and Conditions and is not hereby expanded. This report and the findings contained herein shall not, in whole or in part, be disseminated or conveyed to any other party, nor used by any other party in whole or in part, without the prior written consent of GZA. Client acknowledges and agrees that reliance upon the report and the findings in the report by any other party, or for any other purpose, shall be at that party's sole risk and without any liability to GZA.

J:\ENV\32607.14.MJB\32607.14 REP.DOC

D-10 DEVELOPMENT OF A PRG FOR BENZO(A)PYRENE IN MARINE SEDIMENT

Action Item 3 From 10/23/13

Development of A PRG for Benzo(a)pyrene in Marine Sediment at Site 19

Summarized from SAIC, 1998

In the development of PRGs for Site 19 marine sediment, one PRG was developed for protection of human health: benzo(a)pyrene was identified as a limiting COC based on risk from ingestion of shellfish. In this exposure scenario, it was assumed that the exposure point concentrations of benzo(a)pyrene measured in the fish tissue is taken up from the sediment by the shellfish and transferred in its toxic form to a fisherman consuming an annual average of 15.6 g/day of shellfish. This is an adequate quantity of shellfish to make up 36.5 meals per year for an adult 18 to 65 years of age[(1)]. Using the measured risk, the PRG was back-calculated in four basic steps:

(1) Calculate an acceptable risk-based value (RBV) for COCs in shellfish tissue based on a cancer risk of 1E-6 and the exposure model provided in the HHRA.
(2) Compare the RBV to reference (background) tissue concentrations to assure RBVs are not above reference[(2)]
(3) Select "Limiting" COCs in the media by selecting the COCs which drive risk for the scenario, and which are predominantly present across the sample set.
(4) Calculate a sediment concentration for limiting COCs using Biological-Sediment Accumulation Factors (BSAFs) established in scientific literature.

A PRG of 53.9 µg/kg for benzo(a)pyrene in sediment was calculated using this approach. This PRG value was identified as a "Baseline PRG", meaning that it was purely a calculated value, with uncertainties of the conversions described and contaminant transfers between three media. The Baseline PRG was compared to site data available at the time and it was found to be exceeded in 34 of the 41 samples, including those well outside of what was understood to be an impact area for releases at the site. Exceedances extended outside of Coddington Cove into the east passage of Narragansett Bay, and were unbounded where no shoreline was present. Qualitative evaluation noted the depositional nature of Coddington Cove which is likely to encourage accumulation of PAHs, the concentrations that would be expected to exist in marine sediment within a commercial port and lack of comparability of this value to literature values indicating impacted marine sediment. It was determined that a value of 53.9 µg/kg benzo(a)pyrene in sediment could not be justified as a goal to direct a remedial action. Multipliers of this value (x2, x5, and x10) were all calculated and mapped against available data, and the x10 multiplier resulted in a COC concentration that indicated support of the conceptual site model: Exceedances of 10x the Baseline PRG (539 µg/kg) were evident along the waterfront where releases of contaminants from Site 19 are likely to have occurred. Similarly, it was a value that provided better comparison to literature based values indicative of impact to marine sediment within port areas.

The terminology that was used for the value ("PRG-HQ of 10") in the PRG development document, and carried forward in correspondence is incorrect since the subject PRG is actually a value developed from a target ILCR of 1E-6 for this COC. In risk assessment, the term Hazard Quotient, or HQ, is a term associated only with a non-cancer risk, and in this context of a HQ based PRG, the term is incorrectly used because it is not a non-cancer based PRG. The authors of the PRG document were utilizing quotients for development of ecological cleanup goals and the terminology seems to have been incorrectly carried forward from those comparisons.

The adjusted PRG (539 µg/kg) provides a justifiable match to the CSM, and its derivation by a 10x multiplier also equates it as a PRG developed from an ILCR of 1E-5. The value of 539 µg/kg also provides comparability to known effects concentrations in marine sediment, and allows for the real variations and uncertainties that

should be expected in predicting the transfer of the chemical from sediment to shellfish and then to humans by ingestion. All these factors combine to agree that a PRG of 539 µg/kg for benzo(a)pyrene in depositional marine sediment is justifiably conservative to support a remedial action.

[1]This shellfish ingestion scenario is described in the HHRA as a subsistence scenario, where the fisherman would be collecting shellfish from this and other parts of Narragansett Bay, though it could be considered a recreational scenario with exclusive fishing activity within the study area only.

[2]Note that due to different reporting units, data was converted from wet weight to dry weight for comparison to reference and through transfer between media using BSAFs.

APPENDIX E

COST ESTIMATES FOR REMEDIAL ALTERNATIVES

E-1 ALTERNATIVE 1

TABLE E1-1.1
NAVAL STATION NEWPORT
NEWPORT, RI
Site 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
Alternative SD1: No Action
Capital Cost Detail Sheet

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
NO ACTION							$0	$0	$0	$0	$0
Subtotal							$0	$0	$0	$0	$0
Total Direct Cost							$0	$0	$0	$0	$0
Subtotal											$0
Health & Safety Monitoring @ 2%											$0
Total Field Cost											$0
Engineering and Oversight on Total Field Cost @ 10%											$0
Contingency on Total Field Cost @ 20%											$0
TOTAL CAPITAL COST											**$0**

TABLE E1-1.2
NAVAL STATION NEWPORT
NEWPORT, RI
Site 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
Alternative SD1: No Action
Long Term Costs

Item	Quantity	Unit	Unit Cost Subcontract	Material	Labor	Equipment	Subtotal
ANNUAL COSTS							
TOTAL ANNUAL COST							$0
10% CONTINGENCY							$0
TOTAL							**$0**
FIVE YEAR COSTS							
TOTAL 5 YEAR COST							$0
10% CONTINGENCY							$0
TOTAL							**$0**

TABLE E1-1.3
NAVAL STATION NEWPORT
NEWPORT, RI
Site 19 - DERECKTOR SHIPYARD MARINE SEDIMENT
Alternative SD1: No Action
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 2.0%	Present Worth
0	$0		$0	1.000	$0
1		$0	$0	0.980	$0
2		$0	$0	0.961	$0
3		$0	$0	0.942	$0
4		$0	$0	0.924	$0
5		$0	$0	0.906	$0
6		$0	$0	0.888	$0
7		$0	$0	0.871	$0
8		$0	$0	0.853	$0
9		$0	$0	0.837	$0
10		$0	$0	0.820	$0
11		$0	$0	0.804	$0
12		$0	$0	0.788	$0
13		$0	$0	0.773	$0
14		$0	$0	0.758	$0
15		$0	$0	0.743	$0
16		$0	$0	0.728	$0
17		$0	$0	0.714	$0
18		$0	$0	0.700	$0
19		$0	$0	0.686	$0
20		$0	$0	0.673	$0
21		$0	$0	0.660	$0
22		$0	$0	0.647	$0
23		$0	$0	0.634	$0
24		$0	$0	0.622	$0
25		$0	$0	0.610	$0
26		$0	$0	0.598	$0
27		$0	$0	0.586	$0
28		$0	$0	0.574	$0
29		$0	$0	0.563	$0
30		$0	$0	0.552	$0
				TOTAL PRESENT WORTH	**$0**

E-2 ALTERNATIVE 2

TABLE E1-2.1
NAVAL STATION NEWPORT
NEWPORT, RI
Site 19 -DERECKTOR SHIPYARD MARINE SEDIMENT
Alternative SD2: ENR through Thin Layer Cover, LUCs, and Monitoring
Capital Cost Detail Sheet

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Design Documents & Specs	1,200	hr			$37.00		$0	$0	$44,400	$0	$44,400
1.2 Prepare Permits and RA Work Plans	500	hr			$37.00		$0	$0	$18,500	$0	$18,500
1.3 Prepare LUCs	250	hr			$50.00		$0	$0	$12,500	$0	$12,500
1.4 Prepare LTM Plans & SAP	250	hr			$50.00		$0	$0	$12,500	$0	$12,500
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Equipment Mobilization/Demobilization	1	ls	$500,000.00				$500,000	$0	$0	$0	$500,000
2.2 Silt Curtain Purchase and Management	1	ls	$150,000.00				$150,000	$0	$0	$0	$150,000
3 SITE PREPARATION											
3.1 Multibeam Bathymetric Survey (pre-cover, open water)	15	ea	$6,000.00				$90,000	$0	$0	$0	$90,000
3.2 Singlebeam Bathymetric Survey (pre-cover, beneath pie	2	ea	$10,000.00				$20,000	$0	$0	$0	$20,000
4 THIN LAYER COVER PLACEMENT											
4.1 Open Water Capping (thin layer cover)	10,868	cy	$59.00				$641,212	$0	$0	$0	$641,212
4.2 Sub-Pier Capping (thin layer cover)	4,273	cy	$133.49				$570,403	$0	$0	$0	$570,403
4.3 Water Quality Monitoring	15,141	cy	$4.75				$71,920	$0	$0	$0	$71,920
5 POST CONSTRUCTION COSTS											
5.1 Contractor Completion Report	800	hr			$37.00		$0	$0	$29,600	$0	$29,600
5.2 Remedial Action Closeout Report	500	hr			$37.00		$0	$0	$18,500	$0	$18,500
5.3 Multibeam Bathymetric Survey	15	ea	$6,000.00				$90,000	$0	$0	$0	$90,000
5.4 Single-Beam Bathymetric Survey (beneath pier)	2	ea	$10,000.00				$20,000	$0	$0	$0	$20,000
Subtotal							$2,153,535	$0	$136,000	$0	$2,289,535
Overhead on Labor cost - 30%									$40,800		$40,800
G & A on labor - 10%	G&A on construction included in LS costs above						$0	$0	$13,600	$0	$13,600
Tax on material and Equipment - 7%								$0		$0	$0
Total Direct Cost							$2,153,535	$0	$190,400	$0	$2,343,935
Indirects on total direct cost - 25%	included in LS costs above										$0
Profit on total direct cost - 10%	included in LS costs above										$0
Subtotal											$2,343,935
Health & Safety Monitoring @	2%										$46,879
Total Field Cost											$2,390,813
Engineering and Oversight on Total Field Cost @	10%										$239,081
Contingency on Total Field Cost @	20%										$478,163
TOTAL CAPITAL COST											**$3,108,057**

Source: APEX CO 12/19/13

TABLE E1-2.2
NAVAL STATION NEWPORT
NEWPORT, RI
Site 19 -DERECKTOR SHIPYARD MARINE SEDIMENT
Alternative SD2: ENR through Thin Layer Cover, LUCs, and Monitoring
Long Term Costs

Item	Quantity	Unit	Unit Cost Subcontract	Material	Labor	Equipment	Subtotal
ANNUAL COSTS							
1 YEARLY SITE INSPECTION/VISIT - Assume out of town travel to site, for interviews with site personnel and to ensure implementation of LUCs.							
1.1 Rental Car	1	day				$100.00	$100
1.2 Field Labor	12	hour			$75.00		$900
1.3 Report Production	16	hour			$85.00		$1,360
1.4 Miscelaneous Supplies, Copying, etc.	1	ls		$500.00			$500
2 SEDIMENT SAMPLING - Labor, materials, and analytical costs to conduct LTM sediment sampling (approximately 12 samples plus QC) throughout covered areas of the site.							
2.1 Rental Car	2	day				$100.00	$200
2.2 Field Labor	40	hour			$75.00		$3,000
2.3 Marine Sampling Services	1	ls	$5,000.00				$5,000
2.4 IDW Disposal	1	ls	$500.00				$500
2.5 Miscelaneous Supplies, Copying, etc.	1	ls		$2,500.00			$2,500
2.6 PCBs Sample Analysis	15	ea	$80.00				$1,200
2.7 PAHs Sample Analysis	15	ea	$150.00				$2,250
2.8 Lead Sample Analysis	15	ea	$130.00				$1,950
2.9 QA & QC Data Validation (40% of analysis cost)	1	ls			$2,160.00		$2,160
2.10 Report Preparation & Submittal	1	ls			$5,500.00		$5,500
2.1 Report Comment Response and Republication	1	ls			$8,500.00		$8,500
TOTAL ANNUAL COST							$35,620
10% CONTINGENCY							$3,562
TOTAL ANNUAL							**$39,182**
FIVE YEAR COSTS							
1 FIVE YEAR REVIEW - Assumes that five year review for this site is a component of other for NAVSTA Newport and that only one 5 year review will be required during each cycle.							
1.1 Report LTM results and remedy assessment in 5 Year Review	1	ls			$23,000.00		$23,000
2 FIVE YEAR BATHYMETRIC SURVEY / CAP INSPECTION							
2.1 Open Water Areas	15	ea	$6,000.00				$90,000
2.2 Sub-Pier Areas	2	ea	$10,000.00				$20,000
3 CAP MAINTENANCE AND REPAIRS							
3.1 10% of total capital cost for capping (Item 4)	1	ls	$128,353.45				$128,353
TOTAL 5 YEAR COST							$261,353
10% CONTINGENCY							$26,135
TOTAL FIVE YEAR							**$287,489**

TABLE E1-2.3
NAVAL STATION NEWPORT
NEWPORT, RI
Site 19 -DERECKTOR SHIPYARD MARINE SEDIMENT

Alternative SD2: ENR through Thin Layer Cover, LUCs, and Monitoring
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 2.0%	Present Worth
0	$3,108,057		$3,108,057	1.000	$3,108,057
1		$39,182	$39,182	0.980	$38,414
2		$39,182	$39,182	0.961	$37,661
3		$39,182	$39,182	0.942	$36,922
4		$39,182	$39,182	0.924	$36,198
5		$326,671	$326,671	0.906	$295,876
6		$39,182	$39,182	0.888	$34,792
7		$39,182	$39,182	0.871	$34,110
8		$39,182	$39,182	0.853	$33,441
9		$39,182	$39,182	0.837	$32,786
10		$326,671	$326,671	0.820	$267,984
11		$39,182	$39,182	0.804	$31,513
12		$39,182	$39,182	0.788	$30,895
13		$39,182	$39,182	0.773	$30,289
14		$39,182	$39,182	0.758	$29,695
15		$326,671	$326,671	0.743	$242,721
16		$39,182	$39,182	0.728	$28,542
17		$39,182	$39,182	0.714	$27,982
18		$39,182	$39,182	0.700	$27,434
19		$39,182	$39,182	0.686	$26,896
20		$326,671	$326,671	0.673	$219,840
21		$39,182	$39,182	0.660	$25,851
22		$39,182	$39,182	0.647	$25,344
23		$39,182	$39,182	0.634	$24,847
24		$39,182	$39,182	0.622	$24,360
25		$326,671	$326,671	0.610	$199,116
26		$39,182	$39,182	0.598	$23,414
27		$39,182	$39,182	0.586	$22,955
28		$39,182	$39,182	0.574	$22,505
29		$39,182	$39,182	0.563	$22,064
30		$326,671	$326,671	0.552	$180,345
				TOTAL PRESENT WORTH	**$5,222,851**

E-3 ALTERNATIVE 3

TABLE E1-3.1
NAVAL STATION NEWPORT
NEWPORT, RI
Site 19 - Derecktor Shipyard Marine Sediment
Alternative SD3: In-Situ Cap (Engineered Barrier), LUCs, and Monitoring.
Capital Cost Detail Sheet

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Design Documents & Specs	1,200	hr			$37.00		$0	$0	$44,400	$0	$44,400
1.2 Prepare Permits and RA Work Plans	500	hr			$37.00		$0	$0	$18,500	$0	$18,500
1.3 Prepare LUCs	250	hr			$50.00		$0	$0	$12,500	$0	$12,500
1.4 Prepare LTM Plans & SAP	250	hr			$50.00		$0	$0	$12,500	$0	$12,500
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Equipment Mobilization/Demobilization	1	ls	$500,000.00				$500,000	$0	$0	$0	$500,000
2.2 Silt Curtain Purchase and Management	1	ls	$150,000.00				$150,000	$0	$0	$0	$150,000
3 SITE PREPARATION											
3.1 Multibeam Bathymetric Survey	15	ea	$6,000.00				$90,000	$0	$0	$0	$90,000
3.2 Singlebeam Bathymetric Survey (beneath pier)	2	ea	$10,000.00				$20,000	$0	$0	$0	$20,000
4 CAPPING											
4.1 Open Water Capping (2 foot engineered cap)	22,732	cy	$59.00				$1,341,188	$0	$0	$0	$1,341,188
4.2 Sub-Pier Capping (2 foot engineered cap)	8,794	cy	$133.49				$1,173,911	$0	$0	$0	$1,173,911
4.3 Water Quality Monitoring	31,526	cy	$4.75				$149,749	$0	$0	$0	$149,749
5 POST CONSTRUCTION COSTS											
5.1 Contractor Completion Report	800	hr			$37.00		$0	$0	$29,600	$0	$29,600
5.2 Remedial Action Closeout Report	500	hr			$37.00		$0	$0	$18,500	$0	$18,500
5.3 Multibeam Bathymetric Survey	15	ea	$6,000.00				$90,000	$0	$0	$0	$90,000
5.4 Singlebeam Bathymetric Survey (beneath pier)	2	ea	$10,000.00				$20,000	$0	$0	$0	$20,000
Subtotal							$3,534,848	$0	$136,000	$0	$3,670,848
Overhead on Labor cost - 30%									$40,800		$40,800
G & A on labor - 10%	G&A on construction included in LS costs above						$0	$0	$13,600	$0	$13,600
Tax on material and Equipment - 7%								$0		$0	$0
Total Direct Cost							$3,534,848	$0	$190,400	$0	$3,725,248
Indirects on total direct cost - 25%	included in LS costs above										$0
Profit on total direct cost - 10%	included in LS costs above										$0
Subtotal											$3,725,248
Health & Safety Monitoring @	2%										$74,505
Total Field Cost											$3,799,753
Engineering and Oversight on Total Field Cost @	10%										$379,975
Contingency on Total Field Cost @	20%										$759,951
TOTAL CAPITAL COST											**$4,939,678**

Source: APEX CO 12/19/13

TABLE E1-3.2
NAVAL STATION NEWPORT
NEWPORT, RI
Site 19 - Derecktor Shipyard Marine Sediment
Alternative SD3: In-Situ Cap (Engineered Barrier), LUCs, and Monitoring.
Long Term Costs

Item	Quantity	Unit	Unit Cost Subcontract	Material	Labor	Equipment	Subtotal
ANNUAL COSTS							
1 YEARLY SITE INSPECTION/VISIT - Assume out of town travel to site, for interviews with site personnel and to ensure implementation of LUCs.							
1.1 Rental Car	1	day				$100.00	$100
1.2 Field Labor	12	hour			$75.00		$900
1.3 Report Production	16	hour			$85.00		$1,360
1.4 Miscelaneous Supplies, Copying, etc.	1	ls		$500.00			$500
2 SEDIMENT SAMPLING - Labor, materials, and analytical costs to conduct LTM sediment sampling (approximately 12 samples plus QC) throughout covered areas of the site.							
2.1 Rental Car	2	day				$100.00	$200
2.2 Field Labor	40	hour			$75.00		$3,000
2.3 Marine Sampling Services	1	ls	$5,000.00				$5,000
2.4 IDW Disposal	1	ls	$500.00				$500
2.5 Miscelaneous Supplies, Copying, etc.	1	ls		$2,500.00			$2,500
2.6 PCBs Sample Analysis	15	ea	$80.00				$1,200
2.7 PAHs Sample Analysis	15	ea	$150.00				$2,250
2.8 Lead Sample Analysis	15	ea	$130.00				$1,950
2.9 QA & QC Data Validation (40% of analysis cost)	1	ls			$2,160.00		$2,160
2.10 Report Preparation & Submittal	1	ls			$5,500.00		$5,500
2.1 Report Comment Response and Republication	1	ls			$8,500.00		$8,500
TOTAL ANNUAL COST							$35,620
10% CONTINGENCY							$3,562
TOTAL ANNUAL							**$39,182**
FIVE YEAR COSTS							
1 FIVE YEAR REVIEW - Assumes that five year review for this site is a component of other for NAVSTA Newport and that only one 5 year review will be required during each cycle.							
1.1 Report LTM results and remedy assessment in 5 Year Review	1	ls			$23,000.00		$23,000
2 FIVE YEAR BATHYMETRIC SURVEY / CAP INSPECTION							
2.1 Open Water Areas	15	ea	$6,000.00				$90,000
2.2 Sub-Pier Areas	2	ea	$10,000.00				$20,000
3 CAP MAINTENANCE AND REPAIRS							
3.1 10% of total capital cost for capping (Item 4)	1	ls	$266,484.76				$266,485
TOTAL 5 YEAR COST							$399,485
10% CONTINGENCY							$39,948
TOTAL FIVE YEAR							**$439,433**

TABLE E1-3.3
NAVAL STATION NEWPORT
NEWPORT, RI
Site 19 - Derecktor Shipyard Marine Sediment
Alternative SD3: In-Situ Cap (Engineered Barrier), LUCs, and Monitoring.
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 2.0%	Present Worth
0	$4,939,678		$4,939,678	1.000	$4,939,678
1		$39,182	$39,182	0.980	$38,414
2		$39,182	$39,182	0.961	$37,661
3		$39,182	$39,182	0.942	$36,922
4		$39,182	$39,182	0.924	$36,198
5		$478,615	$478,615	0.906	$433,497
6		$39,182	$39,182	0.888	$34,792
7		$39,182	$39,182	0.871	$34,110
8		$39,182	$39,182	0.853	$33,441
9		$39,182	$39,182	0.837	$32,786
10		$478,615	$478,615	0.820	$392,631
11		$39,182	$39,182	0.804	$31,513
12		$39,182	$39,182	0.788	$30,895
13		$39,182	$39,182	0.773	$30,289
14		$39,182	$39,182	0.758	$29,695
15		$478,615	$478,615	0.743	$355,618
16		$39,182	$39,182	0.728	$28,542
17		$39,182	$39,182	0.714	$27,982
18		$39,182	$39,182	0.700	$27,434
19		$39,182	$39,182	0.686	$26,896
20		$478,615	$478,615	0.673	$322,094
21		$39,182	$39,182	0.660	$25,851
22		$39,182	$39,182	0.647	$25,344
23		$39,182	$39,182	0.634	$24,847
24		$39,182	$39,182	0.622	$24,360
25		$478,615	$478,615	0.610	$291,731
26		$39,182	$39,182	0.598	$23,414
27		$39,182	$39,182	0.586	$22,955
28		$39,182	$39,182	0.574	$22,505
29		$39,182	$39,182	0.563	$22,064
30		$478,615	$478,615	0.552	$264,230
				TOTAL PRESENT WORTH	**$7,708,390**

E-4 ALTERNATIVE 4

TABLE E1-4.1
NAVAL STATION NEWPORT
NEWPORT, RI
Site 19 - Derecktor Shipyard Marine Sediment
Alternative SD4: Combination Dredge/Backfill (open water); Cap, LUCs, and Monitoring (under Pier 2).
Capital Cost Detail Sheet

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Design Documents and Specs	1,500	hr			$37.00		$0	$0	$55,500	$0	$55,500
1.2 Prepare Permits and RA Work Plans	500	hr			$37.00		$0	$0	$18,500	$0	$18,500
1.3 Prepare LUCs	250	hr			$50.00		$0	$0	$12,500	$0	$12,500
1.4 Prepare LTM Plans & SAP	250	hr			$50.00		$0	$0	$12,500	$0	$12,500
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Equipment Mobilization/Demobilization	1	ls	$1,175,000.00				$1,175,000	$0	$0	$0	$1,175,000
2.2 Silt Curtain Purchase and Management	1	ls	$150,000.00				$150,000	$0	$0	$0	$150,000
3 SITE PREPARATION											
3.1 Debris Removal	2,138	ton	$300.00				$641,400	$0	$0	$0	$641,400
3.2 Multibeam Bathymetric Survey (open water)	13	ea	$6,000.00				$78,000	$0	$0	$0	$78,000
3.3 Singlebeam Bathymetric Survey (sub-pier)	2	ea	$10,000.00				$20,000	$0	$0	$0	$20,000
4 DREDGING (open water areas)											
4.1 Dredging (mechanical & hydraulic)	14,016	cy	$59.35				$831,850	$0	$0	$0	$831,850
4.2 Water Quality Monitoring (dredging)	14,016	cy	$4.75				$66,576	$0	$0	$0	$66,576
4.3 Transportation and Offsite Disposal (RCRA-D)	21,024	ton	$166.67				$3,504,070	$0	$0	$0	$3,504,070
4.4 Multibeam Bathymetric Survey (post dredge)	13	ea	$6,000.00				$78,000	$0	$0	$0	$78,000
4.5 Backfill	14,016	cy	$59.00				$826,944	$0	$0	$0	$826,944
4.6 Water Quality Monitoring (backfill)	14,016	cy	$4.75				$66,576	$0	$0	$0	$66,576
5 CAPPING (sub-pier areas)											
5.1 Sub-Pier Capping (2 foot engineered cap)	8,794	cy	$133.49				$1,173,911	$0	$0	$0	$1,173,911
5.2 Water Quality Monitoring	8,794	cy	$4.75				$41,772	$0	$0	$0	$41,772
6 POST CONSTRUCTION COSTS											
6.1 Contractor Completion Report	850	hr			$37.00		$0	$0	$31,450	$0	$31,450
6.2 Remedial Action Closeout Report	500	hr			$37.00		$0	$0	$18,500	$0	$18,500
6.3 Multibeam Bathymetric Survey (open water)	13	ea	$6,000.00				$78,000	$0	$0	$0	$78,000
6.4 Singlebeam Bathymetric Survey (sub-pier)	2	ea	$10,000.00				$20,000	$0	$0	$0	$20,000
7 CONFIRMATION SAMPLING											
7.1 Prepare SAP, Procure Subcontracts	120	hr			75		$0	$0	$9,000	$0	$9,000
7.2 Marine Sediment Sampling Services	1	ls	$12,000.00				$12,000	$0	$0	$0	$12,000
7.3 Sample Analysis	55	ea	$360.00				$19,800	$0	$0	$0	$19,800
7.4 Prepare Report	100	hr			75		$0	$0	$7,500	$0	$7,500
Subtotal							$8,783,898	$0	$165,450	$0	$8,949,348
Overhead on Labor cost - 30%									$49,635		$49,635
G & A on labor - 10%	G&A on construction included in LS costs above						$0	$0	$16,545	$0	$16,545
Tax on material and Equipment - 7%								$0		$0	$0
Total Direct Cost							$8,783,898	$0	$231,630	$0	$9,015,528
Indirects on total direct cost - 25%	included in unit costs above										$0
Profit on total direct cost - 10%	included in unit costs above										$0
Subtotal											$9,015,528
Health & Safety Monitoring @	2%										$180,311
Total Field Cost											$9,195,839
Engineering and Oversight on Total Field Cost @	10%										$919,584
Contingency on Total Field Cost @	20%										$1,839,168
TOTAL CAPITAL COST											**$11,954,590**

Source: APEX CO 12/19/13

TABLE E1-4.2
NAVAL STATION NEWPORT
NEWPORT, RI
Site 19 - Derecktor Shipyard Marine Sediment
Alternative SD4: Combination Dredge/Backfill (open water); Cap, LUCs, and Monitoring (under Pier 2).
Long Term Costs

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Subtotal
ANNUAL COSTS							
1 YEARLY SITE INSPECTION/VISIT - Assume out of town travel to site, for interviews with site personnel and to ensure implementation of LUCs.							
1.1 Rental Car	1	day				$100.00	$100
1.2 Field Labor	12	hour			$75.00		$900
1.3 Report Production	16	hour			$85.00		$1,360
1.4 Miscelaneous Supplies, Copying, etc.	1	ls		$500.00			$500
2 SEDIMENT SAMPLING - Labor, materials, and analytical costs to conduct LTM sediment sampling (approximately 15 samples plus QC) throughout covered areas of the site.							
2.1 Rental Car	3	day				$100.00	$300
2.2 Field Labor	40	hour			$75.00		$3,000
2.3 Marine Sampling Services	1	ls	$3,000.00				$3,000
2.4 IDW Disposal	1	ls	$500.00				$500
2.5 Miscelaneous Supplies, Copying, etc.	1	ls		$1,500.00			$1,500
2.6 PCBs Sample Analysis	18	ea	$80.00				$1,440
2.7 PAHs Sample Analysis	18	ea	$150.00				$2,700
2.8 Lead Sample Analysis	18	ea	$130.00				$2,340
2.9 QA & QC Data Validation (40% of analysis cost)	1	ls			$2,592.00		$2,592
2.10 Report Preparation & Submittal	1	ls			$5,500.00		$5,500
2.1 Report Comment Response and Republication	1	ls			$5,500.00		$5,500
TOTAL ANNUAL COST							$31,232
10% CONTINGENCY							$3,123
TOTAL ANNUAL							**$34,355**
FIVE YEAR COSTS							
1 FIVE YEAR REVIEW - Assumes that five year review for this site is a component of other for NAVSTA Newport and that only one 5 year review will be required during each cycle.							
1.1 Report LTM results and remedy assessment in 5 Year Review	1	ls			$23,000.00		$23,000
2 FIVE YEAR BATHYMETRIC SURVEY / CAP INSPECTION							
2.1 Sub-Pier Areas	2	ea	$10,000.00				$20,000
2.2 Open Water Areas	13	ea	$6,000.00				$78,000
3 CAP MAINTENANCE AND REPAIRS							
3.1 10% of total capital cost for capping (#5 Capital Cost Detail)	1	ls	$121,568.26				$121,568
TOTAL 5 YEAR COST							$242,568
10% CONTINGENCY							$24,257
TOTAL FIVE YEAR							**$266,825**

TABLE E1-4.3
NAVAL STATION NEWPORT
NEWPORT, RI
Site 19 - Derecktor Shipyard Marine Sediment
Alternative SD4: Combination Dredge/Backfill (open water); Cap, LUCs, and Monitoring (under Pier 2).
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 2.0%	Present Worth
0	$11,954,590		$11,954,590	1.000	$11,954,590
1		$34,355	$34,355	0.980	$33,682
2		$34,355	$34,355	0.961	$33,021
3		$34,355	$34,355	0.942	$32,374
4		$34,355	$34,355	0.924	$31,739
5		$301,180	$301,180	0.906	$272,788
6		$34,355	$34,355	0.888	$30,506
7		$34,355	$34,355	0.871	$29,908
8		$34,355	$34,355	0.853	$29,322
9		$34,355	$34,355	0.837	$28,747
10		$301,180	$301,180	0.820	$247,073
11		$34,355	$34,355	0.804	$27,631
12		$34,355	$34,355	0.788	$27,089
13		$34,355	$34,355	0.773	$26,558
14		$34,355	$34,355	0.758	$26,037
15		$206,413	$206,413	0.743	$153,368
16		$25,388	$25,388	0.728	$18,494
17		$34,355	$34,355	0.714	$24,535
18		$34,355	$34,355	0.700	$24,054
19		$34,355	$34,355	0.686	$23,582
20		$301,180	$301,180	0.673	$202,686
21		$34,355	$34,355	0.660	$22,667
22		$34,355	$34,355	0.647	$22,222
23		$34,355	$34,355	0.634	$21,787
24		$34,355	$34,355	0.622	$21,359
25		$301,180	$301,180	0.610	$183,579
26		$34,355	$34,355	0.598	$20,530
27		$34,355	$34,355	0.586	$20,127
28		$34,355	$34,355	0.574	$19,733
29		$34,355	$34,355	0.563	$19,346
30		$301,180	$301,180	0.552	$166,273
				TOTAL PRESENT WORTH	**$13,795,406**

E-5 ALTERNATIVE 5

TABLE E1-5.1
NAVAL STATION NEWPORT
NEWPORT, RI
Site 19 - Derecktor Shipyard Marine Sediment
Alternative SD5: Target Dredging (open water); Cap, LUCs, and Monitoring (under Pier 2).
Capital Cost Detail Sheet

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Design Documents and Specs	1,200	hr			$37.00		$0	$0	$44,400	$0	$44,400
1.2 Prepare Permits and RA Work Plans	500	hr			$37.00		$0	$0	$18,500	$0	$18,500
1.3 Prepare LUCs	250	hr			$50.00		$0	$0	$12,500	$0	$12,500
1.4 Prepare LTM Plans & SAP	250	hr			$50.00		$0	$0	$12,500	$0	$12,500
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Equipment Mobilization/Demobilization	1	ls	$1,175,000.00				$1,175,000	$0	$0	$0	$1,175,000
2.2 Silt Curtain Purchase and Management	1	ls	$150,000.00				$150,000	$0	$0	$0	$150,000
3 SITE PREPARATION											
3.1 Debris Removal	3,600	ton	$300.00				$1,080,000	$0	$0	$0	$1,080,000
3.2 Multibeam Bathymetric Survey (open water)	19	ea	$6,000.00				$114,000	$0	$0	$0	$114,000
3.3 Singlebeam Bathymetric Survey (sub-pier)	2	ea	$10,000.00				$20,000	$0	$0	$0	$20,000
4 DREDGING											
4.1 Dredging (mechanical and hydraulic)	27,646	cy	$59.35				$1,640,790	$0	$0	$0	$1,640,790
4.2 Water Quality Monitoring (dredging)	27,646	cy	$4.75				$131,319	$0	$0	$0	$131,319
4.3 Transportation and Offsite Disposal (RCRA-D)	41,469	ton	$166.67				$6,911,638	$0	$0	$0	$6,911,638
4.4 Multibeam Bathymetric Survey (post dredge)	19	ea	$6,000.00				$114,000	$0	$0	$0	$114,000
5 CAPPING											
5.1 Sub-Pier Capping (2 foot engineered cap)	8,794	cy	$133.49				$1,173,911	$0	$0	$0	$1,173,911
5.2 Water Quality Monitoring	8,794	cy	$4.75				$41,772	$0	$0	$0	$41,772
6 POST CONSTRUCTION COSTS											
6.1 Contractor Completion Report	500	hr			$37.00		$0	$0	$18,500	$0	$18,500
6.2 Remedial Action Closeout Report	500	hr			$37.00		$0	$0	$18,500	$0	$18,500
6.3 Singlebeam Bathymetric Survey (sub-pier)	2	ea	$10,000.00				$20,000	$0	$0	$0	$20,000
7 CONFIRMATION SAMPLING											
7.1 Prepare SAP, Procure Subcontracts	120	hr			$75.00		$0	$0	$9,000	$0	$9,000
7.2 Marine Sediment Sampling Services	1	ls	$12,000.00				$12,000	$0	$0	$0	$12,000
7.3 Sample Analysis	65	ea	$360.00				$23,400	$0	$0	$0	$23,400
7.4 Prepare Report	100	hr			$75.00		$0	$0	$7,500	$0	$7,500
Subtotal							$12,607,829	$0	$141,400	$0	$12,749,229
Overhead on Labor cost - 30%									$42,420		$42,420
G & A on labor - 10%	G&A on construction items included in LS costs above.						$0	$0	$14,140	$0	$14,140
Tax on material and Equipment - 7%								$0		$0	$0
Total Direct Cost							$12,607,829	$0	$197,960	$0	$12,805,789
Indirects on total direct cost - 25%	Included in construction costs above										$0
Profit on total direct cost - 10%	Included in construction costs above										$0
Subtotal											$12,805,789
Health & Safety Monitoring @	2%										$256,116
Total Field Cost											$13,061,905
Engineering and Oversight on Total Field Cost @	10%										$1,306,191
Contingency on Total Field Cost @	20%										$2,612,381
TOTAL CAPITAL COST											**$16,980,477**

Source: APEX CO 12/19/13

TABLE E1-5.2
NAVAL STATION NEWPORT
NEWPORT, RI
Site 19 - Derecktor Shipyard Marine Sediment
Alternative SD5: Target Dredging (open water); Cap, LUCs, and Monitoring (under Pier 2).
Long Term Costs

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Subtotal
ANNUAL COSTS							
1 YEARLY SITE INSPECTION/VISIT - Assume out of town travel to site, for interviews with site personnel and to ensure implementation of LUCs.							
1.1 Rental Car	1	day				$100.00	$100
1.2 Field Labor	12	hour			$75.00		$900
1.3 Report Production	16	hour			$85.00		$1,360
1.4 Miscelaneous Supplies, Copying, etc.	1	ls		$500.00			$500
2 SEDIMENT SAMPLING - Labor, materials, and analytical costs to conduct LTM sediment sampling (approximately 3 samples plus QC) throughout covered areas of the site.							
2.1 Rental Car	2	day				$100.00	$200
2.2 Field Labor	20	hour			$75.00		$1,500
2.3 Marine Sampling Services	1	ls	$3,000.00				$3,000
2.4 IDW Disposal	1	ls	$500.00				$500
2.5 Miscelaneous Supplies, Copying, etc.	1	ls		$1,500.00			$1,500
2.6 PCBs Sample Analysis	5	ea	$80.00				$400
2.7 PAHs Sample Analysis	5	ea	$150.00				$750
2.8 Lead Sample Analysis	5	ea	$130.00				$650
2.9 QA & QC Data Validation (40% of analysis cost)	1	ls			$720.00		$720
2.10 Report Preparation & Submittal	1	ls			$5,500.00		$5,500
2.1 Report Comment Response and Republication	1	ls			$5,500.00		$5,500
TOTAL ANNUAL COST							$23,080
10% CONTINGENCY							$2,308
TOTAL ANNUAL							**$25,388**
FIVE YEAR COSTS							
1 FIVE YEAR REVIEW - Assumes that five year review for this site is a component of other for NAVSTA Newport and that only one 5 year review will be required during each cycle.							
1.1 Report LTM results and remedy assessment in 5 Year Review	1	ls			$23,000.00		$23,000
2 FIVE YEAR BATHYMETRIC SURVEY / CAP INSPECTION							
2.1 Sub-Pier Areas	2	ea	$10,000.00				$20,000
3 CAP MAINTENANCE AND REPAIRS							
3.1 10% of total capital cost for capping (#5 Capital Cost Detail)	1	ls	$121,568.26				$121,568
TOTAL 5 YEAR COST							$164,568
10% CONTINGENCY							$16,457
TOTAL FIVE YEAR							**$181,025**

TABLE E1-5.3
NAVAL STATION NEWPORT
NEWPORT, RI
Site 19 - Derecktor Shipyard Marine Sediment
Alternative SD5: Target Dredging (open water); Cap, LUCs, and Monitoring (under Pier 2).
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 2.0%	Present Worth
0	$16,980,477		$16,980,477	1.000	$16,980,477
1		$25,388	$25,388	0.980	$24,890
2		$25,388	$25,388	0.961	$24,402
3		$25,388	$25,388	0.942	$23,924
4		$25,388	$25,388	0.924	$23,455
5		$206,413	$206,413	0.906	$186,955
6		$25,388	$25,388	0.888	$22,544
7		$25,388	$25,388	0.871	$22,102
8		$25,388	$25,388	0.853	$21,668
9		$25,388	$25,388	0.837	$21,244
10		$206,413	$206,413	0.820	$169,331
11		$25,388	$25,388	0.804	$20,419
12		$25,388	$25,388	0.788	$20,018
13		$25,388	$25,388	0.773	$19,626
14		$25,388	$25,388	0.758	$19,241
15		$206,413	$206,413	0.743	$153,368
16		$25,388	$25,388	0.728	$18,494
17		$25,388	$25,388	0.714	$18,131
18		$25,388	$25,388	0.700	$17,776
19		$25,388	$25,388	0.686	$17,427
20		$206,413	$206,413	0.673	$138,910
21		$25,388	$25,388	0.660	$16,750
22		$25,388	$25,388	0.647	$16,422
23		$25,388	$25,388	0.634	$16,100
24		$25,388	$25,388	0.622	$15,784
25		$206,413	$206,413	0.610	$125,815
26		$25,388	$25,388	0.598	$15,171
27		$25,388	$25,388	0.586	$14,874
28		$25,388	$25,388	0.574	$14,582
29		$25,388	$25,388	0.563	$14,296
30		$206,413	$206,413	0.552	$113,955
				TOTAL PRESENT WORTH	**$18,328,150**

E-6 COST BACKUP (APEX, 2013)

December 31, 2013
(Rev. 6)

CONCEPTUAL COST ESTIMATES
FOR FIVE POTENTIAL REMEDIAL ALTERNATIVES
Former Derecktor Shipyard
Naval Station Newport, Newport, RI

Apex Companies, LLC (Apex) has prepared the following conceptual cost estimates associated with five (5) conceptual remedial alternatives to address impacted sediment at the Former Derecktor Shipyard at Naval Station Newport, Newport, RI.

The five alternatives are as follows:

- Alternative 1 – No Action.
- Alternative 2 – Cover/Capping of 1 Foot Over Select Areas. – This option has been referred to as Enhanced Natural Recovery. The cover for this option is assumed to be granular material.
- Alternative 3 – Cover/Capping of 2 Feet Over Select Areas. This option has been referred to as an "Engineered Barrier". At present, however, the composition of the cap is assumed to be the same as Alternative 2 (i.e. granular material).
- Alternative 4 – Dredge and Backfill Select Areas With In-Situ Capping in Select Areas.
- Alternative 5 – Dredge Select Areas With In-Situ Capping in Select Areas.

Apex has made the following assumptions in preparing its unit cost pricing in the following manner:

- **Elimination of CAD Cell Creation, and Passive Dewatering as Dredge Options:** It is Apex's understanding that the State of Rhode Island has indicated that CAD Cell disposal will not be acceptable in association with this work. Additionally, it is unlikely that the available space (approximately 3 acres) will be sufficient for passive dewatering of dredge spoils; therefore, only mechanical dewatering is currently included in cost estimates.
- **Potential Use of Mechanical Dredging Options:** Due to the need to utilize hydraulic dredging for some areas of the work (shallow areas), it may not be feasible from a budgetary perspective to also conduct mechanical dredging simultaneously. Additionally, existing bathymetry indicates that the proposed dewatering site (see below) does not have sufficient draft adjacent to its bulkhead to allow for a scow to move adjacent to shore for the unloading of mechanical dredging spoils, which would hinder the use of mechanical dredging. Nevertheless, a tiered approach that integrates mechanical dredging into the dredging sequence may be necessary in order to address

You created this PDF from an application that is not licensed to print to novaPDF printer (http://www.novapdf.com)

potential debris that could hinder the functioning of hydraulic dredging equipment (see debris discussion below). In such an instance, mechanical dredges could be used to remove areas that have high quantities of debris into a scow, where the debris could be more easily segregated, and then material could be re-suspended and transported hydraulically to shore. For the purposes of this estimate, the mobilization and demobilization charges associated with both hydraulic and mechanical dredging have been included, and it is assumed that approximately 35% of the material would be dredged mechanically and then transferred onshore hydraulically.

- **Addition of Side-Slope Material Into Dredge Volumes:** Apex has included anticipated side-slope volumes into the total volumes for the dredge footprints. This information may vary somewhat when the full design is prepared; however, the updated volumes are more realistic compared to what volumes should be generated during construction.
- **Addition of Over-Capping Elevation Material**: Apex has added additional volume to capping materials in order to give the proposed contractor a margin of error for cap placement. This is typical for capping operations, as the contractor is not typically able to meet a capping elevation exactly.
- **Additional Costing Items For Hypothetical Under Pier Capping Operations**: After reviewing the photos and plans for the areas under the piers, Apex believes that traditional capping methods would be unlikely to be successful under the piers, and that a diver-led placement of capping materials would most likely be needed. The capping operation would be led by one to two divers that would be part of a three-diver crew. Additionally, there would be losses in efficiency for areas under the pier compared to traditional capping methods.
- **Costing Items for Debris Removal:** Discussions with Tetra Tech have indicated that there is the potential for debris to be present under or adjacent to pier areas due to historic repair and operation activities at the piers. Apex's experience has indicated that debris levels in these locations may be substantial, and Apex has included costs for removal of a relatively substantial quantity of debris; however, the actual quantities cannot be known until the work proceeds and a more informed estimate would require a pre-design inspection. Methodology for debris removal may vary somewhat depending upon the Contractor's means and methods; however, for the purposes of this evaluation, Apex assumes that debris is removed via a drag-line (a submersible rake that gathers and removes debris from the water for decontamination and offsite disposal) prior to conducting hydraulic dredging operations and/or a screen (a grating that would cover the dredge scow such that debris would be caught in the screen and be shunted to the side for segregation, decontamination and offsite disposal) that would be used in association with mechanical dredging operations, as discussed above. Apex recommends a debris survey be conducted during the design process.

A summary of the volumetric and area assumptions utilized in the cost estimates, as well as a relatively detailed breakdown of these cost estimates is attached to this letter within **Table 1**.

Due to the conceptual level of this project to date, costs have been culled from past projects Apex has been associated with, including hydraulic dredging projects, that have included active dewatering components and projects that have had some component of off-site transportation and disposal. This cost estimate is a preliminary estimate for budgeting purposes only and is based

You created this PDF from an application that is not licensed to print to novaPDF printer (http://www.novapdf.com)

on the broad concepts available at this time. Apex has included costs for conducting multi-beam surveys to complete pre-dredge, post-dredge, and post-capping surveys within the dredge areas contemplated in each Alternative. The survey costs are intended to demonstrate that the correct dredge and/or capping elevations, relative to the existing elevations, are achieved, in order to satisfy the project team that the work was completed in accordance with plans and specifications. Please note that multi-beam surveys for areas beneath the piers will not be possible because of the interference of the concrete decking of the pier from allowing GPS systems to operate properly; for this area, a single beam survey system at known points set in advance of the survey would be utilized instead.

Water quality monitoring costs have also been included. The water quality monitoring consists of turbidity monitoring that takes place at multiple levels in the water column both up-current and down-current of the dredging or capping operation. It is currently assumed that monitoring would take place utilizing an optical back-scatter turbidity monitor. Monitoring is estimated to occur for the first three days of dredging, and twice weekly thereafter, based on project schedules predicated on an assumption of 100 cy/day for capping or dredging under piers and 500 cy/day for capping or dredging in open water.

Please note that, until a project such as this has gone through the bidding process, that cost estimates have a relatively high level of uncertainty. At present, Apex has included a 10% cost for engineering oversight of the project, and an overall 20% contingency in the final cost estimate within **Table 1**.

The following additional information is provided regarding the assumptions utilized in preparing the conceptual cost estimates:

Dredging Technologies Anticipated for Each Area

It is currently anticipated that capping areas under the piers will require separate technology than the dredging, capping or backfilling areas that are not under existing piers, as outlined below:

Areas Not Under Piers

Prior to the start of dredging, debris removal will need to take place. Debris left in place could interfere with the efficiency of hydraulic dredging equipment (methods for debris removal are discussed above). This process could be lengthy, particularly if there is a significant quantity of debris, or if that debris is hidden below the surface of the ocean floor (again, the quantity will be confirmed during pre-design investigations).

Areas not currently under existing piers will likely utilize hydraulic dredging, which utilizes a cutting head to mix dredge material with water, which is then pumped to a dewatering location. The dredge runs along the bottom of the dredge area, and is connected to a barge which contains other support equipment. The dredge material is mixed with up to 10 times its volume in liquid, creating a slurry that can be pumped long distances, but must be dewatered prior to disposal. If the proposed dewatering location is far away, booster pumps may be needed to transport the dredge slurry to the dewatering location.

You created this PDF from an application that is not licensed to print to novaPDF printer (http://www.novapdf.com)

Should it be found that a large proportion of debris exists within the dredge material, it is possible that a combination of mechanical dredging (to remove the material and sort debris) plus hydraulic dredging (to transport the material to shore for dewatering) may be utilized. In that case, subsequent to initial mechanical dredging of the material into a scow, the material will be re-suspended within the scow and transported hydraulically to shore to the dewatering area.

Capping or backfill for open water areas could be completed in a number of different ways, and the methodology would likely be left open for the Contractor. Nevertheless, methodologies including: gravity-fed tremie pipe placement, release of material from slow-moving scows or barges, hydraulic washing of coarse sand from a flat-topped barge, or hydraulic transport via pipeline with baffle plate or sand box (or other type) for energy dissipation, could be considered for capping or backfill of material in open water.

Areas Under Piers

No dredging under the piers is currently envisioned within the five Alternatives currently under consideration. It is also currently considered unlikely that debris removal would be required prior to capping under the piers.

Capping for areas under the piers would likely be conducted utilizing the hydraulic methods (likely with pipeline and energy dissipation) listed above. Apex anticipates that coarse capping material would be transported to the nearest location via barge or scow. This material would be then transported hydraulically to the capping location by suspending the material and pumping it to the end of a pipe at the capping location. This work would likely be conducted at a significantly slower rate than that of placement in open water areas. The mechanics for placement of material are not dissimilar to those associated with removal, in that they involve mixing the materials into a slurry and transporting them some distance for placement via piping.

Overdredge and Side-Slopes

When designing a dredge project, it is necessary to grant a contractor an “over-dredge”, which is a depth beyond the target dredge depth that the contractor may be paid. “Over-dredge” depths are typically 1 foot, which would double the volume generated from a 1 foot dredge cut, as proposed within the presentation. However, contractors typically do not ultimately collect the whole over-dredge; therefore, Apex has assumed ¾ of a foot of over-dredge in its volumetric calculations to be conservative.

Typically, as one dredges a location, the side slopes slough into the excavation and need to be removed as well. Material typically ranges in the type of side-slope that it will retain underwater. The side-slope ranges from approximately 1H:6V to 1H:3V, depending on the material. Apex has assumed that the material to be dredged will likely hold to a 1H:5V (although this information will need to be confirmed later in the design process). Apex has assumed that capping material (which is likely to be sandy), will retain a steeper side slope (1H:3V) (although, again, this information will need to be confirmed later in the design process).

You created this PDF from an application that is not licensed to print to novaPDF printer (http://www.novapdf.com)

Dewatering Technologies Anticipated

Once the slurry reaches the dewatering location, Apex presumes that mechanical dewatering equipment will be utilized to remove the water. The water may need to be treated prior to discharge. Typical mechanical dewatering equipment could include a belt press, hydrocyclone, or other technology. Often, a polymer is added to speed coagulation of the material to increase the efficiency of mechanical dewatering.

Sedimentation Controls

Apex's experience in association with jobs such as this are that sedimentation controls may not be necessary if only hydraulic and suction dredging are utilized. Hydraulic and suction dredging relies on negative pressure to capture the dredge material that is generated during the dredging process. As a result, these dredging methodologies are unlikely to generate significant quantities of turbidity that may impact or degrade water quality. Therefore, there may be a reasonable argument that would indicate that sedimentation controls associated with dredging may not be necessary, and that a monitoring program may be adequate to maintain reasonable turbidity levels surrounding the dredge areas, with the use of sedimentation controls to be implemented if turbidity levels exceeded a designated threshold.

However, if mechanical dredging is utilized and/or turbidity controls associated with dredging are required by USEPA, Apex presumes that such controls could be utilized within the targeted dredge areas (although some areas may be more costly to implement than others). Silt curtains would likely be the most reasonable alternative to control potential siltation. Silt curtains are produced in lengths from 3 feet to up to 100 feet; however, documentation of historic use of silt curtains indicate that they have been most typically utilized within water depths of 25 feet of water or less. Use of silt curtains within deeper water is possible; however, the silt curtains become increasingly vulnerable to the force of currents, which can displace the curtains or otherwise impair their effectiveness. To resist currents, the curtains can either be anchored in place, or attached to temporary sheet piling that may be driven for the purposes of holding the silt curtains in place. As the curtains get longer, or are implemented in more atypical configurations, additional controls could be required; often the full extent of necessary controls will not be known until construction begins. For the purposes of the cost estimates provided herein, it is assumed that temporary sheet piling would be utilized at the corners and at one location along the length of the curtain on each side to hold the curtains in place. Under the pier, silt curtains could be attached to the pilings in such a way as to isolate the dredge areas under consideration; however, the implementation of silt curtains under the piers poses significant additional challenges to ensure their effectiveness, not only due to the logistics involved in confirming proper installation, but also due to the challenges posed by regular inspections to determine whether the silt curtains are performing as anticipated.

Typically, the bottom of the silt curtains hang above the bottom of the ocean floor, to prevent the tidal variation from dragging the bottom of the curtain into (and out of) impacted sediment, which would generate turbidity, rather than reducing it. The bottom of the silt curtains may also be weighted to ensure that the curtains hang do their design depths.

You created this PDF from an application that is not licensed to print to novaPDF printer (http://www.novapdf.com)

The cost estimate assumes that two 200 ft X 200 ft areas are surrounded by silt curtains. Dredging and/or capping underneath the piers is anticipated to be significantly slower than the work that is completed in open water; as a result, the work under the pier may take place simultaneously as the work in open water; hence the need for two sets of silt curtains.

Laydown Area

Apex currently assumes that the three (3) acres of waterfront immediately north of the T-Wharf will be available for laydown and dewatering. If additional space were available, it could result in lower costs for the project by allowing passive dewatering as a possibility. Apex presumes that this area will be available for the contractor to set up equipment and trailers, stage materials, and stockpile dredge spoils and capping materials. An area immediately adjacent to the shoreline will minimize the distance that the slurry will need to be pumped over land, while allowing the dewatering fluids to be discharged back into the ocean post-treatment (assuming a NPDES permit for such discharge may be obtained from USEPA).

Although the three (3) acre area north of the T-Wharf is a good location for dewatering, the best location would likely be on the piers themselves. The piers themselves would allow for short distances for dewatering operation, as locations closest to the dredge areas could be used to stage materials and dewater dredge spoils. The piers would also theoretically allow for mechanical dredging without supplemental hydraulic transport, as they have sufficient draft adjacent to them to allow scows to unload. It is Apex's current understanding that these locations are unavailable due to weight handling restrictions that currently exist. Nevertheless, if it has not been conducted recently, an assessment of the existing loading capacity of the piers may be worthwhile and may generate some cost savings if it shows that some use of the piers for the purposes of assisting the contractor is a viable possibility.

Please also note that the costs provided are capital costs and that long-term operating costs are not included in the summary.

Transportation and Disposal

As access to the facility is likely to include security access and frequent inspections for trucks that are delivering equipment, delivering materials, or transporting dredge spoils offsite for disposal, Apex has included additional budget intended to compensate for this extra effort that will be required of contractors.

The pricing currently provided by Apex anticipates that the material will be transported to a Subtitle C landfill in New York by road. Please note that transportation and disposal costs listed herein assume that material can be disposed within a Subtitle C landfill, does not fail TCLP, and is determined to be non-hazardous. If any of these assumptions should prove to be untrue, the final costs may change from those shown.

Attachments: Table 1

You created this PDF from an application that is not licensed to print to novaPDF printer (http://www.novapdf.com)

TABLE 1

You created this PDF from an application that is not licensed to print to novaPDF printer (http://www.novapdf.com)

Table 1: Capital Cost Estimates for Alternatives

Assumptions/ Cost Estimate Line Items for Costing Purposes	Alternative				
	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Assumptions					
MNR Monitoring Costs (Acres)	0	8.7	8.7	0	0
Dredge Volume (Cubic Yards)	0	0	0	14,016	25,769
Dredge Under Pier (Cubic Yards)	0	0	0	0	0
Backfill Volume (Cubic Yards)	0	0	0	14,016	0
Backfill Under Pier (Cubic Yards)	0	0	0	0	0
Capping (Cubic Yards)	0	10,868	22,732	0	0
Capping Under Piers (Cubic Yards)	0	4,273	8,794	8,794	8,794
Debris Removal (Tons)	0	0	0	2,138	2,925
Debris Removal Under Pier (Tons)	0	0	0	0	0
Enhanced MNR Capping (CY)	0	0	0	0	0
Offsite Transportation and Disposal (CY)	0	0	0	14,016	25,769
Non MNR Monitoring (Acres)	15.4	6.7	6.7	0	0
Cost Estimate Line Items					
Mobilization/ Demobilization	$ -	$ 500,000	$ 500,000	$ 1,175,000	$ 1,175,000
Silt Curtain Purchase and Management	$ -	$ 150,000	$ 150,000	$ 150,000	$ 150,000
Mechanical Dredging	$ -	$ -	$ -	$ 294,340	$ 541,139
Capping	$ -	$ 641,221	$ 1,341,179	$ -	$ -
Capping Under Piers	$ -	$ 570,391	$ 1,174,009	$ 1,174,009	$ 1,174,009
Debris Removal (Tons)	$ -	$ -	$ -	$ 641,250	$ 877,500
Debris Removal Under Pier (Tons)	$ -	$ -	$ -	$ -	-
Hydraulic Dredging - Mechanical Dewatering	$ -	$ -	$ -	$ 537,521	$ 988,223
Suction Dreding Under Piers - Mech. Dewater	$ -	$ -	$ -	$ -	$ -
Backfill	$ -	$ -	$ -	$ 826,956	$ -
Backfill Under Piers	$ -	$ -	$ -	$ -	$ -
Enhanced MNR Capping	$ -	$ -	$ -	$ -	$ -
Offsite Disposal	$ -	$ -	$ -	$ 3,504,051	$ 6,442,130
Multi-Beam Bathymetric Survey	$ -	$ 180,000	$ 180,000	$ 234,000	$ 204,000
Single-Beam Bathymetric Surveys Under Pier	$ -	$ 40,000	$ 40,000	$ 40,000	$ 40,000
Water Quality Monitoring	$ -	$ 71,962	$ 140,904	$ 151,506	$ 146,978
Construction Oversight (10%)	$ -	$ 215,357.41	$ 352,609.26	$ 872,863.31	$ 1,173,897.79
Contingency (20%)	$ -	$ 473,786.30	$ 775,740.37	$ 1,920,299.28	$ 2,582,575.13
Total Estimated Costs:	$ -	$ 2,842,718	$ 4,654,442	$ 11,521,796	$ 15,495,451

Notes:
1). Costs are for Capital Costs only. Future operation and maintenance costs not included.
2). Higher end range of potential unit costs utilized to create the cost estimates listed above due to preliminary nature of cost estimate.
3). Hydraulic dredging numbers include 0.75 foot overdredge.
4). Updated costs include side-slopes on a 1V:5H slope for dredging and on a 1V:3H slope for capping.
4). Alternative 1 - No Action.
5). Alternative 2 - Cover/Capping of 1 Foot Over Select Areas.
6). Alternative 3 - Cover/Capping of 2 Feet Over Select Areas.
7). Alternative 4 - Dredge and Backfill Select Areas With In-Situ Capping In Select Areas
8). Alternative 5 - Dredge Select Areas With In-Situ Capping In Select Areas
9). Disposal cost assumes material can be disposed within Subtitle C landfill, does not fail TCLP, and is determined to be non-hazardous.
10). Engineering and permitting costs not included.
11). Assumes 1.5 tons per cubic yard of sediment.
12). Assumes only mechanical dewatering of sediment due to potential space restrictions at facility.
13). Assumes that up to 35% of the material will be dredged mechanically, and that material would be transported to shore hydraulically.
14). Assumes debris is removed via screen (for mechanically dredged material) or via drag line (performed pre-dredge for hydraulic/suction dredging).
15). Assumes water quality monitoring occurs 3 times in the first week of construction, and two times per week thereafter.
16). Assumes rate of 100 cy/day for areas under pier (capping or dredging) and 500 cy/day for areas not under pier (capping or dredging).
17). Silt curtain purchase and management assumes that sufficient silt curtains are utilized to surround one 200 ft X 200 ft area under the pier and one 200 ft X 200 ft area not underneath the pier.

You created this PDF from an application that is not licensed to print to novaPDF printer (http://www.novapdf.com)