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NCBC DAVISVILLE
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RECORD OF DECISION OPERABLE UNIT 9 (OU 9) SITE 16 CREOSOTE DIP TANK AREA FIRE FIGHTER TRAINING AREA AND BUILDING 41 NCBC DAVISVILLE RI

06/01/2014

U S NAVY

RECORD OF DECISION

OPERABLE UNIT 9 (SITE 16, CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA (FFTA), AND FORMER BUILDING 41)

AT

THE FORMER NAVAL CONSTRUCTION BATTALION CENTER (NCBC) DAVISVILLE, NORTH KINGSTOWN, RHODE ISLAND

CONTRACT NUMBER N62467-04-D-0055

CONTRACT TASK ORDER 418

June 2014

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ACRONYMS

AHBA	Allen Harbor Boating Association
ARAR	Applicable or Relevant and Appropriate Requirement
BaP Eq	Benzo(a)pyrene equivalent
BTEX	Benzene, toluene, ethylbenzene, and xylenes
bgs	Below ground surface
BEHP	Bis(2-ethylhexyl)phthalate
BRAC	Base Realignment and Closure
CED	Construction Equipment Department
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CDI	Chronic daily intake
CFR	Code of Federal Regulations
COC	Chemical of concern
COPC	Chemical of potential concern
Cr^{+3}	Trivalent chromium
Cr^{+6}	Hexavalent chromium
CSF	Cancer slope factor
CSM	Conceptual site model
CSGWPP	Comprehensive State Groundwater Protection Program
CTE	Central tendency exposure
CVOC	Chlorinated volatile organic compound
DCA	Dichloroethane
DCE	Dichloroethene
DEC	Direct exposure criterion
DNAPL	Dense non-aqueous phase liquid
EA	EA Engineering, Science, and Technology
EBS	Environmental Baseline Survey
EPA	United States Environmental Protection Agency
EPC	Exposure point concentration
ERA	Ecological risk assessment
ER-L	Effects Range-Low
ER-M	Effects Range-Medium
ESD	Explanation of Significant Differences
EU	Exposure Unit
FEMA	Federal Emergency Management Agency
FFA	Federal Facility Agreement
FFTA	Fire-Fighting Training Area

FIRM	Flood Insurance Rate Map
FS	Feasibility Study
FSA	Feasibility Study Addendum
GA	RIDEM GA groundwater classification
GAC	granular activated carbon
GB	RIDEM GB groundwater classification
HHRA	Human health risk assessment
HI	Hazard index
HQ	Hazard quotient
HRC®	Hydrogen Release Compound
I/C	Industrial/Commercial
ILCR	Incremental lifetime cancer risk
IR	Installation Restoration
IRIS	Integrated Risk Information System
IUR	Inhalation unit risk
LDR	Land disposal restriction
LIFOC	Lease in Furtherance of Conveyance
LUC	Land use control
LUCIP	Land Use Control Implementation Plan
MARAD	Maritime Administration
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
mg/kg	Milligram per kilogram
mg/L	Milligram per liter
MIP	Membrane interface probe
MNA	Monitored natural attenuation
NAS	Naval Air Station
NCA	North central area
NCBC	Naval Construction Battalion Center
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ng/kg	Nanogram per kilogram
NORAD	North Atlantic Distribution, Inc.
NPDES	National Pollutant Discharge Elimination System
NPL	National Priority List
NPW	Net present worth
O&M	Operation and maintenance
ORC	Oxygen-releasing compound

ORP	Oxidation-reduction potential
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PAH	Polycyclic aromatic hydrocarbon
PBC	Public benefit conveyance
PCB	Polychlorinated biphenyl
PCE	Tetrachloroethene
PFOA	Perfluorooctanic Acid
PFOS	Perfluorooctane Sulfonate
PPE	Personal protective equipment
POTW	Publicly Owned Treatment Works
PRG	Preliminary Remediation Goal
QDC	Quonset Development Corporation
RAB	Restoration Advisory Board
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RfC	Reference concentration
RfD	Reference dose
RI	Remedial Investigation
RIEDC	Rhode Island Economic Development Corporation
RIDEM	Rhode Island Department of Environmental Management
RME	Reasonable maximum exposure
RIPA	Rhode Island Port Authority
ROD	Record of Decision
RSL	Regional Screening Level
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SEM/AVS	Simultaneously extracted metals/acid-volatile sulfide
SLERA	Screening level ecological risk assessment
SVOC	Semivolatile organic compound
TBC	To be considered
TCA	Trichloroethane
TCDD	Tetrachlorodibenzodioxin
TCE	Trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
TPH	Total petroleum hydrocarbons

UCL	Upper Confidence Limit
µg/kg	Micrograms per kilogram
µg/L	Micrograms per liter
VC	Vinyl chloride
VOC	Volatile organic compound
WMA	Waste management area

1.0 DECLARATION

1.1 SITE NAME AND LOCATION

Operable Unit (OU) 9, known as Site 16 and which includes the Former Creosote Dip Tank, Former Fire-Fighting Training Area (FFTA), and Former Building 41, at the Former Naval Construction Battalion Center (NCBC) Davisville, is located in North Kingstown, Rhode Island. NCBC Davisville has been assigned United States Environmental Protection Agency (EPA) ID number RI6170022036. The location of Site 16 is shown on Figures 1-1 and 1-2.

1.2 STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) presents the Selected Remedy for Site 16 (see Figure 1-2), which was chosen by the Navy and EPA in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on information contained in the Administrative Record for Site 16. The Rhode Island Department of Environmental Management (RIDEM) concurs with the Selected Remedy, as shown in Appendix A.

1.3 ASSESSMENT OF SITE

The response action selected in this ROD is necessary to protect the public health and welfare or the environment from actual or threatened releases of hazardous substances into the environment. A CERCLA action is required because concentrations of polycyclic aromatic hydrocarbons (PAHs), dioxins/furans, metals (arsenic and lead) in soil pose unacceptable risk to human health under current and hypothetical future residential, industrial, and recreational land use scenarios, and concentrations of volatile organic compounds (VOCs), naphthalene, and metals in groundwater pose unacceptable risk to human health under future industrial and hypothetical future residential use.

1.4 DESCRIPTION OF SELECTED REMEDY

The major components of the Selected Remedy for Site 16 include the following:

- Excavation and off-site disposal of surface soils (to a depth of 2 feet below ground surface [bgs]) in the north central area [NCA] of Site 16 with contaminant concentrations greater than RIDEM industrial/commercial (I/C) direct exposure criteria (DECs).
- Excavation and off-site disposal of surface soils (to a depth of 2 feet bgs) near the marina building (Building E-107, constructed in 1954) with contaminant concentrations greater than RIDEM residential DECs.
- Backfilling and restoration of excavated areas.
- Focused in-situ treatment of groundwater at the eastern end of former Building 41.
- Monitored natural attenuation (MNA) of the residual VOC-contaminated groundwater plume and long-term monitoring (LTM) of groundwater (and surface water and sediments, as necessary) after active groundwater treatment until groundwater standards are achieved.
- LTM of the areas where contaminated soil will be left in place under the soil covers will be required even after groundwater cleanup standards are achieved, unless additional testing of soil shows that leaching of contaminants is unlikely to impact groundwater.

FIGURE 1-1. FORMER NCBC DAVISVILLE LOCATION

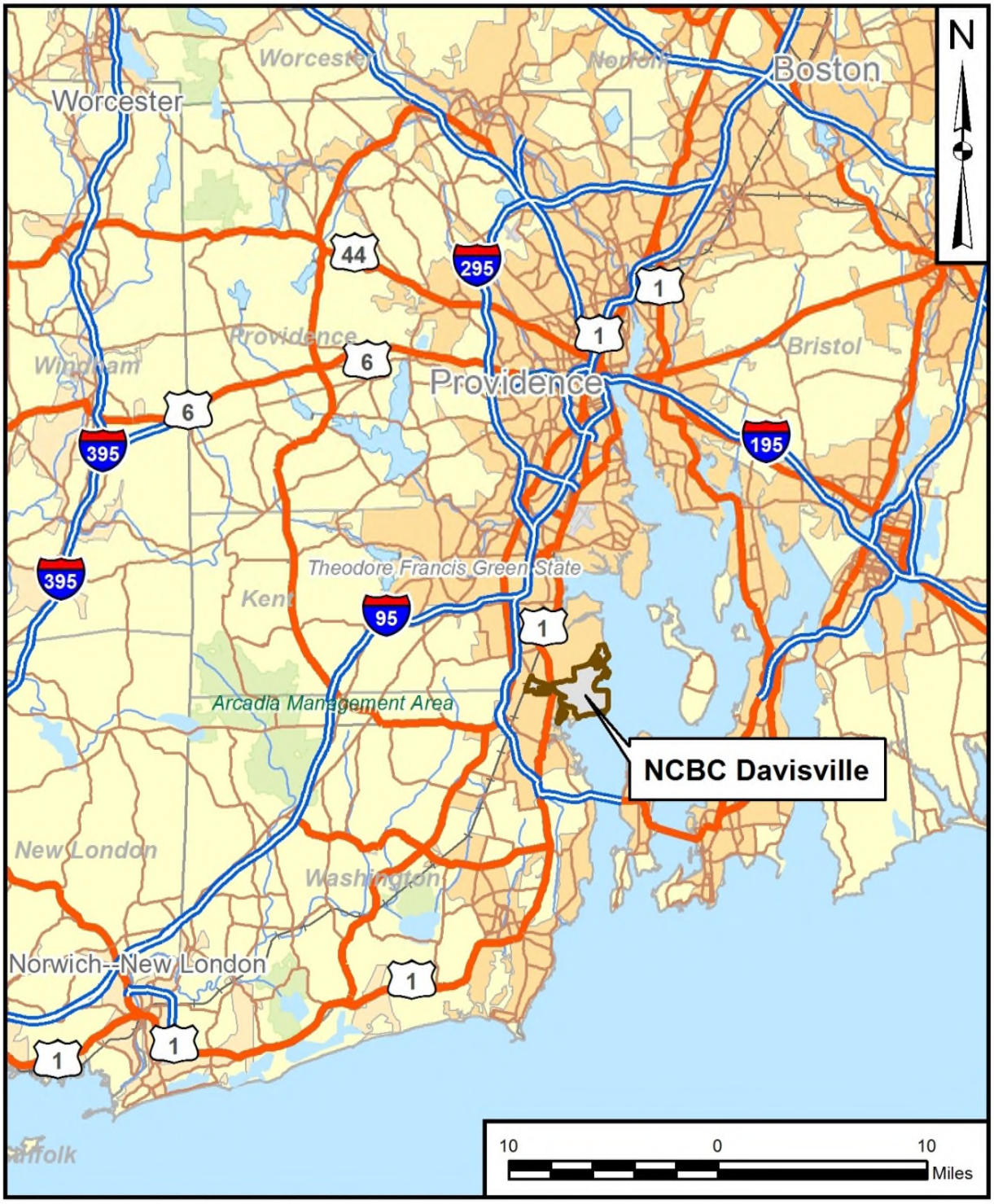
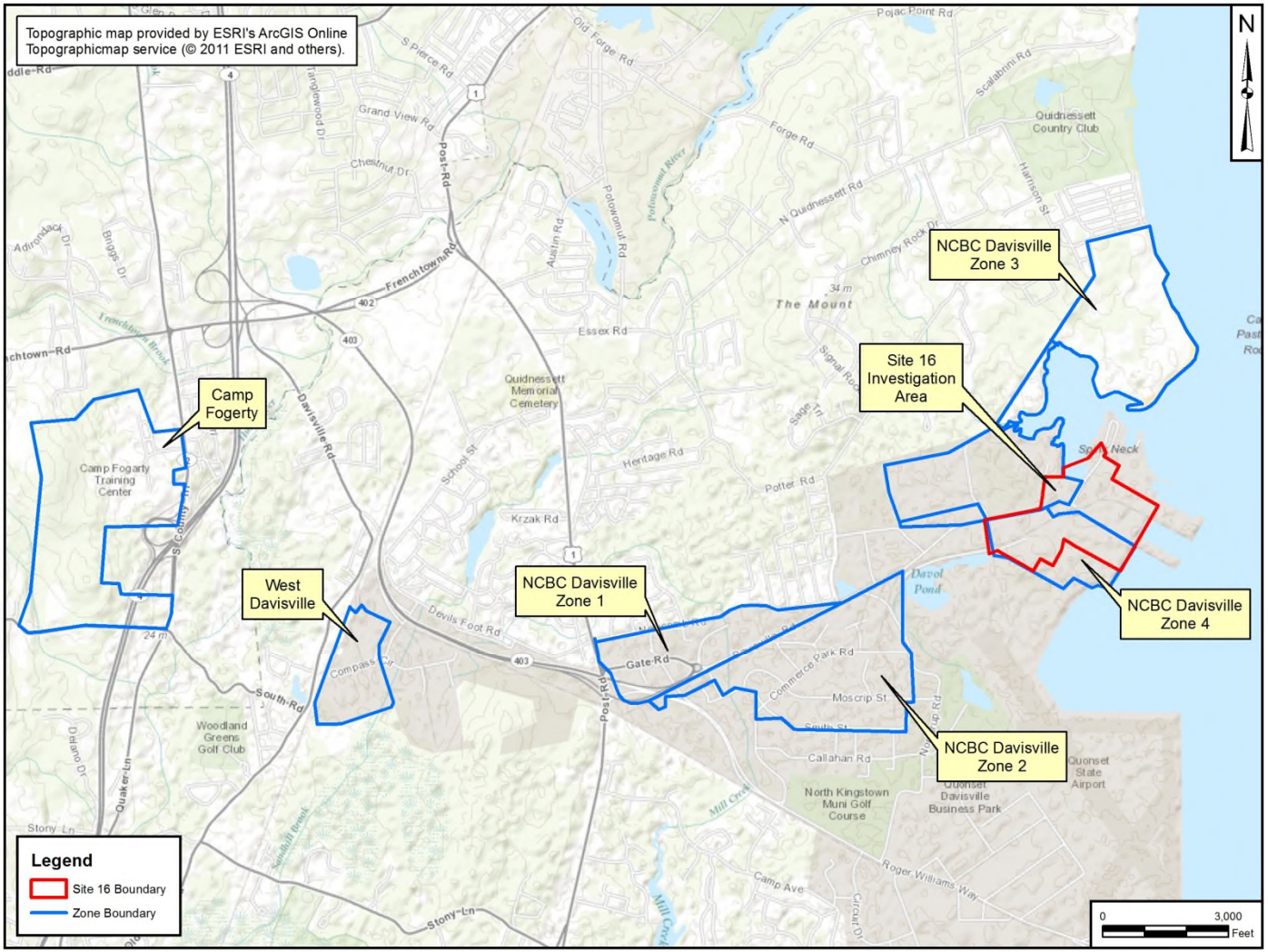


FIGURE 1-2. SITE 16 LOCATION MAP



- Implementation of land use controls (LUCs), including the establishment of a waste management area (WMA) in the NCA/marina, to ensure that future use of the NCA is limited to non-residential activities (also excluding recreational use as defined by RIDEM), disturbance of soil covers and subsurface soils is prohibited without prior authorization, soil covers are inspected and maintained, groundwater is not used (except for sampling under the LTM program), and buildings are designed and constructed to minimize the potential for vapor intrusion. A soil management plan will be implemented to address any disturbance to the soils and covers.

The Selected Remedy eliminates potential unacceptable human exposure to soil and groundwater through a combination of removal, treatment, and LUCs. The current and reasonably anticipated future land use for Site 16 is commercial/industrial, except the area in the immediate vicinity of Building E-107, which is used for marina purposes (i.e., recreational use). The remediation of Site 16 will not adversely impact the current and reasonably anticipated future land uses and is expected to achieve substantial long-term risk reduction. This ROD documents the final remedial action for Site 16 and does not include or affect any other sites at the facility. The Selected Remedy is consistent with current uses, anticipated future uses, and the overall cleanup strategy for NCBC Davisville to cleanup sites to achieve compliance with CERCLA and allow for the beneficial reuse of the sites.

1.5 STATUTORY DETERMINATIONS

The Selected Remedy is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. Through implementation of an in-situ groundwater treatment technology, the Selected Remedy satisfies the statutory preference for remedies that use treatment as a principal element to reduce the toxicity, mobility, or volume of hazardous substances, pollutants, and contaminants. The existing soil contamination is not amenable to treatment and is limited in nature making treatment impracticable.

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on site in excess of levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted a minimum of every 5 years after initiation of the remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

1.6 ROD DATA CERTIFICATION CHECKLIST

The locations in Section 2.0, Decision Summary, of the information required to be included in the ROD are summarized in Table 1-1. Additional information can be found in the Administrative Record file for NCBC Davisville.

TABLE 1-1. ROD DATA CERTIFICATION CHECKLIST

DATA	LOCATION IN ROD
Chemicals of concern (COCs) and their respective concentrations	Sections 2.5 and 2.7
Baseline risk represented by the COCs	Section 2.7
Cleanup levels established for COCs and the basis for these levels	Section 2.7 and 2.8
How source materials constituting principal threats are addressed	Section 2.11
Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the risk assessment	Section 2.6
Potential land and groundwater uses that will be available at the site as a result of the Selected Remedy	Section 2.12.3
Estimated capital, operation and maintenance (O&M), and total net present worth (NPW) costs; discount rate; and number of years over which the remedy costs are projected	Appendix B
Key factors that led to the selection of the remedy	Section 2.12.1

1.7 AUTHORIZING SIGNATURES

This Record of Decision documents the selected remedy for OU9 by the Navy and EPA with concurrence of the State of Rhode Island. Concur and recommend for implementation.

JUNE 11, 2014

David Barney
BRAC Environmental Coordinator
BRAC PMO East
U.S. Navy

Date

June 23, 2014

James T. Owens, III
Director, Office of Site Remediation and Restoration

Date

Region 1 – New England
U.S. Environmental Protection Agency

2.0 DECISION SUMMARY

2.1 SITE NAME, LOCATION, AND BRIEF DESCRIPTION

The former NCBC Davisville is located in the Town of North Kingstown, Rhode Island, approximately 18 miles south of the state capital of Providence. NCBC Davisville was decommissioned in March 1994 and closed on April 1, 1994, under the Base Realignment and Closure (BRAC) Program. At the time of base closure, NCBC Davisville (Figure 1-2) comprised three areas: the Main Center (839 acres, Zones 1 through 4), the West Davisville storage area (70 acres), and Camp Fogarty, a 375-acre training facility located approximately 4 miles west of the Main Center. Camp Fogarty was transferred to the United States Department of the Army in December 1993 and is assigned to the Rhode Island Army Reserve National Guard. Adjoining the southern boundary of the Main Center is the decommissioned Naval Air Station (NAS) Quonset Point, which was transferred by the Navy to the General Services Administration who in turn transferred the property to the Rhode Island Port Authority (RIPA) [now known as the Rhode Island Economic Development Corporation (RIEDC); the Quonset Development Corporation (QDC) is a component of the RIEDC] and others between 1975 and 1980. The pier area of NCBC Davisville was also transferred during this time to RIPA. A portion of the former NCBC Davisville area is contiguous with Narragansett Bay, which is located generally east of the facility. NCBC Davisville has been assigned federal EPA ID number RI6170022036.

Site 16 is an irregularly shaped area (Figures 2-1 and 2-2) bounded on the west by Thompson Road and to the south by railroad tracks; Site 16 also extends north to Allen Harbor and east to Narragansett Bay. Most of Site 16 south of Davisville Road consists of parking areas and buildings. The NCA (the northern portion of Site 16 directly south of Allen Harbor) lies north of Davisville Road and is bounded by Allen Harbor to the north, Westcott Road to the west, Davisville Road to the south, and Allen Harbor Road to the east. Site 16 includes the area between former Building 41 and Narragansett Bay. There are no historical or archeological areas of importance at Site 16.

NCBC Davisville is a closed facility, and environmental investigations and remediation at the base are funded under the BRAC Program. The Navy is the lead agency for CERCLA activities at the facility, and EPA and RIDEM are support agencies.

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

The environmental contamination observed at Site 16 is primarily attributable to releases from the Creosote Dip Tank and FFTA [Environmental Baseline Survey (EBS) Review Item No. 28] and former Building 41 (EBS Review Item No. 29). Creosote dipping operations to preserve wood pilings occurred in the northwestern portion of the NCA. In the north-central portion of the NCA, structures were built, doused with flammable materials, set on fire and then extinguished as part of fire-fighting training exercises. Other NCBC training activities that involved large construction and transport vehicles also occurred in the NCA. Fill materials and subsurface debris exist throughout a significant portion of the NCA, indicating that much of this area received fill material (Figure 2-3). Former Building 41 was used as an equipment preservation/packing shop and vehicle parts storage building. A solvent recovery tank was located in the westernmost portion of this building. The solvent recovery tank reclaimed trichloroethene (TCE) that was used as a degreaser.

A brief summary of the environmental investigations conducted at Site 16, or relevant to the site, are included in Table 2-1. Results of these investigations indicated elevated levels of PAHs, dioxins/furans, and metals (arsenic and lead) in soil, and VOCs, naphthalene, and metals in groundwater at concentrations that are potentially harmful to human health. The nature and extent of contamination identified in soil, groundwater, groundwater-to-surface water seeps, surface water, and sediment are discussed in Section 2.5.

TABLE 2-1. PREVIOUS INVESTIGATIONS AND SITE DOCUMENTATION		
INVESTIGATION	DATE	ACTIVITIES (TERMS IN BLUE TEXT ARE DEFINED IN THE ADMINISTRATIVE RECORD REFERENCE AT THE END OF THIS ROD).
National Priority List (NPL) listing	1989	NCBC Davisville was listed on the EPA NPL. Federal Facility Agreement (FFA) established on March 23, 1992.
Soil Removal Action	1992	Soil with elevated concentrations of PAHs in a spill area around an upended creosote dip tank in the northwestern quadrant of the NCA was **excavated and disposed of off-site**.
EBS	1995	The Basewide EBS for NCBC Davisville was prepared to evaluate and consolidate information regarding the environmental conditions and potential constraints for lease and/or transfer of land and structures at the facility. The EBS identified several EBS Review Items throughout the Site 16 area, most of which were resolved during the EBS process. Six EBS Review Items at Site 16 were identified as requiring additional investigation, which was conducted as part of EBS-related investigations and Remedial Investigation (RI)/Feasibility Study (FS) field investigations.
Phase II EBS – Initial Field Program	1996	A field program was conducted from February through June 1996 during which soil samples were collected and analyzed from six soil borings and test pits excavated in the vicinity of Building E-107.
Phase II EBS Follow-on Investigation	1997	A field program was conducted from June through August 1997 during which soil borings were advanced and soil samples were collected in the Creosote Dip Tank Area and FFTA, one groundwater monitoring well was installed and sampled at the FFTA, and test pits were excavated in the vicinity of former Building E-107 and soil samples were collected and analyzed. **Contaminated soil was excavated during the Building E-107 septic tank removal and was disposed of off-site**.
Phase II EBS Follow-on Addendum Investigation	1998	A field program was conducted during winter 1997/1998 during which soil and groundwater samples were collected and analyzed from the vicinity of the former Building 41 septic tanks, and groundwater, soil, and groundwater-to-surface water seep samples from the vicinity of the Creosote Dip Tank, FFTA, Building E-107 septic tanks, and earthen ramp structure in the NCA were collected and analyzed.
Phase I RI, Stage 1	1999-2001	A field investigation was conducted from December 1999 through March 2001. Seismic refraction profiling was used to investigate the upper bedrock surface and to assist in monitoring well placement. Membrane interface probe (MIP) screening was conducted at 28 locations to assess VOC concentrations in groundwater. Fourteen groundwater monitoring wells were installed and sampled, and soil samples were collected and analyzed from eight borings and from the monitoring wells during monitoring well installation.
Phase I RI, Stage 2	1999-2001	Based on the results of Stage I, Phase I RI field work continued during December 1999 through March 2001. Additional seismic profiling was performed, MIP screening was conducted at 31 additional locations, and two shallow groundwater wells, 22 deep wells, and five bedrock wells were installed and sampled. Geophysical logging was performed on the open rock portions of the shallow bedrock wells. Soil samples were collected from well borings during deep well installation; groundwater-to-surface water seep samples and sediment samples were collected near Allen Harbor, and a tidal study was performed on wells located near Allen Harbor.
Phase II RI	2002	A field investigation was conducted from February through December 2002. Sixteen shallow groundwater, 23 intermediate, 23 deep, 8 shallow bedrock, and 3 deep bedrock wells were installed and sampled. Wells installed in Phase I were also sampled. Twelve soil samples were collected during installation of deep wells near former Building 41. All wells screened in the overburden were slug tested. Two rounds of water level measurements were collected from 117 monitoring wells.

TABLE 2-1. PREVIOUS INVESTIGATIONS AND SITE DOCUMENTATION		
INVESTIGATION	**DATE**	**ACTIVITIES (TERMS IN BLUE TEXT ARE DEFINED IN THE ADMINISTRATIVE RECORD REFERENCE AT THE END OF THIS ROD).**
Phase II Screening Level Ecological Risk Assessment (SLERA)	2004	Fifty-one sediment samples and one core sample were collected from Allen Harbor in March 2004 and analyzed for PAHs and metals. One sediment and six soil samples were collected for chemical and forensic analysis to identify the source of the PAHs. A **Screening Level Ecological Risk Assessment (SLERA)** evaluation of Allen Harbor was also prepared based on data collected in this event and in previous events.
Supplemental Phase II Hydrogeologic Investigation/ Hydrogen Release Compound (HRC®) Injection Pilot Study	2004	Field work was conducted from September through November 2004. Four seismic refraction lines were used to investigate the bedrock surface. Eighteen groundwater monitoring wells were installed, and seven borings were advanced. All monitoring wells (117 existing and 18 new) were sampled, and eight soil samples from the borings were analyzed. For the HRC® pilot study, 49 monitoring wells and 12 injection wells were installed, but **HRC® was never injected** because remedial decisions had not be formalized at that time. Soil samples were collected during the installation of the monitoring and injection wells.
1,4-Dioxane Groundwater Study	2004/ 2006	At the request of EPA Region I, 10 groundwater monitoring wells were sampled in 2004 and 2006 to test for the presence of 1,4-dioxane in groundwater underlying Site 16. 1,4-Dioxane was not detected in any of the groundwater samples collected during either sampling event.
Phase III RI	2007-2008	Field work began in May 2007 and concluded in April 2008. Soil samples were collected from over 134 soil borings advanced primarily to delineate the extent of chlorinated volatile organic compound (CVOC) and PAH contamination. Three rounds of water level measurements were collected during the field investigation conducted in 2007. Twenty-seven new groundwater monitoring wells were installed, and slug tests were performed on over 50 new or existing Site 16 monitoring wells. Twenty-five shallow soil gas samples were collected and analyzed. Samples collected from sediments underlying Allen Harbor, pavement of areas draining to Allen Harbor, pilings associated with the Allen Harbor docks, and select shallow monitoring wells in the NCA were analyzed in support of the supplemental forensics study outlined in the Phase III RI Quality Assurance Project Plan (2006). The forensics investigation was designed to determine the probable sources of the PAHs detected in the sediments underlying Allen Harbor. Eight sediment, 23 pore water/groundwater samples, and 4 deep surface water samples were collected and analyzed to evaluate the potential migration of the CVOC groundwater plume to environmental media within Allen Harbor. The CVOC groundwater plume was initially identified during the Phase I RI; the predominant contaminant in the plume is TCE. Two planned test pits and eight exploratory test pits were also excavated in the NCA to further investigate the presence of subsurface soil contamination. The RI document published in 2009 included a **human health risk assessment (HHRA) and an ecological risk assessment (ERA)**.
FS Support Field Investigation	2010	Additional data were collected to delineate soil contamination in the NCA (e.g., 64 test pits were advanced to further determine the nature and extent of soil contamination in the NCA), characterize shallow/intermediate groundwater contamination in the benzene, toluene, ethylbenzene, and xylenes (BTEX) hot spot area in the NCA, determine the northern extent of the CVOC plume underlying Allen Harbor, characterize overburden groundwater in the vicinity of the Seafreeze Ltd. building area, investigate vapor intrusion potential at the periphery of the CVOC plume, characterize/delineate PAH contamination in the vadose zone south of Davisville Road along the southern boundary of former Building 41, refine the characterization of CVOCs in soil at the eastern edge of former Building 41, and redevelop/resample select upgradient monitoring wells. The BTEX hot spot area was initially identified in the northwestern portion of the NCA during the Phase III RI.

TABLE 2-1. PREVIOUS INVESTIGATIONS AND SITE DOCUMENTATION		
INVESTIGATION	**DATE**	**ACTIVITIES (TERMS IN BLUE TEXT ARE DEFINED IN THE ADMINISTRATIVE RECORD REFERENCE AT THE END OF THIS ROD).**
Perfluorooctanic Acid (PFOA)/ Perfluorooctane Sulfonate (PFOS) Groundwater Study	2011	At the request of EPA Region I, groundwater samples were collected from four monitoring wells to test for the presence of PFOA/PFOS in the groundwater underlying Site 16. PFOA/PFOS were not detected at concentrations exceeding human-health screening levels provided by EPA.
Draft RI Report for the Nike PR-58 Site (USACE)	2007-2011	Field work occurred between May 2007 and 2011. Pertinent to Site 16, site-wide groundwater flow and contaminant migration pathways were investigated and analyzed in order to assess the contaminant fate and transport pathways likely to occur between these two sites. During the summer of 2009, in conjunction with EPA and the USGS, the USACE installed and sampled numerous wells (well clusters including overburden and bedrock wells based on geophysical screening) in the immediate upgradient location of Site 16 (west of Thompson Road). Primary conclusions of the Draft RI (relevant to Site 16) include: 1) Davol Pond (including the eastern unnamed portion) is hydraulically connected to the groundwater flow systems; 2) primary contaminant migration pathways are north-south oriented (not to the southwest, toward Site 16); 3) CVOC concentrations below MCLs are migrating into upgradient portions of Site 16 near the intersection of Davisville and Thompson Roads; and 4) there is no co-mingling of the off-site and Site 16 source area groundwater CVOC plumes.
FS	2012	The FS identified cleanup levels and **remedial action objectives** (RAOs), screened potential remedial technologies, and developed and evaluated remedial alternatives, based on the available information from previous investigations. The final FS presented six remedial alternatives to address contamination in Site 16 soil and six remedial alternatives to address contamination in Site 16 groundwater.
FS Addendum	2013	In response to regulatory comments received on the FS, the FS Addendum (FSA) identified an additional RAO for soil, an additional RAO for groundwater, an **additional remedial alternative for soil**, and an **additional remedial alternative for groundwater**.

*Additional information about terms in **blue text** is provided in the Administrative Record Reference Table included at the end of this ROD.*

FIGURE 2-1. SITE 16 LOCATION AND FEATURES

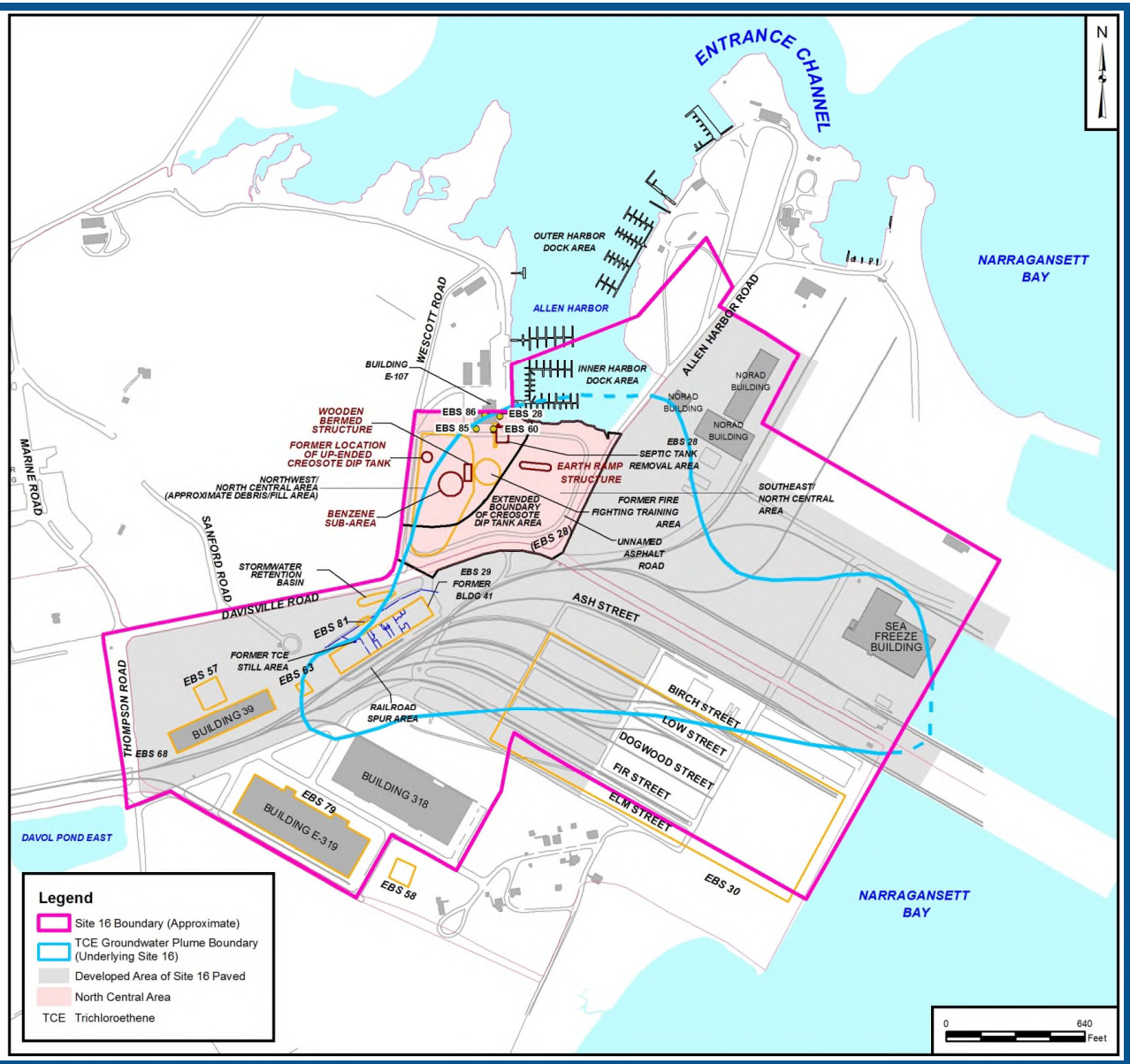


FIGURE 2-2. MARINA BUILDING (E-107) AREA

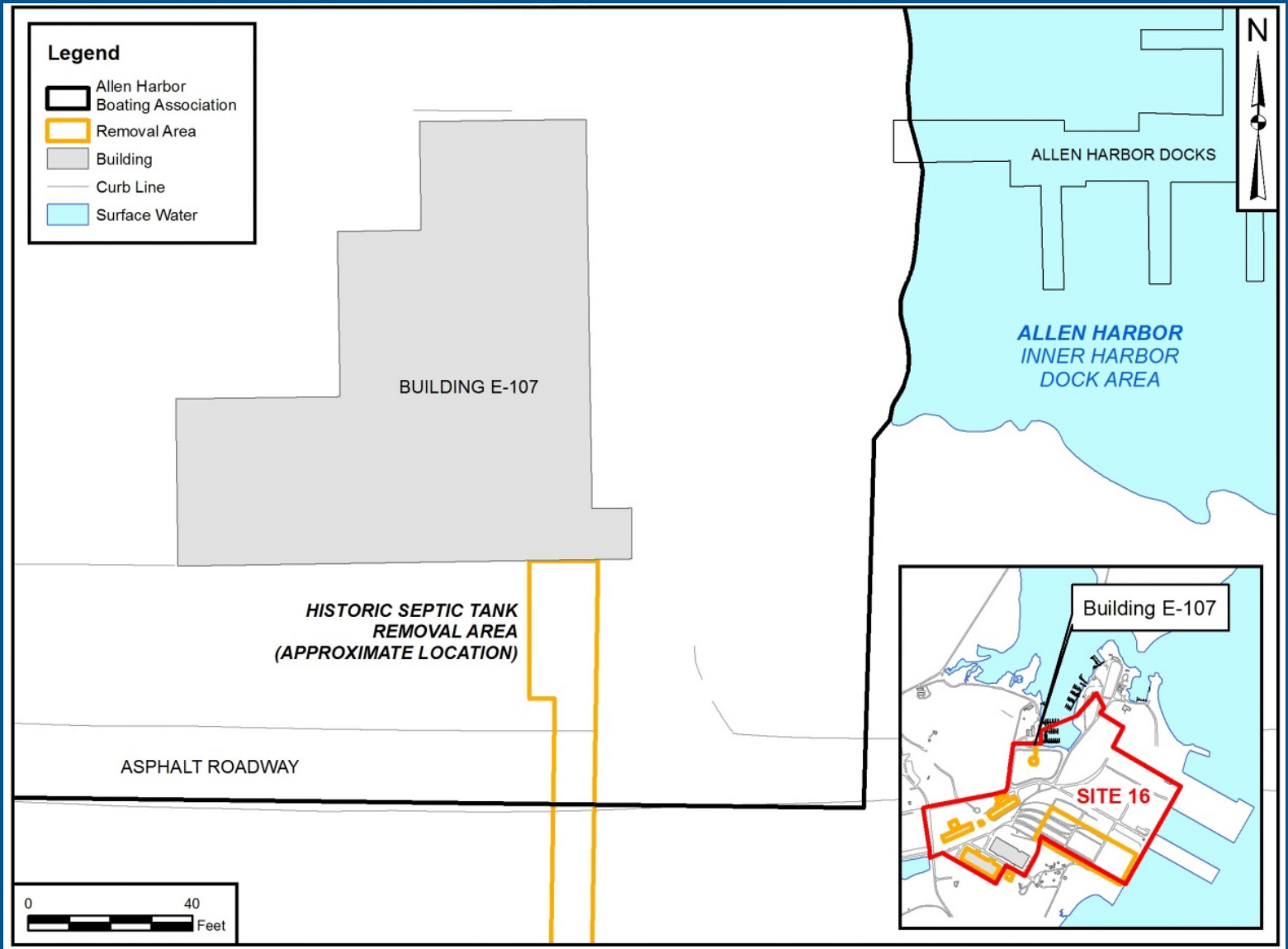
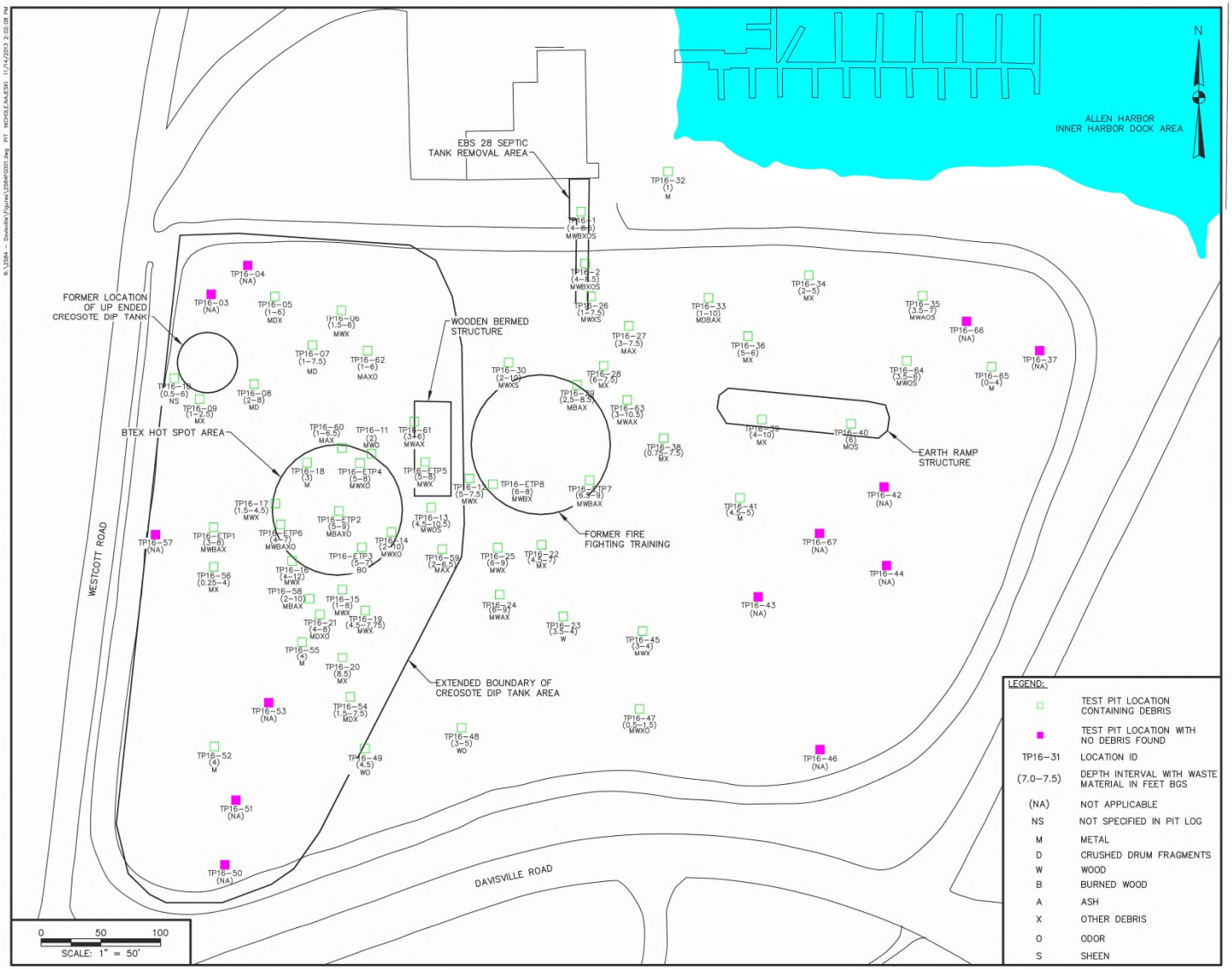


FIGURE 2-3. TYPE OF DEBRIS FOUND IN 2010 TEST PITS IN NORTH CENTRAL AREA SOILS



There have been no cited violations under federal or state environmental law or any past or pending enforcement actions pertaining to the cleanup of Site 16.

2.3 COMMUNITY PARTICIPATION

The Navy performs public participation activities in accordance with CERCLA and the NCP throughout the site cleanup process at NCBC Davisville. The Navy has a comprehensive community relations program for NCBC Davisville, and community relations activities are conducted in accordance with the NCBC Davisville Community Relations Plan. These activities include regular technical and Restoration Advisory Board (RAB) meetings with local officials and the establishment of an Information Repository at the Annex Building, QDC, 95 Cripe Street, North Kingstown, Rhode Island, 02852.

The Navy organized a RAB in December 1993 to review and discuss NCBC Davisville environmental issues with local community officials and concerned citizens. The RAB consists of representatives of the Navy, EPA, and RIDEM and members of the community. The RAB has met frequently since its inception and now meets biannually. Site 16 investigation activities, results, and associated remedial decisions have been discussed at RAB meetings. Documents and other relevant information relied on in the remedy selection process are available for public review at the Information Repository located at the Annex Building, QDC, 95 Cripe Street, North Kingston, Rhode Island, 02852. For access to the Information Repository or additional information about the Installation Restoration (IR) Program at NCBC Davisville, contact Mr. David Barney, BRAC Environmental Coordinator, former NAS South Weymouth, 1134 Main Street, Building 11, South Weymouth, MA 02190 (david.a.barney@navy.mil: phone: 617-753-4656). Information may also be found at the following BRAC website: www.bracpmo.navy.mil.

In accordance with Sections 113 and 117 of CERCLA, the Navy provided a public comment period from October 15, 2013 to November 14, 2013, for the proposed remedial action described in the Proposed Plan for Site 16. An informational meeting and public hearing to present the Proposed Plan and solicit public comments for the record were held on October 24, 2013, at Quonset Development Corporation Conference Center, 95 Cripe Street, North Kingstown, Rhode Island. **Public notice** of the meeting and availability of documents were published in *The Standard Times* on October 10, 2013. A transcript of the oral comments received during the public hearing was prepared as part of the Site 16 Administrative Record. No formal oral or written comments were received during the 30-day comment period. The Navy's Responsiveness Summary is presented in Section 3 of this ROD.

2.4 SCOPE AND ROLE OF OPERABLE UNIT

Site 16 (OU9) is part of a comprehensive environmental investigation and cleanup program currently being performed at NCBC Davisville under CERCLA authority pursuant to the Federal Facility Agreement (FFA) dated March 23, 1992. IR Program cleanup activities are being performed under CERCLA. Sixteen IR sites have been identified at NCBC Davisville. RODs for "no further action" have been signed for Sites 05, 06, 08, 10, 11, 12, 13, 14, and 15 (OUs 2, 3, 4, 5, and 6). RODs were signed for Sites 07 (OU 8) and 09 (OU 1) in September 1999 and September 1997, respectively. To meet the requirements of the RODs for Sites 07 (OU 8) and 09 (OU 1), periodic monitoring is being conducted in accordance with the LTM program for those sites. Study Areas 01 and 04 and Sites 02 and 03 (OU 7) and OU 10 (QDC Outfall) are in the Remedial Investigation (RI)/Feasibility Study (FS) process, and no remedial decisions have been made to date. These two OUs are located immediately northwest of Site 16 (OU 9). Contamination detected at these and other sites has not impacted the Site 16 area.

Investigations at Site 16 indicated the presence of soil and groundwater contamination from past operating practices that poses unacceptable risk to current and potential future human receptors. Previous actions taken in response to the contamination at Site 16 are summarized in Table 2-1. The remedy documented in this ROD will achieve the remedial action objectives (RAOs) for Site 16, as listed in Section 2.8. The Selected Remedy is consistent with current uses, anticipated future uses, and the overall cleanup strategy for NCBC Davisville to cleanup sites to achieve compliance with CERCLA and allow for the beneficial reuse of the sites.

2.5 SITE CHARACTERISTICS

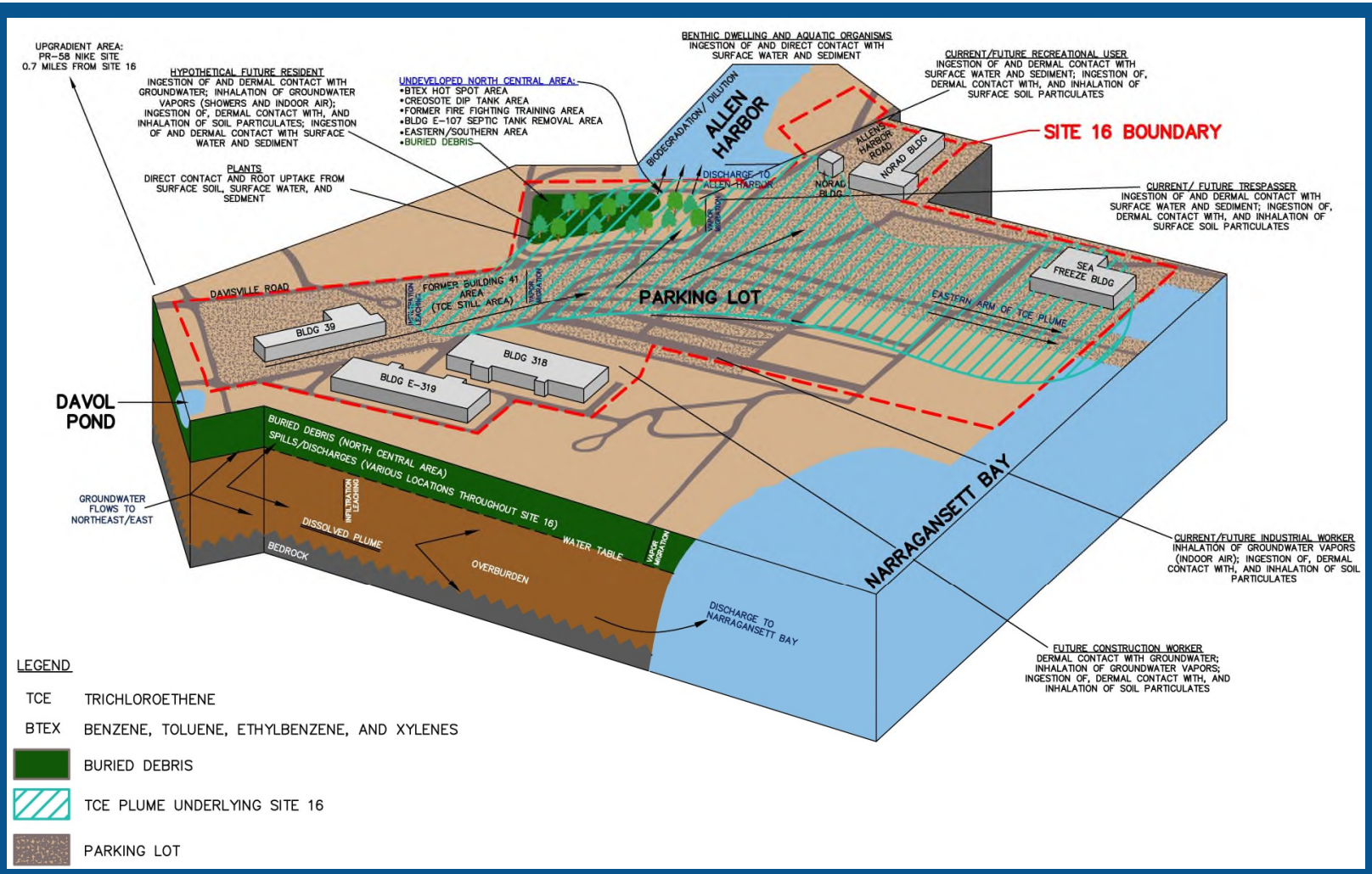
Figure 2-4 presents the Site 16 conceptual site model (CSM), which identifies contaminant sources, contaminant release mechanisms, transport routes, and receptors under current and future land use scenarios. Historical actions have resulted in the presence of PAHs, dioxins/furans, and metals (e.g., arsenic and lead) in soil, and VOCs, naphthalene, and metals in groundwater. In overview, much of the environmental contamination at Site 16 is attributable to releases (e.g., solvent/PAH releases) from EBS Review Items Nos. 28 and 29 and associated areas. Additionally, "fill" materials/debris in shallow subsurface soils (typically soils 2-10 feet bgs) of the NCA (Figure 2-3) may have also contributed to the observed environmental contamination. For example, the metal debris noted in the "fill" materials/debris may have contributed to the metals concentrations detected in the NCA soils. The NCA covers approximately 9.8 acres. Figure 2-4 presents all complete exposure pathways for potential receptors at Site 16 regardless of whether or not they are significant. These pathways are evaluated (qualitatively and quantitatively) in the risk assessments conducted for Site 16 and risk estimates are developed accordingly (see Section 2.7). Risk estimates that are deemed "unacceptable" per EPA or RIDEM guidelines are further evaluated in the Feasibility Study conducted for Site 16 (see Sections 2.8 through 2.12).

Based on the available soil, groundwater, and soil gas data, many of the Site 16 VOC releases appear to be associated with operations in the general vicinity of former Building 41. Additional releases may have also occurred within the NCA (e.g., the benzene-, toluene-, ethyl benzene-, and xylenes (BTEX) hot spot area and FFTA). For example, there is evidence of a lobe of groundwater TCE concentrations oriented in an east-west direction across the northern portion of the NCA. The groundwater contamination in this area has merged with the primary plume emanating from the former Building 41 area. In aggregate, the releases have resulted in an elongated chlorinated volatile organic compound (CVOC) plume (primarily TCE) particularly evident in the deep overburden zone and extending from the former Building 41 area toward both Allen Harbor (to the north/northeast) and Narragansett Bay (to the northeast/east). The groundwater plume covers approximately 31 acres.

The PAH contamination in surface (0-2 feet bgs) and shallow subsurface soil in the NCA is primarily associated with historical operations/releases in the northwestern quadrant of the NCA (i.e., the Creosote Dip Tank area, FFTA, and former septic system area associated with Building E-107) and with the BTEX hot spot area (identified during the Phase III RI, see Figure 2-3). **Environmental forensics investigations** were conducted in 2004 and 2007 to determine if these areas were also the source(s) of PAHs detected in Allen Harbor sediments. The investigations concluded that the Site 16 is not the primary source(s) of the PAHs detected in Allen Harbor. The investigations further indicated that the creosote-treated marina pilings (components of the dock structure in the Harbor) have conveyed PAHs to Allen Harbor sediments. Roadway runoff also likely conveyed heavy petroleum and PAHs into Allen Harbor sediments. An **environmental forensics investigation** was also conducted in 2010 to further investigate the source(s) of PAHs detected in the immediate vicinity of the former Building 41 area. The investigation concluded that the PAHs in the soil samples are consistent with coal tar pitch mixed with historical fill. Materials such as abraded building materials, pavement, or roadway material were likely mixed into the surface soil during site development and maintenance.

The nature and extent of contamination at Site 16 and the associated contaminant transport mechanisms are discussed in Section 2.5.2. The transport of contamination from source area soils to downgradient groundwater, surface waters, and sediments are the contaminant transport mechanisms of primary concern at Site 16. The evaluated contaminant exposure pathways and potential human and ecological receptors under current and future land use scenarios are presented in Section 2.7.1 and 2.7.2, respectively.

FIGURE 2-4. CONCEPTUAL SITE MODEL FOR SITE 16



2.5.1 Physical Characteristics

The terrain at Site 16 is relatively flat to gently sloping towards the adjoining surface water bodies. Ground surface elevations range from approximately 10 to 33 feet above mean sea level. Surface water runoff flows north to Allen Harbor and east to Narragansett Bay, and is facilitated by the extensive pavement south and east of the NCA, but mitigated by the significant vegetative cover that currently exists within the NCA. There are no freshwater streams within Site 16. However, an extensive stormwater drainage system exists in the area. In addition to receiving surface water run-off from the surrounding environs, Allen Harbor and Narragansett Bay are also the discharge areas for groundwater underlying Site 16 and much of the NCBC Davisville. Approximately 20 percent of the NCA is within the 100-year floodplain, and most of the NCA is within the 500-year floodplain.

Information regarding the geological and hydrogeologic conditions at Site 16 is based on data collected during several phases of RI and FS support field investigations.

The results of Site 16 field investigations show that the subsurface geology at the site is characterized by Quaternary glacial deposits mantling quartzitic and phyllitic bedrock (weathered and competent zones), with occasional conglomerate deposits of the Rhode Island Formation. Based on boring logs for the site, the unconsolidated sedimentary deposits at the site include, in descending order, reworked soil and fill material and recent harbor and adjacent deposits; glacio-fluvial, glacio-lacustrine, and lower sand deposits; and sandy silty gravel to gravelly sand to sandy gravelly silt (possibly till). The thickness of the uppermost unit ranges from 4 to 26 feet across the area; however, the thickness is typically between 10 and 18 feet. The overall thickness of the middle unit is variable but is generally approximately 20 to 40 feet. Throughout the intermediate unit, individual lithologies (whether they originate as glacio-fluvial or glacio-lacustrine) are interbedded and often pinch out or grade into another lithology over short lateral and/or vertical distances. The lowermost unit ranges in thickness from approximately 2 to 21.5 feet. In general, the thickness increases from the southwestern side of Site 16 to the northeast toward Allen Harbor. This lowermost unit was not encountered at all locations of the site, particularly in the portions of the site where bedrock elevations are the highest.

Waste materials composed dominantly of charred and uncharred wood, ceramic, glass, plastic, metal, and concrete fragments have been observed at some locations, particularly in the NCA of the site. This debris may be one source of the soil contamination detected within the NCA. Also in the NCA of the site and toward Allen Harbor, geologically recent material was deposited on top of the undisturbed deposits but below the reworked soil and fill material (including the observed waste materials). These deposits include peat-like material (e.g., compacted leaves, seagrass and/or peat moss) and silt/sand with organic material (black burnt appearance with little to no odors). When encountered, these post-glacial fill materials are generally laterally discontinuous and thin, ranging from 0.10 to 4 feet. For the most part, peat was observed in essentially a north-south-trending area approximately 200 feet wide and centered on the FFTA, generally consistent with in-filling during the initial base construction (post 1939). Additionally, the peat appears to be laterally extensive and interconnected within and adjacent to the FFTA, with intermittent occurrences in areas extending away from the FFTA to the north and south.

Weathered bedrock separates the underlying competent (coreable) bedrock from the overlying unconsolidated glacial deposits. The thickness of the weathered bedrock varies from less than 2 feet to 20 feet, although the thickness is typically 5 feet or less. The weathered bedrock is thinnest generally in the north through the south-central portion of the investigation area. The weathered bedrock is generally dark gray, platy, blocky, and highly fractured. Interbedded clay, silt, and sand layers are often present within this zone and between fractured sections, suggesting that the weathered bedrock may have been locally transported by glacial action rather than weathered in place.

Groundwater underlying the site occurs in the shallow unconfined overburden zone, partially confined intermediate and deep overburden zones, and partially confined competent bedrock zone. Bedrock groundwater flows along bedding planes and interconnected fractures and joints in the bedrock. Hydraulic connection within specific fracture depths over several hundred feet has been observed, and it

is generally assumed that large-scale (site-wide) interconnection of fractures also occurs. Based on data from the RI, groundwater flow at Site 16 is generally northeast from the former Building 41 area towards Allen Harbor for each of the monitored groundwater zones, with flow also occurring to the east toward Narragansett Bay from the southeastern portion of the former Building 41 area. Hydraulic connections between the overburden zones (shallow, intermediate, and deep) appear to be strong because groundwater flow directions are essentially identical (at this site, shallow overburden groundwater flow does not mimic the topography as closely as it mimics the bedrock surface). The hydraulic connection between the unconsolidated overburden and shallow bedrock zone also appears to be strong.

Minor deflections in overall groundwater flow patterns are observed within each overburden and bedrock zone, and are most likely due to variances in lithologies (presence of lower and higher permeable lenses within primary deposits). These deflections can cause more northerly and easterly flow components over short distances. On a larger scale however, groundwater flow is consistently northeast or east. In addition, based on comparisons during high and low groundwater elevations (May to November 2007) and from the same month separated by 3 years (November 2004 to November 2007), essentially no changes to groundwater flow patterns are observed. This groundwater flow information was considered during the development of the groundwater remedial alternatives presented in Section 2.9.

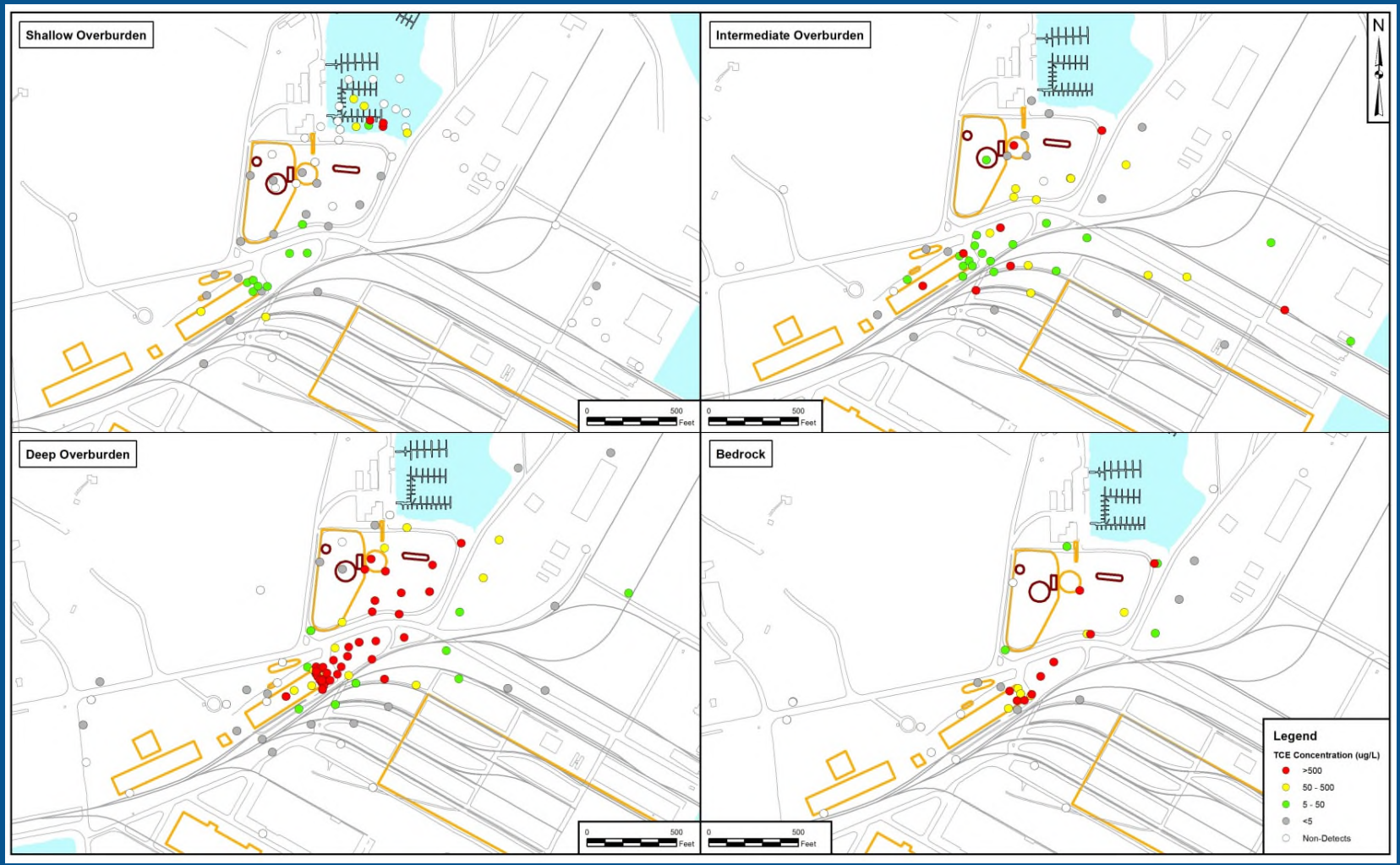
2.5.2 Nature and Extent and Fate and Transport of Contamination

As stated above, it is suspected that much of the environmental contamination observed at Site 16 is attributable to releases (e.g., solvent/PAH releases) from EBS Review Items Nos. 28 and 29 and associated areas. Additionally, fill materials/debris in shallow subsurface soils of the NCA (Figure 2-3) may have also contributed to the observed environmental contamination. The nature and extent of contamination detected in groundwater, soil, surface water (i.e., groundwater-to-surface water seeps and Allen Harbor surface water), sediment, and soil gas at Site 16 is summarized below. In overview, surface and shallow subsurface (unsaturated zone) soil contamination (PAHs, dioxins, and metals [arsenic, and lead]) is found primarily in the NCA in the vicinities of the Creosote Dip Tank area, BTEX hot spot area, FFTA, and Building E-107 Septic Tank Removal area. Additional localized soil contamination (PAHs/VOCs) was also detected within and to the east and south of the former Building 41 footprint. However, limited residual VOC contamination has been detected in unsaturated zone soils throughout Site 16; most VOC contamination in soils is detected in deeper saturated zone soils. Additionally, as noted above, materials such as abraded building material, pavement, or roadway material were likely mixed into shallow-zone soils in the immediate vicinity of the former Building 41 area during site development and maintenance, and these materials are the likely the source of PAHs detected in soil samples from this particular area. Groundwater contamination, primarily TCE with low concentrations of its degradation products, was found at the highest concentrations in the vicinity of the former Building 41 area and then extending downgradient to the north toward Allen Harbor and to the east toward Narragansett Bay. Environmental investigations to date indicate that the Site 16 source areas are not the primary sources of chemicals (e.g., PAHs) detected in the sediments of Allen Harbor. The VOCs detected in the groundwater underlying Site 16 have not been detected in the surface waters and sediments of Allen Harbor at concentrations exceeding conservative, risk-based, screening levels for ecological receptors in Allen Harbor.

VOCs

VOCs, primarily CVOCs (TCE and its degradation products) and benzene, are the most significant (from a risk assessment perspective) environmental contaminants detected in groundwater at Site 16. The shallow groundwater is less contaminated than the intermediate, deep overburden, and bedrock zones. The spatial distribution of the CVOC data, particularly in the intermediate and deep zones, suggests the primary release is old and that contamination has followed complex flowpaths from release points to ultimate discharge points and that CVOC migration has been impacted by local lithologic and hydrogeologic conditions. The footprint of the plume exceeding the drinking water standard of 5 µg/L TCE is approximately 31 acres (Figures 2-1 and 2-5). Analytical data for upgradient wells suggest that no significant CVOC contamination is entering the Site 16 area from other upgradient sites such as the

FIGURE 2-5. TRICHLOROETHENE CONCENTRATIONS IN SITE 16 GROUNDWATER



1 – Groundwater Cleanup Level: 5 µg/L (Federal SDWA MCL)
2 – Please see Figure 2-1 for site features

Construction Equipment Department (CED) Area or the Army Nike PR-58 Site. With the exception of the BTEX hot spot area in the northwestern quadrant of the NCA, minimal contamination has been detected in shallow/unsaturated zone soil.

Figure 2-5 presents TCE concentrations in the shallow, intermediate, and deep overburden zones, the bedrock zone, and in groundwater samples collected from piezometers advanced in the southern portion of Allen Harbor. The CVOC plume has not migrated to Allen Harbor in the shallow zone [i.e., TCE, dichloroethene (DCE), and vinyl chloride (VC) have not been detected in shallow wells near Allen Harbor]. However, the CVOC plume in the intermediate overburden, deep overburden, and bedrock zones is beneath Allen Harbor. TCE and its breakdown products have been detected in groundwater collected from shallow piezometers installed in the southern portion of Allen Harbor. CVOCs are present in the piezometers beneath Allen Harbor because of upward vertical migration within Allen Harbor from greater depths. CVOCs have not been detected at significant concentrations in groundwater seeps discharging to Allen Harbor or in surface water and sediment samples collected from Allen Harbor.

Biodegradation of TCE is evident in the sediments underlying Allen Harbor and in several soil, groundwater, and soil gas samples collected from Site 16. Reducing conditions that favor biodegradation processes were identified in some areas of groundwater in the central and northeastern portions of the CVOC plume, and has resulted in the production of cis-1,2-DCE and VC.

The VOCs are the most mobile of the Site 16 contaminants. The horizontal and vertical extent of the VOCs plume underlying Site 16 is evidence of VOCs relatively high solubility and mobility (e.g., via advective transport and molecular dispersion through fractured bedrock). The presence of the VOCs in soil gas samples collected across the site is evidence of the high volatility of these chemicals and the potential for the migration from the subsurface to the ambient air or the indoor air of a building. However, the low-level VOC detections in Allen Harbor sediments are evidence of the fact that VOCs can be biodegraded under certain environmental conditions. The lack of VOC detections in the actual surface water samples collected from Allen Harbor suggests that biodegradation is occurring in the sediments and/or any groundwater upwelling to the Harbor is quickly diluted by the surface waters of the harbor.

PAHs

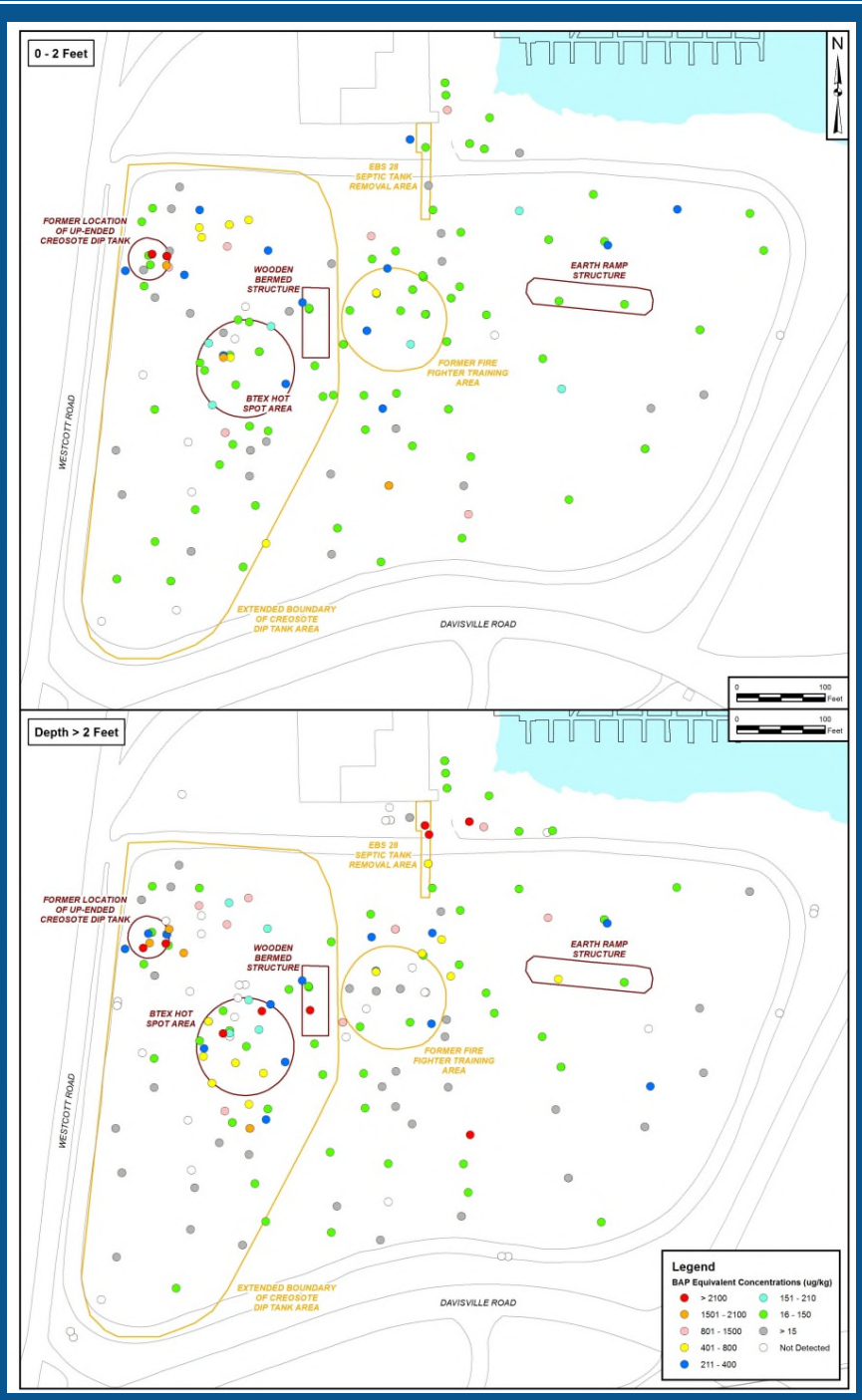
PAHs are the predominant semivolatile organic compounds (SVOCs) detected in Site 16 surface and shallow subsurface soil, Allen Harbor sediments, and groundwater samples collected from shallow monitoring wells in the NCA. The currently available data suggest that PAH contamination in soil is somewhat confined to their release areas. However, PAH contamination has been detected sporadically around these release areas. Figure 2-6 presents PAH data in terms of benzo(a)pyrene equivalent (BaP Eq) concentrations for surface soil (0 to 2 feet bgs) and shallow subsurface soil (2 to 10 feet bgs) intervals. The following carcinogenic PAHs are considered in the calculation of the BaP Eq: benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

PAHs are non-polar hydrocarbons that have a strong affinity for soils, sediments, and suspended solid particles. They are considered persistent in the environment. With the exception of naphthalene, they are only slightly volatile and have very low aqueous solubilities. The PAHs detected in groundwater samples collected from shallow overburden wells in 2007 are predominantly non-carcinogenic in nature, were related to sample turbidity in some cases, and were not at concentrations exceeding Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs) for benzo(a)pyrene. The results are not suggestive of significant PAH migration from the Creosote Dip Tank area or FFTA to Allen Harbor.

Metals

Lead and arsenic were detected in surface and subsurface soils of the NCA at concentrations exceeding available background or reference area concentrations. The elevated metals concentrations are most evident in the shallow subsurface soil zone (i.e., between 2 and 10 feet bgs) in the northwestern portion of the NCA. Most of the locations with concentrations greater than EPA soil screening benchmarks

FIGURE 2-6. BENZO(A)PYRENE EQUIVALENT CONCENTRATIONS IN NORTH CENTRAL AREA SOILS



Relevant Regulatory Benchmarks:

- RIDEM Residential DEC for Benzo(a)pyrene: 400 µg/kg
- RIDEM Industrial DEC for Benzo(a)pyrene: 800 µg/kg (Selected cleanup goal for soils, applied to the benzo(a)pyrene equivalent concentration.)
- EPA 1E-05 Cancer Risk Level for BaP Eqs for Residential Land Use Scenario: 150 µg/kg (Selected cleanup goal for soils.)
- EPA 1E-05 Cancer Risk Level for BaP Eqs for Industrial Land Use Scenario: 2,100 µg/kg.

(i.e., EPA regional screening levels [RSLs]) for industrial exposures and the RIDEM I/C DECs are within the northwestern quadrant of the NCA; many are associated with the BTEX hot spot area. There is a general correlation between known release areas and metals concentrations in soils. Elevated metals concentrations in soils outside the known release areas may be associated with the debris (e.g., metal debris) underlying a significant portion of the NCA. In contrast, the spatial distribution of the metals data for groundwater suggests that the concentrations are not strongly related to releases from Site 16 source areas. The detected concentrations may be attributable, in part, to naturally occurring conditions (e.g., total/dissolved solids or turbidity).

Metals are highly persistent and when released to the environment generally tend to absorb to the soil matrix and remain bound to particulate matter. Because of this, they often tend to migrate from source areas via bulk movement processes (e.g., transport by wind erosion or with suspended particulates in water) and, if leaching from soil to groundwater occurs, it usually results in transportation over relatively short distances.

Figures 2-7 and 2-8 present lead and arsenic concentrations in surface and shallow subsurface soils in the NCA.

Dioxins/Furans

Dioxins/furans were detected in surface and shallow subsurface soil collected from the northwestern quadrant of the NCA. The concentrations detected may be attributable, in part, to historical activities at Site 16 (e.g., emissions from fire-fighting training exercises in the northwestern portion of the NCA). The maximum concentrations detected do not exceed the EPA cleanup levels for industrial exposure but do exceed the EPA cleanup level for residential exposure.

A summary of the soil RI data for the NCA and groundwater RI data for all groundwater zones is presented in Table 2-2.

TABLE 2-2. SUMMARY OF RI RESULTS FOR COCS (CHEMICALS THAT POSE UNACCEPTABLE RISKS TO RECEPTORS OR EXCEED ARARS)

COC[1]	FREQUENCY OF DETECTION	RANGE OF DETECTIONS
Surface Soil – North Central Area		
VOCs [microgram per kilogram(µg/kg)]		
1,1-DCE	0/77	Not Detected
Benzene	1/77	4 – 4
Tetrachloroethene (PCE)	0/77	Not Detected
TCE	1/77	26 -26
VC	0/77	Not Detected
SVOCs (µg/kg)		
1,1-Biphenyl[3]	1/1	1.4
2-Methylnaphthalene	53/152	0.47 – 10,012
BaP Eqs	143/156	0.039 – 4,608
Benzo(g,h,i)perylene	131/156	2.2 – 1,904
Naphthalene	52/156	0.59 – 3,685
Fluoranthene	142/156	3 – 7,900
Fluorene	72/156	0.21 – 984
Pyrene	142/156	4.4 – 8,017

TABLE 2-2. SUMMARY OF RI RESULTS FOR COCS (CHEMICALS THAT POSE UNACCEPTABLE RISKS TO RECEPTORS OR EXCEED ARARS)		
COC[1]	FREQUENCY OF DETECTION	RANGE OF DETECTIONS
Dioxins/Furans [nanogram per kilogram(ng/kg)]		
2,3,7,8-Tetrachlorodibenzodioxin (TCDD) Equivalents	8/8	1.19 – 48.5
Metals [milligram per kilogram (mg/kg)]		
Antimony	21/46	0.5 – 17.9
Arsenic	97/99	1.3 – 32.3
Lead	99/99	6.9 – 1,360
Manganese	46/46	84.4 - 398
Subsurface Soil – North Central Area		
VOCs (µg/kg)		
1,1-DCE	1/252	410
Benzene	9/252	0.9 – 4,800
PCE	1/252	450
TCE	55/253	0.6 – 4,100
VC	14/253	1 – 7.8
SVOCs (µg/kg)		
1,1-Biphenyl[3]	5/5	12 – 14,000
2-Methylnaphthalene	102/213	0.16 – 280,000
BaP Eqs	160/204	0.008 – 17,995
Benzo(g,h,i)perylene	144/213	0.072 – 6,700
Naphthalene	119/214	0.59 – 44,000
Fluoranthene	154/214	0.62 – 60,000
Fluorene	118/213	0.13 – 91,000
Pyrene	164/213	0.4 – 50,000
Dioxins/Furans (ng/kg)		
2,3,7,8-TCDD Equivalents	11/11	0.41 – 505
Metals (mg/kg)		
Antimony	30/80	0.45 - 22.3
Arsenic	123/129	0.81 – 15.1
Lead	129/129	2 – 2,650
Manganese	80/80	26.8 - 587
Groundwater		
VOC (µg/L)		
1,1,2-Trichloroethane (TCA)	73/602	0.0114 – 4
1,1-DCE	179/642	0.0138 – 14
Benzene	99/642	0.008 – 9
cis-1,2-DCE	240/615	0.158 – 390
Methylene Chloride	7/638	1 – 44
PCE	69/602	0.1 – 25

TABLE 2-2. SUMMARY OF RI RESULTS FOR COCS (CHEMICALS THAT POSE UNACCEPTABLE RISKS TO RECEPTORS OR EXCEED ARARS)		
COC[1]	FREQUENCY OF DETECTION	RANGE OF DETECTIONS
TCE	428/639	0.1 – 7,700
VC	127/638	0.0113 – 58
SVOC (µg/L)		
bis(2-ethylhexyl)phthalate (BEHP)	16/89	1 – 53
Naphthalene	13/103	0.013 - 41
Metals (µg/L)		
Antimony	8/358	0.53 – 64.9
Arsenic	192/358	0.203 -92.2
Barium	345/358	0.62 – 2,350
Beryllium	66/348	0.06 -16.8
Cadmium	66/358	0.06 – 9.7
Chromium	141/358	0.4 – 368
Cobalt	243/333	0.06 – 394
Lead	201/358	0.05 – 283
Nickel	263/358	0.38 – 642
Selenium	42/358	0.33 – 87.1
Thallium	48/358	0.033 – 5.9
Miscellaneous Parameters [milligram per liter (mg/L)][2]		
Nitrate	165/317	0.1 – 38.9
Nitrite	13/317	0.11 – 4.74

1) Concentrations as noted. The COCs presented in italics are those identified by the HHRA. Other chemicals are included in this table as COCs because of exceedances of federal SDWA MCLs or RIDEM residential DECs.
2) Minor COCs noted in HHRA.
3) 1,1-Biphenyl was only analyzed for during the forensic investigation.

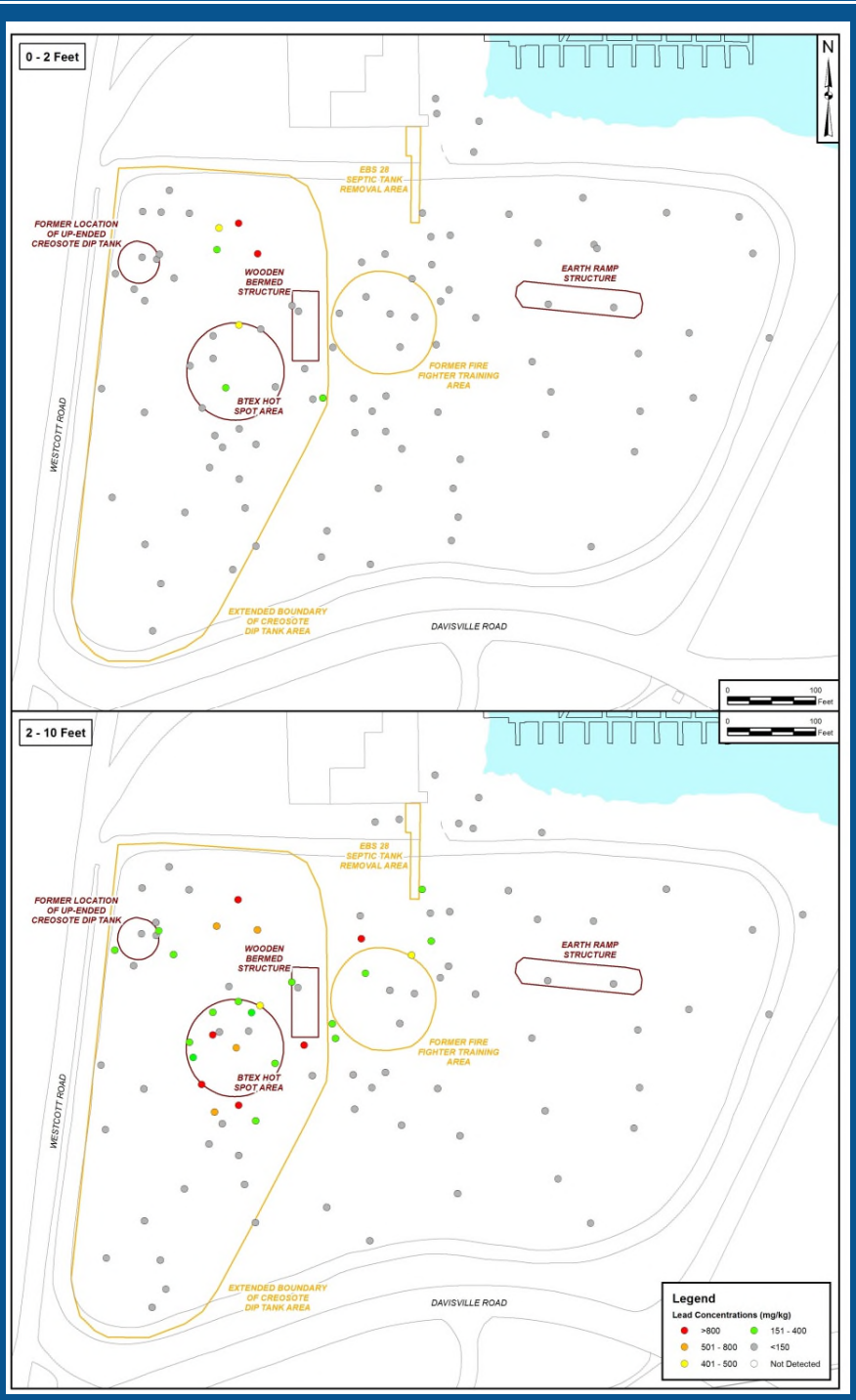
2.6 CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

As noted above, NCBC Davisville was decommissioned in March 1994 and closed on April 1, 1994, under the BRAC Program. The NCA portion of Site 16 is currently forested and shrub land. The small portion of Site 16 immediately north of the NCA and in the immediate vicinity of Building E-107 is used for marina purposes (i.e., recreational purposes). These areas of Site 16 are still owned by the Navy and are currently leased to QDC, which has sub-leased the marina area to the Allen Harbor Boating Association.

The remainder of Site 16 was previously transferred as described in Section 2.1 and includes mostly paved areas that are primarily used by the North Atlantic Distribution, Inc. (NORAD), a commercial automotive company, for the storage of cars delivered by ships and trains, pending delivery to automotive dealers. Seafreeze Ltd., a commercial fish processing enterprise, is located at the eastern edge of Site 16 (at the Narragansett Bay shoreline). The anticipated future land use for most of Site 16 (including the NCA) is commercial/industrial. However, it is anticipated that the area in the immediate vicinity of Building E-107 (the marina building) will continue to be used for marina (recreational) purposes.

Groundwater underlying NCBC Davisville has a State of Rhode Island GB classification, meaning that it is considered not suitable for drinking water without treatment because of known or presumed degradation.

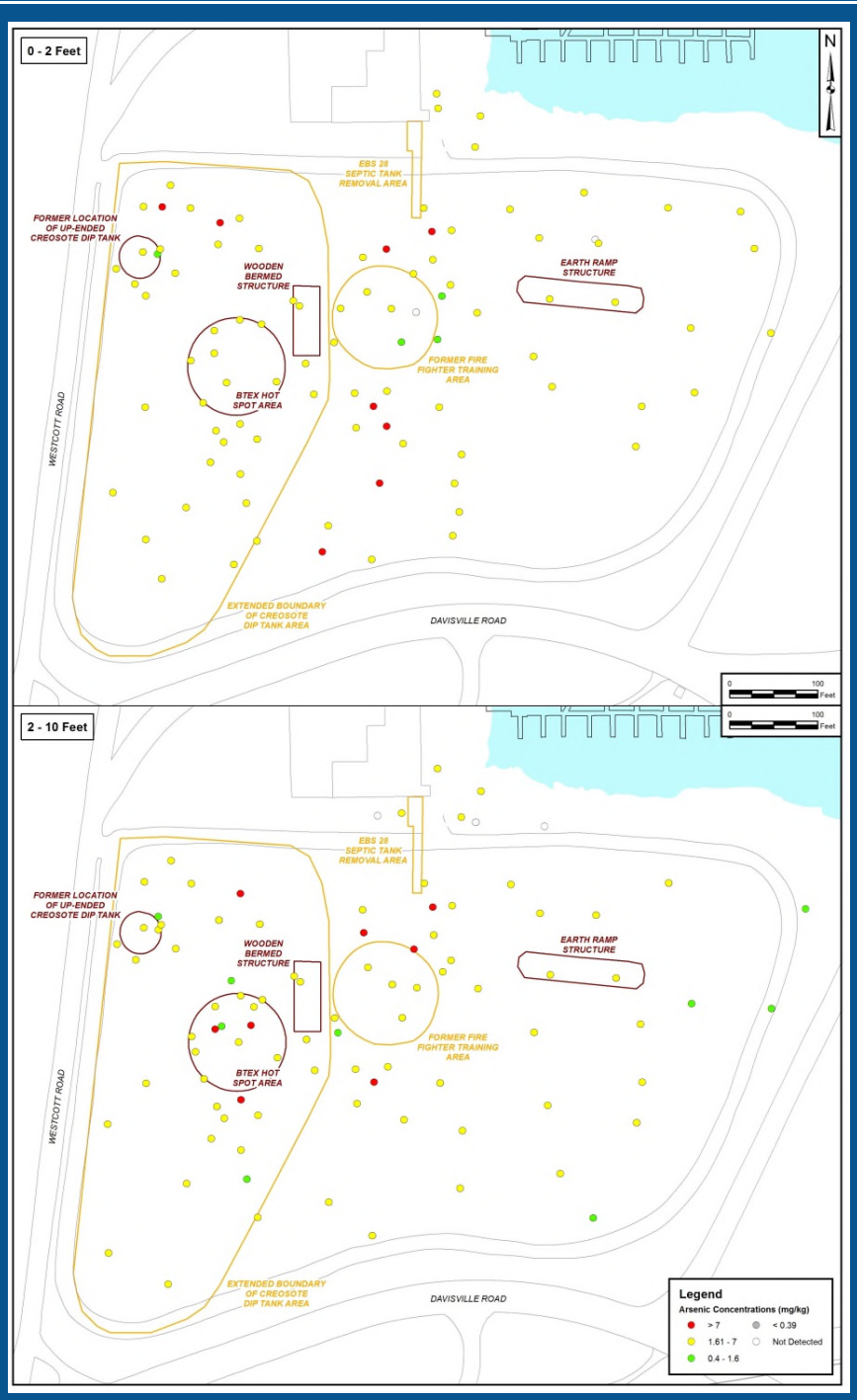
FIGURE 2-7. LEAD CONCENTRATIONS IN NORTH CENTRAL AREA SOILS



Relevant Regulatory Benchmarks:

- RIDEM Residential DEC: 150 mg/kg (Selected cleanup goal for soils).
- RIDEM Industrial DEC: 500 mg/kg (Selected cleanup goal for soils).
- EPA RSL for Residential Land Use Scenario: 400 mg/kg.
- EPA RSL for Industrial Land Use Scenario: 800 mg/kg.

FIGURE 2-8. ARSENIC CONCENTRATIONS IN NORTH CENTRAL AREA SOILS



Relevant Regulatory Benchmarks:

- RIDEM Residential/Industrial Direct Exposure Criterion: 7 mg/kg. (Background-based criterion. Selected cleanup goal for soils).
- EPA 1E-06 Cancer Risk Level for Arsenic for Residential Land Use Scenario: 0.39 mg/kg.
- EPA 1E-06 Cancer Risk Level for Arsenic for Industrial Land Use Scenario: 1.6 mg/kg.

However, per EPA groundwater remediation guidance, in states without an EPA-approved Comprehensive State Groundwater Protection Program (CSGWPP) such as Rhode Island, CERCLA groundwater remediation must meet federal drinking water standards (i.e., MCLs and non-zero Maximum Contaminant Level Goals [MCLGs]) and risk-based standards, or more stringent state groundwater standards (unless the water is non-potable) based on the EPA classification of the groundwater, which is Class IIB in this area.

Groundwater underlying NCBC Davisville is not currently used for drinking water purposes and there is no foreseeable future use of groundwater for drinking water. Drinking water for the former NCBC Davisville area and the towns of North Kingston and East Greenwich is provided from **public supply wells** that draw from the Potowomut-Wickford Aquifer, are located upgradient (north and west) of the former NCBC Davisville area, and are at least 1 mile away from the closest NCBC Davisville IR Program site. Some private residents in the Town of North Kingston rely on private wells for drinking water; however, no private wells in North Kingstown are located downgradient of Site 16. Numerous studies have indicated that there are no wells within (or immediately adjacent to) Site 16 that are withdrawing/using groundwater for any purpose.

No natural surface water bodies are located within the Site 16 boundary. Groundwater underlying Site 16 discharges to Allen Harbor to the north and Narragansett Bay to the east. Two groundwater-to-surface water seeps (which discharge to Allen Harbor) exist along the southern shoreline of Allen Harbor (i.e., the northern boundary of the NCA). Three ponds, named the Davol Pond system, located immediately southwest of Site 16, are not significant discharge points for groundwater underlying Site 16, but the ponds do appear to be a discharge area for groundwater in the general former NCBC Davisville area. An extensive stormwater drainage system exists within the Site 16 boundary. Much of the overland surface water run-off/stormwater from the site drains to Allen Harbor and Narragansett Bay.

The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) provides the base flood elevation for the 100-year flood, but not the elevation for the 500-year flood, to indicate their coverage. Per the FIRM, approximately 20 percent of the NCA is covered by the 100-year flood and nearly all of the NCA is covered by the 500-year flood.

2.7 SUMMARY OF SITE RISKS

The baseline risk assessment estimates what risks the site poses if no action was taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. A baseline human health risk assessment (HHRA) was conducted as part of the Phase III RI (Tetra Tech, 2009). Additional soil and soil gas samples were collected in support of the FS, and the HHRA for these media was updated to include these results. The updated HHRA were published in the FS prepared for Site 16 (Tetra Tech, 2012). A Screening Level Ecological Risk Assessment (SLERA) of Allen Harbor was conducted as part of the Phase II RI (EA, 2004), and a SLERA for surface soils within the NCA area of Site 16 was conducted as part of the Phase III RI (Tetra Tech, 2009). A SLERA was not conducted for soils in the developed portion of Site 16 because the area is paved (i.e., the area lacks suitable habitat for ecological receptors). This section of the ROD summarizes the results of the human health and ecological risk assessments completed for this site.

2.7.1 Summary of Human Health Risk

The quantitative HHRA was conducted using chemical concentrations detected in soil, groundwater, groundwater-to-surface water seeps (groundwater seeps), surface water, sediment, and soil gas samples. Key steps in the risk assessment process included identification of chemicals of potential concern (COPCs), exposure assessment, toxicity assessment, and risk characterization. Tables summarizing data used in the HHRA and the associated results are presented in Appendix C.

Identification of COPCs and Exposure Units

The available data (i.e., chemical concentrations detected in environmental media) collected during the Site 16 field investigations were used to identify soil, groundwater, surface water/groundwater seep, sediment, and soil gas **COPCs for Site 16**. Both federal and RIDEM criteria were used for COPC selection. Federal criteria included EPA RSLs, EPA MCLs, and EPA Groundwater Screening Levels for Evaluating the Vapor Intrusion into Indoor Air from Groundwater. RIDEM criteria included DECs for residential soil and GA groundwater objectives.

Tables C-1 and C-2 in Appendix C present exposure point concentrations (EPCs) for COPCs identified during the HHRA for surface soil, subsurface soil, groundwater, surface water/groundwater seeps, sediment, and soil gas at Site 16. EPCs are the concentrations used in the risk assessment to estimate exposure and risk from each COPC. The following guidelines were used to calculate EPCs for Site 16 during the HHRA:

- For soil and sediment, the 95-percent upper confidence limit (UCL) on the arithmetic mean, which was based on the distribution of the data sets, was selected as the EPC for each parameter. EPCs were calculated following EPA's Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites and using EPA's ProUCL software (2002 and 2007).
- For groundwater, the arithmetic mean concentration for samples collected in the highly contaminated portion of the CVOC plume was used as the EPC. For inorganics, if the maximum concentration was detected in the CVOC plume, then the arithmetic mean concentration within the plume was used as the EPC. If the maximum concentration was not detected in the CVOC plume or if the inorganic was not detected in the CVOC plume, then the maximum detected concentration was used as the EPC.
- The maximum detected concentration was used as the EPC for surface water/groundwater seeps and soil gas.
- Non-detected values were evaluated in accordance with ProUCL guidance. The results of duplicate samples were averaged for purposes of calculating EPCs for COPCs in environmental media at Site 16.

An exposure unit (EU) is the area over which receptor activity is expected. Three EUs were identified for evaluating exposures to soil at Site 16. The NCA area was divided into two EUs, the northwestern area and the southeastern area (Figure 2-1). The northwestern area includes the former Creosote Dip Tank area, FFTA, BTEX hot spot area, and septic tank removal area (associated with Building E-107). The southeastern area includes the remainder of the NCA. The developed area was evaluated as a single EU. Surface soils were evaluated separately from subsurface soils. As noted above, much of the developed portion of Site 16 is currently paved. The HHRA was conducted assuming that the pavement might be removed at some time in the future, exposing the soil beneath it, or that subsurface soils may be excavated at some time in the future and distributed across the surface soils. Groundwater was evaluated as two EUs consisting of the highly contaminated areas of the CVOC plume in the developed areas and NCA. Soil gas was evaluated as three EUs in the baseline HHRA, the Building E-107 area, NCA, and former Building 41 area. In the updated HHRA included in the 2012 FS, three additional EUs were evaluated, the BTEX hot spot area, Seafreeze Ltd. building area, and the NORAD area. The EU for receptors potentially exposed to the Allen Harbor surface water/groundwater seeps and sediments included all RI sample locations within Allen Harbor and its shoreline.

Exposure Assessment

During the **exposure assessment** step of the HHRA, current and potential future exposure pathways through which humans might come into contact with the COPCs identified in the previous step were evaluated. The results of the exposure assessment for Site 16 were used to refine the CSM (Figure 2-4), which identifies potential contaminant sources, contaminant release mechanisms, transport routes, and receptors under current and future land use scenarios. Surface soil, subsurface soil, groundwater, surface water/groundwater seeps, and sediment were identified as the media of concern based on the COPC selection process. The evaluated potential exposure routes included incidental ingestion of soil,

sediment, and surface water/groundwater seeps; ingestion of groundwater; dermal contact with soil, groundwater, sediment, and surface water/groundwater seeps; and inhalation of air or volatiles from soil and groundwater (including vapor intrusion into buildings). The HHRA considered receptor exposure under non-residential (construction and industrial workers, recreational users, and trespassers) and hypothetical future residential land use. Current and hypothetical future exposure pathways at Site 16 are summarized in Table 2-3A. Exposure assumptions and other supporting information used in the HHRA are presented in Tables C-3 through C-6 in Appendix C.

TABLE 2-3A. RECEPTORS AND EXPOSURE ROUTES EVALUATED IN HHRAS

RECEPTOR	EXPOSURE ROUTE
Construction Workers (current and future land use)	Incidental ingestion of soil Dermal contact with soil and groundwater Inhalation of airborne particulates or VOCs from soils or VOCs migrating from groundwater (e.g., pooling in an excavation pit)
Industrial Workers (current and future land use)	Incidental ingestion of soil Dermal contact with soil Inhalation of airborne soil particulates Inhalation of VOCs migrating from groundwater (Vapor intrusion pathway)
Adolescent Trespassers (current and future land use)	Incidental ingestion of soil Dermal contact with soil Inhalation of airborne surface soil particulates
Recreational Users (Children/Adults) (current and future land use)	Incidental ingestion of soil, surface water/groundwater seeps, and sediment Dermal contact with soil, surface water/groundwater seeps, and sediment Inhalation of airborne soil particulates
Hypothetical Residents (Children/Adults) (future land use)	Incidental ingestion of soil Direct ingestion of groundwater Dermal contact with soil and groundwater Inhalation of airborne soil particulates Inhalation of VOCs migrating from groundwater (vapor intrusion pathway)

Toxicity Assessment

The objective of the toxicity assessment is to identify the potential adverse health effects in exposed populations. Quantitative estimates of the relationship between the magnitude and type of exposures and the severity or probability of human health effects are defined for the identified COPCs. Quantitative toxicity values determined during this component of the risk assessment are integrated with outputs of the exposure assessment to characterize the potential for the occurrence of adverse health effects for each receptor group.

Carcinogenic effects are quantified using the cancer slope factor (CSF) for ingestion and dermal exposures and inhalation unit risk (IUR) for inhalation exposures. These CSF/IUR values represent a plausible upper-bound estimate of the probability of development of cancer per unit intake of chemical over a lifetime. The potential carcinogenic effects are calculated using available dose-response data from human and/or animal studies.

The toxicity value used to evaluate non-carcinogenic health effects for ingestion and dermal exposures is the reference dose (RfD). The reference concentration (RfC) is used to evaluate non-carcinogenic health effects for inhalation exposures. RfDs and RfCs are estimates of the daily exposure level for the human population that are likely to be without appreciable risk during a portion or all of a lifetime. RfDs and RfCs

are based on a review of available animal and/or human toxicity data, with adjustments for various uncertainties associated with the data.

Although toxicity criteria can be found in several toxicological sources, EPA's Integrated Risk Information System (IRIS) online database is the preferred source of toxicity values. This database is continuously updated, and the presented values have been verified by EPA. The toxicity criteria for the constituents selected as COPCs during the HHRA are presented in Tables C-7 through C-10 in Appendix C.

Risk Characterization

During the risk characterization, the outputs of the exposure and toxicity assessments are combined to characterize the baseline risk (cancer risks and non-cancer hazards) at the site if no action was taken to address the contamination. Potential **cancer risks and non-cancer hazards** were calculated based on reasonable maximum exposure (RME) and central tendency exposure (CTE) assumptions. The RME scenario assumes the maximum level of human exposure that could reasonably be expected to occur, and the CTE scenario assumes a median or average level of human exposure. Risk characterization results are summarized in Table 2-3B and discussed below. Risk estimates are further summarized in Tables C-11 through C-14.

For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen. Excess incremental lifetime cancer risk (ILCR) is calculated from the following equation:

$$\text{Risk} = \text{CDI} \times \text{CSF}$$

where: risk = a unitless probability (e.g., $2x10^{-5}$) of an individual developing cancer
CDI = chronic daily intake averaged over 70 years (mg/kg-day)
CSF = cancer slope factor ($[\text{mg/kg-day}]^{-1}$)

These calculated risks are probabilities that are usually expressed in scientific notation (e.g., $1x10^{-6}$). An excess lifetime cancer risk of $1x10^{-6}$ under an RME scenario indicates that an individual experiencing the reasonable maximum exposure estimate has an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual developing cancer from all other causes has been estimated to be as high as one in three. EPA's generally acceptable risk range for site-related exposures is $1x10^{-4}$ (one in ten thousand) to $1x10^{-6}$ (one in one million). The cumulative cancer risk benchmark for RIDEM is $1x10^{-5}$ (one in one hundred thousand).

Tables C-11 through C-14 in Appendix C provide RME cancer risk estimates for the Northwestern NCA, Southeastern NCA, and Developed area for the significant receptors and routes of exposure developed by taking into account various conservative assumptions about the frequency and duration of exposure for each receptor and also about the toxicity of the COPCs. Site 16 COPCs associated with carcinogenic risk include arsenic, PAHs, dioxins, and VOCs (Table C-15). Total risk estimates for all applicable exposure routes range from $1x10^{-7}$ for adolescents exposed to subsurface soil in the Developed area to $2x10^{-3}$ for hypothetical future lifelong residents exposed to groundwater in the Developed area (i.e., using the groundwater as a domestic water supply source). These risk levels indicate that if no cleanup action was taken, the increased probabilities of developing cancer as a result of site-related exposure would range from approximately 1 in 10,000,000 to 2 in 1,000.

TABLE 2-3B. SUMMARY OF HUMAN HEALTH RISK ASSESSMENT RESULTS				
AREA	MEDIUM	ILCR EXCEEDS EPA'S TARGET RISK RANGE OF 10^{-4} TO 10^{-6}	ILCR EXCEEDS RIDEM'S CUMULATIVE RISK LEVEL OF 10^{-5}	HI EXCEEDS 1 ON A TARGET ORGAN BASIS
NCA				
Northwest Portion of NCA	Surface Soil[1]	Incremental lifetime cancer risks (ILCRs) do not exceed range	Child Resident Adult Resident Lifelong Resident	Hazard Indices (HIs) within acceptable levels
	Subsurface Soil[1]	Child Resident Lifelong Resident	Industrial Worker Child Recreational User Lifelong Recreational User Child Resident Adult Resident Lifelong Resident	Child Resident
	Groundwater	Child Resident Adult Resident Lifelong Resident	Child Resident Adult Resident Lifelong Resident	Child Residents
Southeast Portion of NCA	Surface Soil	ILCRs do not exceed range	Child Resident Lifelong Resident	HIs within acceptable levels
	Subsurface Soil	ILCRs do not exceed range	Child Resident Adult Resident Lifelong Resident	HIs within acceptable levels
	Groundwater	Child Resident Adult Resident Lifelong Resident	Child Resident Adult Resident Lifelong Resident	Child Residents
Building E-107 area	Vapor Intrusion	ILCRs do not exceed range	ILCRs do not exceed RIDEM benchmark	HIs within acceptable levels
BTEX hot spot area	Vapor Intrusion	ILCRs do not exceed range	ILCRs do not exceed RIDEM benchmark	HIs within acceptable levels
FFTA and southern portion of the NCA	Vapor Intrusion	ILCRs do not exceed range	ILCRs do not exceed RIDEM benchmark	HIs within acceptable levels

TABLE 2-3B. SUMMARY OF HUMAN HEALTH RISK ASSESSMENT RESULTS				
AREA	MEDIUM	ILCR EXCEEDS EPA'S TARGET RISK RANGE OF 10^{-4} TO 10^{-6}	ILCR EXCEEDS RIDEM'S CUMULATIVE RISK LEVEL OF 10^{-5}	HI EXCEEDS 1 ON A TARGET ORGAN BASIS
NCA (continued)				
Allen Harbor	Sediment	Child Recreational User Lifelong Recreational User	Child Recreational User Adult Recreational User Lifelong Recreational User	HIs within acceptable levels
	Groundwater-to-surface water seeps and Allen Harbor Surface Water	ILCRs do not exceed range	ILCRs do not exceed RIDEM benchmark	HIs within acceptable levels
DEVELOPED AREA				
Site 16 area south of Davisville Road [2]	Surface Soil	ILCRs do not exceed range	ILCRs do not exceed RIDEM benchmark	HIs within acceptable levels
	Subsurface Soil	ILCRs do not exceed range	ILCRs do not exceed RIDEM benchmark	HIs within acceptable levels
	Groundwater	Child Resident Adult Resident Lifelong Resident	Child Resident Adult Resident Lifelong Resident	Child Residents Adult Residents
Former Building 41 area	Vapor Intrusion	ILCRs do not exceed range	Residents Industrial Workers	Residents Industrial Workers
Seafreeze Ltd. building area	Vapor Intrusion	ILCRs do not exceed range	ILCRs do not exceed RIDEM benchmark	HIs within acceptable levels
NORAD area	Vapor Intrusion	ILCRs do not exceed range	ILCRs do not exceed RIDEM benchmark	HIs within acceptable levels

1) The HHRA results also indicate unacceptable blood level concentrations may occur as a consequence of resident, industrial worker, or construction worker exposure to lead concentrations in soils in some sub-areas of the northwest portion of the NCA.
2) The HHRA results for soils do not include risk estimates for the anomalous PAH concentrations considered not to be site-related. (Please see explanation provided in the introduction to Section 2.5 and Section 2.5.2.)

The potential for non-carcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., a 70 year lifetime) to an RfD or RfC derived for a similar exposure period. An RfD or RfC represents a level to which an individual may be exposed that is not expected to cause any deleterious effect. The ratio of exposure to toxicity value is called a Hazard Quotient (HQ). An HQ less than 1 indicates that a receptor's dose of a single contaminant is less than the RfD and that toxic non-carcinogenic effects from that chemical are unlikely. The hazard index (HI) is generated by adding the HQs for all chemicals that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may be reasonably exposed. An HI less than 1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic non-carcinogenic effects from all contaminants are unlikely. An HI greater than 1 indicates that site-related exposures may present a risk to human health. The HQ is calculated as follows:

$$\text{Non-cancer HQ} = \text{CDI} / \text{RfD}$$

where: CDI = chronic daily intake
RfD = reference dose

CDIs and RFDs are expressed in the same units and represent the same exposure period (i.e., chronic, sub-chronic, or short-term).

Tables C-11 through C-14 in Appendix C also provide RME non-cancer HQs for the each receptor and route of exposure and also provide total HIs for all routes of exposure. Total HIs for all applicable exposure routes range from 0.01 for adolescent trespassers and adult recreational users exposed to subsurface soil in the Southeastern NCA to 137 for hypothetical future child residents exposed to groundwater underlying the Developed Area (i.e., using the groundwater as a domestic water supply source).

Soil Risks

HIs for all receptors exposed to site-related COPCs in surface soil and subsurface soil in the Northwestern NCA under the RME scenario were less than or equal to 1, with the exception of hypothetical child residents exposed to subsurface soil. Dioxins/furans were the major contributor to the HI for hypothetical child residents.

HIs for all receptors exposed to site-related COPCs in surface soil and subsurface soil in the Southeastern NCA and Developed area under the RME scenario were less than or equal to 1.

ILCRs for hypothetical child residents and lifelong residents exposed to site-related COPCs in subsurface soil in the Northwestern NCA exceeded EPA's target risk range of 10^{-4} to 10^{-6}.

ILCRs for all receptors exposed to site-related COPCs in surface and subsurface soils in the Southeastern NCA and Developed area were within EPA's target risk range of 10^{-4} to 10^{-6}, with the exception of the risk for lifelong residents in the Southeastern NCA. The ILCR for lifelong residents exposed to subsurface soil was equal to the upper bound of EPA's target risk range.

ILCRs for hypothetical child and lifelong residents exposed to surface soil and subsurface soil in the Northwestern NCA were within EPA's target risk range but exceeded RIDEM's cumulative cancer benchmark of $1x10^{-5}$. In addition, ILCRs for hypothetical adult residents exposed to surface soil and subsurface soil and industrial workers and child and lifelong recreational users exposed to subsurface soil in the Northwestern NCA exceeded RIDEM's cumulative cancer risk benchmark.

ILCRs for hypothetical child and lifelong residents exposed to surface soil and subsurface soil in the Southeastern NCA exceeded RIDEM's cumulative cancer benchmark of $1x10^{-5}$. In addition, ILCRs for hypothetical adult residents exposed to subsurface soil in the Southeastern NCA exceeded RIDEM's cumulative cancer risk benchmark.

Carcinogenic PAHs, dioxins/furans, and arsenic were the major contributors to the ILCRs for exposures to surface soil and subsurface soil at the Northwestern and Southeastern NCA areas.

Groundwater Risks

The HI for hypothetical child residents exposed to groundwater underlying the Northwestern and Southeastern NCA areas exceeded 1. Naphthalene, 2-methylnaphthalene, and metals were the major contributors to the HI.

HIs for hypothetical child and adult residents exposed to groundwater underlying the Developed area exceeded 1. Metals were the major contributors to the HIs.

ILCRs for hypothetical child, adult, and lifelong residents using Site 16 groundwater for domestic purposes, in both the Developed and NCA areas, exceeded EPA's target risk range and RIDEM's cumulative cancer benchmark. VOCs, PAHs, and arsenic were the major contributors to the ILCRs for the Northwestern and Southeastern NCA areas, and VOCs and arsenic were the major contributors to the ILCRs for the Developed area.

Groundwater-to-Surface Water Seeps/Allen Harbor Surface Water

The HI for recreational users exposed to groundwater seeps/surface water were less than or equal to 1.

The ILCR for recreational users exposed to groundwater seeps/surface water were within EPA's target risk range and less than RIDEM's cumulative risk benchmark.

Sediment Risks

HIs for recreational users exposed to sediments were less than or equal to 1.

ILCRs for child and lifelong recreational users exposed to sediments exceeded EPA's target risk range. ILCRs for child, adult, and lifelong recreational users exceeded RIDEM's cumulative risk benchmark. Carcinogenic PAHs were the major contributors to the ILCR for estimated exposures to sediments. However, the vast majority of Allen Harbor sediments are submerged; therefore, the potential for direct human exposure is very limited. Additionally, RI evaluations, including the environmental forensic study of Allen Harbor sediments, concluded that Site 16 is not the primary source of contaminants in sediment (i.e., sediment risks are not due to releases at Site 16).

Risks from Vapor Intrusion

For the former Building 41 area, HIs for residential and industrial receptors exposed via the vapor-intrusion-into-buildings pathway exceed 1. TCE was the major contributor to the HI.

ILCRs for all evaluated areas were within EPA's target risk range of 10^{-4} to 10^{-6}. For the former Building 41 area, ILCRs for residential and industrial receptors exposed via the vapor-intrusion-into-buildings pathway exceeded RIDEM's cumulative cancer benchmark of $1x10^{-5}$. Benzene, chloroform, and TCE were the major contributors to the ILCRs.

Risks for Lead

In the Phase III HHRA, exposure and risk from lead in site soil, measured through EPA blood lead models, was found to be below the EPA's level of concern. However, the 2012 HHRA evaluation of the additional soil data collected in 2010 to support the FS, indicate that unacceptable lead concentrations are present in soil in some sub-areas of the Northwestern NCA. Lead was detected at a maximum concentration of 3,950 mg/kg in the 2010 soil samples, which is greater than approximately 10 times the EPA residential screening level of 400 mg/kg and 26 times RIDEM residential DEC of 150 mg/kg. The

lead concentrations reported for the 2010 soil samples exceed those reported in the Phase III RI. The blood lead levels for hypothetical future residents or workers may exceed EPA's level of concern if these receptors were to be exposed long-term to the soil concentrations in these sub-areas. Lead concentrations also exceed RIDEM DECs for both the resident and the industrial worker. Consequently **lead was retained as a chemical of concern (COC)** for soils in the NCA.

Risk Uncertainties

One of the significant uncertainties with the HHRA lies with the measurements of inorganic contaminant concentrations in groundwater. Metal concentrations reported for unfiltered samples were often significantly higher than metal concentrations reported for filtered samples in many of the monitoring wells tested, particularly in the intermediate overburden, deep overburden, and shallow bedrock groundwater zones. Turbidity levels were also often elevated in the monitoring wells in which unfiltered metal concentrations were significantly higher than filtered metal concentrations. The elevated turbidity levels indicate that the elevated metals concentrations in the unfiltered samples are due, in part, to the presence of particulates entrained in the highly turbid groundwater samples. The metals concentrations in some of the groundwater samples collected from monitoring wells located at the Allen Harbor and Narragansett Bay shoreline may have also been influenced by the salinity of the adjoining surface water (i.e., the concentrations of some metals are elevated as a consequence of salinity).

Another uncertainty in the HHRA pertains to the presence of chromium in groundwater. Groundwater samples were analyzed for total chromium whereas the HHRA conservatively assumed that chromium is present as the more toxic hexavalent chromium (Cr^{+6}) rather than the less toxic trivalent form (Cr^{+3}). If chromium was present predominantly in the trivalent form, then chromium would not have been retained as a COC for groundwater.

Identification of COCs for Remediation Goal Development

Human health risk-based COCs were identified based primarily on the cancer and non-cancer risk estimates provided in the HHRA included in the Phase III RI Report (Tetra Tech, 2009).

Human health risk-based COCs are identified for site environmental media for scenarios where the media-specific cancer risk or non-cancer HI exceeds the target risk benchmarks. EPA's target cancer risk range is $1x10^{-4}$ to $1x10^{-6}$, and RIDEM's cumulative cancer risk benchmark is $1x10^{-5}$. Therefore, to comply with both of these criteria for each receptor/exposure scenario, a cumulative site cancer risk benchmark of $1x10^{-5}$ was used as the threshold to indicate whether further evaluation was required in the FS. An HI of 1 on a target organ basis was used for non-cancer effects, which is consistent with both EPA and RIDEM requirements. Chemicals detected at concentrations exceeding RIDEM residential DECs and GA leachability criteria were also retained as COCs.

Remedial (cleanup) goals were developed for COCs that contributed significantly to total cancer risk exceeding 10^{-5} and/or HI greater than 1 for each exposure pathway in a land use scenario for a receptor group. Chemicals in soil were not considered as significant contributors to risk if their individual risk contribution was less than $1x10^{-6}$ and their non-cancer HQ was less than 0.1. For groundwater, a chemical was selected as a COC if the ILCR was greater than $1x10^{-6}$ or the HQ was greater than 0.1, and if the chemical concentration was greater than the SDWA MCL or RIDEM GA groundwater objectives.

In addition to direct contact risks (as described above), contaminant migration from soil to groundwater issues were also considered in the selection of COCs. If a chemical was identified as a COC for groundwater then the potential for chemical migration from soil to groundwater was also considered in the selection of COCs.

Soil COCs

The following chemicals exceeding threshold values for the industrial and residential exposure scenario (or leachability concerns) in either surface or subsurface soil were selected as risk-based COCs for soil:

- Carcinogenic PAHs, arsenic, lead, naphthalene, dioxins/furans, and benzene.

In addition to these risk-based COCs which were identified in the HHRA as the primary risk drivers, the following chemicals were also identified as COCs based on their exceedances of chemical-specific ARARs (i.e., RIDEM's residential DEC and/or GA leachability criteria):

- Antimony, manganese, benzo(g,h,i)perylene, fluoranthene, fluorene, 2-methylnaphthalene, 1,1-DCE, 1,1-biphenyl, pyrene, VC, TCE, and tetrachloroethene (PCE).

Although total petroleum hydrocarbons (TPH) is not a contaminant under CERCLA, TPH concentrations at several locations exceeded the RIDEM residential DEC and leachability criteria. The TPH contamination in the Site 16 soils is generally collocated with PAH contamination.

Groundwater COCs

In the HHRA groundwater was evaluated as two EUs: the highly contaminated portion of the CVOC plume area underlying the NCA and the highly contaminated portion of the CVOC plume area underlying the remainder of the site However, because the groundwater CVOC contamination is continuous throughout Site 16, groundwater was evaluated as a single unit in the FS. The following chemicals were selected as risk-based COCs for groundwater:

- Benzene, cis-1,2-DCE, PCE, TCE, VC, and naphthalene.

In addition to these risk-based COCs which were identified in the HHRA as the primary risk drivers the following chemicals were also identified as COCs primarily based on their exceedances of chemical-specific ARARs (i.e., EPA MCLs or RIDEM GA groundwater objectives):

- 1,1-DCE, 1,1,2-trichloroethane (TCA), bis(2-ethylhexyl)phthalate (BEHP), methylene chloride, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, lead, nickel, nitrate, nitrite, selenium, and thallium.

Chloroform, 1,2-dichloroethane (DCA), hexachlorobenzene, and benzo(a)pyrene were identified as risk drivers for residential exposures to groundwater in the HHRA but were not retained as COCs to be addressed in the FS because concentrations of these chemicals were equal to or less than their respective EPA MCLs and RIDEM GA groundwater objectives. 2-Methylnaphthalene was not retained as a COC because all detected values were less than current EPA RSL for tap water. Aluminum and silver were also identified as risk drivers for residential exposures to groundwater in the HHRA but were not retained as COCs to be addressed in the FS because the maximum dissolved concentrations of these chemicals were less than EPA MCLs, RIDEM GA groundwater objectives, or EPA tap water RSLs. Iron and manganese were not retained as COCs because the RI concluded that reported results for most metals exceeding RSLs were likely attributable, in large part, to sample turbidity or background conditions. However, conservatively, iron and manganese will be included on the list of metals tracked during the LTM program established for Site 16.

2.7.2 Summary of Ecological Risk

Three ERAs were performed at Site 16: 1) A Phase I SLERA completed in 2004 was conducted to evaluate risks to terrestrial ecological receptors exposed to chemicals in surface soil and aquatic ecological receptors exposed to chemicals in groundwater seeps and sediment collected in association with the groundwater seeps in Allen Harbor, located adjacent to Site 16. 2) A Phase II SLERA conducted in 2004 evaluated the ecological risks to benthic invertebrates and wildlife exposed to COPCs in sediment at Allen Harbor based on the sediment samples results evaluated in the Phase I SLERA, as well as additional sediment samples collected as part of the Phase II RI. 3) An updated SLERA was conducted in 2009, using data from all sampling events, to evaluate the ecological risks to terrestrial plants, soil invertebrates, and wildlife exposed to COPCs in surface soil at Site 16 as part of the Phase III RI. The

2009 SLERA focused on surface soil in the NCA portion of Site 16 (see Figures 2-1 and 2-3). The Developed area of Site 16 was not evaluated in the ERAs because it is largely paved and viable habitat is very limited in this area.

Exposure pathways for ecological receptors included direct contact with contaminated soil, sediment, and surface water, incidental ingestion of contaminated soil and sediment, and ingestion of contaminated food items. The ERAs consisted of Steps 1, 2, and 3a of the eight steps required by the EPA guidance and the Navy Policy for Conducting Ecological Risk Assessments. The first two steps comprise a SLERA. Step 3a is the first step of the baseline ecological risk assessment (ERA) and further refines the list of COPCs that were retained from the SLERA and determines if Steps 3b through 7 of the baseline ERA are necessary. Finally, Step 8, Risk Management, was addressed throughout the ERA process, in cooperation with Region 1 regulators.

In Steps 1 and 2, potential risks to ecological receptors resulting from exposure to chemicals were initially evaluated by comparing chemical concentrations to published ecological screening levels. Risks to birds and mammals from exposure to chemicals in soil and sediment were evaluated using representative species. The selection of particular species is required to estimate intake through eating and drinking. The following species were selected as they are either present at the site or are similar to receptors present at the site. The Eastern cottontail, red fox, and American robin were evaluated for risks to wildlife from exposure to soil in the Phase I SLERA. The meadow vole and the bobwhite quail, which are herbivorous (plant-eating) receptors and the short-tailed shrew and American robin, which are insectivorous (insect-eating) receptors, were used to evaluate risks from wildlife exposure to soil in the 2009 SLERA. The raccoon and herring gull were used to evaluate risks from wildlife exposure to sediment in the Phase II SLERA. Risks to these representative birds and mammals from exposure to chemicals in soil and sediment were determined using food chain models to estimate the CDI and compare the CDI to toxicity reference values representing acceptable daily dose in mg/kg-day. A screening level risk HQ was determined using ecological screening levels and exposure estimates. For each chemical and environmental medium, the HQ was expressed as the ratio of a potential exposure level to the applicable screening level/dose. A HQ less than 1 indicates the chemical alone is unlikely to cause adverse ecological effects.

Several chemicals were initially selected as COPCs because they were detected at concentrations that exceeded their respective screening levels. VOCs, SVOCs, PAHs, one pesticide, dioxins, and metals were initially selected as COPCs for soil at Site 16. PAHs, polychlorinated biphenyls (PCBs), pesticides, metals, and dioxins were initially selected as COPCs for sediment in Allen Harbor. PAHs, pesticides, and metals were initially selected as COPCs for the groundwater seeps in Allen Harbor. Note that CVOCs, the primary Site 16 COCs in deep soil (10 feet bgs or deeper) and groundwater were not identified as COPCs in sediment or groundwater seeps. Ecological COPCs identified during the ERAs based on comparison to screening levels and Step 2/conservative food chain models are summarized in Appendix D.

The Step 3a refinement evaluated COPCs retained because of very conservative exposure scenarios and identified those chemicals that significantly contributed to potentially unacceptable levels of ecological risk. Chemicals found to not significantly contribute to potentially unacceptable levels of ecological risk were eliminated from further evaluation at that step. Factors considered in the Step 3a evaluation and uncertainty assessment included spatial distribution and frequency of chemical detection, chemical bioavailability, extent of habitat, food chain modeling using less conservative exposure assumptions, magnitude of criterion exceedance, more appropriate screening levels or toxicity benchmarks such as high effect benchmarks, and background values. Tables relevant to Step 3a evaluations are presented in Appendix D including Step 3a/less conservative food chain models, a comparison of sediment concentrations to higher effects benchmarks for benthic invertebrates, and a comparison of soil concentrations to background values.

Of the chemicals detected in surface soil, the Phase I SLERA concluded that none of the HQs were very high indicating a low potential for risk to terrestrial plants and invertebrates. After the Step 3a refinement

of the conservative food chain model, HQs for Eastern cottontail, red fox, and American robin were all less than 1.0, indicating that risks from surface soil would be minimal to these wildlife receptors.

Of the chemicals detected in groundwater seeps during the Phase I investigation, three inorganics and four organics had HQs greater than 1. However, the Phase I SLERA concluded that there is little potential risk to aquatic receptors, such as fish and plankton, from groundwater seep water because these receptors would not encounter these concentrations after the groundwater seep water was diluted with the surface water in Allen Harbor.

Of the chemicals detected in sediment samples collected at the groundwater seep locations during the Phase I investigation, twenty-seven had HQs greater than 1. An uncertainty assessment of the ecological risk evaluation indicated most chemicals had concentrations less than high effects benchmarks. However, the Phase I SLERA concluded that there was a potential risk to benthic invertebrates, particularly from concentrations of manganese, several PAHs, and several pesticides in sediments at the groundwater seep locations.

Because of uncertainty related to the potential origins and nature and extent of contamination, additional sediment samples were collected and evaluated in a Phase II SLERA conducted in 2004 to better characterize the ecological risks from sediment in Allen Harbor adjacent to Site 16. In addition to sediment samples collected from the site, sediment samples were collected from off-site reference locations for comparison to site data. The three reference locations were: 1) Prudence Coggeshall Cove, 2) the northeast shoreline of Jamestown Island, and 3) Fishing Cove adjacent to Wickford Harbor. These locations were chosen to be representative of sediment not influenced by NCBC Davisville activities. These reference locations were not physically similar to Allen Harbor because Coggeshall Cove and Jamestown Island locations were more representative of open Narragansett Bay and the Fishing Cove location experienced only minimal boat traffic or other influences. The concentrations of contaminants in sediment were lower at the reference locations compared to Allen Harbor.

Based on the Step 3a evaluation for the Phase II SLERA for Allen Harbor, PAHs and pesticides presented slight potential risks to benthic invertebrates in Allen Harbor sediment. A comparison of PAHs and pesticides concentrations to Effects Range-Low (ER-L) sediment screening values, which represent the chemical concentration below which adverse effects would rarely be observed (Long and MacDonald, 1998), indicated potential risks to benthic invertebrates as ER-L quotients exceeded 1. However, only two chemicals had Effects Range-Medium (ER-M) quotients that slightly exceeded 1 (phenanthrene at 1.22 and gamma-chlordane at 1.02). ER-M values represent the chemical concentration above which adverse effects would frequently occur. The average ER-M quotient for Allen Harbor was 0.6. The sediments evaluated in the Phase II SLERA were classified as “medium-low priority” indicating that any impacts on benthic invertebrates would be marginal. Benthic invertebrates were not at potential risk from metals due to relatively low HQs for metals and simultaneously extracted metals/acid-volatile sulfide (SEM/AVS) ratios less than 1, which indicated that divalent metals (e.g., copper, lead, nickel, zinc) would not be bioavailable. Risks to birds and mammals from exposure to sediment were found to be acceptable.

The 2009 SLERA concluded from the Step 3a refinement that no chemicals should be retained for risks to plants and invertebrates. In a Step 3a refinement of the conservative food chain model scenario, HQs for some chemicals exceeded 1. No HQs were greater than 1 for the bobwhite quail. For the meadow vole, only the HQ for aluminum was greater than 1. For the short-tailed shrew, dioxins and five metals had HQs greater than 1. For the American robin, three metals had HQs greater than 1. Additional factors were considered in the Step 3a refinement, such as a comparison of metals to background data, chemical bioavailability, available habitat, and magnitude of criterion exceedance. Based on the Step 3a refinement, it was concluded in the ERA that no chemicals in soil should be retained for potential risks to wildlife.

Although PAHs were identified as posing slight potential risks to benthic invertebrates, it should be noted that forensic investigations, as discussed in Section 2.5, concluded Site 16 source areas were not the

primary sources of the PAHs detected in sediments underlying Allen Harbor or in the soils outside the NCA.

Based on the SLERA, there are no unacceptable ecological risks identified that are solely and definitely attributable to releases from Site 16.

2.7.3 Basis for Action

Unacceptable risks to human health were identified for current and future site exposure scenarios. The results of the HHRA indicated that potential unacceptable risks were associated with (1) exposure to surface soil in the NCA by hypothetical future residents (PAHs, dioxins/furans, arsenic, and lead); (2) exposure to subsurface soil in the NCA by industrial workers, recreational users, and hypothetical future residents (PAHs, dioxins/furans, arsenic, and lead); (3) potable use of groundwater by hypothetical future residents (VOCs, naphthalene, and metals); and (4) exposures to indoor air of a building constructed over the VOC groundwater plume by industrial workers and hypothetical future residents (TCE). Because unacceptable risks were identified for current and hypothetical future receptors, the response action is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment that may present an imminent and substantial endangerment to public health and welfare.

2.8 REMEDIAL ACTION OBJECTIVES (RAO)

RAOs are media-specific goals that define the objective of conducting remedial actions to protect human health and the environment. RAOs specify the COCs, potential exposure routes and receptors, and acceptable concentrations (i.e., cleanup levels) for a site and provide a general description of what the cleanup will accomplish. RAOs typically serve as the design basis for the remedial alternatives described in Section 2.9.

The **RAOs for Site 16** are as follows:

Soil RAOs for the Northwestern Portion of the NCA, Excluding the Benzene Sub-Area

- No.1: Prevent industrial worker (including construction worker) exposure to subsurface soil containing concentrations of COCs (PAHs, arsenic, and lead) that cause unacceptable risk.
- No. 2: Ensure/verify that surface and subsurface soil contaminants (e.g., naphthalene) do not migrate to groundwater, surface water, and sediment causing the groundwater, surface water, and sediment to have associated unacceptable risk.
- No. 3: Prevent hypothetical future residential exposure to surface and subsurface soil contaminants (PAHs, arsenic, lead, and dioxins/furans) that cause unacceptable risk.

Soil RAOs for the Benzene Sub-Area (BTEX hot spot area)

- No.4: Prevent industrial worker (including construction worker) exposure to subsurface soil (in the benzene sub-area) containing concentrations of COCs (PAHs, arsenic, lead) that cause unacceptable risk.
- No. 5: Ensure/verify that surface and subsurface soil contaminants (e.g., benzene and naphthalene in the benzene sub-area) do not migrate to groundwater, surface water, and sediment causing the groundwater, surface water, and sediment to have associated unacceptable risk.
- No. 6: Prevent future residential exposure to surface and subsurface soil (in the benzene sub-area) containing concentrations of COCs (PAHs, arsenic, lead, and dioxins/furans) that cause unacceptable risk.

Soil RAO Specific to Soils in the Vicinity of the Marina Building

- No. 7: Prevent recreational user exposure to soil in the vicinity of the marina building containing concentrations of COCs (PAHs) that cause unacceptable risk.

Groundwater RAOs

- No. 1: Prevent human exposure (including drinking, showering, and irrigation) to groundwater containing COCs that cause unacceptable risk and does not meet the selected cleanup levels.
- No. 2: Verify that groundwater discharging to Allen Harbor and Narragansett Bay continues to pose no unacceptable risks.
- No. 3: Prevent unacceptable risks to industrial workers and hypothetical future residents that could result from exposure to VOC vapors migrating into buildings.
- No. 4: Restore groundwater quality to beneficial use.

Preliminary remediation goals (PRGs) were developed during the FS as target cleanup goals for remedial actions that would reduce COC concentrations in Site 16 media of concern, and thereby mitigate risks to human health and the environment. PRGs were established for the COCs (site-specific constituents that pose unacceptable risks to human health). PRGs were also established for CERCLA hazardous substances, pollutants or contaminants that, although not detected at concentrations causing unacceptable risk, were detected at concentrations exceeding RIDEM's residential DECs and/or GA leachability criteria.

The PRGs were developed to determine the degree of remediation necessary to protect human health and the environment. The PRGs must be protective of each of the principal receptors identified at the site and they should be reasonable and practical to implement. PRGs can be developed based on chemical specific ARARs, when available, and risk-based factors. In addition, the protection of groundwater and the presence of COCs in background locations are also considered in developing the PRGs. For Site 16, PRGs were developed for COCs identified for unrestricted (e.g., residential) site use and for industrial/commercial site use. PRGs also take into consideration RIDEM soil DECs and leachability criteria, as well as federal MCLs, non-zero MCLGs, and federal risk-based standards, and more stringent state standards that are ARARs. (PRGs for groundwater are not applicable at locations where the water is not usable for drinking such as along the coast or along Allen Harbor where groundwater is saline.)

The PRGs developed in the FS have been retained as cleanup levels in this ROD. As shown in Table 2-4, the human health cleanup levels for soil at Site 16 were selected to support industrial use or residential/recreational use. Residential cleanup levels were used to help determine the extent of LUCs. Residential cleanup levels were also used to determine the surface soils to be excavated in the immediate vicinity of the marina. The marina area is the only portion of Site 16 where surface soils will be removed to achieve residential goals. For each COC, the calculated 10^{-6} cancer risk value, the RIDEM Method 1 DEC, the RIDEM GA leachability criterion, and the background value were compared. The lesser of the calculated risk-based value, DEC, and GA leachability criterion was selected and compared to the background value. If the lesser of these values was greater than the background value, the selected value was used as the cleanup level. If lesser of these values was less than the background value, the background value was chosen as the cleanup level. As detailed in Table 2-4, the carcinogenic PAHs were treated as a *group* in the HHRA and FS for Site 16. The risk-based cleanup level presented in Table 2-4 for the carcinogenic PAHs represents the 10^{-5} cancer risk level.

TABLE 2-4. SOIL CLEANUP LEVELS

CHEMICAL OF CONCERN	RIDEM INDUSTRIAL/COMMERCIAL DEC[1] (MG/KG, UNLESS SPECIFIED OTHERWISE)	RIDEM GA LEACHABILITY (MG/KG, UNLESS SPECIFIED OTHERWISE)	RIDEM RESIDENTIAL DEC[1] (MG/KG, UNLESS SPECIFIED OTHERWISE)
BaP Eqs [(2)(3)(4)]	**0.8**	**240**	0.150[7]/**0.400**
Arsenic[(3)]	**7**	Not Available	**7**
Lead[(3)]	**500**	**0.04**[5]	**150**
Naphthalene[(3)]	**10,000**	**0.8**	**54**
Dioxins/Furans[(3)]	600 parts per trillion[7]	Not Available	50 parts per trillion[7]
Benzene[(3)]	**200**	**0.2**	**2.5**
Antimony[(6)]	**820** (220)[7]	**0.05**[5]	**10**
Manganese[(6)]	**10,000**	Not Available	**390**
Benzo(g,h,i)Perylene[(6)]	**10,000** (9,500)[7]	Not Available	**0.8**
Fluoranthene[(6)]	**10,000**	Not Available	**20**
Fluorene[(6)]	**10,000**	Not Available	**28**
2-Methylnaphthalene[(6)]	**10,000** (2,200)[7]	Not Available	**123**
1,1-DCE[(6)]	**9.5**	**0.7**	**0.2**
1,1-Biphenyl[(6)]	**10,000**	Not Available	**0.8**
Pyrene[(6)]	**10,000** (9,500)[7]	Not Available	**13**
VC[(6)]	**3** (0.1)[7]	**0.3**	**0.02**
TCE[(6)]	**520** (3.6)[7]	**0.2**	**13**
PCE[(6)]	**110** (86)[7]	**0.1**	**12**

1 - Remedial goals are presented for the COCs identified in the HHRA for Site 16. The remedial goals for the carcinogenic PAHs in soil for the hypothetical future residential land use will be 0.15 mg/kg for the carcinogenic PAHs (as a group) calculated in terms of BaP Eqs and the RIDEM residential DECs for each individual carcinogenic PAH.
2 - Benzo(a)pyrene (BaP) criterion was used for BaP Equivalent concentrations (BaP Eqs). The following carcinogenic PAHs are considered in the calculation of the BaP Eqs (the RIDEM chemical-specific residential/industrial Direct Exposure Criteria are displayed in mg/kg): Benzo(a)pyrene (0.4/0.8); Benzo(a)anthracene (0.9/7.8); Benzo(b)fluoranthene(0.9/7.8); Benzo(k)fluoranthene (0.9/78); Chrysene (0.4/780); Dibenzo(a,h)anthracene (0.4/0.8); Indeno(1,2,3-cd)pyrene (0.9/7.8). The RIDEM and risk-based residential remedial goals are presented for the BaP equivalents.
3 - COCs based on HHRA.
4 - TPH was also detected in Site 16 soils. The observed contamination is generally collocated with BaP Eqs contamination. The Direct Contact/Leachability Residential Soil/GA and Industrial Soil/GB RIDEM criteria are 500 mg/kg and 2,500 mg/kg, respectively. TPH is not a CERCLA contaminant. This observation is presented for informational purposes only.
5 - Leachability criteria for inorganics are based on SPLP/TCLP analysis (mg/L).
6 - Additional COCs based on exceedances of RIDEM Residential DECs. For these chemicals, there are no exceedances of RIDEM Industrial/Commercial DECs.
7 - Unbolded values in parentheses are risk-based levels calculated using the risk assessment protocol for Site 16. [The lower of the risk-based level for the industrial worker or recreational user, as defined in the Phase III RI, is presented].

The cleanup levels for Site 16 groundwater were selected as the more stringent standards of the federal drinking water MCLs and RIDEM GA Groundwater Objective, as shown in Table 2-5. These cleanup levels apply outside the waste management area; beneath the waste management area they are "Performance Standards" as defined in Section 2.9.1. For COCs with no published MCLs, federal risk-based standards, or RIDEM GA Groundwater Objective, the more stringent of the cancer risk level or non-cancer risk level was selected.

TABLE 2-5 GROUNDWATER CLEANUP LEVELS[1]		
CHEMICAL OF CONCERN	GROUNDWATER CRITERIA (µG/L)	BASIS
1,1-DCE	7	MCL
cis-1,2-DCE[2]	70	MCL
1,1,2-TCA	5	MCL
Benzene[2]	5	MCL
(BEHP	6	MCL
Methylene Chloride	5	MCL
Naphthalene[2,3]	0.14	RSL
PCE[2]	5	MCL
TCE[2]	5	MCL
VC[2]	2	MCL
Antimony	6	MCL
Arsenic	10	MCL
Barium	2,000	MCL
Beryllium	4	MCL
Cadmium	5	MCL
Chromium	To be determined.	MCL or facility-wide background value[4], whichever is greater
Cobalt	4.7	RSL
Lead[3]	15	SDWA Action Level
Nickel	To be determined.	RIDEM GA Level or facility-wide background value[4], whichever is greater
Nitrate	10,000	MCL
Nitrite	1,000	MCL
Selenium	50	MCL
Thallium	To be determined.	MCL or facility-wide background value[4], whichever is greater

1 - These cleanup levels apply outside the waste management area; beneath the waste management area they are "Performance Standards". Please see definitions/explanation provided in Section 2.9.
2 - COCs selected based on HHRA. Other chemicals are included as COCs in this table because of exceedances of EPA MCLs or RIDEM criteria.
3 - The level for cobalt and naphthalene is a calculated risk-based concentration based on EPA toxicity criteria. The level for lead is from the SDWA regulations (40 CFR 141 Subpart I).
4 - To be determined.

2.9 DESCRIPTION OF ALTERNATIVES

To address potential unacceptable human health risks associated with soil and groundwater at Site 16, a **preliminary technology screening** evaluation was conducted in the FS and FS Addendum (FSA). The technologies and process options retained after the initial screening were assembled into various alternatives for soil and groundwater. Consistent with the NCP, the No Action alternatives were evaluated as a baseline for comparison with other alternatives during the comparative analysis. The screening results and remedial alternatives developed in the FS for soil and groundwater are presented in Sections 2.9.1 and 2.9.2, respectively.

2.9.1 Soil Alternatives

To address COCs and associated human health risks in soil, a **preliminary technology screening** evaluation of General Response Actions was conducted in the FS and FSA. The General Response Actions are presented in Table 2-6. Treatment technologies were screened out because treatment was deemed not to be cost effective based on low contaminant concentrations and a wide variety of types of COCs.

TABLE 2-6. GENERAL RESPONSE ACTIONS - SOIL

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTIONS
No Action	None	Not applicable
Limited Action	LUCs	Site use restrictions
	Monitoring	Sampling and analysis
Containment	Surface Cover/Barrier	Soil cover, low-permeability cap, asphalt cap
Removal	Excavation	Mechanical, size reduction, screening
Disposal	Off-Site Disposal	Non-hazardous or hazardous waste landfill

The technologies and process options retained from the detailed screening were assembled into seven remedial alternatives for soil at Site 16. Consistent with the NCP, the No Action alternative was evaluated as a baseline for comparison with other alternatives during the comparative analysis. Table 2-7 summarizes the major components and provides estimated costs for each of the remedial alternatives developed for Site 16 soil.

Many of the soil remedial alternatives include a waste management area (WMA) which is an area where waste is managed in place. For purposes of evaluating these alternatives (that include a WMA), the fill materials and subsurface debris that exist throughout a significant portion of the NCA have been designated a WMA. Per the NCP preamble, the groundwater underlying the WMA will not be required to meet cleanup levels. However, such cleanup levels will be used as “performance standards” for the groundwater underlying the WMA during LTM program of Site 16 to confirm that contaminated groundwater is not migrating beyond the compliance boundary at concentrations that would pose unacceptable risk to aquatic receptors. The boundary of the WMA is referred to as a compliance boundary.

Existing Land Use Restrictions

There are several existing LUCs based on previous transfers and leases (Figure 2-9). The following narrative is provided for informational purposes. The environmental land use restrictions for Site 16 will be “stand alone” and based on the results of the risk assessments prepared for Site 16.

The portion of the site south of Davisville Road is part of Parcel 8 which was assigned to the Department of Transportation, Maritime Administration (MARAD) and subsequently conveyed for port facility purposes to the Rhode Island Economic Development Corporation (RIEDC) on October 14, 1998. The deed did not contain any environmental LUCs, as there were no identified releases requiring a CERCLA ROD for Parcel 8. However, the deed requires that the property be used and maintained in perpetuity for the development or operation of a port facility. Additionally, a condition of the deed requires that the Navy be notified if a well, for any purpose, is installed within Parcel 8, until all necessary response action is completed at all Operable Units at NCBC Davisville.

For Parcel 8 and property transferred prior to BRAC, because this portion of the site is no longer Navy property, implementation of the environmental LUCs will require necessary coordination with the current property owner.

TABLE 2-7. SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED FOR SOIL

ALTERNATIVE	COMPONENTS	DETAILS	COST[1]	TIME TO CLEANUP
No Action (Alternative S-1)	None	No further actions would be taken. Five-year reviews of the No Action decision would be required.	Capital: $7,000 O&M: $0 Five-Year Reviews: $28,000 Total 30-Year NPW: $130,000	Not applicable
Soil Cover and/or Cap, Monitoring, and LUCs (Alternative S-2)	Soil Cover	A 2-foot-thick soil cover (imported clean fill) would be placed over selected areas in the NCA where COC concentrations exceed RIDEM I/C DECs. The areas to be covered extend over an estimated 192,000 ft^2. The soil cover would be placed over existing soil, and no significant regrading of the site would be performed. Covered areas would be revegetated. Pre-construction and post excavation sampling and analysis would be performed to verify the extent of contaminated soil and ensure cleanup levels are achieved.	Capital: $2,051,000 O&M: $3,000 Five-Year Reviews: $28,000 Total 30-Year NPW: $2,502,000	2 Months
	Soil Cap	Areas of unsaturated soil with COC concentration exceeding leachability-based cleanup levels would be capped. The areas to be capped are located in the NCA and extend over an estimated 20,000 square feet. The areas to be capped would be covered with a 2-foot-thick layer of compacted soil with a permeability of 10^{-7} centimeters per second. Pre-construction sampling and analysis would be performed to verity the extent of contaminated soil. The NCA would be designated as a WMA because subsurface contamination and debris would remain under the WMA.		
	Excavation	Soil in the vicinity of the existing marina building with COC concentrations exceeding RIDEM residential and leachability-based cleanup levels would be excavated. The area of contaminated soil is estimated to be approximately 6,200 ft^2, and the depth of the excavation would be 0-2 feet bgs. The total volume of soil to be excavated would be 460 cubic yards. The excavated areas would be backfilled with clean fill and regraded to pre-excavated levels. Based on data from the RI, the excavated soil is expected to be non-hazardous and disposed of at an off-site non-hazardous waste disposal facility.		

TABLE 2-7. SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED FOR SOIL				
ALTERNATIVE	COMPONENTS	DETAILS	COST[1]	TIME TO CLEANUP
	Monitoring	A groundwater monitoring program would be implemented to evaluate long-term potential migration of COCs and to monitor COC concentrations within the compliance boundary of the WMA. The number of groundwater monitoring wells and monitoring frequency would be determined during the remedial design (RD). A line of six monitoring wells would be installed along the downgradient edge of the cover, near Allen Harbor. The results from samples collected from these wells would be compared to screening levels based on water quality criteria (the screening levels were presented in the FSA). Approximately six other wells would be installed within the footprint of the WMA to evaluate changes in groundwater quality. The cleanup levels would be used as performance standards for monitoring wells within the WMA boundary.		
	LUCs and Five-Year Reviews	LUCs would be implemented to prevent residential use of NCA, to protect the covers and caps, to restore cover and cap functions if they are disturbed during site activities and development, to control excavation and disturbance of contaminated soil, and to perform all excavations and backfilling according to a health and safety plan and an approved soil management plan. An additional LUC would describe the extent of the WMA. Also LUCs would be implemented to prevent residential use of the marina area, allow for recreational use associated with the marina, maintain the 2-foot clean soil cover, and implement a soil management plan. Five-year reviews would be conducted within 5 years of initiation of remedial action and every 5 years thereafter by the Navy, EPA, and RIDEM to ensure that the remedy continues to be protective of human health and the environment.		
Excavation, Off-Site Disposal, and LUCs (Alternative S-3)	Excavation	Soil with COC concentrations greater than RIDEM I/C DECs would be excavated to a depth of 0-2 feet bgs. Soils with COC	Capital: $5,136,000 O&M: $3,000 Five-Year Reviews:	5 Months

TABLE 2-7. SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED FOR SOIL				
ALTERNATIVE	COMPONENTS	DETAILS	COST[1]	TIME TO CLEANUP
		concentrations greater than RIDEM GA leachability cleanup levels would be excavated to the depth of the water table. The area of contaminated soil is estimated to be 63,000 ft^2, and the depths of excavated soil vary from 2 to 10 feet bgs. The total volume of excavated soil would be approximately 11,800 cubic yards, including 460 cubic yards from the vicinity of the marina building. The excavated areas would be backfilled with clean fill and regraded to achieve desired surface elevations. The NCA would be designated as a WMA because subsurface contamination and debris would remain at the site.	$28,000 Total 30-Year NPW: $5,312,000	
	Off-Site Disposal	Soil classified as hazardous would be treated at a Resource Conservation and Recovery Act (RCRA) treatment facility prior to disposal to meet land disposal restrictions (LDRs). Non-hazardous waste will be disposed of at a licensed off-site solid waste facility.		
	Monitoring	Same as Alternative S-2.		
	LUCs and Five-Year Review	LUCs would be the same as for Alternative S-2, except that LUCs regarding maintenance of caps and covers would not be applicable, although LUCs would be required to maintain the backfill. Five-Year Reviews would be the same as for Alternative S-2.		
Shallow Excavation, Off-Site Disposal, Soil Cover, Monitoring, and LUCs (AlternativeS-3A)	Excavation	Soil in the NCA with COC concentrations greater than RIDEM I/C DECs would be excavated to a depth of 0-2 feet bgs. The area of contaminated soil is estimated to be approximately 42,000 ft^2, and the total volume is approximately 3,200 cubic yards. The excavated areas would be backfilled with clean fill and regraded to achieve desired surface elevations. Soil near the marina building with COC concentrations greater than the RIDEM residential DEC would be excavated to a depth of 0-2 feet bgs to meet recreational use requirements, per Alternative S-2.	Capital: $1,943,000 O&M: $3,000 Five-Year Reviews: $28,000 Total 30-Year NPW: $2,119,000	5 Months
	Off-Site Disposal	Same as Alternative S-3.		

TABLE 2-7. SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED FOR SOIL

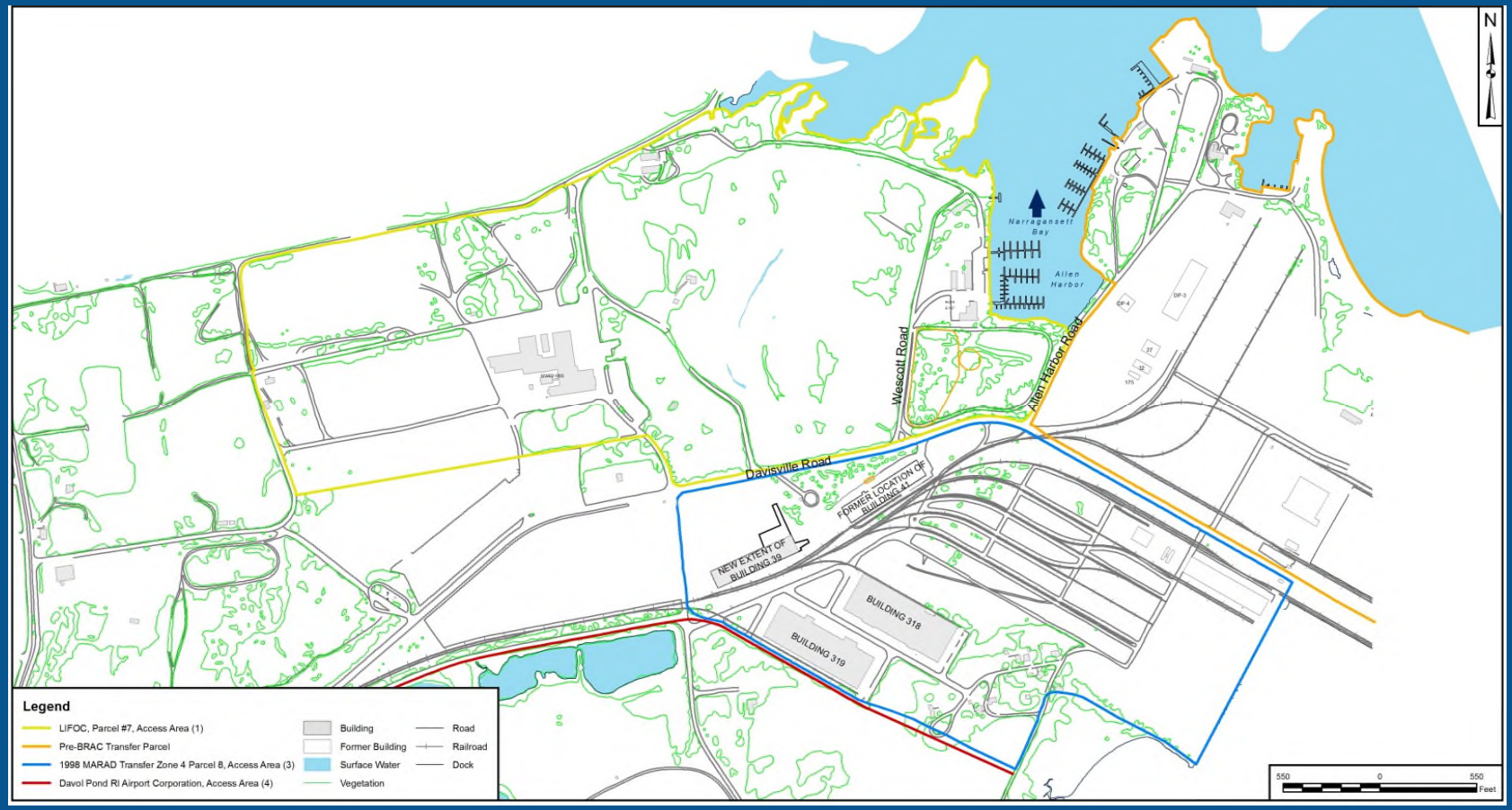
ALTERNATIVE	COMPONENTS	DETAILS	COST[1]	TIME TO CLEANUP
	Soil Cover	The layer of clean backfill placed after the excavation of portions of the NCA and marina areas would be maintained as a cover to prevent direct contact with contaminated subsurface soils. The NCA would be designated as a WMA because subsurface contamination and debris would remain at the site. COCs in groundwater beneath the WMA footprint would not have to meet cleanup levels beneath the WMA.		
	Monitoring	Same as Alternative S-2.		
	LUCs and Five-Year Review	LUCs would be the same as for Alternative S-3. Five-Year Reviews would be the same as for Alternative S-2.		
Soil Cover, Selected Excavation and Disposal, and LUCs (Alternative S-4)	Excavation	Soil with COC concentrations greater than RIDEM GA leachability cleanup levels would be excavated. Pre-construction sampling and analysis would be performed to verify extent of contaminated soil. The area of contaminated soil to be excavated is estimated to be approximately 38,000 ft^2, and the depths of excavation vary from 2 to 10 feet bgs. The total volume is estimated to be approximately 10,000 cubic yards. The excavated areas will be backfilled with clean fill and regraded to achieve desired surface elevations.	Capital: $5,222,000 O&M: $3,000 Five-Year Reviews: $28,000 Total 30-Year NPW: $5,398,000	5 Months
	Excavation Near Marina	Same as Alternative S-2.		
	Cover	A 2-foot-thick soil cover would be placed over areas in the NCA that were not excavated where COC concentrations exceed RIDEM I/C DECs. The areas to be covered extend over an estimated 109,000 square feet. The soil cover would be placed over existing soil, and no significant regrading of the site would be performed. Covered areas would be revegetated. Pre-construction sampling and analysis would be performed to verify extent of contaminated soil. The NCA would be designated as a WMA because subsurface contamination and debris would remain at the site.		
	Off-Site Disposal	Same as Alternative S-3.		
	Monitoring	Same as Alternative S-2.		

TABLE 2-7. SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED FOR SOIL

ALTERNATIVE	COMPONENTS	DETAILS	COST[1]	TIME TO CLEANUP
	LUCs and Five-Year Review	LUCs would be the same as for Alternative S-2. Five-Year Reviews are the same as for Alternative S-2.		
Excavation and Off-Site Disposal – Unrestricted Use (Alternative S-5)	Excavation	Soil with COC concentrations greater than residential cleanup levels would be excavated to the water table. The area of excavated soil is estimated to be approximately 279,000 ft^2, and the depths of excavations range from 2 to 10 feet bgs. The total volume of soil to be excavated is estimated to be approximately 82,000 cubic yards. The excavated areas would be backfilled with clean fill and regraded to achieve desired surface elevations.	Capital: $29,115,000 O&M: $0 Five-Year Reviews: $28,000 Total 30-Year NPW: $29,115,000	12 Months
	Off-Site Disposal	Same as Alternative S-3.		
	LUCs and Five-Year Review	No LUCs or Five-Year Review would be required.		
Full Soil Cover, Monitoring, and LUCs (Alternative S-6)	Cover	The entire NCA would be covered by 1 foot of clean fill underlain by a geotextile membrane. The area to be covered is approximately 425,000 ft^2. Trees would be cleared and grubbed. All surface debris and any remaining structures would be removed and disposed of offsite. The soil cover would be placed over existing soil, and no significant regrading of the site would be performed, although the earthen ramp and mounds would be leveled and graded. Cover areas would be revegetated with grass. The NCA would be designated as a WMA because subsurface contamination and debris would remain at the site.	Capital: $3,090,000 O&M: $3,000 Five-Year Reviews: $28,000 Total 30-Year NPW: $3,185,000	9 Months
	Limited Excavation Near Maria	Same as Alternative S-2.		
	Monitoring	Same as Alternative S-2.		
	LUCs and Five-Year Review	LUCs would be the same as for Alternative S-2. Five-Year Reviews would be the same as for Alternative S-2.		

1 - The cost estimate is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Major changes may be documented in the form of a memorandum in the Administrative Record file, an Explanation of Significant Differences (ESD), or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

FIGURE 2-9. SITE 16 PARCELS



The portion of Site 16 north of Davisville Road is part of Parcel 7 which is owned by the Navy, but RIEDC (Lessee) currently has control and use of the property under a Lease in Furtherance of Conveyance (LIFOC). Although a CERCLA ROD is needed but is not yet in place for the parcel, the following restrictions apply to the parcel:

- Parcel 7 has been approved for a port facility public benefit conveyance (PBC) through MARAD. The purpose of the conveyance must be for the development or operation of a port facility in perpetuity. MARAD has determined that the use of port property for residential use will not likely qualify as an acceptable use of PBC property; accordingly, any request for residential use would require MARAD review and approval. Also, the lease requires that any additions to or alterations of the leased premises requires approval of the Government (Navy).
- The lease terms, as outlined in the Finding of Suitability to Lease, prohibit the use of groundwater as a drinking water source without express written approval of the Navy, EPA, and RIDEM. The Lessee (RIEDC) is responsible for ensuring that adequate institutional controls are in place to protect the public health and to prevent inadvertent use of groundwater by the Lessee or any sub-Lessees in cooperation with the Navy, EPA, and RIDEM.

In accordance with the lease for Parcel 7, annual inspections are conducted to verify compliance with the lease restrictions.

For Parcel 7, environmental LUCs that meet State recording standards would be included in the deed and recorded as part of the eventual property transfer.

2.9.2 Groundwater Alternatives

To address COCs and associated human health risks in groundwater, a **preliminary technology screening** evaluation of General Response Actions was conducted in the FS and FSA. The General Response Actions are presented in Table 2-8. Thermal technologies were screened out due to cost, and permeable reactive barriers were screened out due to the depth of contaminated groundwater.

TABLE 2-8. GENERAL RESPONSE ACTIONS - GROUNDWATER

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTIONS
No Action	None	Not applicable
Limited Action	LUCs	Groundwater use restrictions, construction restrictions
	Monitoring	Sampling and analysis
	Monitored Natural Attenuation	Naturally occurring biodegradation, dilution, and changes in geochemistry.
Removal	Groundwater Extraction	Extraction wells
In-Situ Treatment	Biological	Enhanced bioremediation with an electron-donor compound
	Chemical	Chemical oxidation; oxidation
Ex-Situ Treatment	Physical	Filtration
		Air stripping
		Liquid-phase granular activated carbon (GAC) adsorption
		Vapor-phase GAC adsorption
	Chemical	Neutralization/pH adjustment
Disposal	Discharge	Direct surface water discharge
		Indirect discharge to Publicly Owned Treatment Works (POTW)

The technologies and process options retained from the detailed screening were assembled into eight remedial alternatives for groundwater at Site 16. Consistent with the NCP, the No Action alternative was evaluated as a baseline for comparison with other alternatives during the comparative analysis. Table 2-9 summarizes the major components and provides estimated costs for each of the remedial alternatives developed for Site 16 groundwater. The cleanup levels for groundwater apply outside the waste management area; beneath the waste management area they are considered to be "Performance Standards", as described in Section 2.9.1.

TABLE 2-9. SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED FOR GROUNDWATER

ALTERNATIVE	COMPONENTS	DETAILS	COST	TIME TO CLEANUP
No Action (Alternative G-1)	None	No further actions would be taken. Five-year reviews of the No Action decision would be required	Capital: $7,000 O&M: $0 Five-Year Reviews: $28,000 Total 30-Year NPW: $120,000	Not applicable
MNA and LUCs (Alternative G-2)	MNA	LTM of COCs in groundwater and MNA assessments would be performed to verify that Site 16 plumes are attenuating at an acceptable rate. CVOC concentrations would be reduced through biological activity, dispersion, and dilution through aquifer movement and adsorption onto soil particles. Benzene concentrations in the vicinity of the BTEX hot spot area would be reduced though biological activity, dispersion, dilution, and adsorption. Arsenic concentrations would be reduced as groundwater flows into zones with oxidizing conditions and by dispersion and dilution through aquifer movement. In cases where the soil alternative includes a WMA (Alternatives S-2, S-3, S-3A, S-4, and S-6), groundwater cleanup levels would not need to be met within the compliance boundary of the WMA. Groundwater across the entire site would need to achieve cleanup levels when paired with soil Alternative S-5.	Capital: $44,000 O&M: $45,000 Five-Year Reviews: $28,000 Total 30-Year NPW: $1,124,000	300 Years
	LUCs and Five-Year Reviews	Prohibit installation of groundwater supply wells, including public and private drinking water wells and irrigation wells, in addition to prohibiting any use of groundwater for drinking water purposes. LUCs would also be implemented to require special construction methods to prevent unacceptable exposures to COCs through vapor intrusion for any new buildings that may be constructed on the site. Five-year reviews would be conducted within 5 years of		

TABLE 2-9. SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED FOR GROUNDWATER				
ALTERNATIVE	COMPONENTS	DETAILS	COST	TIME TO CLEANUP
		initiation of remedial action and every 5 years thereafter by the Navy, EPA, and RIDEM to ensure that the remedy continues to be protective of human health and the environment.		
In-Situ Chemical Oxidation (High-Concentration Areas), MNA, and LUCs (Alternative G-3)	In-Situ Chemical Oxidation	Introduction of sodium permanganate or similar oxidant into groundwater in high-concentration areas to destroy VOC contamination through oxidation. The high-concentration areas are the areas within the 1,000 µg/L TCE concentration contour. A second injection event at approximately 50 percent of the level of effort of the primary event is assumed. Monitoring (baseline and quarterly for 1 year) would be performed to evaluate the progress of the chemical oxidation. Groundwater cleanup levels would not need to be met within the compliance boundary of the area of the WMA when paired with soil Alternatives S-2, S-3, S-3A, S-4, and S-6.	Capital: $7,922,000 O&M: $43,000 Five-Year Reviews: $28,000 Total 30-Year NPW: $9,350,000	100 Years
	MNA	Same as Alternative G-2, except because the source area is being treated, less monitoring wells would be required for MNA. Groundwater across the entire site would need to achieve cleanup levels when paired with soil Alternative S-5.		
	LUCs and Five-Year Reviews	Same as Alternative G-2.		
In-Situ Chemical Oxidation (Source Area), MNA, and LUCs (Alternative G-3A)	In-Situ Chemical Oxidation	Similar to Alternative G-3 except only groundwater in the source areas near former Building 41 would be treated. Groundwater in the NCA would not be treated because it would be within the WMA when paired with soil Alternatives S-2, S-3, S-3A, S-4, and S-6. Groundwater across the entire site would need to achieve cleanup levels when paired with soil Alternative S-5.	Capital: $4,283,000 O&M: $48,000 Five-Year Reviews: $28,000 Total 30-Year NPW: $5,587,000	100 Years
	MNA and Monitoring	Same as Alternative G-3 except that wells to be monitored for MNA parameters beneath the WMA would not be required.		
	LUCs and Five-Year Reviews	Same as Alternative G-2.		

TABLE 2-9. SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED FOR GROUNDWATER				
ALTERNATIVE	COMPONENTS	DETAILS	COST	TIME TO CLEANUP
In-Situ Chemical Oxidation (Eastern End of Former Building 41), MNA, and LUCs (Alternative G-3B)	In-Situ Chemical Oxidation	Similar to Alternative G-3A except only groundwater at the eastern end of former Building 41 would be treated. Groundwater in the NCA would not be treated because it would be within the WMA when paired with soil Alternatives S-2, S-3, S-3A, S-4, and S-6. Groundwater across the entire site would need to achieve cleanup levels when paired with soil Alternative S-5.	Capital: $612,000 O&M: $48,000 Five-Year Reviews: $28,000 Total 30-Year NPW: $1,788,000	100 Years
	MNA and Monitoring	Same as Alternative G-3A		
	LUCs and Five-Year Reviews	Same as Alternative G-2		
Enhanced Bioremediation (High-Concentration Areas), MNA, and LUCs (Alternative (G-4)	In-Situ Enhanced Bioremediation	Injection of emulsified vegetable oil into groundwater in high-concentration areas to reduce concentrations of CVOC contaminants through biodegradation. The high-concentration areas are the areas within the 1,000 µg/L TCE concentration contour. Groundwater cleanup levels would not need to be met within the compliance boundary of the area of the WMA when paired with soil Alternatives S-2, S-3, S-3A, S-4, and S-6. Groundwater across the entire site would need to achieve cleanup levels when paired with soil Alternative S-5.	Capital: $6,160,000 O&M: $43,000 - $91,000; $2,222,000 in Year 5 Five-Year Reviews: $28,000 Total 30-Year NPW: $9,656,000	100 Years
	MNA	Same as Alternative G-3		
	LUCs and Five-Year Reviews	Same as Alternative G-2.		
Groundwater Extraction and Treatment (High-Concentration Areas), MNA, and LUCs (Alternative G-5)	Groundwater Extraction	Installation and operation of an array of 45 groundwater extraction wells for a period of 50 years. Extracted groundwater would be sent to an on-site treatment system. Groundwater cleanup levels would not need to be met within the compliance boundary of the area of the WMA when paired with soil Alternatives S-2, S-3, S-3A, S-4, and S-6. Groundwater across the entire site would need to achieve cleanup levels when paired with soil Alternative S-5.	Capital: $4,862,000 O&M: $228,000 - $258,000 Five-Year Reviews: $28,000 Total 30-Year NPW: $9,932,000	100 Years
	On-Site Treatment	VOC concentrations in the extracted groundwater would be reduced through air stripping and activated carbon adsorption.		
	Discharge to Surface Water	Treated groundwater would be discharged to a storm sewer system and then into Narragansett Bay. Treated water would be required to satisfy the		

TABLE 2-9. SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED FOR GROUNDWATER				
ALTERNATIVE	COMPONENTS	DETAILS	COST	TIME TO CLEANUP
		requirements of a National Pollutant Discharge Elimination System (NPDES) permit equivalency administered by RIDEM. Sampling and analysis of the discharge water would be completed to ensure compliance with the ROD discharge standards..		
	MNA	Same as Alternative G-3.		
	LUCs and Five-Year Reviews	Same as Alternative G-2.		
Enhanced Bioremediation, MNA, and LUCs (Reduced Remediation Time) (Alternative G-6)	In-Situ Enhanced Remediation	Similar to Alternative G-4 except that a larger area of the plume, based on the 500 µg/L TCE concentration contours, would undergo active remediation so remediation would be completed in a reduced period of time compared to other alternatives.	Capital: $17,614,000 O&M: $27,000 - $111,000; $6,000,000 in Year 5 Five-Year Reviews: $28,000 Total 30-Year NPW: $24,186,000	50 Years
	In-Situ Oxidation of Arsenic	An oxygen-releasing compound (ORC) such as ORC-Advanced™ would be injected into groundwater in the NCA to reduced arsenic concentrations. A pilot study would be performed to confirm well spacing and ORC-Advanced™ application rate. Monitoring wells would be sampled during the first year, samples would be collected quarterly and analyzed for arsenic, oxidation-reduction potential (ORP), and iron. After the first year, samples would be collected and analyzed annually.		
	MNA	Similar to Alternative G-3 except because of the larger area of plume being treated, a smaller portion of the plume would be treated by MNA.		
	LUCs and Five-Year Reviews	Same as Alternative G-2.		

2.10 COMPARATIVE ANALYSIS OF ALTERNATIVES

Sections 2.10.1 and 2.10.2 summarize the comparative analysis of alternatives for soils and groundwater, respectively.

2.10.1 Comparative Analysis of Soil Alternatives

Table 2-10 and subsequent text in this section summarize the comparison of soil remedial alternatives with respect to the nine CERCLA evaluation criteria outlined in the NCP at 40 Code of Federal Regulations (CFR) 300.430(e)(9)(iii) and categorized as threshold, primary balancing, and modifying criteria. The threshold criteria (e.g., overall protection of human health and the environment) are evaluation criteria that must be met by an alternative. The primary balancing criteria (e.g., long-term effectiveness) are used to differentiate between alternatives that meet the threshold criteria. Modifying criteria (e.g., state acceptance) may be used to modify the recommended cleanup for a site. The

preferred soil alternative for Site 16 is Alternative S-3A, highlighted in grey in Table 2-10. The following narrative evaluates the soil alternatives for Site 16 against the nine CERCLA evaluation criteria. (Further information on the detailed comparison of remedial alternatives is presented in the Site 16 FS and FSA).

TABLE 2-10. SUMMARY OF COMPARATIVE ANALYSIS OF SOIL ALTERNATIVES

EVALUATION CRITERIA	ALT. S-1	ALT. S-2	ALT. S-3	ALT. S-3A	ALT. S-4	ALT. S-5	ALT. S-6
	NO ACTION	COVER/ CAP AND LUCS	EXCAVATION AND LUCS	SHALLOW EXCAVATION, OFF-SITE DISPOSAL, COVER, AND LUCS	COVER, EXCAVATION AND LUCS	EXCAVATION – UNRESTRICTED USE	FULL COVER, MONITORING, AND LUCS
Overall Protection of Human Health and the Environment	Ø	●-	●	●	●	●+	●-
Compliance with ARARs	Ø	●	●	●	●	●	●
Long-Term Effectiveness and Permanence	Ø	●-	●	●	●	●+	●-
Reduction of Toxicity, Mobility, and Volume Through Treatment	Ø	Ø	Ø	Ø	Ø	Ø	Ø
Short-Term Effectiveness	Ø	●+	●	●	●	●-	●+
Implementability	●	●+	●+	●+	●+	O	●
Costs							
Capital Costs (upfront costs to design and construct)	$7,000	$2,051,000	$5,136,000	$1,943,000	$5,222,000	$29,115,000	$3,009,000
Total Present Value (total cost over duration of alternative in today's $)	$120,000	$2,502,000	$5,312,000	$2,119,000	$5,398,000	$29,115,000	$3,185,000
Assumed Duration of Alternative (Years)	30	30	30	30	30	1	30
State Agency Acceptance	RIDEM concurs with the selected Remedy.						
Community Acceptance	There were no objections from the community.						

NOTES:

● Meets or Exceeds Criterion O Partially or Potentially Meets Criterion (some uncertainty) Ø Does NOT Meet Criterion

"+" indicates that the alternative is more favorable compared to the others. "-" indicates that the alternative is less favorable compared to the others.

Threshold Criteria (The selected alternative must meet these criteria)

Overall Protection of Human Health and the Environment. Alternative S-5 would be the most protective because contaminants with concentrations greater than residential cleanup levels would be removed and there would be no site use restrictions. Alternative S-3 would be the next most protective alternative because contaminants with concentrations greater than industrial cleanup levels in surface soil and all soil with contaminant concentrations greater than leachability cleanup levels would be removed in the NCA. Alternative S-3A would be comparable to Alternative S-3 because contaminants with

concentrations greater than cleanup levels and RIDEM I/C DECs would be removed in the NCA, and a soil cover would prevent exposure to subsurface contaminants. Alternative S-4 would be protective but slightly less protective than Alternatives S-3 and S-3A because some contaminants with concentrations greater than industrial cleanup levels would remain in the NCA, although they would be covered. Alternative S-2 would be protective but slightly less than Alternative S-4 because no contaminants would be removed, and contaminants would remain in the NCA at concentrations greater than industrial and leachability cleanup levels, although they would be capped or covered. Alternative S-6 would be as protective as Alternative S-2 because no contaminants would be removed and contaminants would remain in the NCA at concentrations greater than industrial and leachability cleanup levels, although they would be covered. For Alternatives S-2, S-3, S-3A, S-4, and S-6, LUCs would prevent residential uses of the NCA/marina and disturbance of the soil cover. Alternatives S-2, S-3, S-3A, S-4, and S-6 would be protective of recreational users near the marina building by removing contaminated soil to a depth of 0-2 feet bgs and replacing it with clean fill, and by implementing LUCs to prevent exposure to subsurface soil.

Alternative S-1 could provide some protection of human health and the environment. Under current LUCs that are part of existing lease agreements, the portion of the site north of Davisville Road cannot be used for residential purposes. However, contaminants could still leach into groundwater. Because the existing LUCs are not CERCLA environmental restrictions and/or are not memorialized in a real estate instrument that runs with the land in perpetuity, there is a risk that they could be modified or removed in the future. Therefore, Alternative S-1 would not be fully protective and will not be discussed further.

Compliance with ARARs. Alternatives S-2, S-3, S-3A, S-4, S-5, and S-6 would comply with all chemical-, location-, and action-specific ARARs and to be considered (TBCs). Alternatives S-3, S-3A, and S-5 would meet the chemical-specific ARARs by removing the contaminants and implementing LUCs. Alternatives S-2 and S-6 would meet chemical-specific ARARs by covering or capping the site and eliminating the exposure routes. Alternative S-4 would meet the chemical-specific ARARs through a combination of excavation and covering. Alternatives S-2, S-3, S-3A, S-4, and S-6 have a WMA, so RIDEM leachability criteria exceedances are addressed by monitoring to ensure that contaminated groundwater does not migrate beyond the WMA compliance boundary. Monitoring will be used to assess if groundwater migrating beyond the compliance boundary presents an unacceptable risk to human or ecological receptors and, therefore, additional soil remediation may be necessary.

Primary Balancing Criteria (Used to differentiate between alternatives meeting the threshold criteria)

Long-Term Effectiveness and Permanence. Alternatives S-2, S-3, S-3A, S-4, S-5, and S-6 would provide long-term effectiveness and permanence. Alternative S-5 would be the most effective and permanent because all contaminants at concentrations greater than residential and leachability cleanup levels would be removed from the site. Alternative S-3 would be the next most effective and permanent because contaminants with concentrations greater than industrial cleanup levels in surface soil and all soil with contaminant concentrations greater than leachability cleanup levels would be removed from the NCA. Similarly, Alternative S-3A is comparable to Alternative S-3 because contaminants with concentrations greater than cleanup levels and RIDEM I/C DECs in surface soil would be removed from the NCA, but some contaminants would remain at the site under cover. Alternative S-4 would be slightly less permanent than Alternatives S-3 and S-3A, because although some contaminants would be removed from the NCA, some contaminants would remain at the site, although under a cover. Alternatives S-2 and S-6 would both be slightly less permanent than Alternative S-4 because contaminants would remain at the NCA, although under caps and cover. For Alternatives S-2, S-3, S-3A, S-4, and S-6, the LUCs would be effective in maintaining designated site uses and maintaining the cover and caps in good condition. Alternatives S-2, S-3, S-3A, S-4, and S-6 would provide long-term effectiveness in the vicinity of the marina building by removal of contaminated soil to a depth of 0-2 feet bgs and by implementing LUCs for recreational uses and maintaining the condition of the backfill cover.

Reduction in Toxicity, Mobility, or Volume Through Treatment. Contaminant concentrations in soil were relatively low and were not typical of levels observed in source material; therefore, treatment

technologies were not considered because they were not expected to be cost-effective. None of the soil alternatives would provide reductions in toxicity, mobility, or volume through treatment. No treatment residues would be generated by any of the alternatives.

Short-Term Effectiveness. Implementation of Alternatives S-2, S-3, S-3A, S-4, S-5, and S-6 could expose remediation workers to contaminated soil. This potential for exposure would be minimized by the implementation of engineering controls, such as dust suppression, and air quality monitoring. The potential for worker exposure would be further reduced by the wearing of appropriate personal protective equipment (PPE) and compliance with applicable Occupational Safety and Health Administration (OSHA) regulations and proper site-specific health and safety procedures. Alternative S-5 would have the greatest amount of exposure of remediation workers to contaminated soil because the alternative has the largest amount of excavation. Alternative S-4 would have slightly less exposure of remediation workers than Alternatives S-3 and S-3A, because less soil would be excavated. Alternatives S-2 and S-6 have the least amount of excavated soil and the least exposure of remediation workers.

Implementation of Alternative S-2 would have very little adverse impact on either the surrounding community or the environment because of the small amount of excavated soil transported through the community, although the transport of soil to Site 16 for the cover would require approximately 600 truckloads. Alternatives S-3, S-3A, S-4, S-5, and S-6 have greater potentials for community impact because of the handling and transport of contaminated soil for disposal and clean soil for backfill and/or cover material. Alternatives S-3, S-3A, S-4, and S-6 would require approximately 1,000, 470, 1,200, and 1,200 truckloads, respectively. The potential impact from Alternative S-5 would be the greatest because the quantity of excavated soil for disposal and clean soil for backfill would require approximately 7,100 truckloads. However, measures such as spill prevention and containment, erosion and sedimentation control, and perimeter air monitoring would be taken to ensure that the impact remains acceptable.

Alternative S-2 would be expected to be completed in approximately 4 months, Alternatives S-3, S-3A, and S-4 would be expected to be completed within 6 months, Alternative S-6 would be expected to be completed in 9 months, and Alternative S-5 would be expected to be completed in approximately 12 months.

Alternatives S-2, S-3, S-3A, S-4, S-5, and S-6 would meet the soil RAOs. Alternative S-5 would meet all residential soil cleanup levels. Alternative S-3 would meet the soil industrial cleanup levels in surface soil and leachability cleanup levels in all soil in the NCA and would eliminate the exposure pathways to deeper contamination. Alternative S-3A would meet the soil industrial cleanup levels and RIDEM I/C DECs in surface soil in the NCA, and meet the RIDEM soil leachability standards through monitoring to ensure soil contaminants do not migrate beyond the compliance boundary of the waste management area. Under Alternatives S-2, S-4, and S-6, COCs would be present in soil at concentrations greater than the cleanup levels in the NCA, but a cover and caps would eliminate the exposure pathways. Alternatives S-2, S-3, S-3A, S-4, S-5, and S-6 would meet recreational use requirements in the vicinity of the marina building.

Implementability. Alternative S-2 would be slightly easier to implement than Alternatives S-3, S-3A, and S-4 because installation of the cover and caps would require little handling of contaminated soil. Alternative S-6 would be slightly more difficult to implement than Alternative S-3, S-3A, and S-4 because of the larger area to cover. Alternative S-4 would be slightly more difficult to implement than Alternative S-2 because Alternative S-4 includes excavation and Alternative S-2 does not. Alternative S-3 would be more difficult to implement compared to the other alternatives because of the larger extent of excavation. Alternative S-3A would be less difficult to implement than Alternative S-3 because of the lower volume of excavated soil. Alternative S-5 would be the most difficult to implement because it has the largest volume of excavated soil. Alternative S-6 would also be somewhat difficult to implement because a local source of fill material may be difficult to identify. The monitoring aspects of Alternatives S-2 and S-6 would be easy to implement. The technologies used by all of these alternatives are available from many contractors.

LUCs can be memorialized through an established Land Use Control Implementation Plan (LUCIP) and readily applied to property still owned by the Navy. However, Alternatives S-2, S-3, S-3A, S-4, and S-6 would all require implementation of LUCs for property that is already under an existing leasing agreement and would require coordination with the current property user. The mechanism for implementing LUCs on property that the Navy has already transferred will be determined during the Remedial Design (RD). For property that has already been transferred, the Navy will work with the property owner to establish legally enforceable environmental restrictions that provide the Navy the right to enforce the environmental restrictions. No LUCs would be required for Alternative S-5.

Cost. The estimated 30-year net present worth (NPW) cost is greatest for Alternative S-5 ($29,115,000). The estimated NPW costs for Alternatives S-3 and S-4 are comparable ($5,312,000 and $5,398,000, respectively). The estimated net NPW cost for S-6 is $3,185,000. The estimated NPW costs for Alternatives S-2 and S-3A are also comparable $2,502,000 and $2,119,000, respectively.

Modifying Criteria (May be used to modify recommended cleanup)

State Acceptance. State involvement has been solicited throughout the CERCLA process. RIDEM, as the designated state support agency in Rhode Island, concurs with the Selected Remedy. RIDEM's concurrence letter is presented in Appendix A.

Community Acceptance. No written questions were received during the formal public comment period for the Proposed Plan. The questions raised at the public meeting on October 24, 2013, were general inquiries for informational purposes only; no objections to the preferred alternative were voiced. No formal questions or comments were received at the public meeting.

2.10.2 Comparative Analysis of Groundwater Alternatives

Table 2-11 and subsequent text in this section summarize the comparison of the groundwater remedial alternatives with respect to the nine CERCLA evaluation criteria outlined in the NCP at 40 CFR 300.430(e)(9)(iii) and categorized as threshold, primary balancing, and modifying criteria. As noted above, the threshold criteria (e.g., overall protection of human health and the environment) are evaluation criteria that must be met by an alternative. The primary balancing criteria (e.g., long-term effectiveness) are used to differentiate between alternatives that meet the threshold criteria. Modifying criteria (e.g., state acceptance) may be used to modify the recommended cleanup for a site. The preferred groundwater alternative for Site 16 is Alternative G3-B, highlighted in grey in Table 2-11. The following narrative evaluates the groundwater alternatives for Site 16 against nine CERCLA evaluation criteria. Further information on the detailed comparison of remedial alternatives is presented in the Site 16 FS.

In the following comparative analysis for groundwater alternatives, it is assumed that a soil alternative with a WMA has been selected. Additionally, the effects of selecting soil Alternative S-5, which does not have a WMA, are also discussed separately.

TABLE 2-11. SUMMARY OF COMPARATIVE ANALYSIS OF GROUNDWATER ALTERNATIVES

	ALT. G-1	ALT. G-2	ALT. G-3	ALT. G-3A	ALT. G-3B	ALT. G-4	ALT. G-5	ALT. G-6
EVALUATION CRITERIA	NO ACTION	MNA AND LUCS	CHEMICAL OXIDATION, MNA, AND LUCS	CHEMICAL OXIDATION (SOURCE AREA), MNA, AND LUCS	CHEMICAL OXIDATION (EASTERN END OF FORMER BUILDING 41) MNA, AND LUCS	BIOREM., MNA, AND LUCS	EXTRACTION, TREATMENT, MNA, AND LUCS	BIOREM., MNA, AND LUCS (REDUCED TIME)
Overall Protection of Human Health and the Environment	Ø	●-	●	●	●	●	●	●+
Compliance with ARARs	Ø	●	●	●	●	●	●	●
Long-Term Effectiveness and Permanence	Ø	●-	●	●	●	●	●	●
Reduces Toxicity, Mobility, and Volume Through Treatment	Ø	Ø	O	O	O	O	O	O +
Short-Term Effectiveness	Ø	O	●	●	●	●	●	●+
Implementability	●	●+	O	O	O	O	O -	O
Costs								
Capital Costs (upfront costs to design and construct)	$7,000	$44,000	$7,922,000	$4,283,000	$612,000	$6,160,000	$4,862,000	$17,614,000
Total Present Value (total cost over duration of alternative in today's $)	$120,000	$1,124,000	$9,350,000	$5,587,000	$1,788,000	$9,656,000	$9,932,000	$24,186,000
Duration of alternative cleanup (Years)	NA	300	100	100	100	100	100	50
State Agency Acceptance	RIDEM concurs with the selected Remedy.							
Community Acceptance	There were no objections from the community.							

NOTES:

● Meets or Exceeds Criterion O Partially or Potentially Meets Criterion (some uncertainty) Ø Does NOT Meet Criterion

"+" indicates that the alternative is more favorable compared to the others. "-" indicates that the alternative is less favorable compared to the others.

Threshold Criteria (The selected alternative must meet these criteria)

Overall Protection of Human Health and the Environment. Alternatives G-2, G-3, G-3A, G-3B, G-4, G-5, and G-6 would all provide protection to human health and the environment. Alternative G-6 would provide the best protection because the largest volume of groundwater would be actively treated. Alternatives G-3 and G-5 would provide the next best protection because they would treat the high-TCE concentration areas in the shortest amount of time. Alternative G-4 would provide the next best protection because of the relatively long time that the high-concentrations areas would persist as they pass through the treatment barriers. Alternative G-3A would provide the next best protection because a smaller area would be treated compared to Alternative G-3. Alternative G-3B would provide less protection than Alternative G-3A because a smaller area would be treated. Under Alternative G-2, high-concentrations would persist for the longest time because of the slow rate of natural attenuation.

The natural attenuation components of Alternatives G-3, G-3A, G-3B, G-4, G-5, and G-6 would further reduce contaminant concentrations. This would significantly reduce risk from exposure to contaminated groundwater. The duration of natural attenuation for Alternative G-6 would be less than that of the other alternatives. Monitoring would be effective in detecting the potential migration of the plume and in monitoring the progress of the remediation. LUCs would provide protection of human health by restricting the use of groundwater until cleanup levels are met.

Alternative G-1 would provide some protection of human health and the environment. Under the existing LUCs, the portion of the site north of Davisville Road cannot be used for residential purposes and groundwater supply wells cannot be installed. However, groundwater contamination might migrate beyond Site 16, and the potential for vapor intrusion into buildings to be constructed in the future would not be considered. Because no monitoring would be performed, potential migration of COCs would not be detected. Therefore, Alternative G-1 would not be fully protective and will not be discussed further.

If the groundwater alternatives would be paired with Alternative S-5, which does not include designation of a WMA, the conclusions of the comparative analysis for this criterion would be the same. LUCs would still be required to restrict groundwater use.

Compliance with ARARs. Alternatives G-2, G-3, G-3A, G-3B, G-4, G-5, and G-6 would comply with location- and action-specific ARARs and TBCs.

Alternatives G-2, G-3, G-3A, G-3B, G-4, G-5, and G-6 would not immediately comply with chemical-specific ARARs and TBCs. Alternatives G-3, G-3A, G-3B, G-4, G-5, and G-6 would eventually achieve compliance as they attain cleanup levels through a combination of active treatment and natural attenuation. Alternative G-2 would eventually achieve compliance as it attains cleanup levels through natural attenuation. Cleanup levels would not need to be met beneath the WMA in Alternatives S-2, S-3, S-3A, S-4, and S-6.

Primary Balancing Criteria (Used to differentiate between alternatives meeting threshold criteria)

Long-Term Effectiveness and Permanence. Alternatives G-2, G-3, G-3A, G-3B, G-4, G-5, and G-6 would provide long-term effectiveness and permanence. Alternatives G-3, G-3A, G-4, G-5, and G-6 would provide essentially equal levels of long-term effectiveness and permanence through a combination of treatment, MNA, and LUCs. Alternative G-3B would be slightly less effective than Alternative G-3A because a smaller area of groundwater would be treated. Alternative G-2 would be somewhat less permanent because there would be no active treatment to remove high concentrations of contaminants, thus extending the time to meet cleanup levels. For all alternatives, LUCs would be maintained until cleanup levels are met.

If the groundwater alternatives would be paired with Alternative S-5, which does not include designation of a WMA, the conclusions of the comparative analysis for this criterion would be the same.

Reduction in Toxicity, Mobility, or Volume Through Treatment. Alternatives G-3, G-3A, G-3B, G-4, and G-6 would achieve reductions in COC toxicity and volume through treatment. Alternative G-5 would achieve reductions in COC volume through treatment assuming that the spent GAC is regenerated or destroyed by a thermal process off site.

Alternative G-6 would permanently and irreversibly remove an estimated 670 pounds of COCs (640 pounds of TCE and 30 pounds of cis-1,2-DCE) through bioremediation. Alternative G-3 would permanently and irreversibly remove an estimated 324 pounds of COCs (310 pounds of TCE and 14 pounds of cis-1,2-DCE) through chemical oxidation. Alternative G-4 would permanently and irreversibly remove the same amount of COCs as Alternative G-3 through bioremediation, and Alternative G-5 would permanently and irreversibly remove the same amount of COCs through groundwater extraction as Alternatives G-3 and G-4. However, under Alternative G-5, the contaminants would be captured by GAC (both vapor-phase and liquid-phase), which might then be landfilled,

regenerated, or thermally treated. Alternative G-3A would permanently and irreversibly remove an estimated 117 pounds of COCs (110 pounds of TCE and 7 pounds of cis-1,2-DCE) through chemical oxidation. Alternative G-3B would permanently and irreversibly remove an estimated 48 pounds of COCs (46 pounds of TCE and 2 pounds of cis-1,2-DCE) through chemical oxidation.

Alternatives G-3, G-3A, G-3B, G-4, G-5, and G-6 would not generate treatment residues. Alternative G-5 would generate used GAC that would require off-site disposal.

Alternative G-2 would not achieve any reduction of toxicity, mobility, or volume of COCs through active treatment.

If the groundwater alternatives would be paired with Alternative S-5, which does not include designation of a WMA, the conclusions of the comparative analysis for this criterion would be the same.

Short-Term Effectiveness. Implementation of Alternatives G-2, G-3, G-3A, G-3B, G-4, G-5, and G-6 would result in a slight possibility of exposing workers to contaminated groundwater during the installation, maintenance, and sampling of new and existing monitoring wells and during active remediation. Alternative G-2 would result in the lowest short-term risk with the potential for exposure only during groundwater sampling. Alternative G-3A would result in approximately the same level of short-term exposure, with additional potential exposure during installation of injection points. During implementation of Alternative G-3A, workers also would be required to handle a strong oxidizer. Implementation of Alternative G-3B would also require workers to handle a strong oxidizer, but workers would not be potentially exposed to contaminants because existing injection wells would be used for injection. Alternatives G-3 and G-4 would result in approximately the same level of short-term exposure, with additional potential exposure during installation of injection points. During implementation of Alternative G-3, workers also would be required to handle a strong oxidizer. Alternative G-6 would result in a greater level of short-term exposure because of additional potential exposure during installation of a large number of injection points. Alternative G-5 would present the greatest potential for additional exposure to contaminated groundwater during long-term operation of the groundwater treatment plant; however, these risks of exposure would be effectively controlled by wearing appropriate PPE and compliance with proper site-specific health and safety procedures. Implementation of Alternatives G-2, G-4, G-5, and G-6 would not adversely impact the surrounding community or environment. Alternatives G-3, G-3A, and G-3B would have a slight risk to the community due to the transport of oxidizer to Site 16. Implementation of Alternative G-5 has a slight risk to the surrounding community associated with transport of spent GAC from Site 16.

Alternatives G-2, G-3, G-3A, G-3B, G-4, G-5, and G-6 would achieve groundwater RAO Nos. 1 and 3 immediately upon implementation of LUCs and monitoring. Construction activities associated with Alternative G-4 would be completed in 3 months, construction activities associated with Alternatives G-3 and G-3A would be completed in 4 months, construction activities associated with Alternative G-3B would be completed in 12 months, and construction activities associated with Alternatives G-5 and G-6 would be completed in 6 months. Groundwater RAO No. 2 would be attained in approximately 50 years for Alternative G-6. Groundwater RAO No. 2 would be attained in excess of approximately 300 years for Alternative G-2 and in approximately 100 years for Alternatives G-3, G-3A, G-3B, G-4, and G-5. Because natural attenuation for a large portion of the plume is a component for Alternatives G-3, G-3A, G-3B, G-4, and G-5, the time to meet cleanup levels would be approximately the same for these five alternatives.

If the groundwater alternatives would be paired with Alternative S-5, which does not include designation of a WMA, the conclusions of the comparative analysis for this criterion would be the same. However, the estimated time to meet RAO No. 2 would increase for most of the alternatives. The estimated time for Alternative G-2 to meet RAO No. 2 would be greater than 300 years. For Alternatives G-3, G-3A, G-4, and G-5, the estimated time to meet RAO No. 2 would be 100 to 150 years. There would be no change in the estimated time (50 years) for Alternative G-6.

Implementability. The various components of Alternative G-2 would be the easiest to implement. Alternatives G-3, G-3A, G-3B, G-4, and G-6 would be the next easiest to implement, although handling of

the oxidizing agent in Alternatives G-3, G-3A, and G-3B, would be slightly more difficult. For all six of these alternatives, contractors and equipment are readily available. Alternative G-5 would be more complicated to implement and would require long-term operation and maintenance (O&M); however, equipment and operators are readily available.

Because some of the property has already been transferred, implementation of LUCs would be coordinated with the current property owner. Additional LUCs could be applied to the land that the Navy still controls. The mechanism for implementing LUCs on property that the Navy has already transferred will be determined during the RD. For property that has already been transferred, the Navy will work with the property owner to establish legally enforceable environmental restrictions that provide the Navy the right to enforce the environmental restrictions.

NORAD, a subleasee to the QDC, and the QDC have stated that their use of the property would be substantially affected by implementation of Alternatives G-3, G-3A, G-4, G-5, and G-6. Specifically, the area around the injection areas would have to be cleared of vehicles to allow for drilling equipment, injection equipment, and personnel. Similarly, the area around each monitoring well would have to be cleared of vehicles to make way for sampling equipment and personnel. Alternative G-2 would have the least impact because only monitoring well sampling would be involved, and most existing wells are readily accessible. Alternative G-3B would have the second-least impact on property use because the alternative uses 12 existing wells for injection and because the activity would be completed in 1 to 2 weeks. Alternatives G-3 and G-3A would temporarily impact site use for 1 to 2 months during installation of the injection wells and during injection of the oxidant, and Alternative G-4 would temporarily impact site use for 1 to 2 months during installation of the injection wells and injection of emulsified vegetable oil. Alternative G-6 would also impact site use for another 2 months during installation of the injection wells, but also because of the large number of injection wells compared to the other alternatives. Alternative G-5 would impact site use for 1 to 2 months during well and extraction piping installation. The buried piping and treatment plant building required for Alternative G-5 might also limit site uses. The area around each extraction well would have to be kept clear at all times to allow for access for routine inspection and maintenance of the well and extraction pump.

If the groundwater alternatives would be paired with Alternative S-5, which does not include designation of a WMA, the conclusions of the comparative analysis for this criterion would be the same.

Cost. The estimated 30-year NPW is greatest for Alternative G-6 ($24,505,000). The estimated NPW costs for Alternatives G-3, G-4, and G-5 are comparable ($9,350,000, $9,656,000, and $9,932,000, respectively). The estimated NPW cost for G-3A is $5,587,000. The estimated NPW costs for Alternatives G-2 and G-3B are also comparable ($1,124,000 and $1,788,000, respectively).

Modifying Criteria (May be used to modify recommended cleanup)

State Acceptance. State involvement has been solicited throughout the CERCLA process. RIDEM, as the designated state support agency in Rhode Island, concurs with the Selected Remedy. RIDEM's concurrence letter is presented in Appendix A.

Community Acceptance. No written questions were received during the formal public comment period for the Proposed Plan. The questions raised at the public meeting on October 24, 2013, were general inquiries for informational purposes only; no objections to the preferred alternative were voiced. No formal questions or comments were received at the public meeting.

2.11 PRINCIPAL THREAT WASTE

The NCP at 40 CFR 300.430(a)(1)(iii)(A) establishes an expectation that treatment will be used to address the principal threats posed by a site wherever practicable. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or that would present a significant risk to human health or the environment should exposure occur. A source material is a material that includes or contains hazardous substances, pollutants, or contaminants

that act as a reservoir for migration of contamination to groundwater, surface water, or air, or acts as a source for direct exposure. At Site 16, the contaminant concentrations are not high enough to be considered "source material" and there is no evidence of dense non-aqueous phase liquid (DNAPL); therefore, principal threat wastes are not present at the site.

2.12 SELECTED REMEDY

2.12.1 Rationale for Selected Remedy

The Selected Remedy for Site 16 is a combination of soil Alternative S-3A and groundwater Alternative G-3B. This includes selective excavation and off-site disposal of shallow soil (to a depth of 0-2 feet bgs), maintaining and monitoring the protective cover, establishment of a WMA at the NCA/marina, limited in-situ chemical oxidation of groundwater at the eastern end of former Building 41, MNA, and LUCs. This combination of alternatives was selected because it provides the best balance with respect to the nine evaluation criteria and will be least disruptive to continued industrial use of the property. The remedy will also allow for the continued recreational use of the area in the immediate vicinity of the marina.

The principal factors in the selection of this remedy included the following:

- Chemical concentrations in surface soil exceeding commercial/industrial cleanup levels occur at limited locations only across the NCA. These locations are accessible and easily excavated to prevent exposure.
- Chemical concentrations in soil exceeding RIDEM residential DECs occur in the vicinity of the marina building. The surface soils in the vicinity of the marina building are accessible and easily excavated to allow recreational land use in this area.
- LUCs will effectively prevent exposure to contaminated subsurface soils.
- The current/future land use at Site 16 is primarily industrial/commercial and is not conducive to use of the underlying groundwater for public water supply, and groundwater underlying Site 16 is not currently used as a water supply source nor is it a foreseeable future water supply source.
- The remedy is consistent with the reasonably anticipated future non-residential use of the site.
- The groundwater discharging to Allen Harbor does not adversely impact human or ecological receptors in the harbor.
- The time frame for remediation for Alternative G-3B (100 years) is consistent with most other remedial alternatives. Groundwater at Site 16 is not currently used or anticipated to be used as a potable water source and potable water is already provided to the site from an off-site municipal source. Therefore, more aggressive active remediation of groundwater is not considered cost-effective.

2.12.2 Description of Selected Remedy

The following sections provide a detailed description of the selected remedy which combines Alternative S-3A and G-3B.

The Selected Remedy includes the following components:

- Excavation of shallow surface soil in the NCA and in the portion of the marina which is within the boundary of Site 16.
- Off-site disposal of excavated soil
- Covering contaminated soil in the NCA and in the portion of the marina which is within the boundary of Site 16

- Implementation of soil LUCs: Prevent residential use of NCA and marina, prevent exposure to contaminated subsurface soil in the marina area, maintain soil cover and fill at the NCA and marina, control excavation and disturbance of contaminated soil, and perform all excavations according to a health and safety plan and soil management plan approved in advanced by the FFA signatories.
- Limited in-situ chemical oxidation
- MNA of groundwater
- Implementation of groundwater LUCs: Prohibit any use of groundwater, unless authorized in advance by the FFA signatories, except for purposes of environmental monitoring or remediation. Prohibit construction and occupation of any future buildings unless (1) an investigation, concurred upon by FFA signatories, shows that risks to human health from vapor intrusion are within acceptable limits or (2) the FFA signatories concur on the design of a vapor mitigation system for the building, and the vapor mitigation system is installed and operating properly and successfully.

The components for Alternatives S-3A and G-3B are described below:

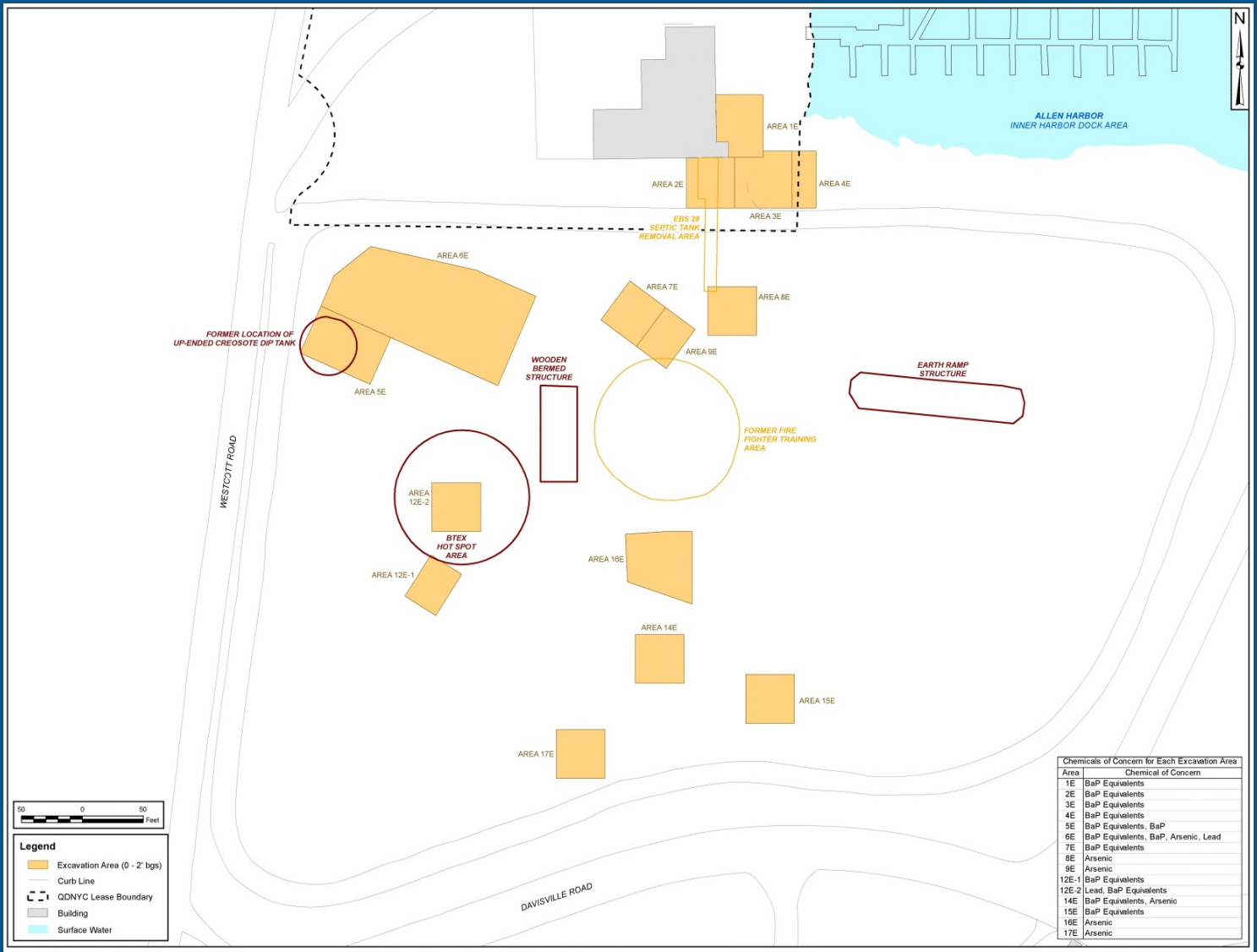
Excavation of Shallow Surface Soil

In the NCA, soil with COC concentrations greater than RIDEM I/C DEC levels will be excavated to a depth of 0-2 feet bgs using conventional excavation equipment. The area of contaminated soil is estimated to be approximately 42,000 ft^2 as shown on Figure 2-10. The total volume of soil to be excavated (including soil from the vicinity of the marina building described below) will be approximately 3,200 cubic yards. Pre-excavation sampling will be conducted to verify the exact extent of the contamination and to characterize the soil for disposal. Following excavation, the excavated areas will be backfilled with clean fill and regraded to achieve desired surface elevations. Because of the shallow excavation depths and absence of adjacent structures, sloping will be used in most areas to control and maintain the stability of the excavation side walls.

Near the marina building (constructed in 1954), contaminated soil with COC concentrations greater than RIDEM Residential DECs will be excavated to a depth of 0-2 feet bgs (approximately 460 cubic yards) to meet recreational use requirements. The limits of soil excavation in the marina area are based on existing sampling locations where cleanup levels have been met such that pre-excavation sampling in the marina area is not warranted. There is uncertainty as to whether the building will remain structurally sound; therefore, shoring was assumed to be required due to the close proximity of the excavation to the building. If sampling indicates that contamination extends beneath the marina building, soil beneath the building will be included in the LUCs to prevent potential receptor exposure to contamination in those soils in the future (e.g., should the building be demolished). Only soil in the unsaturated zone will be excavated in this area, so no dewatering of the excavation will be required. Following excavation, the excavated area will be backfilled with clean fill and regraded to achieve original surface elevations and conditions (i.e., paved or unpaved).

An estimated 10 pounds of BaP Eqs, 1 pound of naphthalene, and 101 pounds of arsenic will be removed by this alternative. Approximately 100 pounds of TPH that is collocated with the BaP Eqs and naphthalene will also be removed.

FIGURE 2-10. SOIL REMEDY EXCAVATION AREAS



Chemicals of Concern for Each Excavation Area

Area	Chemical of Concern
1E	BaP Equivalents
2E	BaP Equivalents
3E	BaP Equivalents
4E	BaP Equivalents
5E	BaP Equivalents, BaP
6E	BaP Equivalents, BaP, Arsenic, Lead
7E	BaP Equivalents
8E	Arsenic
9E	Arsenic
12E-1	BaP Equivalents
12E-2	Lead, BaP Equivalents
14E	BaP Equivalents, Arsenic
15E	BaP Equivalents
16E	Arsenic
17E	Arsenic

Off-Site Disposal

Based on data from the RI, most of the soil is expected to be non-hazardous. However, some lead concentrations are greater than 100 mg/kg and therefore the Toxicity Characteristic Leaching Procedure (TCLP) criterion of 5 mg/L for lead could be exceeded. For the purposes of costing the FSA, 10 percent of the excavated soil (approximately 490 tons) was assumed to be hazardous. Prior to excavation, the soil will be analyzed to determine disposal characteristics. Based on the results of the characterization, soil will either be disposed of at an off-site non-hazardous waste disposal facility (approximately 4,400 tons) or a permitted hazardous waste disposal facility (approximately 490 tons). Any soil determined to be hazardous soil will be treated offsite at a RCRA treatment facility prior to disposal to meet land disposal restrictions (LDRs).

Cover

Because subsurface soil contamination and buried debris will remain at the site, the NCA (including the marina area) will be designated as a WMA. Figure 2-11 shows the boundary of the WMA. Concentrations of COCs in groundwater beneath the WMA footprint do not need to meet the cleanup levels, but beneath the WMA, the cleanup levels will be used as performance standards. The Navy will maintain the two-foot cover over the excavated areas within the NCA and will conduct LTM to ensure the cover remedy remains protective.

Limited In-Situ Chemical Oxidation

Groundwater in a small area at the eastern end of former Building 41 only will be treated because most of the other high-concentration areas are within the WMA. This area contains elevated TCE concentrations (greater than 1,000 µg/L), and is upgradient and outside the WMA. The focused treatment of VOCs in this area will reduce the mass of contaminants available for transport downgradient and will reduce the time for MNA to meet cleanup levels. A sodium permanganate solution, or similar oxidant, will be injected into the subsurface using the 12 existing injection wells in the vicinity of the eastern end of former Building 41 (shown on Figure 2-12) that were installed for a pilot test in 2004 but not used. Approximately 4,300 gallons of sodium permanganate solution (5.3 percent) will be injected at each injection point for a total volume of approximately 52,000 gallons and a total mass of approximately 23,000 pounds of sodium permanganate. A bench test is assumed to be required to refine chemical feed requirements and select the appropriate oxidant.

It was assumed for costing purposes that two injection events will be required, with the second event occurring 12 months after the first. Each event will take one to two weeks. Monitoring, including baseline sampling and quarterly sampling for 1 year, will be performed to evaluate the effectiveness of the chemical oxidation and to monitor for rebound. After the chemical oxidation step is completed, monitoring for MNA (described below) will begin.

Because the NCA will be designated a WMA, COCs in groundwater beneath the WMA footprint do not need not meet groundwater cleanup levels. However, the groundwater cleanup levels will be used as performance standards for groundwater underlying the WMA.

Monitored Natural Attenuation

Natural attenuation will rely on naturally occurring processes within the aquifer to reduce the concentrations of TCE, cis-1,2-DCE, and VC. CVOC concentrations throughout the plume and benzene concentrations in the vicinity of the BTEX hot spot area will be reduced through anaerobic biological activity, dispersion, and dilution through aquifer movement and adsorption onto soil particles. Arsenic concentrations will be reduced as groundwater flows downgradient into zones with oxidizing conditions and by dispersion and dilution through aquifer movement. As stated above, groundwater cleanup levels do not need to be met within the compliance boundary of the WMA.

FIGURE 2-11. RELEVANT SITE 16 BOUNDARIES

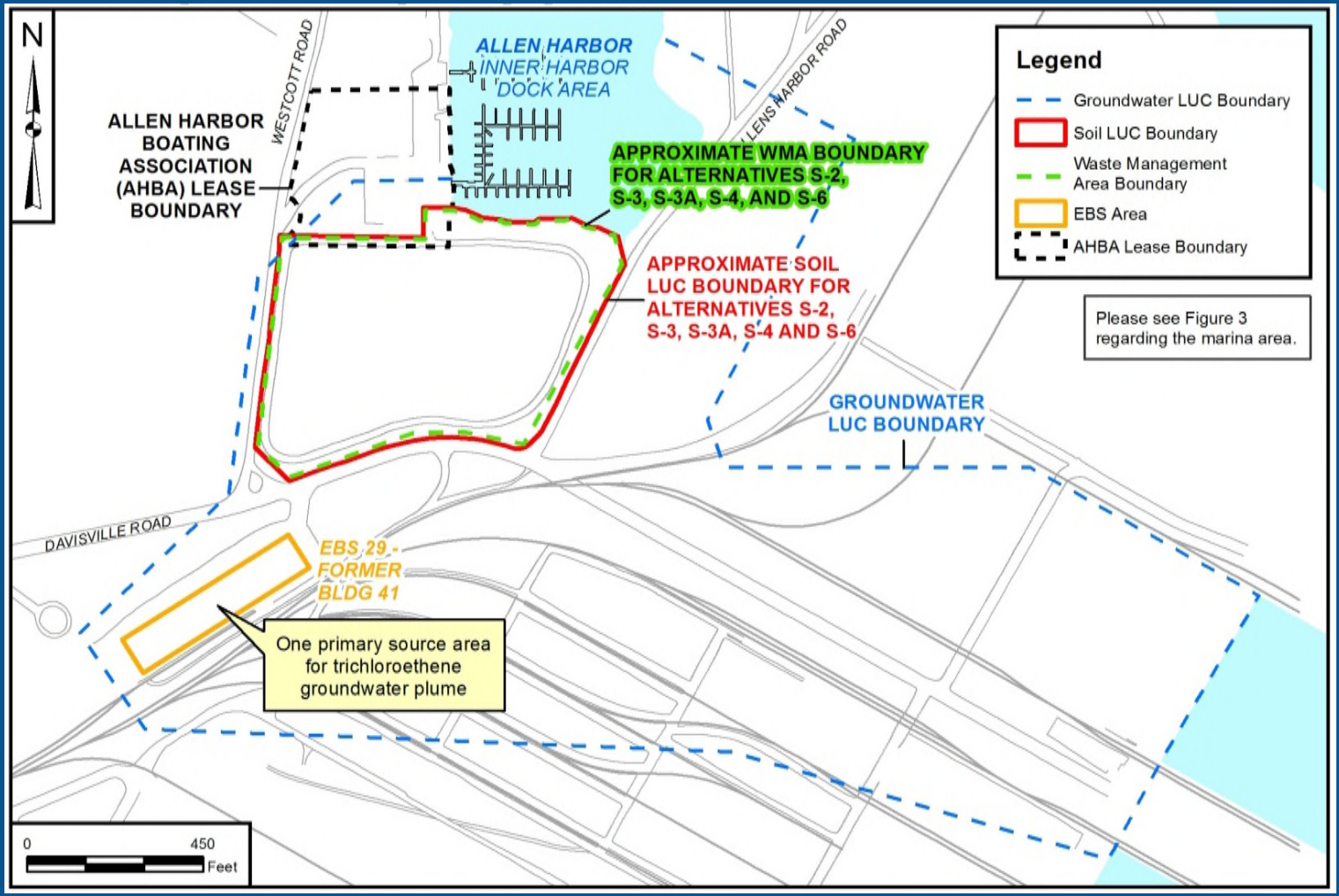
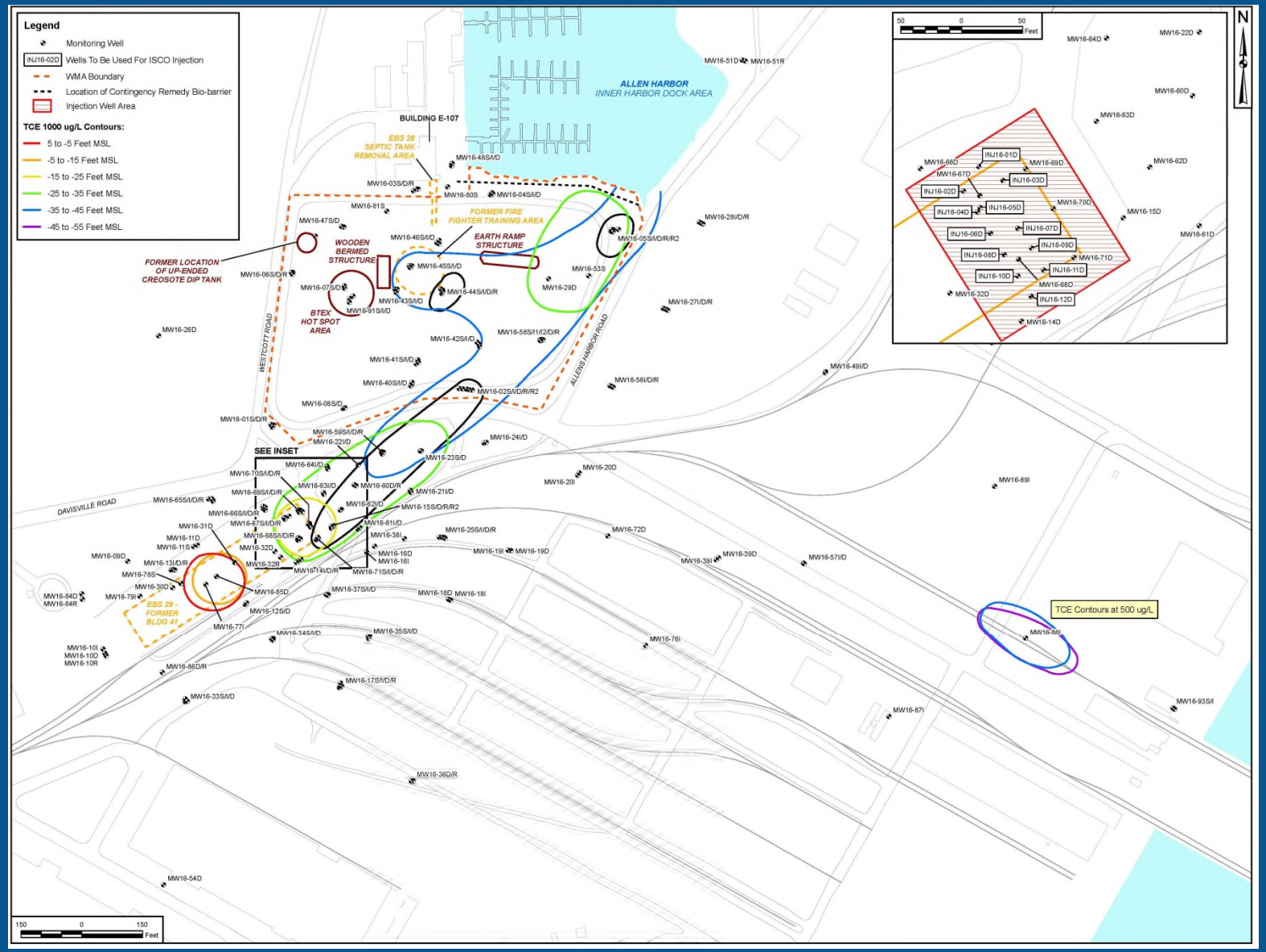


FIGURE 2-12. GROUNDWATER REMEDY CHEMICAL OXIDATION TREATMENT AREA



Monitoring will be conducted to assess the effectiveness of natural attenuation. Groundwater samples will be collected from existing and/or new wells, and analyzed for COCs and natural attenuation parameters. Wells will be located upgradient of the source and high-concentration areas, within the source and high-concentration areas, within the plume, and near the downgradient edge of the plume. The existing and/or new wells will be screened in the shallow, intermediate, and deep portions of the overburden aquifer and in the bedrock aquifer, as appropriate, to meet the objectives of the monitoring program. The LTM plan will be prepared to identify the wells to be sampled and the analyses to be performed to monitor changes in COC concentrations and natural attenuation parameters.

Several other COCs, such as naphthalene, antimony, and chromium were observed at low frequencies and low concentrations. Natural attenuation processes such as dispersion, dilution, and sorption are anticipated to reduce the concentrations of these COCs to cleanup levels. Because of the low frequencies of detection and low concentrations, these COCs may not be included in the monitoring program. Iron and manganese were detected at concentrations greater than cleanup levels at several locations. However, because of the low toxicities of these metals and the implementation of LUCs preventing potable water use (as part of the Selected Remedy), a passive approach using monitoring and natural attenuation will be used in lieu of active remediation.

Because natural attenuation processes are expected to be slow, LTM will be conducted annually until trends can be identified to refine the time frame to reach cleanup levels. Approximately 28 wells are assumed to be included in the LTM program.

In addition to monitoring for MNA, monitoring will be performed at the WMA compliance boundary to ensure contaminants that may leach from soil in the WMA or contaminated groundwater exceeding performance standards is not migrating beyond the compliance boundary either into areas of adjacent groundwater or into marine sediments and surface water in Allen Harbor or Narragansett Bay at concentrations that would pose risk to aquatic receptors. Compliance monitoring will be conducted to ensure the LUCs remain in effect and are enforced. The monitoring frequency will be determined during the preparation of the RD.

Cleanup levels are not applicable to groundwater beneath the WMA. However, these levels will be used as performance criteria for the groundwater underlying the WMA. Additionally, cleanup levels are not applicable at locations were the water is not usable for drinking such as along the coast or along Allen Harbor where groundwater is saline because the cleanup levels are based on use of groundwater as a drinking water source. The saline areas exempted from the cleanup levels will be defined during the RD.

Groundwater samples will be collected from wells near the shoreline where groundwater beneath Site 16 is saline, during the LTM. Screening levels protective of ecological receptors in surface water and sediment, initially developed during the preparation of the Feasibility Study Addendum, will be confirmed during the RD. Exceedances of these screening levels will be evaluated during the LTM to determine if groundwater remediation for purposes of protecting ecological receptors is necessary. There are currently no adverse risks to ecological receptors.

LUCs

LUCs will be implemented at Site 16 to limit use of the property and control access to the contaminated soil remaining after excavation and following backfilling/covering. The LUC boundaries are shown on Figure 2-11. Consistent with the RAOs developed for the site, the specific performance objectives for the LUCs to be implemented at Site 16 are as follows:

- Allow recreational uses within the existing Allen Harbor Boating Association (AHBA) marina that are consistent with marina activities and will not disturb components of the remedy (e.g., soil cover, monitoring wells).
- Prohibit expansion of residential use (which also excludes recreational use as defined by RIDEM) within the NCA. Prohibited residential uses shall include, but are not limited to, any form of housing, child-care facilities, pre-schools, elementary schools, secondary schools, playgrounds, convalescent, or nursing care facilities.

- Establish a waste management area to control excavation/disturbance of contaminated surface and subsurface soil by requiring all soil disturbance and excavation activities be conducted according to a health and safety plan and soil management plan approved in advance by the FFA signatories.
- To prohibit disturbance of the cover on the NCA and marina, within Site 16 boundaries, without approval from Navy, USEPA, and RIDEM.
- To prohibit any use of groundwater, unless authorized in advance by the FFA signatories, except for purposes of environmental monitoring or remediation.
- To prohibit construction and occupation of any future buildings unless (1) an investigation, concurred upon by FFA signatories, shows that risks to human health from vapor intrusion are within acceptable limits or (2) the FFA signatories concur on the design of a vapor mitigation system for the building, and the vapor mitigation system is installed and operating properly and successfully.
- To maintain the integrity of any existing or future monitoring or remediation system(s).

The following generally describes those LUCs that will be implemented at Site 16 to achieve these LUC Performance Standards:

- Modify the existing LUCIP to describe these LUCs.
- Incorporation of these restrictions into any real estate property documents (i.e., deeds or leases) associated with future sale or lease of the site.
- Annual inspections to ensure that there are no violations of these restrictions. The Navy will provide annual certifications of the inspections to EPA and RIDEM.
- If a violation of the restrictions occurs, a description of the violation and the corrective actions to be taken to restore protectiveness will be reported to EPA and RIDEM.
- Establish restrictions, enforceable by the Navy, on properties that the Navy has already transferred to other parties.

LUCs will be in place until concentrations of hazardous substances in soil/groundwater are at levels that allow for unrestricted use and unlimited exposure. The Navy is responsible for implementing, maintaining, reporting on, and enforcing the LUCs described in this ROD. Although the Navy may later transfer these procedural responsibilities to another party by contract, property transfer agreement, or through other means, the Navy shall retain ultimate responsibility for the remedy integrity.

The LUC implementation actions including monitoring and enforcement requirements will be provided in a LUC RD that will be prepared by the Navy as the LUC component of the overall RD. Within 21 days of ROD signature, the Navy shall prepare and submit to EPA and RIDEM for review and comment (pursuant to those Primary Document review procedures stipulated in the FFA) a schedule for the delivery of the draft LUC RD for Site 16 that shall contain implementation and maintenance actions, including periodic inspections. The Navy or its designee will maintain, monitor, and enforce the LUCs according to the LUC RD. LUCs will be developed in accordance with the Principles and Procedures for Specifying, Monitoring, and Enforcement of Land Use Controls and Other Post-ROD Actions, per letter dated October 2, 2003, from Raymond F. DuBois, Deputy Under Secretary of Defense (Installations and Environment), to Hon. Marianne Lamont Horinko, Acting Administrator, EPA and other Department of Defense, Navy, and EPA guidance, as appropriate. Implementation of this remedy will therefore require a survey of the site, annual visual inspections, and five-year reviews. Also, as discussed in Section 2.9.3 above, the exact legal mechanism for instituting LUCs on the portions of Site 16 no longer owned by the Navy will be developed in coordination with the current property owner during preparation of the LUC RD document.

2.12.3 Expected Outcomes of Selected Remedy

The current non-residential land use, which will be supported by the Selected Remedy, is expected to continue at Site 16. Groundwater at Site 16 is not used and is not expected to be used in the future, and the Selected Remedy will have no impact on current or future groundwater uses available at Site 16. The primary expected outcome of the selected groundwater portion of the remedy is that the groundwater will

be restored to its permissible, beneficial use and will no longer present an unacceptable risk to human health. The effectiveness of the groundwater remedy will be determined based upon attainment of the cleanup levels outlined in Table 2-5 as well as any additional site related Contaminants of Concern (COCs) added through subsequent decision documents. A monitoring program will be implemented in order to evaluate remedy performance and progress towards attainment. The details of the monitoring program will be established during the remedial design phase and will include the preparation of a long-term monitoring plan. Monitoring scope and frequency would change over time based on technical analysis of the remedy, optimization studies, revised conceptual site model, or other information as determined by the Navy with approval from EPA and RIDEM. The determination that all cleanup levels have been met should consider historical and current monitoring data, contaminant distribution, trend analysis, and the appropriateness of the compliance monitoring program. (i.e., locations, frequency of monitoring, and sampling parameters).

There are no socio-economic, community revitalization, or economic impacts or benefits associated with implementation of the Selected Remedy. RAOs for Site 16 are anticipated to be achieved within approximately 15 months for soil and 100 years for groundwater. Table 2-12 describes how the Selected Remedy mitigates risk and achieves RAOs for Site 16.

TABLE 2-12. HOW SELECTED REMEDY MITIGATES RISK AND ACHIEVES RAOS

RISK	RAO	COMMENTS
Direct exposure to and ingestion of contaminated soil in NCA	Soil RAO No. 1 - Prevent industrial worker (including construction worker) exposure to subsurface soil containing concentrations of COCs (PAHs, arsenic, and lead) that cause unacceptable risk.	Excavation of soil from 0 to 2 feet bgs will achieve RIDEM I/C DECs. LUCs will prevent human exposure to subsurface soil via ingestion and dermal contact associated with unacceptable risk to industrial workers.
	Soil RAO No. 2 - Ensure/verify that surface and subsurface soil contaminants (e.g., naphthalene) do not migrate to groundwater causing the groundwater, sediment, and surface water to have associated unacceptable risk.	Groundwater monitoring will be performed to confirm that concentrations of COCs that may leach from the soil do not migrate beyond the compliance boundary into groundwater, reach sediment and surface water at concentrations that cause unacceptable risk.
	Soil RAO No. 3 - Prevent future resident exposure to surface and subsurface soil contaminants (PAHs, arsenic, lead, and dioxins/ furans) that cause unacceptable risk.	LUCs will prevent human exposure via ingestion and dermal contact and inhalation to surface and subsurface soil associated with unacceptable risk (residential uses.)
Direct exposure to and ingestion of contaminated soil in the Benzene Sub-Area (i.e., BTEX hot spot area)	Soil RAO No. 4 - Prevent industrial worker (including construction worker) exposure to subsurface soil (in the benzene sub-area) containing concentrations of COCs (PAHs, arsenic and lead) that cause unacceptable risk.	Excavation of soil from 0 to 2 feet bgs will achieve RIDEM I/C DECs. LUCs will prevent human exposure to subsurface soil via ingestion and dermal contact and inhalation associated with unacceptable risk to industrial workers.
	Soil RAO No. 5 - Ensure/verify that surface and subsurface soil contaminants (e.g., benzene and naphthalene in the benzene sub-area) do not migrate to groundwater causing the groundwater, sediment, and surface water to have associated unacceptable risk.	Groundwater monitoring will be performed to confirm that concentrations of COCs that may leach from the soil do not migrate beyond the compliance boundary into groundwater, reach sediment and surface water at concentrations that cause unacceptable risk.
	Soil RAO No. 6 - Prevent future resident exposure to surface and subsurface soil (in the benzene sub-area) containing concentrations of	LUCs will prevent human exposure via ingestion and dermal contact and inhalation to surface and subsurface soil associated with

TABLE 2-12. HOW SELECTED REMEDY MITIGATES RISK AND ACHIEVES RAOS		
RISK	RAO	COMMENTS
	COCs (PAHs, arsenic, lead and dioxins/ furans) that cause unacceptable risk.	unacceptable risk (residential uses.)
Direct exposure to and ingestion of contaminated soil in the vicinity of the marina building	Soil RAO No. 7 – Prevent recreational user exposure to soil in the vicinity of the marina building containing concentrations of COCs (e.g., PAHs) that cause unacceptable risk.	Excavation of soil from 0 to 2 feet bgs will remove risk from exposure to COCs in surface soil, and the backfill will act as a cover to prevent exposure from contaminants at greater depths. LUCs will prevent disturbance of the cover, and LUCs and soil cover will prevent human exposure by preventing contact with deep soil.
Direct exposure to or ingestion of contaminants in groundwater	Groundwater RAO No. 1: Prevent human exposure (including drinking, showering, and irrigation) to groundwater containing concentrations of COCs that cause unacceptable risk and that exceed cleanup levels.	LUCs will prevent human exposure via ingestion and dermal contact and inhalation with groundwater associated with unacceptable risk (residential uses).
	Groundwater RAO No. 2: Verify that groundwater discharging to Allen Harbor and Narragansett Bay continues to pose no unacceptable risks.	Long-term groundwater monitoring will track trends in contaminant concentrations.
	Groundwater RAO No. 3: Prevent unacceptable risks to industrial workers/future residents that could result from exposure to VOC vapors migrating into buildings.	LUCs will prevent human exposure via vapor intrusion by requiring building design and construction methods that prevent infiltration of VOCs from shallow groundwater into new buildings.
	Groundwater RAO No. 4: Restore groundwater quality to its beneficial use.	Beneficial use will be restored through groundwater treatment and natural attenuation.

Because the current non-residential use of the site is expected to continue for the foreseeable future, it is not expected that modification or removal of the LUCs will be required. However, if proposed land use changes in the future and uses other than industrial/commercial activities and recreational activities associated with the marina are expected, additional remedial approaches may be required. Any modifications to LUCs will be conducted in accordance with provisions in the Site 16 LUC RD, CERCLA, and the NCP.

2.13 STATUTORY DETERMINATIONS

The selected remedy will reduce exposure levels to protective ARAR levels or, in the absence of protective ARAR levels, to within EPA's generally acceptable risk range of 10^{-4} to 10^{-6} for carcinogenic risk and below the HI of 1 for non-carcinogens in soil and groundwater as outlined in Table 2-4 (Soil Cleanup Levels) and Table 2-5 (Groundwater Clean-Up Levels) for the purposes of this CERCLA remediation. In accordance with the NCP, the Selected Remedy meets the following statutory determinations:

- **Protection of Human Health and the Environment** – The Selected Remedy is needed to prevent current and hypothetical future risks associated with residential, recreational, and industrial exposure to contaminated soil and groundwater. Excavation, cover, groundwater treatment, MNA, and LUCs will be implemented to ensure protectiveness.

- **Compliance with ARARs** – The Selected Remedy will attain all identified federal and state ARARs, as presented in Appendix E.
- **Cost-Effectiveness** – The Selected Remedy is the most cost-effective alternative that allows for continued non-residential use of the property and represents the most reasonable value for the money. The costs are proportional to overall effectiveness by achieving an adequate amount of long-term effectiveness and permanence within a reasonable time frame. Detailed costs for the Selected Remedy are presented in Appendix B.
- **Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable** – The Selected Remedy represents the maximum extent to which permanent solutions and alternative treatment technologies can be used in a practical manner at Site 16. Groundwater in the high-concentration area will be treated in-situ by chemical oxidation. Based on the low concentrations of contaminants, no treatment alternatives were evaluated for soil. Excavation and off-site disposal to achieve the cleanup levels provides the best balance of tradeoffs for long-term effectiveness and permanence with ease of implementation for reasonable cost.
- **Preference for Treatment as a Principal Element** – Treatment is not a principal element of the Selected Remedy for soil at Site 16 because there are no principal threat wastes at the site, and excavation, off-site disposal, and LUCs provides the best balance of tradeoffs with respect to long-term effectiveness and permanence at a reasonable cost. For groundwater, treatment is included in the source area where elevated COC concentrations were detected.
- **Five-Year Review Requirement** – Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on site in excess of levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after initiation of remedial action and every 5 years thereafter to ensure that the remedy is, or will be, protective of human health and the environment.

2.14 DOCUMENTATION OF SIGNIFICANT CHANGES

CERCLA Section 117(b) requires an explanation of significant changes from the Selected Remedy presented in the Proposed Remedial Action Plan that was published for public comment. No significant changes to the remedy, as originally identified in the Proposed Remedial Action Plan, were necessary or appropriate. Formal comments received during the public comment period and the associated responses are provided in Section 3.0, Responsiveness Summary.

3.0 RESPONSIVENESS SUMMARY

3.1 STAKEHOLDER COMMENTS AND LEAD AGENCY RESPONSES

Participants in the public meeting held on October 24, 2013, included RAB members and representatives of the Navy, EPA, and RIDEM. No formal written comments, concerns, or questions were received by the Navy, EPA, or RIDEM during the public comment period. (See Appendix A-2.)

3.2 TECHNICAL AND LEGAL ISSUES

No technical or legal issues associated with the Site 16 ROD were identified.

Administrative Record Reference Table

DETAILED ADMINISTRATIVE RECORD REFERENCE TABLE

ITEM	REFERENCE PHRASE IN ROD	LOCATION IN ROD	LOCATION OF INFORMATION IN ADMINISTRATIVE RECORD
1	**excavated and disposed of offsite**	Table 2-1	Halliburton NUS Corporation, December 1994. UST Remedial Investigation Report, Naval Construction Battalion Center Davisville, North Kingstown, Rhode Island.
2	**Contaminated soil was excavated during the Building E-107 septic tank removal and was disposed of offsite**	Table 2-1	EA, March 1998. Final Phase II Environmental Baseline Survey Follow-On Investigation Report, Naval Construction Battalion Center Davisville, Rhode Island.
3	**Screening Level Ecological Risk Assessment (SLERA)**	Table 2-1	EA, July 2004. Screening Level Ecological Risk Assessment at IR Program Site 16 (Former Creosote Dip Tank and Fire Fighting Training Area), Naval Construction Battalion Center Davisville, North Kingstown, Rhode Island.
4	**HRC® was never injected**	Table 2-1	EA, July 2004. Quality Assurance Project Plan for HRC Injection Pilot Study, IR Program 16, Naval Construction Battalion Center Davisville, North Kingstown, Rhode Island.
5	**Human Health Risk Assessment (HHRA)**	Table 2-1	Tetra Tech, 2009. Phase III Remedial Investigation Report for Installation Restoration Program Site 16. Former Naval Construction Battalion Center Davisville North Kingstown, Rhode Island. March. Section 6.
6	**Ecological Risk Assessment (ERA)**	Table 2-1	Tetra Tech, 2009. Section 7.
7	**remedial action objectives**	Table 2-1	Tetra Tech, 2012. Draft Final Feasibility Study Report for Installation Restoration Program Site 16. Former Naval Construction Battalion Center Davisville, North Kingstown, Rhode Island. May. Section 2.
8	**additional remedial alternative for soil**	Table 2-1	Tetra Tech, 2013. Feasibility Study Addendum for Installation Restoration Program Site 16. Former Naval Construction Battalion Center Davisville, North Kingstown, Rhode Island. March. Section 3.
9	**additional remedial alternative for groundwater**	Table 2-1	Tetra Tech, 2013. Section 3.
10	**Public notice**	Section 2.3	U.S. Navy, 2013. Legal Notice. Public Information Meeting and Public Hearing for Site 16 (Operable Unit No. 9) Proposed Plan, Former Naval Construction Battalion Center (NCBC), Kingstown, Rhode Island. Published in the Standard Times on October 10, 2013.
11	**Biodegradation**	Section 2.5.2	Tetra Tech, 2009. Sections 4 and 5.
12	**Environmental forensics investigations**	Section 2.5	Tetra Tech, 2009. Appendix F. Tetra Tech, 2010. Data Package for 2010 Feasibility Study Support Field Investigation at Installation Restoration Program Site 16. November. Appendix G.
13	**public supply wells**	Section 2.6	Tetra Tech, 2009. Section 3.7.
14	**COPCs for Site 16**	Section 2.7.1	Tetra Tech, 2012. Appendix D.1
15	**exposure assessment**	Section 2.7.1	Tetra Tech, 2009. Section 6.2.

DETAILED ADMINISTRATIVE RECORD REFERENCE TABLE

ITEM	REFERENCE PHRASE IN ROD	LOCATION IN ROD	LOCATION OF INFORMATION IN ADMINISTRATIVE RECORD
16	**cancer risks and non-cancer hazards**	Section 2.7.1	Tetra Tech, 2012. Appendix D.1
17	**lead was retained as a COC**	Section 2.7.1	Tetra Tech, 2012. Appendix D.1
18	**RAOs for Site 16**	Section 2.8	Tetra Tech, 2012. Section 2.0. Tetra Tech, 2013. Section 2.0.
19	**PRGs**	Section 2.8	Tetra Tech, 2012. Appendix D.5.
20	**preliminary technology screening**	Section 2.9	Tetra Tech, 2012. Section 3.0. Tetra Tech, 2013. Section 3.0.
21	**nine CERCLA evaluation criteria**	Section 2.10	Tetra Tech, 2012. Section 4.0.

ADDITIONAL REFERENCES

EPA, December 2002. Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. Office of Emergency and Remedial Response. OSWER Publication No. 9285.6-10.

EPA, April 2007. ProUCL Version 4.00.02 User Guide. Office of Research and Development, Washington, D.C. EPA/600/R-07/038.

Long, E. R., and D. D. MacDonald. 1998. Recommended uses of empirically derived, sediment quality guidelines for marine and estuarine ecosystems. *Human and Ecological Risk Assessment* 4(5): 1019-1039.

Appendix A
A-1 Rhode Island Department of Environmental Management Concurrence Letter
A-2 Transcript of Proposed Plan Public Meeting October 24, 2013

Appendix A-1
Rhode Island Department of Environmental Management Concurrence Letter

RHODE ISLAND
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
235 Promenade Street, Providence, RI 02908-5767 TDD 401-222-4462

19 June 2014

Mr. James T. Owens, III
Director, Office of Site Remediation and Restoration
USEPA – Region 1
5 Post Office Square
Mail Code: OSRR0701
Boston, MA 02109-3912.

RE: Record of Decision for Operable Unit 9
(Creosote Dip Tank Area, Firefighting Training Area,
and Former Building 41 – Site 16)
Naval Construction Battalion Center
North Kingstown, Rhode Island

Dear Mr. Owens:

On 23 March 1992 the State of Rhode Island entered into a Federal Facilities Agreement (FFA) with the Department of the Navy and the Environmental Protection Agency. One of the primary goals of the FFA is to insure that the environmental impacts associated with past activities at the former Naval Construction Battalion Center (NCBC) located in North Kingstown, Rhode Island are thoroughly investigated and that appropriate actions are taken to protect human health and the environment.

In accordance with the FFA, the Department has reviewed the Record of Decision for the above referenced site, dated June 2014. Our review of this document combined with our knowledge of this site gathered through our historical involvement in the investigatory phases leads to a determination that the selected remedy achieves our primary goal of protectiveness of human health and the environment. Therefore, in accordance with Section 17.3 of the FFA, the Department offers its concurrence with the selected remedy as detailed in the Record of Decision contingent upon the conduct of 5-Year Reviews as noted in Section 32.1 of the FFA and the condition that existing recreational use of the marina continues.

The selected remedy consists of the following actions:

1. Excavation and off-site disposal of surface soils (to a depth of 2 feet below ground surface [bgs]) in the North Central Area [NCA] of Site 16 with contaminant concentrations greater than RIDEM industrial/commercial direct exposure criteria.

30% post-consumer fiber

2. Excavation and off-site disposal of surface soils to a depth of 2 feet bgs near the marina building (Building E-107) with contaminant concentrations greater than RIDEM residential direct exposure criteria.

3. Backfilling and restoration of excavated areas.

4. Focused in-situ treatment of groundwater at the eastern end of former Building 41.

5. Monitored Natural Attenuation (MNA) of residual VOC-contaminated groundwater plume and long-term monitoring (LTM) of groundwater (and surface water and sediments as necessary) after active groundwater treatment until groundwater standards are achieved.

6. LTM of the areas where contaminated soil will be left in place under the soil covers will be required even after groundwater cleanup standards are achieved, unless additional testing of soil shows that leaching of contaminates is unlikely to impact groundwater.

7. Implementation of land use controls (LUCs), including the establishment of a waste management area (WMA) in the NCA/marina, to ensure that future use of the NCA is limited to non-residential activities (also excluding recreational use as defined by RIDEM), disturbance of soil covers and subsurface soils is prohibited without prior authorization, soil covers are inspected and maintained, groundwater is not used (except for sampling under the LTM program), and buildings are designed and constructed to minimize the potential for vapor intrusion. A soil management plan will be implemented to address any disturbance to the soils and covers.

RIDEM would like to commend the Navy staff for their diligence in investigating this site and considering affected stakeholders issues in the decision making process. RIDEM concurs with this Record of Decision and looks forward to continuing working with the Navy and USEPA on the remaining concerns at this base.

Sincerely,

Janet Coit, Director
Department of Environmental Management

CC: Curt Spalding, Regional Administrator, USEPA Region 1

Michael Embury, Town Administrator, North Kingstown
Steven King, QDC
Jeffrey Dale, US Navy
Terrence Gray, Assistant Director, DEM
Leo Hellested, Chief, DEM Office of Waste Management
Matthew DeStefano, Deputy Chief, DEM Office of Waste Management
Richard Gottlieb, DEM Office of Waste Management
Richard Bianculli, Esquire, DEM Office of Legal Services

Appendix A-2
Transcript of Proposed Plan Public Meeting
October 24, 2013

Proposed Plan

Site 16 - Creosote Dip Tank Area, Fire-Fighting Training Area, and Former Building 41 Area (OU 9)

Former Naval Construction Battalion Center

Davisville, Rhode Island

PUBLIC MEETING

8:00 P.M.

October 24, 2013

Quonset Development Corporation

Conference Center

95 Cripe Street

North Kingston, Rhode Island

06:56:53 1 P R O C E E D I N G S

08:22:57 2 MR. BARNEY: Welcome. My name is Dave

08:23:00 3 Barney. I'm the BRAC Environmental Coordinator for

08:23:02 4 the Navy for this site being located at the Battalion

08:23:04 5 Center, Davisville.

08:23:09 6 Tonight we are here to receive comments

08:23:11 7 on the Navy's proposed remedial action plan for Site

08:23:15 8 16. As we heard earlier, this plan has been prepared

08:23:22 9 in accordance with the federal laws to present the

08:23:26 10 Navy's proposed cleanup approach for Site 16, the

08:23:31 11 creosote dip tank area, the fire-fighting training

08:23:31 12 area and former Building 41 at the former NCBC site.

08:23:37 13 This proposed remedy for the site

08:23:40 14 consists of the following elements: Excavation of

15 the surface soils where necessary in the

16 north-central portion of the site including surface

17 soils by Building E-107, focused treatment of

18 groundwater at the eastern end of the former Building

19 41 area, natural attenuation and long-term monitoring

20 of groundwater after the active groundwater treatment

21 until groundwater standards are achieved and

22 implementation of land use controls to prevent

08:24:08 23 exposure to contaminants in soil and groundwater.

08:24:08 This plan provides information on the remedial
08:24:08 alternatives evaluated.
08:24:14 At this point I will ask if there are
08:24:16 any comments to be made. With that, not seeing any
08:24:27 comments to be heard, we'll close the hearing.
(Whereupon, the hearing was adjourned
at 8:24 P.M.)

1 C E R T I F I C A T E
COMMONWEALTH OF MASSACHUSETTS:
2 PLYMOUTH, SS.:

3 I, ELAINE M. BUCKLEY, a Notary Public in and for the Commonwealth Massachusetts, do hereby certify:
4

5 That the said proceeding was taken before me as a Notary Public at the said time and place and was
6 taken down in shorthand writing by me;

7 That I am a Registered Professional Reporter, that the said proceeding was thereafter under my direction
8 transcribed into computer-assisted transcription, and that the foregoing transcript constitutes a full,
9 true, and correct report of the proceedings which then and there took place;
10

IN WITNESS WHEREOF, I have hereunto subscribed my
11 hand and affixed my official seal this 28th day of October 2013.
12

13 ELAINE M. BUCKLEY
14

15 My commission expires:
November 19, 2015
16

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Appendix B
Cost Estimate

NCBC DAVISVILLE
Davisville, Rhode Island
Site 16
Alternative S-3A: Selected Excavation and Disposal and LUCs
Capital Cost

2/6/2013 11:12 AM

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 Work Plans	400	hr			$37.00		$0	$0	$14,800	$0	$14,800
1.2 Prepare LUCs	100	hr			$37.00		$0	$0	$3,700	$0	$3,700
1.3 Construction Completion Report	100	hr			$37.00		$0	$0	$3,700	$0	$3,700
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Site Support Facilities (trailers, phone, electric, etc.)	1	ls		$1,000.00		$3,500.00	$0	$1,000	$0	$3,500	$4,500
2.2 Equipment Mobilization/Demobilization	8	ea			$177.00	$610.00	$0	$0	$1,416	$4,880	$6,296
3 FIELD SUPPORT											
3.1 Site Support Facilities (trailers, phone, electric, etc.)	4	mo		$470.00		$452.00	$0	$1,880	$0	$1,808	$3,688
3.2 Survey Suppor (Excavation limits and LUC boundaries)	4	day	$1,075.00				$4,300	$0	$0	$0	$4,300
3.3 Site Superintendent	13	week		$700.00	$1,923.20		$0	$9,100	$25,002	$0	$34,102
3.4 Site Health & Safety and QA/QC	13	week		$700.00	$1,538.40		$0	$9,100	$19,999	$0	$29,099
4 DECONTAMINATION											
4.1 Decontamination Services	3	mo		$1,220.00	$2,244.00	$1,550.00	$0	$3,660	$6,732	$4,650	$15,042
4.2 Temporary Equipment Decon Pad	1	ls		$1,800.00	$2,200.00	$450.00	$0	$1,800	$2,200	$450	$4,450
4.3 Decon Water	3,000	gal		$0.20			$0	$600	$0	$0	$600
4.4 Decon Water Storage Tank, 6,000 gallon	3	mo				$771.00	$0	$0	$0	$2,313	$2,313
4.5 Clean Water Storage Tank, 4,000 gallon	3	mo				$693.00	$0	$0	$0	$2,079	$2,079
4.6 Disposal of Decon Waste (liquid & solid)	3	mo	$985.00				$2,955	$0	$0	$0	$2,955
5 SITE PREPARATION											
5.1 Underground Utility Clearance	1	ls	$10,000.00				$10,000	$0	$0	$0	$10,000
5.2 Soil Sampling: PAHs	26	ea	$120.00				$3,120	$0	$0	$0	$3,120
5.3 Soil Sampling: Lead/Arsenic	16	ea	$20.00				$320	$0	$0	$0	$320
5.4 Soil Sampling: TCLP (disposal)	30	ea	$750.00				$22,500	$0	$0	$0	$22,500
5.5 Soil Sampling: Labor	80	hr			$32.00		$0	$0	$2,560	$0	$2,560
5.6 Monitoring Well Abandonment, 15 wells	445	lf	$6.00				$2,670	$0	$0	$0	$2,670
5.7 Monitoring Well Head Abandonment, 15 wells	15	ea	$100.00				$1,500	$0	$0	$0	$1,500
5.8 Clear & Grub North Central Area (NCA)	1.5	ac			$2,400.00	$2,025.00	$0	$0	$3,600	$3,038	$6,638
6 EXCAVATION AND DISPOSAL											
6.1 Non-Hazardous Soil Transportation & Disposal	4,386	ton	$95.00				$416,670	$0	$0	$0	$416,670
6.2 Hazardous Soil Transportation & Disposal	488	ton	$235.00				$114,680	$0	$0	$0	$114,680
6.3 Building Shoring Support	200	sf	$3.65				$730	$0	$0	$0	$730
6.4 Backfill	2,399	cy		$17.96			$0	$43,086	$0	$0	$43,086
6.5 Topsoil	850	cy		$27.67			$0	$23,520	$0	$0	$23,520
6.6 Excavator, 2.5 cy	25	day			$355.20	$1,784.00	$0	$0	$8,880	$44,600	$53,480
6.7 Dozer, 300 hp	25	day			$342.60	$1,592.00	$0	$0	$8,565	$39,800	$48,365
6.8 Compactor	25	day			$342.60	$1,243.00	$0	$0	$8,565	$31,075	$39,640
6.9 Site Labor, (3 laborers)	75	day			$264.80		$0	$0	$19,860	$0	$19,860
7 SITE RESTORATION											
7.1 Revegetation, seed	7,000	sy		$0.50	$1.67	$0.34	$0	$3,500	$11,690	$2,380	$17,570
7.2 Pavement Replacement	1,500	sf	$3.03				$4,545	$0	$0	$0	$4,545
7.3 Replace Monitoring Wells, 7 wells	250	lf	$65.00				$16,250	$0	$0	$0	$16,250
7.4 Monitoring Well Head	7	ea	$500.00				$3,500	$0	$0	$0	$3,500
7.5 IDW Disposal	25	drum	$175.00				$4,375	$0	$0	$0	$4,375
Subtotal							$608,115	$97,246	$141,269	$140,573	$987,202

NCBC DAVISVILLE
Davisville, Rhode Island
Site 16
Alternative S-3A: Selected Excavation and Disposal and LUCs
Capital Cost

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
Overhead on Labor Cost @ 30%									$42,381		$42,381
G & A on Labor Cost @ 10%									$14,127		$14,127
G & A on Material Cost @ 10%								$9,725			$9,725
G & A on Equipment Cost @ 10%										$14,057	$14,057
G & A on Subcontract Cost @ 10%							$60,812				$60,812
Tax on Materials and Equipment Cost @ 7%								$6,807		$9,840	$16,647
Total Direct Cost							$668,927	$113,777	$197,776	$164,470	$1,144,950
Indirects on Total Direct Cost @ 25%		(excluding transportation and disposal cost)									$151,567
Profit on Total Direct Cost @ 10%											$114,495
Subtotal											$1,411,012
Health & Safety Monitoring @ 2%											$28,220
Total Field Cost											$1,439,233
Contingency on Total Field Costs @ 25%											$359,808
Engineering on Total Field Cost @ 10%											$143,923
TOTAL CAPITAL COST											**$1,942,964**

NCBC DAVISVILLE
Davisville, Rhode Island
Site 16
Alternative S-3A: Selected Excavation and Disposal and LUCs
Annual Cost

2/6/2013 11:12 AM

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Site Inspection and Report	$2,650		LUC Inspection and Reporting
Five Year Site Review		$25,000	Five Year Site Reviews
SUBTOTAL	$2,650	$25,000	
Contingency @ 10%	$265	$2,500	
TOTAL	**$2,915**	**$27,500**	

NCBC DAVISVILLE
Davisville, Rhode Island
Site 16
Alternative S-3A: Selected Excavation and Disposal and LUCs
Present Worth Analysis

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Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 2.3%	Present Worth
0	$1,942,964		$1,942,964	1.000	$1,942,964
1		$2,915	$2,915	0.978	$2,849
2		$2,915	$2,915	0.956	$2,785
3		$2,915	$2,915	0.934	$2,723
4		$2,915	$2,915	0.913	$2,662
5		$30,415	$30,415	0.893	$27,146
6		$2,915	$2,915	0.872	$2,543
7		$2,915	$2,915	0.853	$2,486
8		$2,915	$2,915	0.834	$2,430
9		$2,915	$2,915	0.815	$2,376
10		$30,415	$30,415	0.797	$24,229
11		$2,915	$2,915	0.779	$2,270
12		$2,915	$2,915	0.761	$2,219
13		$2,915	$2,915	0.744	$2,169
14		$2,915	$2,915	0.727	$2,120
15		$30,415	$30,415	0.711	$21,625
16		$2,915	$2,915	0.695	$2,026
17		$2,915	$2,915	0.679	$1,980
18		$2,915	$2,915	0.664	$1,936
19		$2,915	$2,915	0.649	$1,892
20		$30,415	$30,415	0.635	$19,301
21		$2,915	$2,915	0.620	$1,808
22		$2,915	$2,915	0.606	$1,768
23		$2,915	$2,915	0.593	$1,728
24		$2,915	$2,915	0.579	$1,689
25		$30,415	$30,415	0.566	$17,226
26		$2,915	$2,915	0.554	$1,614
27		$2,915	$2,915	0.541	$1,578
28		$2,915	$2,915	0.529	$1,542
29		$2,915	$2,915	0.517	$1,507
30		$30,415	$30,415	0.506	$15,375
AVERAGE ANNUAL COST		**$8,415**		**TOTAL PRESENT WORTH**	**$2,118,567**

NCBC DAVISVILLE
Davisville, Rhode Island
Site 16
Alternative G-3B - In-Situ Chemical Oxidation using Existing INJ Wells
Capital Cost

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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 Documents & Plans	80	hr			$37.00		$0	$0	$2,960	$0	$2,960
1.2 Prepare MNA Plans	0	hr			$37.00		$0	$0	$0	$0	$0
1.3 Prepare LUCs	0	hr			$37.00		$0	$0	$0	$0	$0
1.4 Subcontractor Design	1	ls	$3,400.00				$3,400	$0	$0	$0	$3,400
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Site Support Facilities (trailers, phone, electric, etc.)	0	ls		$1,000.00		$3,500.00	$0	$0	$0	$0	$0
2.2 Equipment Mobilization/Demobilization	0	ea			$177.00	$610.00	$0	$0	$0	$0	$0
3 FIELD SUPPORT (two injections)											
3.1 Site Support Facilities (trailers, phone, electric, etc.)	1	mo		$470.00		$452.00	$0	$470	$0	$452	$922
3.2 Survey Support	0	day	$1,075.00				$0	$0	$0	$0	$0
3.3 Site Superintendent	4	week		$700.00	$1,923.20		$0	$2,800	$7,693	$0	$10,493
3.4 Site Health & Safety and QA/QC	2	week		$700.00	$1,538.40		$0	$1,400	$3,077	$0	$4,477
4 DECONTAMINATION (Two injections)											
4.1 Decontamination Services	0	mo		$1,220.00	$2,244.00	$1,550.00	$0	$0	$0	$0	$0
4.2 Temporary Equipment Decon Pad	0	ls		$1,800.00	$2,200.00	$450.00	$0	$0	$0	$0	$0
4.3 Decon Water	2,000	gal		$0.20			$0	$400	$0	$0	$400
4.4 Decon Water Storage Tank, 6,000 gallon	2	mo				$771.00	$0	$0	$0	$1,542	$1,542
4.5 Clean Water Storage Tank, 4,000 gallon	2	mo				$693.00	$0	$0	$0	$1,386	$1,386
4.6 Disposal of Decon Waste (liquid & solid)	2	mo	$985.00				$1,970	$0	$0	$0	$1,970
5 SITE PREPARATION AND BENCH SCALE TESTING											
5.1 Underground Utility Clearance	0	ls	$7,750.00				$0	$0	$0	$0	$0
5.2 Bench Scale Planning/Sampling	0	hr			$37.00		$0	$0	$0	$0	$0
5.3 Bench Scale Analyses	0	ea	$200.00				$0	$0	$0	$0	$0
5.4 Bench Scale ODCs	0	ls		$500.00			$0	$0	$0	$0	$0
5.5 Bench Scale Test	0	ls	$65,000.00				$0	$0	$0	$0	$0
6 CHEMICAL INJECTION No. 1								$0	$0	$0	
6.1 Subcontractor Mob/Demob	1	ls	$8,100.00				$8,100	$0	$0	$0	$8,100
6.2 Install injection wells	0	ls	$896,000.00				$0	$0	$0	$0	$0
6.3 Injection (1 week)	1	ls	$28,000.00				$28,000	$0	$0	$0	$28,000
6.4 Sodium Permanganate	1	ls		$66,000.00			$0	$66,000	$0	$0	$66,000
6.5 Subcontractor's Report	1	ls	$2,700.00				$2,700	$0	$0	$0	$2,700
6.6 Water Tank Truck	5	day				$470.00	$0	$0	$0	$2,350	$2,350
6.7 Injection Water	52,000	gal		$0.20			$0	$10,400	$0	$0	$10,400
6.8 IDW	0	drum	$175.00				$0	$0	$0	$0	$0
7 CHEMICAL INJECTION No. 2								$0	$0	$0	
7.1 Subcontractor Mob/Demob	1	ls	$8,100.00				$8,100	$0	$0	$0	$8,100
7.2 Install injection wells	0	ls	$896,000.00				$0	$0	$0	$0	$0
7.3 Injection (1 week)	1	ls	$28,000.00				$28,000	$0	$0	$0	$28,000
7.4 Sodium Permanganate	1	ls		$66,000.00			$0	$66,000	$0	$0	$66,000
7.5 Subcontractor's Report	1	ls	$2,700.00				$2,700	$0	$0	$0	$2,700
7.6 Water Tank Truck	5	day				$470.00	$0	$0	$0	$2,350	$2,350
7.7 Injection Water	52,000	gal		$0.20			$0	$10,400	$0	$0	$10,400
7.8 IDW	0	drum	$175.00				$0	$0	$0	$0	$0

NCBC DAVISVILLE
Davisville, Rhode Island
Site 16
Alternative G-3B - In-Situ Chemical Oxidation using Existing INJ Wells
Capital Cost

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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
8 POST-INJECTION SAMPLING (Two phases of Five events)											
8.1 Sampling Labor	300	hr		$37.00			$0	$11,100	$0	$0	$11,100
8.2 Sampling ODCs	10	ea	$500.00				$5,000	$0	$0	$0	$5,000
8.3 Sampling Analysis	10	ea	$400.00				$4,000	$0	$0	$0	$4,000
8.4 Sampling Report	400	hr		$37.00			$0	$14,800	$0	$0	$14,800
Subtotal							$91,970	$183,770	$13,730	$8,080	$297,550
Overhead on Labor Cost @ 30%									$4,119		$4,119
G & A on Labor Cost @ 10%									$1,373		$1,373
G & A on Material Cost @ 10%								$18,377			$18,377
G & A on Equipment Cost @ 10%										$808	$808
G & A on Subcontract Cost @ 10%							$9,197				$9,197
Tax on Materials and Equipment Cost @ 7%								$12,864		$566	$13,430
Total Direct Cost							$101,167	$215,011	$19,221	$9,454	$344,853
Indirects on Total Direct Cost @ 25%											$86,213
Profit on Total Direct Cost @ 10%											$34,485
Subtotal											$465,551
Health & Safety Monitoring @ 1%											$4,656
Total Field Cost											$470,207
Contingency on Total Field Costs @ 25%											$117,552
Engineering on Total Field Cost @ 5%											$23,510
TOTAL CAPITAL COST											**$611,269**

NCBC DAVISVILLE
Davisville, Rhode Island
Site 16
Alternative G-3B - In-Situ Chemical Oxidation using Existing INJ Wells
Annual Cost

Item	Item Cost yearly	Item Cost every 5 years	Notes
Site Inspection and Report	$2,650		LUC Inspection and Reporting
MNA Sampling	$18,000		Labor and supplies to collect samples from 28 wells using a crew of two annually.
MNA Sampling Analysis/Water	$6,500		Analyze groundwater samples for MNA
MNA Sampling Report	$6,000		
WMA Sampling	$3,200		Labor and supplies to collect samples from 6 wells using a crew of two annually.
WMA Sampling Analysis/Water	$800		Analyze groundwater samples for VOCs
WMA Sampling Report	$6,000		
Surface Water/Seep Sampling		$4,000	Labor and supplies to collect samples from 10 locations using a crew of two annually.
Surface Water/Seep Analysis		$4,500	Analyze surface water/seep samples for VOCs and SVOCs.
Five Year Site Review		$25,000	Five Year Site Reviews
SUBTOTAL	$43,150	$33,500	
Contingency @ 10%	$4,315	$3,350	
TOTAL	**$47,465**	**$36,850**	
Well Abandonment		$5,000	

NCBC DAVISVILLE
Davisville, Rhode Island
Site 16
Alternative G-3B - In-Situ Chemical Oxidation using Existing INJ Wells
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 2.3%	Present Worth
0	$611,269		$611,269	1.000	$611,269
1		$47,465	$47,465	0.978	$46,398
2		$47,465	$47,465	0.956	$45,355
3		$47,465	$47,465	0.934	$44,335
4		$47,465	$47,465	0.913	$43,338
5		$89,315	$89,315	0.893	$79,716
6		$47,465	$47,465	0.872	$41,411
7		$47,465	$47,465	0.853	$40,480
8		$47,465	$47,465	0.834	$39,570
9		$47,465	$47,465	0.815	$38,681
10		$84,315	$84,315	0.797	$67,166
11		$47,465	$47,465	0.779	$36,961
12		$47,465	$47,465	0.761	$36,130
13		$47,465	$47,465	0.744	$35,318
14		$47,465	$47,465	0.727	$34,523
15		$84,315	$84,315	0.711	$59,947
16		$47,465	$47,465	0.695	$32,989
17		$47,465	$47,465	0.679	$32,247
18		$47,465	$47,465	0.664	$31,522
19		$47,465	$47,465	0.649	$30,813
20		$84,315	$84,315	0.635	$53,505
21		$47,465	$47,465	0.620	$29,443
22		$47,465	$47,465	0.606	$28,781
23		$47,465	$47,465	0.593	$28,134
24		$47,465	$47,465	0.579	$27,502
25		$84,315	$84,315	0.566	$47,754
26		$47,465	$47,465	0.554	$26,279
27		$47,465	$47,465	0.541	$25,688
28		$47,465	$47,465	0.529	$25,111
29		$47,465	$47,465	0.517	$24,546
30		$84,315	$84,315	0.506	$42,622

AVERAGE ANNUAL COST **$55,002** **TOTAL PRESENT WORTH** **$1,787,534**

Appendix C
Human Health Risk Tables

TABLE C-1

EXPOSURE POINT CONCENTRATIONS - SOIL, GROUNDWATER, SEEPS, AND SEDIMENTS
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Chemical	Northwest Undeveloped Area		Southeast Undeveloped Area		Developed Area		Groundwater Undeveloped Area (ug/L)	Groundwater Developed Area (ug/L)	Seeps (ug/L)	Sediment (mg/kg)
	Surface Soil (mg/kg)	Subsurface Soil (mg/kg)	Surface Soil (mg/kg)	Subsurface Soil (mg/kg)	Surface Soil (mg/kg)	Subsurface Soil (mg/kg)				
Volatile Organic Compounds										
1,1,2-Trichloroethane	NA	NA	NA	NA	NA	NA	0.271[1]	0.534[1]	NA	NA
1,2-Dibromethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA	NA	1.72[1]	2.73[1]	NA	NA
1,1-Dichloroethene	NA	0.41[2]	NA	NA	NA	NA	0.827[1]	2.35[1]	NA	NA
1,2-Dichloroethane	NA	NA	NA	NA	NA	NA	0.214[1]	2.01[1]	NA	NA
1,4-Dichlorobenzene	NA	NA	NA	NA	NA	NA	0.221[1]	NA	NA	NA
Benzene	NA	0.38[3]	NA	NA	NA	NA	0.284[1]	2.01[1]	NA	NA
Chloroform	NA	0.047[3]	NA	NA	NA	NA	0.787[1]	2.46[1]	NA	NA
cis-1,2-Dichloroethene	NA	0.012[4]	NA	NA	NA	NA	8.55[1]	5.69[1]	NA	NA
Ethylbenzene	NA	NA	NA	NA	NA	NA	1.78[1]	NA	NA	NA
Tetrachloroethene	NA	NA	NA	NA	NA	NA	1.78[1]	1.43[1]	NA	NA
Trichloroethene	NA	0.015[5]	NA	0.006[4]	NA	0.015[6]	484[1]	686[1]	NA	NA
Vinyl Chloride	NA	0.077[7]	NA	NA	NA	NA	3.32[1]	2.06[1]	0.5[4]	NA
Semivolatile Organic Compounds										
2-Methylnaphthalene	NA	22.9[3]	NA	1.16[8]	NA	NA	96.8[1]	NA	NA	NA
Acenaphthene	NA	NA	NA	NA	NA	NA	377[1]	NA	NA	21.5[6]
Anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA	31.9[6]
Benzo(a)pyrene Equivalents	0.722[3]	2.47[3]	0.292[8]	1.38[8]	0.052[9]	0.005[4]	2.83[1]	NA	0.006[4]	18.8[6]
Benzo(g,h,i)perylene	0.26[10]	0.906[3]	0.121[10]	0.454[8]	0.034[11]	NA	NA	NA	NA	6.87[6]
Bis(2-ethylhexyl)phthalate	NA	NA	NA	NA	NA	NA	NA	NA	39[4]	NA
Fluoranthene	NA	6.53[3]	NA	1.33[3]	0.069[9]	NA	NA	NA	NA	371[6]
Fluorene	NA	5.93[3]	NA	0.035[7]	NA	NA	NA	NA	NA	24.2[6]
Hexachlorobenzene	NA	NA	NA	NA	NA	NA	1[4]	NA	NA	NA
Naphthalene	NA	3.85[3]	NA	0.13[3]	NA	NA	472[1]	NA	9[4]	NA
Phenanthrene	NA	NA	NA	NA	NA	NA	2.41[1]	NA	NA	145[6]
Pyrene	NA	5.55[3]	NA	1.04[3]	0.059[9]	NA	NA	NA	NA	213[6]
Pesticides/PCBs										
Aroclor-1254	NA	0.12[4]	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.035[11]
alpha-BHC	NA	NA	NA	NA	NA	NA	NA	NA	0.03[4]	NA
Dieldrin	NA	NA	NA	NA	NA	NA	NA	NA	0.02[4]	NA
Heptachlor Epoxide	NA	NA	NA	NA	NA	NA	NA	NA	0.02[4]	NA
Dioxins/Furans										
2,3,7,8-TCDD Equivalents	0.00005[4]	0.0005[4]	0.000004[4]	0.000002[4]	NA	NA	NA	NA	NA	NA
Inorganics										
Aluminum	6111[11]	6781[12]	6953[11]	6853[11]	6320[11]	5430[11]	989[1]	14700[1]	NA	10400[12]
Antimony	4.19[5]	5.44[5]	7.04[3]	0.76[13]	NA	NA	NA	61.7[4]	NA	NA
Arsenic	6.83[10]	5.0[7]	6.5[10]	2.88[11]	2.4[11]	1.9[11]	3.9[1]	92.2[4]	1.9[4]	13.2[12]
Barium	NA	NA	NA	NA	NA	NA	35.5[1]	2350[4]	NA	NA

TABLE C-1

EXPOSURE POINT CONCENTRATIONS - SOIL, GROUNDWATER, SEEPS, AND SEDIMENTS
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Chemical	Northwest Undeveloped Area		Southeast Undeveloped Area		Developed Area		Groundwater Undeveloped Area (ug/L)	Groundwater Developed Area (ug/L)	Seeps (ug/L)	Sediment (mg/kg)
	Surface Soil (mg/kg)	Subsurface Soil (mg/kg)	Surface Soil (mg/kg)	Subsurface Soil (mg/kg)	Surface Soil (mg/kg)	Subsurface Soil (mg/kg)				
Inorganics (continued)										
Beryllium	0.456[5]	0.436[7]	0.38[13]	0.416[13]	0.5[11]	0.46[11]	0.16[1]	0.58[1]	NA	1.2[11]
Cadmium	NA	NA	NA	NA	NA	NA	0.15[1]	0.5[1]	NA	NA
Chromium	10.9[14]	21.9[7]	10.2[15]	8.7[11]	9.8[11]	NA	1.6[1]	21.7[1]	NA	42.2[12]
Cobalt	6.2[12]	5.95[12]	7.4[11]	6.33[11]	6.8[11]	7.0[12]	4.64[1]	15.6[1]	10.2[4]	9.76[14]
Copper	NA	331[9]	NA	14.6[11]	NA	NA	6.3[1]	43.3[1]	NA	NA
Iron	18464[12]	27429[12]	17041[12]	14951[11]	13300[11]	13900[11]	12200[1]	36700[1]	32000[4]	30200[11]
Lead	105[1]	303[1]	19.1[1]	16.1[1]	NA	NA	2.4[1]	14[1]	8.35[4]	80.6[1]
Manganese	214[12]	266[12]	209[11]	226[14]	194[12]	258[12]	845[1]	32100[4]	2170[4]	250[12]
Nickel	NA	NA	NA	NA	NA	NA	5.3[1]	35[1]	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	2.3[1]	2.7[1]	NA	NA
Silver	NA	NA	NA	NA	NA	NA	2.8[1]	170[4]	NA	NA
Thallium	0.973[13]	1.0[13]	1.5[13]	1.5[13]	2[11]	1.9[11]	0.13[1]	5.9[4]	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	1.9[1]	25.9[1]	NA	44.0[12]
Zinc	NA	NA	NA	NA	NA	NA	20.1[1]	110[1]	NA	NA
Nitrate	NA	NA	NA	NA	NA	NA	772[1]	2960[1]	NA	NA
Nitrite	NA	NA	NA	NA	NA	NA	94.2[1]	49.4[1]	NA	NA

Notes
NA - Not applicable. Not a COPC for this media.
1 - Arithmetic Mean.
2 - 97.5% Chebyshev(Mean, Std) UCL.
3 - 97.5% KM (Chebyshev) UCL
4 - Maximum detected concentration.
5 - 95% KM(t) UCL
6 - 99% Chebyshev(Mean, Std) UCL.
7 - 95% KM (BCA) UCL
8 - 99% KM (Chebyshev) UCL
9 - 95% Chebyshev(Mean, Std) UCL.
10 - 95% KM (Chebyshev) UCL
11 - Student-t UCL.
12 - Approximate Gamma 95% UCL.
13 - 95% KM (Percentile Bootstrap) UCL
14 - H-UCL.
15 - 95% Modified-t UCL

TABLE C-2

EXPOSURE POINT CONCENTRATIONS - SOIl GAS
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Chemical	Building E-107 (ppmv)	Undeveloped Area (ppmv)	Building 41 (ppmv)	BTEX Hotspot (ppmv)	Seafreeze Building (ppmv)
Volatile Organic Compounds					
1,1,2-Trichloroethane	NA	NA	NA	0.042	NA
1,2-Dibromethane	NA	0.00089	NA	NA	NA
Benzene	0.019	0.015	0.071	NA	0.025
Chloroform	0.0016	0.00017	0.089	NA	0.000092
Ethylbenzene	0.0043	0.0074	NA	NA	0.025
Tetrachloroethene	0.00016	0.00042	0.021	NA	0.019
Trichloroethene	NA	0.00051	1.8	NA	0.19
Vinyl Chloride	0.000078	0.35	NA	NA	NA

Notes
NA - Not applicable. Not a COPC for this media.
ppmv - parts per million by volume.

TABLE C-3

SUMMARY OF EXPOSURE INPUT PARAMETERS - REASONABLE MAXIMUM EXPOSURES
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Parameter Code	Exposure Parameter	Construction Worker	Industrial Worker	Adolescent Trespasser	Child Recreational User	Adult Recreational User	Child Resident	Adult Resident
All Exposures								
ED	Exposure Duration (years)	1[1]	25[2]	10[3]	6[4]	24[4]	6[4]	24[4]
BW	Body Weight (kg)	70[4]	70[4]	43[4]	15[4]	70[4]	15[4]	70[4]
AT-N	Averaging Time (Non-Cancer) (days)	365[4]	9,125[4]	3,650[4]	2,190[4]	8,760[4]	2,190[4]	8,760[4]
AT-C	Averaging Time (Cancer) (days)	25,550[4]	25,550[4]	25,550[4]	25,550[4]	25,550[4]	25,550[4]	25,550[4]
Incidental Ingestion/Dermal Contact with Soil								
C_{soil}	Exposure concentration for soil (mg/kg)	Maximum or 95% UCL[5]	Maximum or 95% UCL[5]	Maximum or 95% UCL[5]	Maximum or 95% UCL[5]	Maximum or 95% UCL[5]	Maximum or 95% UCL[5]	Maximum or 95% UCL[5]
IR	Ingestion Rate (mg/day)	330[2]	100[2]	100[6]	200[6]	100[6]	200[6]	100[6]
EF	Exposure Frequency (days/year)	150[1]	250[2]	26[7]	100[8]	100[8]	350[2]	350[2]
FI	Fraction Ingested (unitless)	1[2]	1[2]	1[6]	0.5[9]	0.5[9]	1[6]	1[10]
SA	Skin Surface Available for Contact (cm^2)	3,300[2,11]	3,300[11]	5,300[12]	2,800[11]	5,700[11]	2,800[11]	5,700[11]
AF	Soil to Skin Adherence Factor (mg/cm^2/event)	0.3[2,11]	0.2[11]	0.2[11]	0.2[11]	0.07[11]	0.2[11]	0.07[11]
EV	Event Frequency (events/day)	1	1	1	1	1	1	1
ABS	Absorption Factor (unitless)	chemical-specific[11]	chemical-specific[11]	chemical-specific[11]	chemical-specific[11]	chemical-specific[11]	chemical-specific[11]	chemical-specific[11]
CF	Conversion Factor (kg/mg)	1E-06	1E-06	1E-06	1E-06	1E-06	1E-06	1E-06
Inhalation Fugitive Dust/Volatile Emissions from Surface Soil								
C_{air}	Exposure concentration for air (mg/m^3)	calculated[2]	calculated[2]	calculated[13]	calculated[13]	calculated[13]	calculated[13]	calculated[13]
ET	Exposure Time (hours/day)	8[14]	8[14]	4[15]	4[9]	4[9]	24[6]	24[6]
EF	Exposure Frequency (days/year)	150[1]	250[2]	26[7]	100[8]	100[8]	350[2]	350[2]
PEF	Particulate Emission Factor (m^3/kg)	1.62E+06[2]	1.1E+10[16]	1.1E+10[16]	1.1E+10[16]	1.1E+10[16]	1.1E+10[16]	1.1E+10[16]
Ingestion/Dermal Contact with Groundwater								
C_{gw}	Exposure concentration for groundwater (ug/L)	Average	Average	NA	NA	NA	Average	Average
IR	Ingestion Rate (L/day)	0.01[15]	NA	NA	NA	NA	1.0[17]	2.0[17]
EF	Exposure Frequency (days/year)	30[1]	NA	NA	NA	NA	350[17]	350[17]
ET	Exposure Time (hours/day)	4[1]	NA	NA	NA	NA	0.33[18]	0.33[18]
EV	Event Frequency (events/day)	1[1]	NA	NA	NA	NA	1[11]	1[11]
SA	Skin Surface Available for Contact (cm^2)	3,300[11]	NA	NA	NA	NA	6,600[11]	18,000[11]
	Kp (cm/hour), t* (hour/event), τ (hour), and B (unitless)	chemical-specific[11]	NA	NA	NA	NA	chemical-specific[11]	chemical-specific[11]
Inhalation of Volatile Emissions from Groundwater								
C_{air}	Exposure concentration for air (mg/m^3)	calculated[19]	NA	NA	NA	NA	NA	NA
ET	Exposure Time (hours/day)	4[1]	NA	NA	NA	NA	NA	NA

TABLE C-3

SUMMARY OF EXPOSURE INPUT PARAMETERS - REASONABLE MAXIMUM EXPOSURES
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Parameter Code	Exposure Parameter	Construction Worker	Industrial Worker	Adolescent Trespasser	Child Recreational User	Adult Recreational User	Child Resident	Adult Resident
Ingestion/Dermal Contact with Surface Water								
C_{sw}	Exposure concentration for surface water (ug/L)	NA	NA	NA	Maximum or 95% UCL[5]	Maximum or 95% UCL[5]	Maximum or 95% UCL[5]	Maximum or 95% UCL[5]
IR	Ingestion Rate (L/hr)	NA	NA	NA	0.01[20]	0.01[20]	NA	NA
EF	Exposure Frequency (days/year)	NA	NA	NA	52[21]	52[21]	NA	NA
ET	Exposure Time (hours/day)	NA	NA	NA	4[9]	4[9]	NA	NA
EV	Event Frequency (events/day)	NA	NA	NA	1[15]	1[15]	NA	NA
SA	Skin Surface Available for Contact (cm^2)	NA	NA	NA	2,800[11]	5,700[11]	NA	NA
	Kp (cm/hour), t* (hour/event), τ (hour), and B (unitless)	NA	NA	NA	chemical-specific[11]	chemical-specific[11]	NA	NA
CF	Conversion Factor (L/cm^3)	NA	NA	NA	1E-03	1E-03	NA	NA
Incidental Ingestion/Dermal Contact with Sediment								
C_{sed}	Exposure concentration for sediment (mg/kg)	Maximum or 95% UCL[5]	Maximum or 95% UCL[5]	Maximum or 95% UCL[5]	Maximum or 95% UCL[5]	Maximum or 95% UCL[5]	Maximum or 95% UCL[5]	Maximum or 95% UCL[5]
IR	Ingestion Rate (mg/day)	NA	NA	NA	200[10]	100[10]	NA	NA
EF	Exposure Frequency (days/year)	NA	NA	NA	52[21]	52[21]	NA	NA
FI	Fraction Ingested (unitless)	NA	NA	NA	0.5[9]	0.5[9]	NA	NA
SA	Skin Surface Available for Contact (cm^2)	NA	NA	NA	2,800[11]	5,700[11]	NA	NA
AF	Soil to Skin Adherence Factor (mg/cm^2/event)	NA	NA	NA	3.3[22]	0.335[23]	NA	NA
EV	Event Frequency (events/day)	NA	NA	NA	1	1	NA	NA
ABS	Absorption Factor (unitless)	NA	NA	NA	chemical-specific[11]	chemical-specific[11]	NA	NA
CF	Conversion Factor (kg/mg)	NA	NA	NA	1E-06	1E-06	NA	NA
Vapor Intrusion								
EF	Exposure Frequency (days/year)	NA	250[2]	NA	NA	NA	350[2]	350[2]

TABLE C-3

SUMMARY OF EXPOSURE INPUT PARAMETERS - REASONABLE MAXIMUM EXPOSURES
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

1 - Assumes a 30 week construction project over a course of one year. Exposure to groundwater occurs only for 6 weeks.
2 - USEPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9365.4-24.
3 - Adolescents ages 7 to 16 years old.
4 - USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.
5 - USEPA, 2002. Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.
6 - USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.
7 - Assume one day a week in warm weather months for reasonable maximum exposure and every other week for central tendency exposure.
8 - Assume four days a week in warm weather months for reasonable maximum exposure and two days a week for central tendency exposure.
9 - Child and adult recreational users are assumed to be at the site only a portion of the day.
10 - USEPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.
11 - USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. PA/540/R/99/005.
12 - Assume that head, forearms, hands, lower legs, and feet are exposed, USEPA, 1997a.
13 - USEPA, 1996: Soil Screening Guidance: Technical Background Document (PEF values site specific).
14 - Assume an 8-hour work shift.
15 - Professional judgment.
16 - USEPA, 2008: Soil Screening Guidance calculation Internet site at http://risk.lsd.ornl.gov/calc_start.htm. Site-specific values for Hartford, Connecticut.
17 - USEPA, 1994: USEPA Region I Risk Updates, August 1994.
18 - USEPA, 1997: Exposure Factors Handbook. EPA/600/8-95/002FA.
19 - VDEQ September 2004. Virginia Department of Environmental Quality (VDEQ, online -http://www.deq.state.va.us/brownfieldweb/vrp.html).
20 - USEPA Region 4, 2000: Supplement Guidance to RAGS: Region 4 Bulletins.
21 - Assume two days a week in warm weather months for reasonable maximum exposure and one day a week for central tendency exposure.
22 - USEPA, 2004, 95th percentile for a child playing in wet soil, Exhibit 3-3.
23 - Shoaf et. Al. 2005: Child Dermal Sediment Loads Following Olay in Tide Flat, Journal of Exposure Analysis and Environmental Epodemiology 15, 407-412.

TABLE C-4

CHEMICAL PROPERTIES FOR VOLATILIZATION FROM SOIL/GROUNDWATER TO OUTDOOR AIR MODELS
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Chemical	Molecular Weight (g/mole)	Organic Carbon Partition Coefficient (cm^3/g)	Air Diffusivity (cm^2/sec)	Water Diffusivity (cm^2/sec)	Solubility Limit (mg/L)	Henry's Law Constant	
						(Dimensionless)	($atm\text{-}m^3/mol$)
1,1-Dichloroethene	9.69E+01	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.61E-02
1,1,2-Trichloroethane	1.33E+02	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.74E-02	9.12E-04
1,2,4-Trichlorobenzene	1.82E+02	1.78E+03	3.00E-02	8.23E-06	3.00E+02	5.82E-02	1.42E-03
1,2-Dichloroethane	9.90E+01	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.01E-02	9.78E-04
2-Butanone	7.20E+01	1.23E+00	8.08E-02	9.80E-06	2.23E+05	5.33E-03	1.30E-04
Acetone	5.80E+01	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.88E-05
Benzene	7.81E+01	5.89E+01	8.80E-02	9.80E-06	1.75E+03	2.28E-01	5.56E-03
Bromodichloromethane	1.64E+02	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.56E-02	1.60E-03
Chloroform	1.19E+02	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03
cis-1,2-Dichloroethene	9.70E+01	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03
Methylene Chloride	8.49E+01	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.98E-02	2.19E-03
Tetrachloroethene	1.66E+02	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.54E-01	1.84E-02
Trichloroethene	1.31E+02	1.66E+02	7.90E-02	9.10E-06	1.10E+03	4.22E-01	1.03E-02
Vinyl Chloride	6.25E+01	1.86E+01	1.06E-01	1.23E-05	2.76E+03	1.11E+00	2.71E-02
2-Methylnaphthalene	1.42E+02	2.24E+03	4.80E-02	7.84E-06	2.46E+01	2.38E-03	5.80E-05
Acenaphthene	1.54E+02	7.08E+03	4.21E-02	7.69E-06	4.24E+00	6.36E-03	1.55E-04
Anthracene	1.78E+02	2.95E+04	3.24E-02	7.74E-06	4.34E-02	2.67E-03	6.51E-05
Dibenzofuran	1.68E+02	8.13E+03	6.01E-02	1.00E-05	4.22E+00	8.73E-03	2.13E-04
Fluorene	1.16E+02	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.61E-03	6.37E-05
Naphthalene	1.28E+02	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.83E-04
Phenanthrene	1.78E+02	4.80E+03	2.72E-02	7.24E-06	1.15E+00	3.92E-02	9.55E-04

Source:
USEPA 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

TABLE C-5

INPUT PARAMETERS FOR CALCULATION OF THE VOLATILIZATION FROM SOIL TO OUTDOOR AIR MODELS
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Parameter	Definition	Value	Reference
Q/C	Inverse of mean concentration at center of source (g/m^2-s per kg/m^3).	73.95	USEPA, 2008
T	Exposure interval (seconds).	9.5E+08	USEPA, 2002
pb	Dry soil bulk density (g/cm^3).	1.5	USEPA, 2002
ps	Soil particle density (g/cm^3).	2.65	USEPA, 2002
θw	Water-filled soil porosity (L_{pore}/L_{soil}).	0.15	USEPA, 2002
n	Total soil porosity (L_{pore}/L_{soil}).	0.434	USEPA, 2002
Di	Diffusivity in air (cm^2/sec).	Chemical specific	USEPA, 2002
H'	Dimensionless Henry's Law Constant.	Chemical specific	USEPA, 2002
S	Solubility limit (mg/L)	Chemical specific	USEPA, 2002
Dw	Diffusivity in water (cm^2/sec).	Chemical specific	USEPA, 2002
Koc	Soil organic carbon partition coefficient (cm^3/g).	Chemical specific	USEPA, 2002
foc	Fraction organic carbon in soil (g/g).	0.006	USEPA, 2002

Notes:
Chemical specific values are presented in Table C-4.
USEPA 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.
USEPA 2008: Soil Screening Guidance calculation Internet site at http://risk.lsd.ornl.gov/calc_start.htm.
Site-specific values for Hartford, Connecticut.

TABLE C-6

INTERMEDIATE VARIABLES FOR CALCULATING DA(EVENT)
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Chemical of Potential Concern	Media	Dermal Absorption Fraction (soil)	FA	Kp		T(event)		Tau		T*		B
			Value	Value	Units	Value	Units	Value	Units	Value	Units	Value
Volatile Organic Compounds												
1,1-Dichloroethene	Soil	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	Groundwater	NA	1	6.7E-03	cm/hr	(1)	hr	3.8E-01	hr	9.2E-01	hr	2.6E-02
1,4-Dichlorobenzene	Groundwater	NA	1	4.2E-02	cm/hr	(1)	hr	7.1E-01	hr	1.7E+00	hr	2.0E-01
1,1,2-Trichloroethane	Soil, Groundwater	NA	1	6.4E-03	cm/hr	(1)	hr	6.0E-01	hr	1.4E+00	hr	2.9E-02
1,2,4-Trichlorobenzene	Groundwater	NA	1	6.6E-02	cm/hr	(1)	hr	1.1E+00	hr	2.7E+00	hr	3.4E-01
1,2-Dichloroethane	Groundwater	NA	1	4.2E-03	cm/hr	(1)	hr	3.8E-01	hr	9.2E-01	hr	1.6E-02
2-Butanone	Groundwater	NA	1	9.6E-04	cm/hr	(1)	hr	2.7E-01	hr	6.5E-01	hr	3.1E-03
Acetone	Groundwater	NA	1	5.2E-04	cm/hr	(1)	hr	2.2E-01	hr	5.3E-01	hr	1.5E-03
Benzene	Soil, Groundwater	0	1	1.5E-02	cm/hr	(1)	hr	2.9E-01	hr	7.0E-01	hr	5.1E-02
Bromodichloromethane	Groundwater	NA	1	4.6E-03	cm/hr	(1)	hr	8.8E-01	hr	2.1E+00	hr	2.3E-02
Chlorodibromomethane	Groundwater	NA	1	3.2E-03	cm/hr	(1)	hr	1.6E+00	hr	3.8E+00	hr	1.8E-02
Chloroform	Soil, Groundwater	0	1	6.8E-03	cm/hr	(1)	hr	5.0E-01	hr	1.2E+00	hr	2.9E-02
cis-1,2-Dichloroethene	Soil, Groundwater	0	1	1.1E-02	cm/hr	(1)	hr	3.7E-01	hr	8.8E-01	hr	4.1E-02
Methylene Chloride	Soil, Groundwater	0	1	3.5E-03	cm/hr	(1)	hr	3.2E-01	hr	7.6E-01	hr	1.3E-02
Tetrachloroethene	Groundwater	NA	1	3.3E-02	cm/hr	(1)	hr	9.1E-01	hr	2.2E+00	hr	1.7E-01
Trichloroethene	Soil, Groundwater, Seeps	0	1	1.2E-02	cm/hr	(1)	hr	5.8E-01	hr	1.4E+00	hr	5.1E-02
Vinyl Chloride	Soil, Groundwater, Seeps	0	1	5.6E-03	NA	NA	NA	2.4E-01	hr	5.7E-01	hr	1.7E-02
Semivolatile Organic Compounds												
2-Methylnaphthalene	Soil, Groundwater, Seeps	0.13	1	8.9E-02	cm/hr	(1)	hr	6.6E-01	hr	1.6E+00	hr	4.1E-01
Acenaphthene	Sediment	0.13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Anthracene	Sediment	0.13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	Soil, Groundwater, Sediment, Seeps	0.13	NA(2)	NA(2)	NA(2)	NA(2)	NA(2)	NA(2)	NA(2)	NA(2)	NA(2)	NA(2)
Benzo(g,h,i)perylene	Soil	0.13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate	Groundwater, Seeps	NA	0.8	2.5E-02	cm/hr	(1)	hr	1.7E+01	hr	4.0E+01	hr	1.9E-01
Carbazole	Soil, Groundwater	0.13	1	5.2E-02	cm/hr	(1)	hr	9.1E-01	hr	2.2E+00	hr	2.6E-01
Dibenzofuran	Groundwater, Seeps, Sediment	0.1	1	9.5E-02	cm/hr	(1)	hr	9.2E-01	hr	2.2E+00	hr	4.7E-01
Fluoranthene	Soil, Sediment	0.13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluorene	Soil, Sediment	0.13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	Soil, Groundwater, Seeps	0.13	1	4.7E-02	cm/hr	(1)	hr	5.6E-01	hr	1.3E+00	hr	2.0E-01
Phenanthrene	Groundwater, Sediment	0.13	NA(2)	NA(2)	NA(2)	NA(2)	NA(2)	NA(2)	NA(2)	NA(2)	NA(2)	NA(2)
Pyrene	Soil, Sediment	0.13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs												
alpha-BHC	Seeps	NA	1	2.0E-02	cm/hr	(1)	hr	4.5E+00	hr	1.1E+01	hr	1.3E-01
Aroclor-1254	Sediment	0.14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	Seeps	NA	0.8	1.2E-02	cm/hr	(1)	hr	1.5E+01	hr	3.5E+01	hr	9.2E-02

TABLE C-6

INTERMEDIATE VARIABLES FOR CALCULATING DA(EVENT)
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Chemical of Potential Concern	Media	Dermal Absorption Fraction (soil)	FA	Kp		T(event)		Tau		T*		B
			Value	Value	Units	Value	Units	Value	Units	Value	Units	Value
Heptachlor Epoxide	Groundwater, Seeps	NA	1	2.0E-02	cm/hr	(1)	hr	1.6E+01	hr	3.8E+01	hr	1.5E-01
Dioxin/Furans												
2,3,7,8-TCDD Equivalents	Soil	0.03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics												
Aluminum	Soil, Groundwater, Sediment	0	1	1.0E-03	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	Soil, Groundwater	0	1	1.0E-03	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	Soil, Groundwater, Seeps, Sediment	0.03	1	1.0E-03	NA	NA	NA	NA	NA	NA	NA	NA
Barium	Groundwater	NA	1	1.0E-03	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	Soil, Groundwater, Sediment	0	1	1.0E-03	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	Soil, Groundwater	0.001	1	1.0E-03	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	Soil, Groundwater	0	1	2.0E-03	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt	Soil, Groundwater, Sediment	0	1	1.0E-03	NA	NA	NA	NA	NA	NA	NA	NA
Copper	Soil, Groundwater, Seeps	0	1	1.0E-03	NA	NA	NA	NA	NA	NA	NA	NA
Iron	Soil, Groundwater, Seeps, Sediment	0	1	1.0E-03	NA	NA	NA	NA	NA	NA	NA	NA
Lead	Soil, Groundwater, Seeps	0	1	1.0E-03	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	Soil, Groundwater, Seeps, Sediment	0	1	1.0E-03	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	Groundwater	NA	1	2.0E-04	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	Groundwater	NA	1	1.0E-03	NA	NA	NA	NA	NA	NA	NA	NA
Silver	Groundwater	NA	1	6.0E-04	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	Soil, Groundwater	0	1	1.0E-03	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	Soil, Groundwater, Seeps, Sediment	0	1	1.0E-03	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	Groundwater	NA	1	6.0E-04	NA	NA	NA	NA	NA	NA	NA	NA
Miscellaneous Parameters												
Nitrate	Groundwater	NA	1	1.0E-04	NA	NA	NA	NA	NA	NA	NA	NA
Nitrite	Groundwater	NA	1	1.0E-04	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
All values from EPA's Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final, July 2004.
1 - T(event) is 4 hours for RME and 2 hours for CTE for the construction worker and recreational users; and 0.33 hrs for RME and 0.25 hr for CTE for hypothetical residents.
2 - RAGS Part E recommends not attempting to quantify risk because contaminants are outside the effective predictive domain of the model.
FA = Fraction Absorbed Water
Kp = Dermal Permeability Coefficient of Compound in Water
T(event) = Event Duration
Tau = Lag Time
T* = Time to Reach Steady-State
B = Dimensionless Ratio of the Permeability Coefficient of a Compound Through the Stratum Corneum Relative to its Permeability Coefficient Across the Viable Epidermis
NA = Not applicable.

TABLE C-7

NON-CANCER TOXICITY DATA -- ORAL/DERMAL
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal[1]	Absorbed RfD for Dermal[2]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Volatile Organic Compounds										
1,1,2-Trichloroethane	Chronic	4.0E-03	mg/kg/day	1	4.0E-03	mg/kg/day	Blood	1000/1	IRIS	9/12/2008
1,1-Dichloroethene	Chronic	5.0E-02	mg/kg/day	1	5.0E-02	mg/kg/day	Liver	100/1	IRIS	2/1/2011
1,1-Dichloroethane	Chronic	2.0E-01	mg/kg/day	1	2.0E-01	mg/kg/day	Central Nervous System	3000	PPRTV	9/27/2006
1,4-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	Chronic	1.0E-02	mg/kg/day	1	1.0E-02	mg/kg/day	Adrenals	1000/1	IRIS	9/12/2008
1,2-Dibromoethane	Chronic	9.0E-03	mg/kg/day	1	9.0E-03	mg/kg/day	Liver, Kidney	3000/1	IRIS	9/12/2008
1,2-Dichloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Butanone	Chronic	6.0E-01	mg/kg/day	1	6.0E-01	mg/kg/day	Body Weight	1000/1	IRIS	9/12/2008
Acetone	Chronic	9.0E-01	mg/kg/day	1	9.0E-01	mg/kg/day	Liver, Kidney, Central Nervous System	1000/1	IRIS	9/12/2008
Benzene	Chronic	4.0E-03	mg/kg/day	1	4.0E-03	mg/kg/day	Blood	300/1	IRIS	2/1/2011
Bromodichloromethane	Chronic	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	Kidney	1000/1	IRIS	9/12/2008
Chlorodibromomethane	Chronic	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	Liver	1000/1	IRIS	9/12/2008
Chloroform	Chronic	1.0E-02	mg/kg/day	1	1.0E-02	mg/kg/day	Liver	100/1	IRIS	2/1/2011
cis-1,2-Dichloroethene	Chronic	2.0E-03	mg/kg/day	1	2.0E-03	mg/kg/day	Blood	NA	IRIS	2/1/2011
Ethylbenzene	Chronic	1.0E-01	mg/kg/day	1	1.0E-01	mg/kg/day	Liver, Kidney	1000/1	IRS	9/12/2008
Methylene Chloride	Chronic	6.0E-02	mg/kg/day	1	6.0E-02	mg/kg/day	Liver	100/1	IRIS	9/12/2008
Tetrachloroethene	Chronic	1.0E-02	mg/kg/day	1	1.0E-02	mg/kg/day	Liver	1000/1	IRS	9/12/2008
trans-1,2-Dichloroethene	Chronic	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	Blood	1000/1	IRIS	9/12/2008
Trichloroethene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	Chronic	3.0E-03	mg/kg/day	1	3.0E-03	mg/kg/day	Liver	30/1	IRIS	2/1/2011
Semivolatile Organic Compounds										
2,6-Dinitrotoluene	Chronic	1.0E-03	mg/kg/day	1	1.0E-03	mg/kg/day	Blood, Kidney, Central Nervous System	3000/1	PPRTV	12/13/2004
2-Methylnaphthalene	Chronic	4.0E-03	mg/kg/day	1	4.0E-03	mg/kg/day	Lungs	1000/1	IRIS	2/1/2011
Acenaphthene	Chronic	6.0E-02	mg/kg/day	1	6.0E-02	mg/kg/day	Blood	3000/1	IRIS	9/12/2008
Anthracene	Chronic	3.0E-01	mg/kg/day	1	3.0E-01	mg/kg/day	None Specified	3000/1	IRIS	9/12/2008
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene[3]	Chronic	3.0E-02	mg/kg/day	1	3.0E-02	mg/kg/day	Kidney	3000/1	IRIS	2/1/2011
Bis(2-ethylhexyl)phthalate	Chronic	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	Liver	1000/1	IRIS	9/12/2008
Carbazole	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	Chronic	4.0E-02	mg/kg/day	1	4.0E-02	mg/kg/day	Liver	3000/1	IRIS	2/1/2011
Fluorene	Chronic	4.0E-02	mg/kg/day	1	4.0E-02	mg/kg/day	Blood	3000/1	IRIS	2/1/2011
Hexachlorobenzene	Chronic	8.0E-04	mg/kg/day	1	8.0E-04	mg/kg/day	Liver	100/1	IRIS	9/12/2008
Naphthalene	Chronic	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	Body Weight	3000/1	IRIS	2/1/2011
Phenanthrene[3]	Chronic	3.0E-02	mg/kg/day	1	3.0E-02	mg/kg/day	Kidney	3000/1	IRIS	9/12/2008
Pyrene	Chronic	3.0E-02	mg/kg/day	1	3.0E-02	mg/kg/day	Kidney	3000/1	IRIS	2/1/2011
Dioxin/Furans										
2,3,7,8-TCDD	Chronic	1.0E-09	mg/kg/day	1	1.0E-09	mg/kg/day	NA	NA	ATSDR	12/1998
Pesticides/PCBs										
alpha-BHC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1254	Chronic	2.0E-05	mg/kg/day	1	2.0E-05	mg/kg/day	Immune	300/1	IRIS	2/1/2011
Dieldrin	Chronic	5.0E-05	mg/kg/day	1	5.0E-05	mg/kg/day	Liver	100/1	IRIS	9/12/2008
Heptachlor Epoxide	Chronic	1.3E-05	mg/kg/day	1	1.3E-05	mg/kg/day	Liver	1000/1	IRIS	9/12/2008

TABLE C-7

NON-CANCER TOXICITY DATA -- ORAL/DERMAL
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal[1]	Absorbed RfD for Dermal[2]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Inorganics										
Aluminum	Chronic	1.0E+00	mg/kg/day	1	1.0E+00	mg/kg/day	Central Nervous System	100	PPRTV	10/23/2006
Antimony	Chronic	4.0E-04	mg/kg/day	0.15	6.0E-05	mg/kg/day	Blood	1000/1	IRIS	2/1/2011
Arsenic	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	Skin, Cardiovascular System	3/1	IRIS	2/1/2011
Barium	Chronic	2.0E-01	mg/kg/day	0.07	1.4E-02	mg/kg/day	Kidney	300/1	IRIS	9/12/2008
Beryllium	Chronic	2.0E-03	mg/kg/day	0.007	1.4E-05	mg/kg/day	Gastrointestinal System	300/1	IRIS	2/1/2011
Cadmium[4]	Chronic	5.0E-04	mg/kg/day	0.05	2.5E-05	mg/kg/day	Kidney	10/1	IRIS	9/12/2008
Chromium[5]	Chronic	3.0E-03	mg/kg/day	0.025	7.5E-05	mg/kg/day	Fetotoxicity, Gastrointestinal System, Bone	300/3	IRIS	2/1/2011
Cobalt	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	Thyroid	3000/1	PPRTV	8/25/2008
Copper	Chronic	4.0E-02	mg/kg/day	1	4.0E-02	mg/kg/day	Gastrointestinal System	NA	HEAST	7/1997
Iron	Chronic	7.0E-01	mg/kg/day	1	7.0E-01	mg/kg/day	Gastrointestinal System	1.5	PPRTV	9/11/2006
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese (soil)[6]	Chronic	1.4E-01	mg/kg/day	0.04	5.6E-03	mg/kg/day	Central Nervous System	1/1	IRIS	2/1/2011
Manganese (water)[6]	Chronic	2.4E-02	mg/kg/day	0.04	9.6E-04	mg/kg/day	Central Nervous System	1/3	IRIS	9/12/2008
Nickel	Chronic	2.0E-02	mg/kg/day	0.04	8.0E-04	mg/kg/day	Body Weight	300/1	IRIS	9/12/2008
Selenium	Chronic	5.0E-03	mg/kg/day	1	5.0E-03	mg/kg/day	Hair Loss, Central Nervous System, Skin	3/1	IRIS	9/12/2008
Silver	Chronic	5.0E-03	mg/kg/day	0.04	2.0E-04	mg/kg/day	Skin	3/1	IRIS	9/12/2008
Thallium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	Chronic	5.0E-03	mg/kg/day	0.026	1.3E-04	mg/kg/day	Kidney	300	ORNL	7/7/2008
Zinc	Chronic	3.0E-01	mg/kg/day	1	3.0E-01	mg/kg/day	Blood	3/1	IRIS	9/12/2008
Miscellaneous Parameters										
Nitrate	Chronic	1.6E+00	mg/kg/day	1	1.6E+00	mg/kg/day	Blood	1/1	IRIS	9/12/2008
Nitrite	Chronic	1.0E-01	mg/kg/day	1	1.0E-01	mg/kg/day	Blood	1/10	IRIS	9/12/2008

Notes:
1 - U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.
2 - Adjusted dermal RfD = Oral RfD x Oral Absorption Efficiency for Dermal.
3 - Values are for pyrene.
4 - Values are for cadmium - water.
5 - Values are for hexavalent chromium.
6 - Adjusted IRIS value in accordance with USEPA Region I Risk Update Number 4, November 1996.

Definitions:
ATSDR = Agency for Toxic Substances and Disease Registry.
HEAST = Health Effects Assessment Summary Tables
IRIS = Integrated Risk Information System
NA = Not Available.
ORNL = Oak Ridge National Laboratory, Regional Screening Levels for Chemical Contaminants at Superfund Sites, July 7, 2008.
PPRTV = Provisional Peer Reviewed Toxicity Value.

TABLE C-8

NON-CANCER TOXICITY DATA -- INHALATION
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD[1]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Volatile Organic Compounds									
1,1,2-Trichloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	Chronic	2.0E-01	mg/m^3	5.7E-02	(mg/kg/day)	Liver	30/1	IRIS	2/1/2011
1,1-Dichloroethane	Chronic	5.0E-01	mg/m^3	1.4E-01	(mg/kg/day)	None Reported	1000	HEAST	7/1997
1,4-Dichlorobenzene	Chronic	8.0E-01	mg/m^3	2.3E-01	(mg/kg/day)	Liver	100/1	IRIS	9/12/2008
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane	Chronic	9.0E-03	mg/m^3	2.6E-03	(mg/kg/day)	Nasal	300/1	IRIS	9/12/2008
1,2-Dichloroethane	Chronic	2.4E+00	mg/m^3	6.9E-01	(mg/kg/day)	NA	NA	ATSDR	9/2001
2-Butanone	Chronic	5.0E+00	mg/m^3	1.4E+00	(mg/kg/day)	Developmental	300/1	IRIS	9/12/2008
Acetone	Chronic	3.1E+01	mg/m^3	8.9E+00	(mg/kg/day)	NA	NA	ATSDR	5/1994
Benzene	Chronic	3.0E-02	mg/m^3	8.6E-03	(mg/kg/day)	Blood	300/1	IRIS	2/1/2011
Bromodichloromethane	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlorodibromomethane	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	Chronic	9.8E-02	mg/m3	2.8E-02	(mg/kg/day)	Liver	100/1	ATSDR	9/1997
cis-1,2-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	Chronic	1.0E+00	mg/m^3	2.9E-01	(mg/kg/day)	Developmental	300/1	IRIS	9/12/2008
Methylene Chloride	Chronic	1.1E+00	mg/m^3	3.0E-01	(mg/kg/day)	Liver	NA	ATSDR	9/2000
Tetrachloroethene	Chronic	2.7E-01	mg/m^3	7.7E-02	(mg/kg/day)	Liver	NA	ATSDR	09/1997
trans-1,2-Dichloroethene	Chronic	6.0E-02	mg/m^3	1.7E-02	(mg/kg/day)	Fetotoxicity	3000/1	PPRTV	3/1/2006
Trichloroethene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	Chronic	1.0E-01	mg/m^3	2.9E-02	(mg/kg/day)	Liver	30/1	IRIS	2/1/2011
Semivolatile Organic Compounds									
2,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene(3)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbazole	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	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
Semivolatile Organic Compounds (Continued)									
Naphthalene	Chronic	3.0E-03	mg/m^3	8.6E-04	(mg/kg/day)	Nasal	3000/1	IRIS	
Hexachlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE C-8

NON-CANCER TOXICITY DATA -- INHALATION
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD[1]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Phenanthrene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dioxin/Furans									
2,3,7,8-TCDD	Chronic	4.0E-08	mg/m^3	1.1E-08	(mg/kg/day)	Developmental	NA	Cal EPA	9/2009
Pesticides/PCBs									
alpha-BHC	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1254	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	NA	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor Epoxide	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics									
Aluminum	Chronic	5.0E-03	mg/m3	1.4E-03	(mg/kg/day)	Central Nervous System	300	PPRTV	10/23/2006
Antimony	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	Chronic	1.5E-05	mg/m3	4.3E-06	(mg/kg/day)	NA	NA	Cal EPA	9/2009
Barium	Chronic	5.0E-04	mg/m3	1.4E-04	(mg/kg/day)	Fetotoxicity	1000/1	HEAST	9/97
Beryllium	Chronic	2.0E-05	mg/m3	5.7E-06	(mg/kg/day)	Lungs	10/1	IRIS	2/1/2011
Cadmium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	Chronic	1.0E-04	mg/m^3	2.9E-05	(mg/kg/day)	Lungs	300/1	IRIS	2/1/2011
Cobalt	Chronic	6.0E-06	mg/m^3	1.7E-06	(mg/kg/day)	Lungs	NA	PPRTV	8/25/2008
Copper	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	Chronic	5.0E-05	mg/m^3	1.4E-05	(mg/kg/day)	Central Nervous System	1000/1	IRIS	2/1/2011
Nickel	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver	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	NA	NA	NA	NA	NA	NA	NA
Miscellaneous Parameters									
Nitrate	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrite	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE C-8

NON-CANCER TOXICITY DATA -- INHALATION
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Notes:

1 - Extrapolated RfD = RfC *20m^3/day / 70 kg

Definitions:

HEAST= Health Effects Assessment Summary Tables

IRIS = Integrated Risk Information System

NA = Not Applicable

ORNL = Oak Ridge National Laboratory, Regional Screening Levels for Chemical Contaminants at Superfund Sites, July 7, 2008.

PPRTV = Provisional Peer Reviewed Toxicity Value.

TABLE C-9

CANCER TOXICITY DATA -- ORAL/DERMAL
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal[1]	Absorbed Cancer Slope Factor for Dermal[2]		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Volatile Organic Compounds								
1,1,2-Trichloroethane	5.7E-02	$(mg/kg/day)^{-1}$	1	5.7E-02	$(mg/kg/day)^{-1}$	C / Possible Human Carcinogen	IRIS	9/12/2008
1,1-Dichloroethene	NA	NA	NA	NA	NA	C / Possible Human Carcinogen	IRIS	2/1/2011
1,1-Dichloroethane	5.7E-03	$(mg/kg/day)^{-1}$	1	5.7E-03	$(mg/kg/day)^{-1}$	C / Possible Human Carcinogen	Cal EPA(1)	9/2009
1,4-Dichlorobenzene	5.4E-03	$(mg/kg/day)^{-1}$	1	5.4E-03	$(mg/kg/day)^{-1}$	NA	Cal EPA(1)	9/2009
1,2,4-Trichlorobenzene	3.6E-03	$(mg/kg/day)^{-1}$	1	3.6E-03	$(mg/kg/day)^{-1}$	D / Not classifiable as to human carcinogenicity	Cal EPA(2)	2/1999
1,2-Dibromoethane	2.0E+00	$(mg/kg/day)^{-1}$	1	2.0E+00	$(mg/kg/day)^{-1}$	Likely to be carcinogenic to humans	IRIS	9/12/2008
1,2-Dichloroethane	9.1E-02	$(mg/kg/day)^{-1}$	1	9.1E-02	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	9/12/2008
2-Butanone	NA	NA	NA	NA	NA	Data are inadequate for an assessment of human carcinogenic potential	IRIS	9/12/2008
Acetone	NA	NA	NA	NA	NA	Data are inadequate for an assessment of human carcinogenic potential	IRIS	9/12/2008
Benzene	5.5E-02	$(mg/kg/day)^{-1}$	1	5.5E-02	$(mg/kg/day)^{-1}$	A / Known human carcinogen	IRIS	2/1/2011
Bromodichloromethane	6.2E-02	$(mg/kg/day)^{-1}$	1	6.2E-02	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	9/12/2008
Chlorodibromomethane	8.4E-02	$(mg/kg/day)^{-1}$	1	8.4E-02	$(mg/kg/day)^{-1}$	C / Possible Human Carcinogen	IRIS	9/12/2008
Chloroform	3.1E-02	$(mg/kg/day)^{-1}$	1	3.1E-02	$(mg/kg/day)^{-1}$	Likely to be carcinogenic to humans	Cal EPA	9/2009
cis-1,2-Dichloroethene	NA	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	9/12/2008
Ethylbenzene	1.1E-02	$(mg/kg/day)^{-1}$	1	1.1E-02	$(mg/kg/day)^{-1}$	D / Not classifiable as to human carcinogenicity	Cal EPA(3)	11/2007
Methylene Chloride	7.5E-03	$(mg/kg/day)^{-1}$	1	7.5E-03	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	9/12/2008
Tetrachloroethene	5.4E-01	$(mg/kg/day)^{-1}$	1	5.4E-01	$(mg/kg/day)^{-1}$	NA	USEPA(1)	6/12/2003
trans-1,2-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	5.9E-03	(mg/kg/day)-1	1	5.9E-03	(mg/kg/day)-1	B1 / Probable human carcinogen	Cal EPA(1)	9/2009
Vinyl Chloride (early life)	1.5E+00	$(mg/kg/day)^{-1}$	1	1.5E+00	$(mg/kg/day)^{-1}$	A / Known/likely human carcinogen	IRIS	9/12/2008
Vinyl Chloride (adult)	7.2E-01	$(mg/kg/day)^{-1}$	1	7.2E-01	$(mg/kg/day)^{-1}$	A / Known/likely human carcinogen	IRIS	2/1/2011
Semivolatile Organic Compounds								
2,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	NA	NA	NA	NA	NA	Data are inadequate for an assessment of human carcinogenic potential	IRIS	2/1/2011
Acenaphthene	NA	NA	NA	NA	NA	NA	NA	NA
Anthracene	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene[3]	7.3E+00	$(mg/kg/day)^{-1}$	1	7.3E+00	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	2/1/2011
Benzo(g,h,i)perylene	NA	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	2/1/2011
Bis(2-ethylhexyl)phthalate	1.4E-02	$(mg/kg/day)^{-1}$	1	1.4E-02	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	9/12/2008
Carbazole	2.0E-02	$(mg/kg/day)^{-1}$	1	2.0E-02	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	HEAST	7/1997
Dibenzofuran	NA	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	9/12/2008
Fluoranthene	NA	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	2/1/2011

TABLE C-9

CANCER TOXICITY DATA -- ORAL/DERMAL
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal[1]	Absorbed Cancer Slope Factor for Dermal[2]		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Semivolatile Organic Compounds (Continued)								
Fluorene	NA	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	2/1/2011
Naphthalene	NA	NA	NA	NA	NA	C / Inadequate data of carcinogenicity in humans	IRIS	2/1/2011
Hexachlorobenzene	1.6E+00	$(mg/kg/day)^{-1}$	1	1.6E+00	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	9/12/2008
Phenanthrene	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	NA	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	2/1/2011
Dioxin/Furans								
2,3,7,8-TCDD	1.3E+05	$(mg/kg/day)^{-1}$	1	1.3E+05	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	Cal EPA(1)	9/2009
Pesticides/PCBs								
alpha-BHC	6.3E+00	$(mg/kg/day)^{-1}$	1	6.3E+00	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	9/12/2008
Aroclor-1254	2.0E+00	$(mg/kg/day)^{-1}$	1	2.0E+00	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	USEPA(2)	9/1996
Dieldrin	1.6E+01	$(mg/kg/day)^{-1}$	1	1.6E+01	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	9/12/2008
Heptachlor Epoxide	9.1E+00	$(mg/kg/day)^{-1}$	1	9.1E+00	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	9/12/2008
Inorganics								
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	1.5E+00	$(mg/kg/day)^{-1}$	1	1.5E+00	$(mg/kg/day)^{-1}$	A	IRIS	2/1/2011
Barium	NA	NA	NA	NA	NA	D (Not classifiable as to human carcinogenicity)	IRIS	9/12/2008
Beryllium	NA	NA	NA	NA	NA	B1 / Probable human carcinogen	IRIS	9/12/2008
Cadmium	NA	NA	NA	NA	NA	B1 / Probable human carcinogen	IRIS	9/12/2008
Chromium	NA	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	9/12/2008
Cobalt	NA	NA	NA	NA	NA	NA	NA	NA
Copper	NA	NA	NA	NA	NA	D (Not classifiable as to human carcinogenicity)	IRIS	9/12/2008
Iron	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	B2 / Probable human carcinogen	IRIS	9/12/2008
Manganese	NA	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	9/12/2008
Nickel	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	9/12/2008
Silver	NA	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	9/12/2008
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	9/12/2008

TABLE C-9

CANCER TOXICITY DATA -- ORAL/DERMAL
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal[1]	Absorbed Cancer Slope Factor for Dermal[2]		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Miscellaneous Parameters								
Nitrate	NA	NA	NA	NA	NA	NA	NA	NA
Nitrite	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
1 - USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.
2 - Adjusted cancer slope factor for dermal = Oral cancer slope factor / Oral Absorption Efficiency for Dermal.
3 - The carcinogenic PAHs are considered to act via the mutagenic mode of action. These chemicals are evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).
Cal EPA(1) = California Environmental Protection Agency, Technical Support Document for Describing Available Cancer Slope Factors, September 2009.
Cal EPA(2) = Public Health Goal for 1,2,4-Trichlorobenzene in Drinking Water, February 1999.
Cal EPA(3) = Notice of Adoption of Unit Risk Values for Ethylbenzene, November 2007.
HEAST = Health Effects Assessment Summary Tables
IRIS = Integrated Risk Information System.
NA = Not Available.
USEPA(1) = OSWER Directive No.9285.7-75.
USEPA(2) = USEPA, PCBs: Cancer Dose-Response Assessment and Applications to Environmental Mixtures, September 1996, EPA/600/P-96/001F.

TABLE C-10

CANCER TOXICITY DATA -- INHALATION
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor[1]		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Volatile Organic Compounds							
1,1,2-Trichloroethane	1.6E-05	$(ug/m^3)^{-1}$	5.6E-02	$(mg/kg/day)^{-1}$	C / Possible Human Carcinogen	IRIS	9/12/2008
1,1-Dichloroethene	NA	NA	NA	NA	C / Possible Human Carcinogen	IRIS	2/1/2011
1,1-Dichloroethane	1.6E-06	$(ug/m^3)^{-1}$	5.6E-03	$(mg/kg/day)^{-1}$	C / Possible Human Carcinogen	Cal EPA(1)	9/2009
1,4-Dichlorobenzene	1.1E-05	$(ug/m^3)^{-1}$	3.9E-02	$(mg/kg/day)^{-1}$	NA	Cal EPA(1)	9/2009
1,2,4-Trichlorobenzene	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	9/12/2008
1,2-Dibromoethane	6.0E-04	$(ug/m^3)^{-1}$	2.1E+00	$(mg/kg/day)^{-1}$	Likely to be carcinogenic to humans	IRIS	9/12/2008
1,2-Dichloroethane	2.6E-05	$(ug/m^3)^{-1}$	9.1E-02	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	9/12/2008
2-Butanone	NA	NA	NA	NA	Data are inadequate for an assessment of human carcinogenic potential	IRIS	9/12/2008
Acetone	NA	NA	NA	NA	Data are inadequate for an assessment of human carcinogenic potential	IRIS	9/12/2008
Benzene	7.8E-06	$(ug/m^3)^{-1}$	2.7E-02	$(mg/kg/day)^{-1}$	A / Known human carcinogen	IRIS	2/1/2011
Bromodichloromethane	NA	NA	NA	NA	B2 / Probable human carcinogen	NA	NA
Chlorodibromomethane	NA	NA	NA	NA	C / Possible Human Carcinogen	IRIS	9/12/2008
Chloroform	2.3E-05	$(ug/m^3)^{-1}$	8.1E-02	$(mg/kg/day)^{-1}$	Likely to be carcinogenic to humans	IRIS	2/1/2011
cis-1,2-Dichloroethene	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	2/1/2011
Ethylbenzene	2.5E-06	NA	8.8E-03	NA	D / Not classifiable as to human carcinogenicity	Cal EPA(2)	11/2007
Methylene Chloride	4.7E-07	$(ug/m^3)^{-1}$	1.6E-03	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	9/12/2008
Tetrachloroethene	5.9E-06	$(ug/m^3)^{-1}$	2.1E-02	$(mg/kg/day)^{-1}$	NA	USEPA(1)	6/12/2003
trans-1,2-Dichloroethene	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	2.0E-06	$(ug/m^3)^{-1}$	7.0E-03	(mg/kg/day)-1	B1 / Probable human carcinogen	Cal EPA(1)	9/2009
Vinyl Chloride (early life)	8.8E-06	$(ug/m^3)^{-1}$	3.1E-02	$(mg/kg/day)^{-1}$	A / Known/likely human carcinogen	IRIS	9/12/2008
Vinyl Chloride (adult)	4.4E-06	$(ug/m^3)^{-1}$	1.5E-02	$(mg/kg/day)^{-1}$	A / Known/likely human carcinogen	IRIS	2/1/2011
Semivolatile Organic Compounds							
2,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	NA	NA	NA	NA	Data are inadequate for an assessment of human carcinogenic potential	IRIS	2/1/2011
Acenaphthene	NA	NA	NA	NA	NA	NA	NA
Anthracene	NA	NA	NA	NA	NA	NA	NA

TABLE C-10

CANCER TOXICITY DATA -- INHALATION
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor[1]		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Semivolatile Organic Compounds (Continued)							
Benzo(a)pyrene[2]	1.1E-03	$(ug/m^3)^{-1}$	3.9E+00	$(mg/kg/day)^{-1}$	NA	Cal EPA(3)	9/2009
Benzo(g,h,i)perylene	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	2/1/2011
Bis(2-ethylhexyl)phthalate	NA	NA	NA	NA	NA	NA	NA
Carbazole	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	9/12/2008
Fluoranthene	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	2/1/2011
Fluorene	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	2/1/2011
Hexachlorobenzene	4.6E-04	$(ug/m3)^{-1}$	1.6E+00	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	9/12/2008
Naphthalene	3.4E-05	$(ug/m3)^{-1}$	1.2E-01	$(mg/kg/day)^{-1}$	C / Inadequate data of carcinogenicity in humans	Cal EPA(2)	9/2009
Phenanthrene	NA	NA	NA	NA	NA	NA	9/12/2008
Pyrene	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	2/1/2011
Dioxin/Furans							
2,3,7,8-TCDD	3.8E+01	$(ug/m3)^{-1}$	1.3E+05	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	Cal EPA(2)	9/2009
Pesticides/PCBs							
alpha-BHC	1.8E-03	$(ug/m3)^{-1}$	6.3E+00	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	9/12/2008
Aroclor-1254	5.7E-04	$(ug/m^3)^{-1}$	2.0E+00	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	USEPA(2)	9/1996
Dieldrin	4.6E-03	$(ug/m3)^{-1}$	1.6E+01	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	9/12/2008
Heptachlor Epoxide	2.6E-03	$(ug/m3)^{-1}$	9.1E+00	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	9/12/2008
Inorganics							
Aluminum	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA
Arsenic	4.3E-03	$(ug/m^3)^{-1}$	1.5E+01	$(mg/kg/day)^{-1}$	A / Known human carcinogen	IRIS	2/1/2011
Barium	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	9/12/2008
Beryllium	2.4E-03	$(ug/m^3)^{-1}$	8.4E+00	$(mg/kg/day)^{-1}$	Carcinogenic potential cannot be determined (Oral route)	IRIS	2/1/2011
Cadmium	1.8E-03	$(ug/m^3)^{-1}$	6.3E+00	$(mg/kg/day)^{-1}$	B1 / Probable human carcinogen	IRIS	9/12/2008

TABLE C-10

CANCER TOXICITY DATA -- INHALATION
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor[1]		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Inorganics (Continued)							
Chromium	8.4E-02	$(ug/m^3)^{-1}$	2.9E+02	$(mg/kg/day)^{-1}$	A / Known human carcinogen	IRIS	2/1/2011
Cobalt	9.0E-03	$(ug/m^3)^{-1}$	3.2E+01	$(mg/kg/day)^{-1}$	NA	PPRTV	8/25/2008
Copper	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	2/1/2011
Iron	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	B2 / Probable human carcinogen	IRIS	2/1/2011
Manganese	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	2/1/2011
Nickel	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	9/12/2008
Silver	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	9/12/2008
Thallium	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	9/12/2008
Miscellaneous Parameters							
Nitrate	NA	NA	NA	NA	NA	NA	NA
Nitrite	NA	NA	NA	NA	NA	NA	NA

Notes:

1 - Inhalation CSF = Unit Risk * 70 kg / $20m^3$/day.

2 - The carcinogenic PAHs are considered to act via the mutagenic mode of action. These chemicals are evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Definitions:

IRIS = Integrated Risk Information System.

NA = Not Available.

USEPA(1) = OSWER Directive No.9285.7-75.

USEPA(2) = USEPA, PCBs: Cancer Dose-Response Assessment and Applications to Environmental Mixtures, September 1996, EPA/600/P-96/001F.

Cal EPA(1) = California Environmental Protection Agency, Technical Support Document for Describing Available Cancer Slope Factors, September 2009.

Cal EPA(2) = Notice of Adoption of Unit Risk Values for Ethylbenzene, November 2007.

TABLE C-11

SUMMARY OF CANCER RISKS AND HAZARD INDICES - NORTHWEST UNDEVELOPED AREA - REASONABLE MAXIMUM EXPOSURES
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an HI > 1
Construction Workers	Surface Soil	Incidental Ingestion	6E-07	--	--	--	0.3	--
		Dermal Contact	1E-07	--	--	--	0.01	--
		Inhalation	1E-07	--	--	--	0.6	--
		Total	8E-07	--	--	--	0.9	--
	Subsurface Soil	Incidental Ingestion	3E-06	--	--	Dioxins/Furans	1	--
		Dermal Contact	4E-07	--	--	--	0.1	--
		Inhalation	2E-07	--	--	--	0.7	--
		Total	3E-06	--	--	Dioxins/Furans	2	Target Organs < 1
	Groundwater	Incidental Ingestion	6E-09	- -	- -	- -	0.002	- -
		Dermal Contact	2E-07	- -	- -	- -	0.09	- -
		Inhalation	1E-07	- -	- -	- -	0.08	- -
		Total	3E-07	- -	- -	- -	0.2	- -
	Total Surface Soil and Groundwater		1E-06				1	
	Total Suburface Soil and Groundwater		3E-06				2	
Industrial Workers	Surface Soil	Incidental Ingestion	8E-06	--	--	cPAHs, Dioxins/Furans, Arsenic	0.1	- -
		Dermal Contact	3E-06	--	--	cPAHs	0.01	- -
		Inhalation	7E-10	--	--	--	0.0001	- -
		Total	1E-05	--	--	cPAHs, Dioxins/Furans, Arsenic	0.2	- -
	Subsurface Soil	Incidental Ingestion	3E-05	--	Dioxins/Furans	cPAHs, Arsenic	0.6	- -
		Dermal Contact	1E-05	--	--	cPAHs, Dioxins/Furans	0.1	- -
		Inhalation	3E-07	--	--	--	0.007	- -
		Total	4E-05	--	Dioxins/Furans	cPAHs, Arsenic	0.7	- -
Adolescent Trespassers	Surface Soil	Incidental Ingestion	8E-07	--	--	--	0.02	- -
		Dermal Contact	6E-07	--	--	--	0.004	- -
		Inhalation	1E-11	--	--	--	0.000008	- -
		Total	1E-06	--	--	--	0.03	- -
	Subsurface Soil	Incidental Ingestion	3E-06	--	--	Dioxins/Furans	0.1	- -
		Dermal Contact	2E-06	--	--	cPAHs	0.03	- -
		Inhalation	6E-09	--	--	--	0.0004	- -
		Total	5E-06	--	--	cPAHs, Dioxins/Furans	0.1	- -
Child Receational Users	Surface Soil	Incidental Ingestion	7E-06	--	--	cPAHs, Arsenic	0.3	- -
		Dermal Contact	4E-06	--	--	cPAHs	0.02	- -
		Inhalation	3E-11	--	--	--	0.00003	- -
		Total	1E-05	--	--	cPAHs, Arsenic	0.3	- -
	Subsurface Soil	Incidental Ingestion	3E-05	--	cPAHs	Dioxins/Furans	1	- -
		Dermal Contact	1E-05	--	--	cPAHs, Dioxins/Furans	0.2	- -
		Inhalation	1E-08	--	--	--	0.001	- -
		Total	4E-05	--	cPAHs	Dioxins/Furans	1	- -
	Surface Water	Ingestion	2E-07	- -	- -	- -	0.07	- -
		Dermal Contact	1E-06	- -	- -	- -	0.3	- -
		Total	1E-06	- -	- -	- -	0.4	- -
	Sediment	Incidental Ingestion	6E-05	- -	cPAHs	Arsenic	0.2	- -
		Dermal Contact	7E-04	cPAHs	- -	- -	0.4	- -
		Total	8E-04	cPAHs	- -	Arsenic	0.5	- -
	Total Surface Soil, Surface Water, and Sediment		8E-04				1	
	Total Suburface Soil, Surface Water, and Sediment		8E-04				2	

TABLE C-11

SUMMARY OF CANCER RISKS AND HAZARD INDICES - NORTHWEST UNDEVELOPED AREA - REASONABLE MAXIMUM EXPOSURES
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an HI > 1
Adult Receational Users	Surface Soil	Incidental Ingestion	2E-06	--	--	--	0.03	- -
		Dermal Contact	9E-07	--	--	--	0.003	- -
		Inhalation	1E-10	--	--	--	0.00003	- -
		Total	3E-06	--	--	--	0.03	- -
	Subsurface Soil	Incidental Ingestion	7E-06	--	--	cPAHs, Dioxins/Furans	0.1	- -
		Dermal Contact	3E-06	--	--	cPAHs	0.03	- -
		Inhalation	6E-08	--	--	--	0.001	- -
		Total	1E-05	--	--	cPAHs, Dioxins/Furans	0.2	- -
	Surface Water	Ingestion	1E-07	- -	- -	- -	0.01	- -
		Dermal Contact	2E-06	- -	- -	- -	0.1	- -
		Total	2E-06	- -	- -	- -	0.1	- -
	Sediment	Incidental Ingestion	9E-06	- -	- -	cPAHs	0.02	- -
		Dermal Contact	4E-05	- -	cPAHs	- -	0.02	- -
		Total	5E-05	- -	cPAHs	- -	0.03	- -
	Total Surface Soil, Surface Water, and Sediment		6E-05				0.2	
	Total Suburface Soil, Surface Water, and Sediment		6E-05				0.3	
Lifelong Recreational Users (Child and Adult)	Surface Soil	Incidental Ingestion	1E-07	--	--	cPAHs, Arsenic	NA	- -
		Dermal Contact	4E-06	--	--	cPAHs	NA	- -
		Inhalation	3E-06	--	--	--	NA	- -
		Total	9E-06	--	--	cPAHs, Dioxins/Furans, Arsenic	NA	- -
	Subsurface Soil	Incidental Ingestion	4E-05	--	cPAHs	Dioxins/Furans, Arsenic	NA	- -
		Dermal Contact	6E-05	--	--	cPAHs, Dioxins/Furans	NA	- -
		Inhalation	6E-05	--	--	--	NA	- -
		Total	6E-05	--	cPAHs, Dioxins/Furans	Arsenic	NA	- -
	Surface Water	Ingestion	3E-07	- -	- -	- -	NA	- -
		Dermal Contact	3E-06	- -	- -	Bis(2-ethylhexyl)phthalate	NA	- -
		Total	3E-06	- -	- -	Bis(2-ethylhexyl)phthalate	NA	- -
	Sediment	Incidental Ingestion	7E-05	- -	cPAHs	Arsenic	NA	- -
		Dermal Contact	8E-04	cPAHs	- -	Arsenic	NA	- -
		Total	8E-04	cPAHs	- -	Arsenic	NA	- -
	Total Surface Soil, Surface Water, and Sediment		8E-04				NA	
	Total Suburface Soil, Surface Water, and Sediment		9E-04				NA	
Child Residents	Surface Soil	Incidental Ingestion	5E-05	--	cPAHs	Dioxins/Furans, Arsenic	2	Target Organs < 1
		Dermal Contact	1E-05	--	--	cPAHs	0.08	--
		Inhalation	7E-10	--	--	--	0.0006	--
		Total	6E-05	--	cPAHs	Dioxins/Furans, Arsenic	2	Target Organs < 1
	Subsurface Soil	Incidental Ingestion	2E-04	--	cPAHs, Dioxins/Furans	Arsenic	8	Dioxins/Furans
		Dermal Contact	5E-05	--	cPAHs	Dioxins/Furans	0.6	--
		Inhalation	3E-07	--	--	--	0.03	--
		Total	2E-04	--	cPAHs, Dioxins/Furans	Arsenic	9	Dioxins/Furans
	Groundwater	Ingestion	7E-04	cPAHs	TCE, Arsenic	PCE, Vinyl Chloride, Hexachlorobenzene	9	2-Methylnaphthalene, Naphthalene, Aluminum, Cobalt, Manganese
		Dermal Contact	3E-05	- -	- -	Hexachlorobenzene	2	- -
		Inhalation	5E-05	- -	TCE	PCE, Vinyl Chloride	4	2-Methylnaphthalene, Naphthalene
		Total	8E-04	cPAHs	TCE, Vinyl Chloride, Hexachlorobenzene, Arsenic	PCE	15	2-Methylnaphthalene, Naphthalene, Aluminum, Cobalt, Manganese
	Total Surface Soil and Groundwater		9E-04				17	
	Total Subsurface Soil and Groundwater		1E-03				24	

TABLE C-11

SUMMARY OF CANCER RISKS AND HAZARD INDICES - NORTHWEST UNDEVELOPED AREA - REASONABLE MAXIMUM EXPOSURES
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an HI > 1
Adult Residents	Surface Soil	Incidental Ingestion	1E-05	--	--	cPAHs, Dioxins/Furans, Arsenic	0.2	--
		Dermal Contact	3E-06	--	--	cPAHs	0.01	--
		Inhalation	3E-09	--	--	--	0.0006	--
		Total	2E-05	--	--	cPAHs, Dioxins/Furans, Arsenic	0.2	--
	Subsurface Soil	Incidental Ingestion	5E-05	--	cPAHs, Dioxins/Furans	Arsenic	0.9	--
		Dermal Contact	1E-05	--	--	cPAHs, Dioxins/Furans	0.09	--
		Inhalation	1E-06	--	--	--	0.03	--
		Total	6E-05	--	cPAHs, Dioxins/Furans	Arsenic	1.0	--
	Groundwater	Ingestion	5E-04	cPAHs	TCE, Vinyl Chloride, Arsenic	PCE, Hexachlorobenzene	4	Target Organ HIs ≤ 1
		Dermal Contact	7E-05	- -	Hexachlorobenzene	PCE, TCE	1	- -
		Inhalation	9E-05	- -	TCE, Vinyl Chloride	PCE	2	Target Organ HIs ≤ 1
		Total	7E-04	cPAHs	TCE, Vinyl Chloride, Hexachlorobenzene, Arsenic	- -	7	Target Organ HIs ≤ 1
	Total Surface Soil and Groundwater		7E-04				7	
	Total Subsurface Soil and Groundwater		8E-04				8	
Lifelong Residents (Child and Adult)	Surface Soil	Incidental Ingestion	9E-04	--	cPAHs, Arsenic	Dioxins/Furans	NA	--
		Dermal Contact	1E-03	--	--	cPAHs, Arsenic	NA	--
		Inhalation	5E-04	--	--	--	NA	--
		Total	8E-05	--	cPAHs, Arsenic	Dioxins/Furans	NA	--
	Subsurface Soil	Incidental Ingestion	9E-05	--	cPAHs, Dioxins/Furans	Arsenic	NA	--
		Dermal Contact	7E-04	--	cPAHs	Dioxins/Furans	NA	--
		Inhalation	7E-04	--	--	--	NA	--
		Total	8E-04	cPAHs	Dioxins/Furans	Arsenic	NA	--
	Groundwater	Ingestion	1E-03	cPAHs	TCE, Vinyl Chloride, Hexachlorobenzene, Arsenic	PCE	NA	- -
		Dermal Contact	9E-05	- -	Hexachlorobenzene	PCE, TCE	NA	- -
		Inhalation	1E-04	- -	TCE, Vinyl Chloride	PCE	NA	- -
		Total	1E-03	cPAHs, TCE	PCE, Vinyl Chloride, Hexachlorobenzene, Arsenic	- -	NA	- -
	Total Surface Soil and Groundwater		1E-03				NA	
	Total Subsurface Soil and Groundwater		2E-03				NA	

Notes:
cPAHs - Carcinogenic PAHs
PCE - Teterachloroethene
TCE - Trichloroethene

TABLE C-12

SUMMARY OF CANCER RISKS AND HAZARD INDICES - SOUTHEAST UNDEVELOPED AREA - REASONABLE MAXIMUM EXPOSURES
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an HI > 1
Construction Workers	Surface Soil	Incidental Ingestion	3E-07	--	--	--	0.2	--
		Dermal Contact	5E-08	--	--	--	0.004	--
		Inhalation	1E-07	--	--	--	0.6	--
		Total	5E-07	--	--	--	0.8	--
	Subsurface Soil	Incidental Ingestion	4E-07	--	--	--	0.1	--
		Dermal Contact	1E-07	--	--	--	0.002	--
		Inhalation	9E-08	--	--	--	0.6	--
		Total	6E-07	--	--	--	0.7	--
	Groundwater	Incidental Ingestion	6E-09	- -	- -	- -	0.002	- -
		Dermal Contact	2E-07	- -	- -	- -	0.09	- -
		Inhalation	1E-07	- -	- -	- -	0.08	- -
		Total	3E-07	- -	- -	- -	0.2	- -
	Total Surface Soil and Groundwater		8E-07				1	
	Total Suburface Soil and Groundwater		9E-07				0.9	
Site Industrial Workers	Surface Soil	Incidental Ingestion	4E-06	--	--	Arsenic	0.1	--
		Dermal Contact	1E-06	--	--	--	0.005	--
		Inhalation	7E-10	--	--	--	0.0002	--
		Total	6E-06	--	--	Arsenic	0.1	--
	Subsurface Soil	Incidental Ingestion	5E-06	--	--	cPAHs, Arsenic	0.06	--
		Dermal Contact	3E-06	--	--	cPAHs	0.003	--
		Inhalation	8E-09	--	--	--	0.0003	--
		Total	8E-06	--	--	cPAHs, Arsenic	0.07	--
Adolescent Trespassers	Surface Soil	Incidental Ingestion	4E-07	--	--	--	0.02	--
		Dermal Contact	3E-07	--	--	--	0.001	--
		Inhalation	1E-11	--	--	--	0.000008	--
		Total	7E-07	--	--	--	0.02	--
	Subsurface Soil	Incidental Ingestion	8E-07	--	--	--	0.01	--
		Dermal Contact	1E-06	--	--	--	0.0007	--
		Inhalation	2E-10	--	--	--	0.00002	--
		Total	2E-06	--	--	cPAHs	0.01	--
Child Receational Users	Surface Soil	Incidental Ingestion	2E-06	--	--	Arsenic	0.2	--
		Dermal Contact	7E-07	--	--	--	0.008	--
		Inhalation	3E-11	--	--	--	0.00003	--
		Total	3E-06	--	--	Arsenic	0.2	--
	Subsurface Soil	Incidental Ingestion	3E-06	--	--	cPAHs	0.1	--
		Dermal Contact	2E-06	--	--	cPAHs	0.004	--
		Inhalation	4E-10	--	--	--	0.00007	--
		Total	5E-06	--	--	cPAHs	0.1	--
	Surface Water	Ingestion	2E-07	- -	- -	- -	0.07	- -
		Dermal Contact	1E-06	- -	- -	- -	0.3	- -
		Total	1E-06	- -	- -	- -	0.4	- -
	Sediment	Incidental Ingestion	6E-05	- -	cPAHs	Arsenic	0.2	- -
		Dermal Contact	7E-04	cPAHs	- -	- -	0.4	- -
		Total	8E-04	cPAHs	- -	Arsenic	0.5	- -
	Total Surface Soil, Surface Water, and Sediment		8E-04				1	
	Total Suburface Soil, Surface Water, and Sediment		8E-04				1	

TABLE C-12

SUMMARY OF CANCER RISKS AND HAZARD INDICES - SOUTHEAST UNDEVELOPED AREA - REASONABLE MAXIMUM EXPOSURES
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an HI > 1
Adult Receational Users	Surface Soil	Incidental Ingestion	1E-06	--	--	--	0.02	--
		Dermal Contact	4E-07	--	--	--	0.001	--
		Inhalation	1E-10	--	--	--	0.00003	--
		Total	1E-06	--	--	--	0.02	--
	Subsurface Soil	Incidental Ingestion	2E-06	--	--	--	0.01	--
		Dermal Contact	1E-06	--	--	--	0.0006	--
		Inhalation	1E-09	--	--	--	0.00007	--
		Total	3E-06	--	--	cPAHs	0.01	--
	Surface Water	Ingestion	1E-07	- -	- -	- -	0.01	- -
		Dermal Contact	2E-06	- -	- -	- -	0.1	- -
		Total	2E-06	- -	- -	- -	0.1	- -
	Sediment	Incidental Ingestion	9E-06	- -	- -	cPAHs	0.02	- -
		Dermal Contact	4E-05	- -	cPAHs	- -	0.02	- -
		Total	5E-05	- -	cPAHs	- -	0.03	- -
	Total Surface Soil, Surface Water, and Sediment		5E-05				0.2	
	Total Suburface Soil, Surface Water, and Sediment		6E-05				0.1	
Lifelong Recreational Users (Child and Adult)	Surface Soil	Incidental Ingestion	3E-06	--	--	Arsenic	NA	--
		Dermal Contact	1E-06	--	--	--	NA	--
		Inhalation	2E-10	--	--	--	NA	--
		Total	4E-06	--	--	Arsenic	NA	--
	Subsurface Soil	Incidental Ingestion	5E-06	--	--	cPAHs	NA	--
		Dermal Contact	3E-06	--	--	cPAHs	NA	--
		Inhalation	2E-09	--	--	--	NA	--
		Total	8E-06	--	--	cPAHs	NA	--
	Surface Water	Ingestion	3E-07	- -	- -	- -	NA	- -
		Dermal Contact	3E-06	- -	- -	Bis(2-ethylhexyl)phthalate	NA	- -
		Total	3E-06	- -	- -	Bis(2-ethylhexyl)phthalate	NA	- -
	Sediment	Incidental Ingestion	7E-05	- -	cPAHs	Arsenic	NA	- -
		Dermal Contact	8E-04	cPAHs	- -	Arsenic	NA	- -
		Total	8E-04	cPAHs	- -	Arsenic	NA	- -
	Total Surface Soil, Surface Water, and Sediment		8E-04				NA	
	Total Suburface Soil, Surface Water, and Sediment		8E-04				NA	
Child Residents	Surface Soil	Incidental Ingestion	2E-05	--	--	cPAHs, Arsenic	1	--
		Dermal Contact	5E-06	--	--	cPAHs	0.03	--
		Inhalation	7E-10	--	--	--	0.0006	--
		Total	3E-05	--	cPAHs	Arsenic	1	--
	Subsurface Soil	Incidental Ingestion	6E-05	--	cPAHs	Arsenic	0.8	--
		Dermal Contact	2E-05	--	cPAHs	--	0.01	--
		Inhalation	8E-09	--	--	--	0.001	--
		Total	9E-05	--	cPAHs	Arsenic	0.9	--
	Groundwater	Ingestion	7E-04	cPAHs	TCE, Arsenic	PCE, Vinyl Chloride, Hexachlorobenzene	9	2-Methylnaphthalene, Naphthalene, Aluminum, Cobalt, Manganese
		Dermal Contact	3E-05	- -	- -	Hexachlorobenzene	2	- -
		Inhalation	5E-05	- -	TCE	PCE, Vinyl Chloride	4	2-Methylnaphthalene, Naphthalene
		Total	8E-04	cPAHs	TCE, Vinyl Chloride, Hexachlorobenzene, Arsenic	PCE	15	2-Methylnaphthalene, Naphthalene, Aluminum, Cobalt, Manganese
	Total Surface Soil and Groundwater		8E-04				16	
	Total Subsurface Soil and Groundwater		9E-04				16	

TABLE C-12

SUMMARY OF CANCER RISKS AND HAZARD INDICES - SOUTHEAST UNDEVELOPED AREA - REASONABLE MAXIMUM EXPOSURES
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an HI > 1
Adult Residents	Surface Soil	Incidental Ingestion	7E-06	--	--	cPAHs, Arsenic	0.1	--
		Dermal Contact	2E-06	--	--	--	0.004	--
		Inhalation	3E-09	--	--	--	0.0006	--
		Total	8E-06	--	--	cPAHs, Arsenic	0.1	--
	Subsurface Soil	Incidental Ingestion	1E-05	--	--	cPAHs, Arsenic	0.09	--
		Dermal Contact	5E-06	--	--	cPAHs	0.002	--
		Inhalation	3E-08	--	--	--	0.001	--
		Total	2E-05	--	--	cPAHs, Arsenic	0.09	--
	Groundwater	Ingestion	5E-04	cPAHs	TCE, Vinyl Chloride, Arsenic	PCE, Hexachlorobenzene	4	Target Organs ≤ 1
		Dermal Contact	7E-05	- -	Hexachlorobenzene	PCE, TCE	1	- -
		Inhalation	9E-05	- -	TCE, Vinyl Chloride	PCE	2	Target Organs ≤ 1
		Total	7E-04	cPAHs	TCE, Vinyl Chloride, Hexachlorobenzene, Arsenic	- -	7	Target Organs ≤ 1
	Total Surface Soil and Groundwater		7E-04				7	
	Total Subsurface Soil and Groundwater		7E-04				7	
Lifelong Residents (Child and Adult)	Surface Soil	Incidental Ingestion	3E-05	--	Arsenic	cPAHs	NA	--
		Dermal Contact	7E-06	--	--	cPAHs	NA	--
		Inhalation	4E-09	--	--	--	NA	--
		Total	4E-05	--	cPAHs, Arsenic	--	NA	--
	Subsurface Soil	Incidental Ingestion	7E-05	--	cPAHs	Arsenic	NA	--
		Dermal Contact	3E-05	--	cPAHs	--	NA	--
		Inhalation	4E-08	--	--	--	NA	--
		Total	1E-04	--	cPAHs	Arsenic	NA	--
	Groundwater	Ingestion	1E-03	cPAHs	TCE, Vinyl Chloride, Hexachlorobenzene, Arsenic	PCE	NA	- -
		Dermal Contact	9E-05	- -	Hexachlorobenzene	PCE, TCE	NA	- -
		Inhalation	9E-05	- -	TCE, Vinyl Chloride	PCE	NA	- -
		Total	1E-03	cPAHs, TCE	PCE, Vinyl Chloride, Hexachlorobenzene, Arsenic	- -	NA	- -
	Total Surface Soil and Groundwater		1E-03				NA	
	Total Subsurface Soil and Groundwater		1E-03				NA	

Notes:
cPAHs - Carcinogenic PAHs
PCE - Teterachloroethene
TCE - Trichloroethene

TABLE C-13

SUMMARY OF CANCER RISKS AND HAZARD INDICES - DEVELOPED AREA - REASONABLE MAXIMUM EXPOSURES
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an HI > 1
Construction Workers	Surface Soil	Incidental Ingestion	1E-07	- -	- -	- -	0.2	- -
		Dermal Contact	1E-08	- -	- -	- -	0.001	- -
		Inhalation	2E-07	- -	- -	- -	0.5	- -
		Total	4E-07	- -	- -	- -	0.7	- -
	Subsurface Soil	Incidental Ingestion	8E-08	- -	- -	- -	0.2	- -
		Dermal Contact	7E-09	- -	- -	- -	0.001	- -
		Inhalation	9E-08	- -	- -	- -	0.6	- -
		Total	2E-07	- -	- -	- -	0.8	- -
	Groundwater	Incidental Ingestion	3E-08	- -	- -	- -	0.02	- -
		Dermal Contact	7E-08	- -	- -	- -	0.6	- -
		Inhalation	1E-08	- -	- -	- -	0.03	- -
		Total	1E-07	- -	- -	- -	0.6	- -
	Total Surface Soil and Groundwater		5E-07				1	
	Total Subsurface Soil and Groundwater		3E-07				1	
Site Industrial Workers	Surface Soil	Incidental Ingestion	1E-06	- -	- -	- -	0.09	- -
		Dermal Contact	4E-07	- -	- -	- -	0.002	- -
		Inhalation	1E-09	- -	- -	- -	0.0001	- -
		Total	2E-06	- -	- -	Arsenic	0.09	- -
	Subsurface Soil	Incidental Ingestion	1E-06	- -	- -	- -	0.08	- -
		Dermal Contact	2E-07	- -	- -	- -	0.001	- -
		Inhalation	1E-09	- -	- -	- -	0.0003	- -
		Total	1E-06	- -	- -	- -	0.08	- -
Adolescent Trespassers	Surface Soil	Incidental Ingestion	1E-07	- -	- -	- -	0.01	- -
		Dermal Contact	6E-08	- -	- -	- -	0.0004	- -
		Inhalation	3E-11	- -	- -	- -	0.0006	- -
		Total	2E-07	- -	- -	- -	0.02	- -
	Subsurface Soil	Incidental Ingestion	7E-08	- -	- -	- -	0.01	- -
		Dermal Contact	3E-08	- -	- -	- -	0.0003	- -
		Inhalation	3E-11	- -	- -	- -	0.001	- -
		Total	1E-07	- -	- -	- -	0.02	- -
Child Receational Users	Surface Soil	Incidental Ingestion	9E-07	- -	- -	- -	0.2	- -
		Dermal Contact	3E-07	- -	- -	- -	0.002	- -
		Inhalation	7E-11	- -	- -	- -	0.0006	- -
		Total	1E-06	- -	- -	- -	0.2	- -
	Subsurface Soil	Incidental Ingestion	5E-07	- -	- -	- -	0.2	- -
		Dermal Contact	1E-07	- -	- -	- -	0.002	- -
		Inhalation	6E-11	- -	- -	- -	0.001	- -
		Total	6E-07	- -	- -	- -	0.2	- -
	Surface Water	Ingestion	2E-07	- -	- -	- -	0.07	- -
		Dermal Contact	1E-06	- -	- -	- -	0.3	- -
		Total	1E-06	- -	- -	- -	0.4	- -
	Sediment	Incidental Ingestion	6E-05	- -	cPAHs	Arsenic	0.2	- -
		Dermal Contact	7E-04	cPAHs	- -	Arsenic	0.4	- -
		Total	8E-04	cPAHs	- -	Arsenic	0.5	- -
	Total Surface Soil, Surface Water, and Sediment		8E-04				1	
	Total Subsurface Soil, Surface Water, and Sediment		8E-04				1	

TABLE C-13

SUMMARY OF CANCER RISKS AND HAZARD INDICES - DEVELOPED AREA - REASONABLE MAXIMUM EXPOSURES
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an HI > 1
Adult Receational Users	Surface Soil	Incidental Ingestion	3E-07	- -	- -	- -	0.02	- -
		Dermal Contact	1E-07	- -	- -	- -	0.0004	- -
		Inhalation	3E-10	- -	- -	- -	0.0006	- -
		Total	4E-07	- -	- -	- -	0.02	- -
	Subsurface Soil	Incidental Ingestion	2E-07	- -	- -	- -	0.02	- -
		Dermal Contact	5E-08	- -	- -	- -	0.0003	- -
		Inhalation	2E-10	- -	- -	- -	0.001	- -
		Total	2E-07	- -	- -	- -	0.02	- -
	Surface Water	Ingestion	1E-07	- -	- -	- -	0.01	- -
		Dermal Contact	2E-06	- -	- -	- -	0.1	- -
		Total	2E-06	- -	- -	- -	0.1	- -
	Sediment	Incidental Ingestion	9E-06	- -	- -	cPAHs	0.02	- -
		Dermal Contact	4E-05	- -	cPAHs	- -	0.02	- -
		Total	5E-05	- -	cPAHs	- -	0.03	- -
	Total Surface Soil, Surface Water, and Sediment		6E-05				0.2	
	Total Subsurface Soil, Surface Water, and Sediment		6E-05				0.2	
Lifelong Recreational Users (Child and Adult)	Surface Soil	Incidental Ingestion	1E-06	- -	- -	- -	NA	- -
		Dermal Contact	4E-07	- -	- -	- -	NA	- -
		Inhalation	3E-10	- -	- -	- -	NA	- -
		Total	2E-06	- -	- -	- -	NA	- -
	Subsurface Soil	Incidental Ingestion	7E-07	- -	- -	- -	NA	- -
		Dermal Contact	1E-07	- -	- -	- -	NA	- -
		Inhalation	3E-10	- -	- -	- -	NA	- -
		Total	8E-07	- -	- -	- -	NA	- -
	Surface Water	Ingestion	3E-07	- -	- -	- -	NA	- -
		Dermal Contact	3E-06	- -	- -	Bis(2-ethylhexyl)phthalate	NA	- -
		Total	3E-06	- -	- -	Bis(2-ethylhexyl)phthalate	NA	- -
	Sediment	Incidental Ingestion	7E-05	- -	cPAHs	Arsenic	NA	- -
		Dermal Contact	8E-04	cPAHs	- -	Arsenic	NA	- -
		Total	8E-04	cPAHs	- -	Arsenic	NA	- -
	Total Surface Soil, Surface Water, and Sediment		8E-04				NA	
	Total Subsurface Soil, Surface Water, and Sediment		8E-04				NA	

TABLE C-13

SUMMARY OF CANCER RISKS AND HAZARD INDICES - DEVELOPED AREA - REASONABLE MAXIMUM EXPOSURES
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an HI > 1
Child Residents	Surface Soil	Incidental Ingestion	6E-06	- -	- -	cPAHs, Arsenic	1	- -
		Dermal Contact	1E-06	- -	- -	- -	0.009	- -
		Inhalation	1E-09	- -	- -	- -	0.0006	- -
		Total	7E-06	- -	- -	cPAHs, Arsenic	1	- -
	Subsurface Soil	Incidental Ingestion	3E-06	- -	- -	Arsenic	1	- -
		Dermal Contact	3E-07	- -	- -	- -	0.007	- -
		Inhalation	1E-09	- -	- -	- -	0.001	- -
		Total	4E-06	- -	- -	Arsenic	1	- -
	Groundwater	Ingestion	8E-04	Arsenic	TCE	PCE, Vinyl Chloride	132	Aluminum, Antimony, Arsenic, Cobalt, Iron, Manganese, Silver, Thallium
		Dermal Contact	8E-06	- -	- -	TCE	5	Manganese
		Inhalation	6E-05	- -	TCE	PCE, Vinyl Chloride	0.1	- -
		Total	9E-04	Arsenic	TCE, Vinyl Chloride	1,2-DCA, PCE	137	Aluminum, Antimony, Arsenic, Cobalt, Iron, Manganese, Silver, Thallium
	Total Surface Soil and Groundwater		9E-04				138	
	Total Subsurface Soil and Groundwater		9E-04				138	
Adult Residents	Surface Soil	Incidental Ingestion	2E-06	- -	- -	Arsenic	0.1	- -
		Dermal Contact	4E-07	- -	- -	- -	0.001	- -
		Inhalation	6E-09	- -	- -	- -	0.0006	- -
		Total	2E-06	- -	- -	Arsenic	0.1	- -
	Subsurface Soil	Incidental Ingestion	1E-06	- -	- -	- -	0.1	- -
		Dermal Contact	2E-07	- -	- -	- -	0.001	- -
		Inhalation	5E-09	- -	- -	- -	0.001	- -
		Total	2E-06	- -	- -	- -	0.1	- -
	Groundwater	Ingestion	1E-03	Arsenic	TCE	PCE, Vinyl Chloride	56	Aluminum, Antimony, Arsenic, Chromium, Cobalt, Iron, Manganese, Silver, Thallium
		Dermal Contact	2E-05	- -	- -	PCE, TCE, Arsenic	3	Manganese
		Inhalation	1E-04	- -	TCE	PCE, Vinyl Chloride	0.06	- -
		Total	2E-03	TCE, Arsenic	PCE, Vinyl Chloride	1,2-DCA, Benzene	59	Aluminum, Antimony, Arsenic, Chromium,Cobalt, Iron, Manganese, Silver, Thallium
	Total Surface Soil and Groundwater		2E-03				60	
	Total Subsurface Soil and Groundwater		2E-03				60	

TABLE C-13

SUMMARY OF CANCER RISKS AND HAZARD INDICES - DEVELOPED AREA - REASONABLE MAXIMUM EXPOSURES
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an HI > 1
Lifelong Residents (Child and Adult)	Surface Soil	Incidental Ingestion	8E-06	- -	- -	cPAHs, Arsenic	NA	- -
		Dermal Contact	2E-06	- -	- -	- -	NA	- -
		Inhalation	7E-09	- -	- -	- -	NA	- -
		Total	1E-05	- -	- -	cPAHs, Arsenic	NA	- -
	Subsurface Soil	Incidental Ingestion	5E-06	- -	- -	Arsenic	NA	- -
		Dermal Contact	5E-07	- -	- -	- -	NA	- -
		Inhalation	6E-09	- -	- -	- -	NA	- -
		Total	5E-06	- -	- -	Arsenic	NA	- -
	Groundwater	Ingestion	2E-03	Arsenic	TCE, Vinyl Chloride	1,2-DCA, PCE	NA	- -
		Dermal Contact	3E-05	- -	- -	PCE, TCE, Arsenic	NA	- -
		Inhalation	2E-04	- -	TCE, Vinyl Chloride	1,2-DCA, PCE, Benzene	NA	- -
		Total	2E-03	TCE, Arsenic	PCE, Vinyl Chloride	1,2-DCA, Benzene, Chloroform	NA	- -
	Total Surface Soil and Groundwater		2E-03				NA	
	Total Subsurface Soil and Groundwater		2E-03				NA	

Notes:
1,2-DCA - 1,2-Dichloroethane
cPAHs - Carcinogenic PAHs
PCE - Teterachloroethene
TCE - Trichloroethene

TABLE C-14

SUMMARY OF CANCER RISKS AND HAZARD INDICES - VAPOR INTRUSION
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Exposure Unit	Cancer Risk		Hazard Index	
	Residential	Industrial	Residential	Industrial
Undeveloped Area	1E-05	9E-06	0.04	0.03
BTEX Hotspot	4E-06	(1)	NA	NA
Former Building 41	3E-05	2E-05	2	2
Sea Freeze Buildling	4E-06	(1)	0.3	(1)
Building E-107	1E-06	6E-07	0.007	0.005

1 - Since residential risks were within acceptable levels, potential risks for industrial exposures would also be within acceptable levels.
NA - Not calculated, no toxicity criteria available.

TABLE C-15

CHEMICALS RETAINED AS CHEMICALS OF CONCERN
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Chemical	Receptor								
	Construction Workers	Industrial Workers	Adolescent Trespassers	Child Recreational Users	Adult Recreational Users	Lifelong Recreational Users	Child Residents	Adult Residents	Lifelong Residents
Surface Soil									
Northwest Undeveloped Area									
Carcinogenic PAHs						X	X		X
Dioxins/Furans						X	X		X
Arsenic						X	X		X
Southeast Undeveloped Area									
No COCs identified for surface soil.									
Developed Area									
Carcinogenic PAHs	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)
Subsurface Soil									
Northwest Undeveloped Area									
Carcinogenic PAHs		X		X	X	X	X	X	X
Dioxins/Furans		X		X	X	X	X	X	X
Southeast Undeveloped Area									
No COCs identified for subsurface soil.									
Developed Area									
Carcinogenic PAHs	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)	X(1)
Groundwater									
Undeveloped Area									
Tetrachloroethene							X		X
Trichloroethene							X	X	X
Vinyl Chloride							X	X	X
Carcinogenic PAHs							X	X	X
2-Methylnaphthalene							X		
Hexachlorobenzene							X	X	X
Naphthalene							X		
Aluminum							X		
Arsenic							X	X	X
Cobalt							X		
Lead							X	X	X
Manganese							X		

TABLE C-15

CHEMICALS RETAINED AS CHEMICALS OF CONCERN
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Chemical	Receptor								
	Construction Workers	Industrial Workers	Adolescent Trespassers	Child Recreational Users	Adult Recreational Users	Lifelong Recreational Users	Child Residents	Adult Residents	Lifelong Residents
Groundwater									
Developed Area									
1,2-Dichloroethane							X	X	X
Benzene								X	X
Chloroform									X
Tetrachloroethene							X	X	X
Trichloroethene							X	X	X
Vinyl Chloride							X	X	X
Aluminum							X	X	
Antimony							X	X	
Arsenic							X	X	X
Chromium								X	
Cobalt							X	X	
Iron							X	X	
Lead							X	X	X
Manganese							X	X	
Silver							X	X	
Thallium							X	X	
Surface Water									
No COCs identified for surface water.									
Sediment									
Carcinogenic PAHs				X	X	X			
Arsenic				X		X			
Soil Gas									
Building E-107									
No COCs identified for soil gas.									
Undeveloped Area									
No COCs identified for soil gas.									
Former Building 41									
Chloroform		X							X
Trichloroethene		X							X

TABLE C-15

CHEMICALS RETAINED AS CHEMICALS OF CONCERN
SITE 16 – CREOSOTE DIP TANK AREA, FIRE-FIGHTING TRAINING AREA, AND FORMER BUILDING 41 AREA (OU 9)
FORMER NAVAL CONSTRUCTION BATTALION CENTER, DAVISVILLE, RHODE ISLAND

Notes:
1 - Carcinogenic PAHs were detected at elevated concentrations (58 mg/kg) at location SB16-A3-12. Analytical results from this location were not included in the risk assessment, but carcinogenic PAHs are retained as chemicals of concern for the developed area due to the magnitude of the detected concentrations.

Concentrations of aluminum in surface soil and aluminum and arsenic in subsurface soil at the northwest undeveloped area; aluminum in surface soil and subsurface soil at the southeast undeveloped area, and aluminum and manganese in surface soil and subsurface soil at the developed area were within basewide background levels therefore these inorganics were not retained as COCs.

Concentrations of aluminum in groundwater at the undeveloped area and aluminum, antimony, thallium, and silver in groundwater from that developed area were within background levels and therefore these inorganics were not retained as COCs.

Appendix D
Ecological Risk Tables

Appendix D.1
Phase I SLERA

TABLE 3 SITE 16 SURFACE SOIL COPC SCREEN

Analyte	Units	Minimum Concentration	Maximum Concentration	Maximum Location	Detection Frequency	Screening Value[1]	HQ	COPC
INORGANICS								
Aluminum	mg/kg	2,570	8,590	SB16-28-0-2	9/9	NA[2]	NA[2]	
Arsenic	mg/kg	ND	4	SB16-28-0-2	7/9	10	0.4	
Barium	mg/kg	14.8	40.6	SB16-26-0-2	9/9	500	0.1	
Beryllium	mg/kg	0.33	0.64	SB16-28-0-2	9/9	10	0.1	
Cadmium	mg/kg	ND	0.56	SB16-24-0-2	2/9	1.6	0.4	
Calcium	mg/kg	ND	1,200	SB16-23-0-2	8/9	EN	EN	
Chromium	mg/kg	2.9	11.6	SB16-28-0-2	9/9	10	1.2	**YES**
Cobalt	mg/kg	2	7.8	SB16-28-0-2	9/9	20	0.4	
Copper	mg/kg	8.2	40.2	SB16-23-0-2	9/9	40	1.0	**YES**
Iron	mg/kg	5,930	21,200	SB16-28-0-2	9/9	EN	EN	
Lead	mg/kg	13.45	98.4	SB16-24-0-2	9/9	50	2.0	**YES**
Magnesium	mg/kg	540	2,140	SB16-28-0-2	9/9	EN		
Manganese	mg/kg	84.4	248	SB16-28-0-2	9/9	500	0.5	
Mercury	mg/kg	ND	0.11	SB16-25-0-2	1/9	2.2	0.1	
Nickel	mg/kg	ND	11	SB16-28-0-2	6/9	90	0.1	
Potassium	mg/kg	ND	685	SB16-21-0-2	8/9	EN	EN	
Selenium	mg/kg	ND	0.88	SB16-28-0-2	1/9	1	0.9	
Silver	mg/kg	ND	0.32	SB16-25-0-2	1/9	50	0.0	
Sodium	mg/kg	ND	82	SB16-23-0-2	5/9	EN	EN	
Thallium	mg/kg	ND	0.65	SB16-27-0-2	1/9	1	0.7	
Vanadium	mg/kg	4.7	16.1	SB16-28-0-2	9/9	20	0.8	
Zinc	mg/kg	29.8	85.3	SB16-28-0-2	9/9	50	1.7	**YES**

Analyte	Units	Minimum Concentration	Maximum Concentration	Maximum Location	Detection Frequency	Screening Value[1]	HQ	COPC
PAH								
Acenaphthene	µg/kg	ND	2,400	28-SB-01B	6/29	20,000	0.1	
Acenaphthylene	µg/kg	ND	770	SB16-21-0-2	4/29	1,000	0.8	
Anthracene	µg/kg	ND	4,600	28-SB-01B	11/29	10,000	0.5	
Benzo(A)Anthracene	µg/kg	ND	4,450	SB16-21-0-2	18/29	1,000	4.5	YES
Benzo(A)Pyrene	µg/kg	ND	2,350	SB16-21-0-2	19/29	1,000	2.4	YES
Benzo(B)Fluoranthene	µg/kg	ND	7,400	SB16-21-0-2	21/29	1,000	7.4	YES
Benzo[G,H,I]Perylene	µg/kg	ND	1,050	SB16-21-0-2	17/29	1,000	1.1	YES
Benzo(K)Fluoranthene	µg/kg	ND	1,800	SB16-21-0-2	15/29	1,000	1.8	YES
Chrysene	µg/kg	ND	4,750	SB16-21-0-2	21/29	1,000	4.8	YES
Dibenzo(A,H)Anthracene	µg/kg	ND	750	SB16-21-0-2	10/29	1,000	0.8	
Fluoranthene	µg/kg	ND	4,305	SB16-21-0-2	20/29	1,000	4.3	YES
Fluorene	µg/kg	ND	592.5	SB16-21-0-2	6/29	30,000	0.0	
Indeno(1,2,3-Cd)Pyrene	µg/kg	ND	2,300	SB16-21-0-2	17/29	1,000	2.3	YES
Naphthalene	µg/kg	ND	557	SB16-21-0-2	3/29	5,000	0.1	
Phenanthrene	µg/kg	ND	920	SB16-28-0-2	17/29	5,000	0.2	
Pyrene	µg/kg	ND	6,400	SB16-21-0-2	21/29	10,000	0.6	
PESTICIDE/PCB								
4,4'-DDT	µg/kg	ND	3.7	SB16-26-0-2	1/8	2,000	0.0	
Alpha BHC	µg/kg	ND	2.4	SB16-28-0-2	1/8	500	0.0	
Gamma-Chlordane	µg/kg	ND	2.9	SB16-21-0-2	1/9	500	0.0	
Pcb-1260	µg/kg	ND	14	SB16-21-0-2	1/9	40,000	0.0	
DIOXIN/FURAN								
Dioxin Toxicity Equivalent[3]	ppth	2.60	45.21	SB16-25-0-2	8/8	NSV	NSV	YES
SVOC								
2-Methylnaphthalene	µg/kg	ND	558	SB16-21-0-2	2/25	5,000	0.1	
Bis(2-Ethylhexyl) Phthalate	µg/kg	ND	106	EBS-28-SB08-0-2	2/25	30,050	0.0	
Carbazole	µg/kg	ND	405	SB16-21-0-2	2/25	NSV	NSV	YES
Di-N-Butyl Phthalate	µg/kg	ND	56	EBS-28-SB05-0-2	6/25	200,000	0.0	

Analyte	Units	Minimum Concentration	Maximum Concentration	Maximum Location	Detection Frequency	Screening Value[1]	HQ	COPC
VOC								
2-Butanone	µg/kg	ND	12	SB16-27-0-2	3/26	NSV	NSV	**YES**
Acetone	µg/kg	ND	3,700	EBS-28-SB04-0-2	14/26	NSV	NSV	**YES**
Methylene Chloride	µg/kg	ND	4.5	EBS-28-SB07-0-2	3/26	NSV	NSV	**YES**
Toluene	µg/kg	ND	6	EBS-28-SB15-0-2	1/26	200,000	0.0	

[1]From Table 2.
[2]Aluminum not screened in surface soil because all soil pH measurements were 5.5 or greater, following EPA (2000).
[3]Based on World Health Organization (WHO) Toxic Equivalency Factors for mammals.

NOTE:
COPC = Constituent of Potential Concern.
EN = Essential nutrient (not screened).
HQ = Hazard Quotient.
mg/kg = Micrograms per kilogram.
ND = Not detected.
NSV = No screening value.
PAH = Polycyclic aromatic hydrocarbons.
PCB = Polychlorinated biphenyls.
ppth = Parts per thousand.
SVOC = Semivolatile organic compounds.
µg/kg = Micrograms per kilogram.
VOC = Volatile organic compounds.

TABLE 4 SITE 16 SEEP WATER COPC SCREEN

Analyte	Minimum Concentration (µg/L)	Maximum Concentration (µg/L)	Maximum Location	Detection Frequency	Screening Value (µg/L)[1]	HQ	COPC
METALS							
Barium	1.8	271.5	SEEP16-01	2/2	3.8	71.4	**YES**
Calcium	25,700	47,950	SEEP16-01	2/2	EN	EN	
Cobalt	ND	9	SEEP16-02	1/2	3.06	2.9	**YES**
Iron	5,100	20,700	SEEP16-01	2/2	EN	EN	
Magnesium	4,820	26,200	SEEP16-02	2/2	EN	EN	
Manganese	445	2,040	SEEP16-02	2/2	80.3	25.4	**YES**
Mercury	ND	0.07	SEEP16-02	1/2	0.94	0.1	
Nickel	ND	2.1	SEEP16-02	1/2	8.2	0.3	
Potassium	3,575	10,500	SEEP16-02	2/2	EN	EN	
Sodium	13,300	176,000	SEEP16-02	2/2	EN	EN	
PAH							
Acenaphthene	ND	35.5	SEEP16-01	2/3	710	0.1	
Acenaphthylene	ND	0.2	SEEP16-01	1/3	30	0.0	
Anthracene	ND	1.5	SEEP16-01	1/3	30	0.1	
Fluoranthene	ND	4	28-SP-01	2/3	16	0.3	
Fluorene	ND	14.5	SEEP16-01	2/3	30	0.5	
Naphthalene	ND	4	SEEP16-01	2/3	235	0.0	
Phenanthrene	ND	7	28-SP-01	2/3	4.6	1.5	**YES**
Pyrene	ND	2	28-SP-01	2/3	30	0.1	
PESTICIDE/PCB							
Alpha Bhc	ND	0.0325	SEEP16-01	1/3	2.44	0.0	
Dieldrin	ND	0.02	28-SP-01	1/3	0.0019	10.5	**YES**
Endrin	ND	0.0039	28-SP-01	1/3	0.0023	1.7	**YES**
Heptachlor Epoxide	ND	0.02	28-SP-01	1/3	0.0036	5.6	**YES**

Analyte	Minimum Concentration (µg/L)	Maximum Concentration (µg/L)	Maximum Location	Detection Frequency	Screening Value (µg/L)[1]	HQ	COPC
SVOC							
2-Methylnaphthalene	ND	0.95	SEEP16-01	1/3	30,000	0.0	
Dibenzofuran	8	11.5	SEEP16-01	2/2	20.4	0.6	
VOC							
Cis-1,2-Dichloroethene	ND	0.7	SEEP16-02	1/2	22,400	0.0	
Total 1,2-Dichloroethene	ND	0.7	SEEP16-02	1/3	22,400	0.0	
Trichloroethene	ND	0.7	SEEP16-02	1/3	200	0.0	
Vinyl Chloride	ND	0.45	SEEP16-01	1/3	87.8	0.0	

[1]From Table 2.

NOTE: COPC = Constituent of Potential Concern.
EN = Essential nutrient (not screened).
HQ = Hazard Quotient.
ND = Not detected.
PAH = Polycyclic aromatic hydrocarbons.
PCB = Polchlorinated biphenyls.
SVOC = Semivolatile organic compounds.
µg/L = Micrograms per Liter.
VOC = Volatile organic compounds.

TABLE 5 SITE 16 SEDIMENT COPC SCREEN

Analyte	Units	Minimum Concentration	Maximum Concentration	Maximum Location	Detection Frequency	Screening Value[1]	HQ	COPC
METALS								
Aluminum	mg/kg	2,370	5,670	SED16-02	3/3	18,000	0.3	
Antimony	mg/kg	0.5	1.35	SED16-01	3/3	2	0.7	
Arsenic	mg/kg	0.97	36.6	SED16-02	3/3	8.2	4.5	**YES**
Barium	mg/kg	23.5	110.1	SED16-01	3/3	20	5.5	**YES**
Beryllium	mg/kg	0.32	0.905	SED16-01	3/3	10	0.1	
Cadmium	mg/kg	ND	0.19	SED16-02	1/3	1.2	0.2	
Calcium	mg/kg	1,380	1,815	SED16-01	3/3	EN	EN	
Chromium	mg/kg	11.7	33.5	OPSED16-01	3/3	81	0.4	
Cobalt	mg/kg	2.4	37.9	SED16-02	3/3	NSV	NSV	**YES**
Copper	mg/kg	13.4	127	SED16-01	3/3	34	3.7	**YES**
Iron	mg/kg	6,400	63,350	SED16-01	3/3	EN	EN	
Lead	mg/kg	11.4	154	OPSED16-01	3/3	46.7	3.3	**YES**
Magnesium	mg/kg	994	2,020	SED16-02	3/3	EN	EN	
Manganese	mg/kg	89	788	SED16-02	3/3	260	3.0	**YES**
Mercury	mg/kg	ND	0.055	SED16-01	1/3	0.15	0.4	
Nickel	mg/kg	11.5	53.8	SED16-01	3/3	20.9	2.6	**YES**
Potassium	mg/kg	599	916	SED16-02	3/3	EN	EN	
Selenium	mg/kg	ND	1.3	SED16-01	1/3	1	1.3	**YES**
Sodium	mg/kg	ND	239.5	SED16-01	1/3	EN	EN	
Vanadium	mg/kg	15.45	22.9	SED16-02	3/3	NSV	NSV	**YES**
Zinc	mg/kg	50.5	346	SED16-01	3/3	150	2.3	**YES**

Analyte	Units	Minimum Concentration	Maximum Concentration	Maximum Location	Detection Frequency	Screening Value[1]	HQ	COPC
PAH								
Acenaphthene	µg/kg	ND	905	SED16-01	1/3	16	56.6	YES
Acenaphthylene	µg/kg	ND	110	OPSED16-01	1/3	44	2.5	YES
Benzo(A)Anthracene	µg/kg	20	200	OPSED16-01	3/3	261	0.8	
Benzo(A)Pyrene	µg/kg	ND	300	OPSED16-01	1/3	430	0.7	
Benzo(B)Fluoranthene	µg/kg	41	480	OPSED16-01	3/3	NSV	NSV	YES
Benzo(K)Fluoranthene	µg/kg	ND	340	OPSED16-01	1/3	240	1.4	YES
Benzo[G,H,I]Perylene	µg/kg	ND	380	OPSED16-01	2/3	170	2.2	YES
Chrysene	µg/kg	34	450	OPSED16-01	3/3	384	1.2	YES
Fluoranthene	µg/kg	64	1,800	SED16-01	3/3	600	3.0	YES
Fluorene	µg/kg	ND	580	SED16-01	1/3	19	30.5	YES
Indeno(1,2,3-Cd)Pyrene	µg/kg	ND	250	OPSED16-01	1/3	200	1.3	YES
Phenanthrene	µg/kg	44	790	OPSED16-01	3/3	240	3.3	YES
Pyrene	µg/kg	68	855	SED16-01	3/3	665	1.3	YES
PESTICIDE/PCB								
4,4'-DDD	µg/kg	ND	3.45	SED16-01	2/3	2	1.7	YES
4,4'-DDE	µg/kg	ND	1.7	OPSED16-01	2/3	2.2	0.8	
4,4'-DDT	µg/kg	ND	1.8	SED16-02	2/3	1	1.8	YES
Delta BHC	µg/kg	ND	1.5	OPSED16-01	1/3	3	0.5	
Dieldrin	µg/kg	ND	1.7	SED16-02	1/3	0.02	85.0	YES
Endosulfan Sulfate	µg/kg	ND	2.1	SED16-01	1/3	5.481	0.4	
Endrin Ketone	µg/kg	0.64	1.6	OPSED16-01	3/3	0.02	80.0	YES
Gamma-Chlordane	µg/kg	ND	1.7	OPSED16-01	1/3	0.5	3.4	YES
Heptachlor	µg/kg	ND	0.71	SED16-02	2/3	0.5	1.4	YES
Heptachlor Epoxide	µg/kg	ND	1.2	OPSED16-01	1/3	0.5	2.4	YES
PCB-1260	µg/kg	ND	36	SED16-01	1/3	22.7	1.6	YES

Analyte	Units	Minimum Concentration	Maximum Concentration	Maximum Location	Detection Frequency	Screening Value[1]	HQ	COPC
SVOC								
Bis(2-Ethylhexyl) Phthalate	µg/kg	320	3,600	OPSED16-01	3/3	890,000	0.0	
Carbon Disulfide	µg/kg	ND	27.5	SED16-01	2/3	30,000	0.0	
Dibenzofuran	µg/kg	ND	255	SED16-01	1/3	420	0.6	
Di-N-Octylphthalate	µg/kg	ND	550	OPSED16-01	1/3	11,000	0.1	
VOC								
Acetone	µg/kg	57	120	SED16-02	3/3	8.7	13.8	**YES**

[1]From Table 2.

NOTE: COPC = Constituent of Potential Concern.
EN = Essential nutrient (not screened).
HQ = Hazard Quotient.
mg/kg = Milligrams per kilogram.
ND = Not detected.
NSV = No screening value.
PAH = Polycyclic aromatic hydrocarbons.
µg/kg = Micrograms per kilogram.

TABLE 8 CONSERVATIVE FOOD-WEB RESULTS FOR THE EASTERN COTTONTAIL NCBC DAVISVILLE SITE 16

Ecological Contaminant of Concern	Soil Concentration (mg/kg)	Food Concentration (mg/kg)	Dose (mg/kg/day)	TRV (mg/kg/day)	HQ	HQ>1?
Chromium	11.6	11.6	2.578	1,445	0.0	
Copper	40.2	40.2	8.933	8.0	1.1	**YES**
Lead	98.4	98.4	21.867	4.22	5.2	**YES**
Zinc	85.3	85.3	18.956	84.5	0.2	
Benzo(a)anthracene	4.45	4.45	0.989	0.29	3.4	**YES**
Benzo(a)pyrene	2.35	2.35	0.522	0.29	1.8	**YES**
Benzo(b)fluoranthene	7.4	7.4	1.644	0.29	5.7	**YES**
Benzo[g,h,i]perylene	1.05	1.05	0.233	0.29	0.8	
Benzo(k)fluoranthene	1.8	1.8	0.400	0.29	1.4	**YES**
Chrysene	4.75	4.75	1.056	0.29	3.6	**YES**
Fluoranthene	4.305	4.035	0.900	0.29	3.1	**YES**
Indeno(1,2,3-cd)pyrene	2.3	2.3	0.511	0.29	1.8	**YES**
Dioxin Toxicity Equivalent	0.00004521	0.00004521	0.000	0.0000005	20.1	**YES**
Carbazole	0.405	0.405	0.090	No TRV	No TRV	
2-Butanone	0.012	0.012	0.003	1301	0.0	
Acetone	3.7	3.7	0.822	7.3	0.1	
Methylene chloride	0.0045	0.0045	0.001	4.3	0.0	

NOTE: HQ = Hazard Quotient.
mg/kg = Milligrams per kilogram.
NCBC = Naval Construction Battalion Center.
TRV = Toxicity Reference Value.

TABLE 9 CONSERVATIVE FOOD-WEB RESULTS FOR THE RED FOX NCBC DAVISVILLE SITE 16

Ecological Contaminant of Concern	Soil Concentration (mg/kg)	Food Concentration (mg/kg)	Dose (mg/kg/day)	TRV (mg/kg/day)	HQ	HQ>1?
Chromium	11.6	11.6	0.763	1445	0.0	
Copper	40.2	40.2	2.645	8.0	0.3	
Lead	98.4	98.4	6.475	4.22	1.5	**YES**
Zinc	85.3	85.3	5.613	84.5	0.1	
Benzo(a)anthracene	4.45	4.45	0.293	0.29	1.0	**YES**
Benzo(a)pyrene	2.35	2.35	0.155	0.29	0.5	
Benzo(b)fluoranthene	7.4	7.4	0.487	0.29	1.7	**YES**
Benzo[g,h,i]perylene	1.05	1.05	0.069	0.29	0.2	
Benzo(k)fluoranthene	1.8	1.8	0.118	0.29	0.4	
Chrysene	4.75	4.75	0.313	0.29	1.1	**YES**
Fluoranthene	4.305	4.035	0.266	0.29	0.9	
Indeno(1,2,3-cd)pyrene	2.3	2.3	0.151	0.29	0.5	
Dioxin Toxicity Equivalent	0.00004521	0.00004521	0.000	0.0000005	5.9	**YES**
Carbazole	0.405	0.405	0.027	No TRV	No TRV	
2-Butanone	0.012	0.012	0.001	935	0.0	
Acetone	3.7	3.7	0.243	5.3	0.0	
Methylene chloride	0.0045	0.0045	0.000	3.1	0.0	

NOTE: HQ = Hazard Quotient.
mg/kg = Milligram per kilogram.
NCBC = Naval Construction Battalion Center.
TRV = Toxicity Reference Value.

TABLE 10 CONSERVATIVE FOOD-WEB RESULTS FOR THE AMERICAN ROBIN NCBC DAVISVILLE SITE 16

Ecological Contaminant of Concern	Soil Concentration (mg/kg)	Food Concentration (mg/kg)	Dose (mg/kg/day)	TRV (mg/kg/day)	HQ	HQ>1?
Chromium	11.6	11.6	15.376	1	15.4	**YES**
Copper	40.2	40.2	53.286	47.0	1.1	**YES**
Lead	98.4	98.4	130.430	3.85	33.9	**YES**
Zinc	85.3	85.3	113.066	14.5	7.8	**YES**
Benzo(a)anthracene	4.45	4.45	5.899	NoTRV	NoTRV	
Benzo(a)pyrene	2.35	2.35	3.115	NoTRV	NoTRV	
Benzo(b)fluoranthene	7.4	7.4	9.809	NoTRV	NoTRV	
Benzo[g,h,i]perylene	1.05	1.05	1.392	NoTRV	NoTRV	
Benzo(k)fluoranthene	1.8	1.8	2.386	NoTRV	NoTRV	
Chrysene	4.75	4.75	6.296	NoTRV	NoTRV	
Fluoranthene	4.305	4.035	5.381	NoTRV	NoTRV	
Indeno(1,2,3-cd)pyrene	2.3	2.3	3.049	NoTRV	NoTRV	
Dioxin Toxicity Equivalent	0.00007554	0.00007554	0.000	0.000014	7.2	**YES**
Carbazole	0.405	0.405	0.537	No TRV	No TRV	
2-Butanone	0.012	0.012	0.016	No TRV	No TRV	
Acetone	3.7	3.7	4.904	No TRV	No TRV	
Methylene chloride	0.0045	0.0045	0.006	No TRV	No TRV	

NOTE: HQ = Hazard Quotient.
mg/kg = Milligram per kilogram.
NCBC = Naval Construction Battalion Center.
TRV = Toxicity Reference Value.

TABLE 12 STEP 3a REFINED FOOD-WEB RESULTS FOR THE EASTERN COTTONTAIL, NCBC DAVISVILLE SITE 16

Ecological Contaminant of Concern	Soil Concentration (mg/kg)	Vegetation Concentration (mg/kg)	Dose (mg/kg/day)	TRV (mg/kg/day)	HQ	HQ>1?
Chromium	9.164	2.7840	0.7031	1,445	0.00	
Copper	31.758	2.0083	0.8398	8.0	0.10	
Lead	77.736	0.8347	1.2027	4.22	0.29	
Zinc	67.387	13.6742	3.7492	84.5	0.04	
Benz(a)anthracene	3.516	0.0224	0.0512	0.29	0.18	
Benzo(a)pyrene	1.857	0.0079	0.0262	0.29	0.09	
Benzo(b)fluoranthene	5.846	0.0195	0.0814	0.29	0.28	
Benzo(g,h,i)perylene	0.830	0.0015	0.0113	0.29	0.04	
Benzo(k)fluoranthene	1.422	0.0004	0.0189	0.29	0.07	
Chrysene	3.753	0.0239	0.0546	0.29	0.19	
Fluoranthene	3.401	0.0548	0.0564	0.29	0.19	
Indeno(1,2,3-cd)pyrene	1.817	0.0033	0.0247	0.29	0.09	
Dioxin Toxicity Equivalent	3.572E-05	1.1935E-07	4.9738E-07	0.0000005	0.99	
Carbazole	0.320	0.0972	0.0245	No TRV	No TRV	
2-Butanone	0.009	0.0029	0.0007	935	0.00	
Acetone	2.923	0.8880	0.2243	5.3	0.04	
Methylene chloride	0.004	0.0011	0.0003	3.1	0.00	

NOTE: HQ = Hazard Quotient.
mg/kg = Milligram per kilogram.
NCBC = Naval Construction Battalion Center.
TRV = Toxicity Reference Value.
Soil Concentration= Maximum site value on wet weight basis.

TABLE 13 STEP 3a REFINED FOOD-WEB RESULTS FOR THE RED FOX, NCBC DAVISVILLE SITE 16

Ecological Contaminant of Concern	Soil Concentration (mg/kg)	Vegetation Concentration (mg/kg)	Mammal Concentration (mg/kg)	Dose (mg/kg/day)	TRV (mg/kg/day)	HQ	HQ>1?
Chromium	9.1640	2.7840	0.4324	0.0004	1,445	0.00	
Copper	31.758	2.0083	4.2037	0.0019	8.0	0.00	
Lead	77.7360	0.8347	1.5439	0.0014	4.22	0.00	
Zinc	67.3870	13.6742	38.8611	0.0147	84.5	0.00	
Benz(a)anthracene	3.5155	0.0224	1.4240	0.0005	0.29	0.00	
Benzo(a)pyrene	1.8565	0.0079	0.7520	0.0003	0.29	0.00	
Benzo(b)fluoranthene	5.8460	0.0195	2.3680	0.0009	0.29	0.00	
Benzo(g,h,i)perylene	0.8295	0.0015	0.3360	0.0001	0.29	0.00	
Benzo(k)fluoranthene	1.4220	0.0004	0.5760	0.0002	0.29	0.00	
Chrysene	3.7525	0.0239	1.5200	0.0006	0.29	0.00	
Fluoranthene	3.4010	0.0548	1.3776	0.0005	0.29	0.00	
Indeno(1,2,3-cd)pyrene	1.8170	0.0033	0.7360	0.0003	0.29	0.00	
Dioxin Toxicity Equivalent	3.5716E-05	1.1935E-07	1.4467E-05	5.3902E-09	0.0000005	0.01	
Carbazole	0.3200	0.0972	0.1296	0.0001	No TRV	NA	
2-Butanone	0.0095	0.0029	0.0038	1.5401E-06	935	0.00	
Acetone	2.9230	0.8880	1.1840	0.0005	5.3	0.00	
Methylene chloride	0.0036	0.0011	0.0014	5.7753E-07	3.1	0.00	

NOTE:
HQ = Hazard Quotient.
mg/kg = Milligrams per kilogram.
NA = Not available.
NCBC = Naval Construction Battalion Center.
TRV = Toxicity Reference Value.
Soil Concentration = Maximum site value on wet weight basis.

TABLE 14 STEP 3a REFINED FOOD-WEB RESULTS FOR THE AMERICAN ROBIN, NCBC DAVISVILLE SITE 16

Ecological Contaminant of Concern	Soil Concentration (mg/kg)	Vegetation Concentration (mg/kg)	Invertebrate Concentration (mg/kg)	Dose (mg/kg/day)	TRV (mg/kg/day)	HQ	HQ>1?
Chromium	9.164	2.7840	0.939	2.992	1	2.99	**YES**
Copper	31.758	2.0083	2.265	6.451	47.0	0.14	
Lead	77.736	0.8347	5.221	13.862	3.85	3.60	**YES**
Zinc	67.387	13.6742	58.837	60.516	14.5	4.17	**YES**
Benz(a)anthracene	3.516	0.0224	0.712	0.999	No TRV	NA	
Benzo(a)pyrene	1.857	0.0079	0.376	0.526	No TRV	NA	
Benzo(b)fluoranthene	5.846	0.0195	1.184	1.654	No TRV	NA	
Benzo(g,h,i)perylene	0.830	0.0015	0.168	0.234	No TRV	NA	
Benzo(k)fluoranthene	1.422	0.0004	0.288	0.401	No TRV	NA	
Chrysene	3.753	0.0239	0.760	1.066	No TRV	NA	
Fluoranthene	3.401	0.0548	0.689	0.980	No TRV	NA	
Indeno(1,2,3-cd)pyrene	1.817	0.0033	0.368	0.513	No TRV	NA	
Dioxin Toxicity Equivalent	5.967E-05	1.5754E-07	1.209E-05	1.687E-05	0.000014	1.20	**YES**
Carbazole	0.320	0.0972	0.065	0.130	No TRV	NA	
2-Butanone	0.009	0.0029	0.002	0.004	No TRV	NA	
Acetone	2.923	0.8880	0.592	1.187	No TRV	NA	
Methylene chloride	0.004	0.0011	0.001	0.001	No TRV	NA	

NOTE: HQ = Hazard Quotient.
mg/kg = Milligrams per kilogram.
NA = Not available.
NCBC = Naval Construction Battalion Center.
TRV = Toxicity Reference Value.
Soil Concentration = Maximum site value on wet weight basis.

TABLE B-1 COMPARISON OF SITE 16 SEDIMENT CONCENTRATIONS TO ERM BENCHMARKS

Analyte	Units	Maximum Concentration	ERM	HQ	COPC
Metals					
ARSENIC	mg/kg	36.6	70	0.5	
CADMIUM	mg/kg	0.19	9.6	0.0	
CHROMIUM	mg/kg	33.5	370	0.1	
COPPER	mg/kg	127	270	0.5	
LEAD	mg/kg	154	218	0.7	
MERCURY	mg/kg	0.055	0.71	0.1	
NICKEL	mg/kg	53.8	51.6	1.04	YES
ZINC	mg/kg	346	410	0.8	
PAH					
ACENAPHTHENE	ug/kg	905	500	1.8	YES
ACENAPHTHYLENE	ug/kg	110	640	0.2	
BENZO(A)ANTHRACENE	ug/kg	200	1600	0.1	
BENZO(A)PYRENE	ug/kg	300	1600	0.2	
CHRYSENE	ug/kg	450	2800	0.2	
FLUORANTHENE	ug/kg	1800	5100	0.4	
FLUORENE	ug/kg	580	540	1.1	YES
PYRENE	ug/kg	855	2600	0.3	
Pesticide/PCB					
4,4'-DDE	ug/kg	1.7	27	0.1	
PCB-1260	ug/kg	36	180	0.2	

Note:
ERM = Effects Range-Median (Long et al. 1995).
HQ = Hazard Quotient.
COPC = Constituent of Potential Concern.
mg/kg = Milligrams per kilogram.
ug/kg = Micrograms per kilogram.
PAH = Polycyclic aromatic hydrocarbons.
PCB = Polychlorinated biphenyl.

Appendix D.2
Phase II SLERA

TABLE 5-3 SEDIMENT COPC SELECTION

Chemical	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Eco Screening Value	Screening Quotient Ratio	COPC Flag
INORGANICS											
Aluminum	2370		15900	/	mg/kg	AH-29	16/16	2.7 - 56	26000	0.61	No
Antimony	0.5	J	1.35	UJ / J	mg/kg	SED16-01	3/12	0.76 - 2.4	9.3	0.14	No
Arsenic	0.97		36.6		mg/kg	SED16-02	15/16	0.3 - 2.1	8.2	4.46	**Yes**
Barium	13.8	/	133	/	mg/kg	AH-32	16/16	0.05 - 0.94	48	2.77	**Yes**
Beryllium	0.29	/	1.9	/	mg/kg	AH-17	16/16	0.014 - 0.94	ND	N/A	**Yes**
Cadmium	0.19		2.4	/	mg/kg	AH-17	11/16	0.031 - 2.65	1.2	2	**Yes**
Calcium	1380		5110	/	mg/kg	AH-42	4/16	4.8 - 29	ND	N/A	No
Chromium	7.7	/	66.8	/	mg/kg	AH-29	16/16	0.081 - 2.8	81	0.82	No
Cobalt	2.1	/	37.9		mg/kg	SED16-02	16/16	0.22 - 5.6	10	3.79	**Yes**
Copper	13.4	J	212	/	mg/kg	AH-17	16/16	0.44 - 6.6	34	6.23	**Yes**
Iron	5820	/	63350		mg/kg	SED16-01	16/16	2.6 - 190	ND	N/A	No
Lead	11.4		154	J	mg/kg	OPSED16-01	16/16	0.13 - 1.3	46.7	3.30	**Yes**
Magnesium	994	J	7890	/	mg/kg	AH-17	14/16	2.1 - 9.4	ND	N/A	No
Manganese	46.2	/	788		mg/kg	SED16-02	16/16	0.15 - 0.94	260	3.03	**Yes**
Mercury	0.039	J/J / J/J	0.38	/	mg/kg	AH-17	13/16	0.023 - 0.071	0.15	2.53	**Yes**
Nickel	6.3	/	53.8		mg/kg	SED16-01	16/16	0.17-10.55	20.9	2.57	**Yes**
Potassium	599		4380	/	mg/kg	AH-29	11/16	6.8 - 190	ND	N/A	No
Selenium	1.3	U / _	1.3	U / _	mg/kg	SED16-01	1/16	0.67 -2.65	1	1.3	**Yes**
Sodium	239.5		239.5		mg/kg	SED16-01	1/16	13.9 - 190	ND	N/A	No
Vanadium	8.6	/	80.9	/	mg/kg	AH-29	16/16	0.3 - 4.7	57	1.42	**Yes**
Zinc	50.5		449	/	mg/kg	AH-17	16/16	1.4 - 6.6	150	2.99	**Yes**
PAHS											
2-methylnapthalene	0.01576	J/J	0.21346	J/J	mg/kg	AH-29	13/16	0.00157 -0.62	0.07	3.05	**Yes**
Acenaphthene	0.02287	J/J	0.905	J / _	mg/kg	SED16-01	14/16	0.00157 -0.62	0.016	56.56	**Yes**
Acenaphthylene	0.02795	J/J	0.79131	J/J	mg/kg	AH-49	14/16	0.00157 -0.62	0.044	17.98	**Yes**
Anthracene	0.19753	J/J	0.81422	/	mg/kg	AH-49	14/16	0.00157 -0.62	0.085	9.58	**Yes**
Benzo(a)anthracene	0.02		1.59669	/	mg/kg	AH-35	16/16	0.00157 -0.62	0.26	6.14	**Yes**
Benzo(a)pyrene	0.3		1.65423	/	mg/kg	AH-49	14/16	0.00157 -0.62	0.43	3.85	**Yes**
Benzo(b)fluoranthene	0.041		2.19547	/	mg/kg	AH-29	16/16	0.00157 -0.62	0.24	9.15	**Yes**
Benzo(k)fluoranthene	0.34		2.03361	/	mg/kg	AH-29	14/16	0.00313 -0.62	0.24	8.47	**Yes**

Chemical	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Eco Screening Value	Screening Quotient Ratio	COPC Flag
Benzo[g,h,i]perylene	0.023		1.24388	/	mg/kg	AH-28	15/16	0.00157 -0.62	0.29	4.29	**Yes**
Chrysene	0.034		2.41621	/	mg/kg	AH-49	16/16	0.00157 -0.62	0.38	6.36	**Yes**
Dibenzo(a,h)anthracene	0.07576	/	0.33117	/	mg/kg	AH-49	13/16	0.00157 -0.62	0.063	5.26	**Yes**
Fluoranthene	0.064		4.87256	/	mg/kg	AH-49	16/16	0.00157 -0.62	0.6	8.12	**Yes**
Fluorene	0.03943	J/J	0.58	J	mg/kg	SED16-01	14/16	0.00157 -0.62	0.019	30.53	**Yes**
Indeno(1,2,3-cd)pyrene	0.25		1.36112	/	mg/kg	AH-28	14/16	0.00157 -0.62	0.078	17.45	**Yes**
Naphthalene	0.03046	J/J	0.12842	J/J	mg/kg	AH-29	13/16	0.00157 -0.62	0.16	0.80	**No**
Phenanthrene	0.044		4.4937	/	mg/kg	AH-49	16/16	0.00157 -0.62	0.24	18.72	**Yes**
Pyrene	0.068		4.721	/	mg/kg	AH-49	16/16	0.00157 -0.62	0.67	7.04	**Yes**
TOTAL PAH	0.294		28.14211	/	mg/kg	AH-49	16/16	0.00313 -0.62	2.9	9.70	**Yes**
PCBs											
PCB-1260[1]	0.016	/	0.07	/	mg/kg	AH-23	13/16	0.0087 -0.033	ND	N/A	No
TOTAL PCB	0.016	/	0.07	/	mg/kg	AH-23	13/15	0.018 - 0.039	0.023	3.04	**Yes**
PESTICIDES											
4,4'-DDD	0.0016	/	0.00345	J	mg/kg	SED16-01	5/14	0.00087-0.0065	0.002	1.73	**Yes**
4,4'-DDE	0.0015	J	0.0034	J/J	mg/kg	AH-23	4/12	0.00087 - 0.0065	0.002	1.7	**Yes**
4,4'-DDT	0.0014	J	0.0018	J	mg/kg	SED16-02	2/14	0.00087 - 0.0065	0.001	1.0	**Yes**
TOTAL DDT Metabolites	0.0014		0.0053		mg/kg	SED16-02	8/8	0.00087 - 0.0065	0.003	1.77	**Yes**
Alpha-chlordane	0.002	/	0.002	/	mg/kg	AH-47	1/13	0.00045 - 0.0033	0.0005	4	**Yes**
DELTA BHC	0.00092	J/J	0.0015		mg/kg	OPSED16-01	2/13	0.00045 - 0.0033	0.0032	0.47	No
Dieldrin	0.0017	J	0.0081	/	mg/kg	AH-28	3/11	0.00087 - 0.0065	0.00002	405	**Yes**
Endosulfan sulfate	0.0021	J / U	0.0021	J / U	mg/kg	SED16-01	1/14	0.00087 - 0.0065	ND	N/A	**Yes**
Endrin ketone	0.00064	J	0.0016		mg/kg	OPSED16-01	3/13	0.00087 - 0.0065	0.00002	80	**Yes**
Gamma-chlordane	0.0017		0.01	/	mg/kg	AH-23	7/10	0.00045 - 0.0033	0.0005	20	**Yes**
Heptachlor	0.000625	J / _	0.00071		mg/kg	SED16-02	2/10	0.00045 - 0.0033	0.0003	2.37	**Yes**
Heptachlor epoxide	0.0012	J	0.0012	J	mg/kg	OPSED16-01	1/11	0.00045 - 0.0033	0.00247	0.49	No
VOLATILES											
1,1-Dichloroethene	0.0009	J/J	0.0009	J/J	mg/kg	AH-47	1/16	0.005 - 0.02	4.8	0.00018	No
2-Butanone	0.008	J/J / / / J/J	0.02	J/J /// J/J / /J	mg/kg	AH-17 / AH-35 / AH-33	8/16	0.01 - 0.041	2.9	0.007	No
Acetone	0.057	J	0.2	/	mg/kg	AH-17	4/16	0.01 - 0.041	2.3	0.087	No
Carbon disulfide	0.012		0.0275	J	mg/kg	SED16-01	2/16	0.005 - 0.02	0.22	0.13	No

Chemical	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Eco Screening Value	Screening Quotient Ratio	COPC Flag
Cis-1,2-Dichloroethene	0.005	J/J	0.88	/	mg/kg	AH-47	3/16	0.005 - 1.3	4.8	0.18	No
Trans-1,2-Dichloroethene	0.003	J/J	0.003	J/J	mg/kg	AH-47	1/16	0.005 - 0.02	4.8	0.000625	No
Trichloroethene	0.002	J/J	0.002	J/J	mg/kg	AH-47	1/16	0.005 - 0.02	6.5	0.00031	No

(1) Use Total PCB for Aroclor 1260 risk.

NOTES: NA = Not Applicable
ND = No Data
COPC = Constituent of Potential Concern
-- = No Qualifier, or not applicable
J = Indicates an estimated value.

TABLE 5-14 SUMMARY OF STEP 2 FOOD WEB RISKS

Ecological Contaminants of Concern	Raccoon NOAEL HQ_n	Herring Gull NOAEL HQ_n
Arsenic	**278.06**	**1.55**
Barium	**12.99**	**1.38**
Beryllium	**1.48**	NA
Cadmium	**1.29**	0.36
Cobalt	0.25	**1.57**
Copper	**7.25**	0.97
Lead	**9.98**	**8.64**
Manganese	**4.69**	0.17
Mercury	**10.39**	**13.68**
Nickel	0.70	0.15
Selenium	**5.80**	0.98
Vanadium	**214.82**	**1.53**
Zinc	**2.36**	**10.90**
Total PAH	**26.54**	**6.08**
Total PCB	3.74E-01	1.59E-01
Total DDT	8.56E-03	9.54E-01
Alpha-Chlordane	8.21E-04	4.04E-04
Dieldrin	2.01E-01	2.27E-02
Endosulfan Sulfate	1.04E-01	6.63E-04
Endrin Ketone	4.85E-01	1.01E+00
Gamma-Chlordane	4.10E-03	2.02E-03
Heptachlor	7.08E-03	2.16E-04

NA = Not Available HQ_n= Hazard Quotient based on the NOAEL

TABLE 5-17 SUMMARY OF STEP 3a FOOD WEB RISKS

Ecological Contaminants of Concern	Raccoon		Herring Gull	
	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l
Arsenic	1.46E-01	1.46E-02	1.93E-03	1.33E-03
Barium	9.50E-03	2.53E-03	1.13E-03	5.61E-04
Beryllium	7.61E-04	7.61E-05	NA	NA
Cadmium	1.11E-03	1.11E-04	5.89E-04	4.27E-05
Cobalt	5.82E-05	5.82E-06	7.09E-04	7.09E-05
Copper	4.75E-03	3.58E-03	1.22E-03	9.26E-04
Lead	4.32E-03	4.32E-04	6.13E-03	2.09E-03
Manganese	1.74E-03	5.34E-04	8.83E-05	8.83E-06
Mercury	1.07E-02	6.29E-03	1.91E-02	1.79E-03
Nickel	3.31E-04	1.66E-04	1.38E-04	1.00E-04
Selenium	1.00E-02	6.09E-03	4.23E-03	2.11E-03
Vanadium	8.86E-02	8.86E-03	1.10E-03	1.10E-04
Zinc	3.14E-03	1.57E-03	3.65E-02	4.04E-03
Total PAH	1.60E-02	1.62E-03	7.20E-03	7.20E-04
Total PCB	4.09E-04	8.29E-05	4.79E-04	4.79E-05
Total DDT	1.05E-05	2.08E-06	3.37E-03	3.61E-04
Alpha-Chlordane	6.76E-07	3.38E-07	9.34E-07	1.83E-07
Dieldrin	1.17E-04	1.21E-05	2.95E-05	2.95E-06
Endosulfan Sulfate	1.09E-04	1.09E-05	2.07E-06	2.07E-07
Endrin Ketone	4.91E-04	4.85E-05	3.13E-03	3.13E-04
Gamma-Chlordane	5.49E-05	2.74E-05	8.35E-05	1.64E-05
Heptachlor	1.13E-05	1.13E-06	9.30E-07	9.30E-08

TABLE 5-18 POTENTIAL HAZARD QUOTIENTS FOR BENTHIC INVERTEBRATES

Analyte	UCLM95 (mg/kg)	ER-L (mg/kg)	ER-L Hazard Quotient	ER-M (mg/kg)	ER-M Hazard Quotient
Inorganics					
ARSENIC	2.64E+01	8.2	**3.22**	70	0.38
BARIUM	7.28E+01	48	**1.52**	ND	NC
BERYLLIUM	1.29E+00	ND	NC	ND	NC
CADMIUM	9.32E-01	1.2	0.78	9.6	0.097
COBALT	1.25E+01	10	**1.25**	ND	NC
COPPER	1.36E+02	34	**4.01**	270	0.05
LEAD	8.99E+01	46.7	**1.93**	218	0.41
MANGANESE	3.41E+02	260	**1.31**	ND	NC
MERCURY	2.32E-01	0.15	**1.55**	0.71	0.33
NICKEL	2.75E+01	20.9	**1.32**	51.6	0.53
SELENIUM	9.59E-01	1	0.96	ND	NC
VANADIUM	4.67E+01	57	0.82	ND	NC
ZINC	2.72E+02	150	**1.81**	410	0.66
PAH					
2-METHYLNAPHTHALENE	1.10E-01	0.07	**1.57**	0.67	0.16
ACENAPHTHENE	2.26E-01	0.016	**14.15**	0.5	0.45
ACENAPHTHYLENE	6.03E-01	0.044	**13.71**	0.64	0.94
ANTHRACENE	4.84E-01	0.085	**5.70**	1.1	0.44
BENZO(A)ANTHRACENE	8.77E-01	0.26	**3.37**	1.6	0.54
BENZO(A)PYRENE	1.01E+00	0.43	**2.34**	1.6	0.63
BENZO(B)FLUORANTHENE	1.21E+00	0.24	**5.03**	ND	NC
BENZO[G,H,I]PERYLENE	7.49E-01	0.29	**2.58**	ND	NC
BENZO(K)FLUORANTHENE	1.16E+00	0.24	**4.82**	ND	NC
CHRYSENE	1.36E+00	0.38	**3.58**	2.8	0.49
DIBENZO(A,H)ANTHRACENE	2.26E-01	0.063	**3.59**	0.26	0.86
FLUORANTHENE	2.73E+00	0.6	**4.55**	5.1	0.54

Analyte	UCLM95 (mg/kg)	ER-L (mg/kg)	ER-L Hazard Quotient	ER-M (mg/kg)	ER-M Hazard Quotient
PAH continued					
FLUORENE	2.18E-01	0.019	**11.45**	0.54	0.40
INDENO(1,2,3-CD)PYRENE	8.46E-01	0.078	**10.85**	ND	NC
PHENANTHRENE	1.83E+00	0.24	**7.63**	1.5	**1.22**
PYRENE	2.51E+00	0.67	**3.75**	2.6	0.97
Total PAH	1.55E+01	2.9	**5.33**	44.8	0.35
PCB and Pesticides					
TOTAL PCB	3.83E-02	0.023	**1.66**	0.18	0.21
4,4'-DDD	2.20E-03	0.002	**1.10**	0.02	0.11
4,4'-DDE	2.03E-03	0.002	**1.02**	0.015	0.14
4,4'-DDT	1.16E-03	0.00158	0.73	0.0461	0.03
Total DDT metabolites	3.66E-03	0.00158	**2.32**	0.027	0.14
ALPHA-CHLORDANE	1.12E-03	0.0005	**2.24**	0.006	0.19
DIELDRIN	4.45E-03	0.00002	**222.31**	0.008	0.56
ENDRIN KETONE	9.73E-04	0.00002	**48.63**	0.045	0.02
GAMMA-CHLORDANE	6.12E-03	0.0005	**12.24**	0.006	**1.02**
HEPTACHLOR	6.00E-04	0.003	0.20	ND	NC

NOTE:
ND = No Screening data.
NC = Not Calculable.

Appendix D.3
Phase III SLERA

TABLE 7-1

ECOLOGICAL COPC SELECTION
PHASE III SURFACE SOIL - UNDEVELOPED AREA -
PHASE III RI FOR IR PROGRAM SITE 16
FORMER NCBC DAVISVILLE
NORTH KINGSTOWN, RHODE ISLAND

Parameter	Frequency of Detection	Minimum Detected Concentration[1]	Maximum Detected Concentration[1]	Range of Non-Detects[2]	Mean Concentration	Average of Positive Detects	Sample with Maximum Detection	Ecological Screening Level	HQ	COPC (YES/NO)	Rationale for COPC Selection
Volatile Organic Compounds (ug/kg)											
2-Butanone	4/31	10	55 J	0.64 - 13	7	22	EBS85-SB01-050196-00	NA	NA	YES	NSL
Acetone	21/33	2	3700 J	1.3 - 13	290	450	28SB-04-NSO-061897-00	NA	NA	YES	NSL
Carbon Disulfide	1/35	1.6	1.6 J	0.21 - 13	4	2	SB16-093-SO-0102	NA	NA	YES	NSL
Ethylbenzene	1/35	2	2 J	0.43 - 13	4	2	SB16-093-SO-0102	13000 [4]	0.0002	NO	BSL
Methylene Chloride	3/35	4	4 J	0.53 - 13	4	4	0,28SB-07-NSO-061897-00,SB1	400 [5]	0.01	NO	BSL
Toluene	2/35	6	36 0	0.21 - 13	4	21	EBS85-SB01-050196-00	200000 [6]	0.0002	NO	BSL
Total Xylenes	1/35	13	13 0	0.61 - 13	4	13	SB16-093-SO-0102	3700 [4]	0.004	NO	BSL
Semivolatile Organic Compounds (ug/kg)											
Bis(2-ethylhexyl)phthalate	4/47	36	150 J	50 - 440	110	71	SB16-047-SO-0002-AUG	100000 [6, 9]	0.002	NO	BSL
Carbazole	4/47	66	550 J	33 - 440	110	210	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
di-n-Butyl Phthalate	6/47	37	56 J	48 - 440	88	46	SB16-047-SO-0002-AUG	200000 [6]	0.0003	NO	BSL
Dibenzofuran	3/67	50	54 J	5.6 - 440	72	47	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
Polycyclic Aromatic Hydrocarbons (ug/kg)											
2-Methylnaphthalene	7/73	4.15 J	10,012 J	6.6 - 440	330	2,800	SOURCE2-2-NSD-032604	29000 [7]	0.345	NO	BSL
Acenaphthene	46/54	0.17 J	2,400 J	0.17 - 2200	88	100	28SB-01B-NSO-042496-00	29000 [7]	0.083	NO	BSL
Acenaphthylene	10/72	11.28 J	963 J	5.9 - 440	100	270	SOURCE1-2-NSD-032604	29000 [7]	0.033	NO	BSL
Anthracene	51/54	0.29 J	4,600 J	20 - 2200	150	160	28SB-01B-NSO-042496-00	29000 [7]	0.159	NO	BSL
BaP Equivalent	49/73	3.4	4,608	0 - 38	260	380	SOURCE1-2-NSD-032604	NA	NA	NA	NA
Benzo(a)anthracene	54/54	2.1	4,800	-	230	230	SB16-21-NSO-062600-00	**1100** [8]	4.36	YES	ASL
Benzo(a)pyrene	50/53	0.46 J	2,700	0.61 - 1.7	150	150	SB16-21-NSO-062600-00-D	**1100** [8]	2.45	YES	ASL
Benzo(b)fluoranthene	54/54	2	7,400	-	320	320	SB16-21-NSO-062600-00-D, SB16-21-NSO-062600-00	**1100** [8]	6.73	YES	ASL
Benzo(g,h,i)perylene	33/73	37	1,904 J	4.9 - 440	160	250	SOURCE1-2-NSD-032604	**1100** [8]	1.73	YES	ASL
Benzo(k)fluoranthene	28/73	27 J	6,221 J	7.7 - 440	260	540	SOURCE1-2-NSD-032604	**1100** [8]	5.66	YES	ASL
Chrysene	43/73	36 J	6,549 J	10 - 440	350	530	SOURCE1-2-NSD-032604	**1100** [8]	5.95	YES	ASL
Dibenzo(a,h)anthracene	16/73	13.09	825 J	6.4 - 440	89	150	SOURCE1-2-NSD-032604	1100 [8]	0.750	NO	BSL
Fluoranthene	54/54	3	7,900	-	450	450	SB16-21-NSO-062600-00-D	29000 [7]	0.272	NO	BSL
Fluorene	11/73	5.49	984	6.6 - 440	95	220	SOURCE2-2-NSD-032604	29000 [7]	0.034	NO	BSL
Indeno(1,2,3-cd)pyrene	28/73	38	2,708 J	7 - 440	180	330	SOURCE1-2-NSD-032604	**1100** [8]	2.46	YES	ASL
Naphthalene	6/73	13.46 J	3,685 J	7.5 - 440	170	1,200	SOURCE2-2-NSD-032604	29000 [7]	0.127	NO	BSL
Phenanthrene	31/73	37	2,767	5.2 - 440	250	460	SOURCE2-2-NSD-032604	29000 [7]	0.095	NO	BSL
Pyrene	48/73	38 J	8,017 J	6.6 - 440	490	690	SOURCE1-2-NSD-032604	**1100** [8]	7.28798	YES	ASL
Pesticides/PCBs (ug/kg)											
4,4'-DDD	1/29	6.8	6.8 J	3.3 - 4.2	2	7	SB16-047-SO-0002-AUG	21 [8]	0.324	NO	BSL
4,4'-DDT	1/29	3.7	3.7 0	3.3 - 4.2	2	4	SB16-047-SO-0002-AUG	21 [8]	0.176	NO	BSL
alpha-BHC	1/29	2.4	2.4 J	1.7 - 1.9	0.9	2	SB16-047-SO-0002-AUG	3 [5]	0.8	NO	BSL
Aroclor-1260	1/30	19	19 0	18 - 36	15	14	SB16-047-SO-0002-AUG	40000 [6]	0.0005	NO	BSL
gamma-Chlordane	1/30	2.9	2.9 J	1.7 - 2.1	1	3	SB16-047-SO-0002-AUG	**0.03** [5,10]	96.7	YES	ASL
Total Aroclor	1/30	19	19 0	0 - 36	3.2	14	SB16-047-SO-0002-AUG	40000 [6]	0.0005	NO	BSL
Total DDT	1/21	6.8	6.8 0	0 - 0	0.3	7	SB16-047-SO-0002-AUG	21 [8]	0.324	NO	BSL
Dioxins (ng/kg)[3]											
1,2,3,4,6,7,8,9-OCDD	8/8	740	3310 0	-	1620	1620	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
1,2,3,4,6,7,8,9-OCDF	8/8	15.1	113 0	-	61.8	61.8	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
1,2,3,4,6,7,8-HPCDD	8/8	22.5	664 0	-	171	171	SB16-047-SO-0002-AUG	NA	NA	YES	NSL

TABLE 7-1

ECOLOGICAL COPC SELECTION
PHASE III SURFACE SOIL - UNDEVELOPED AREA -
PHASE III RI FOR IR PROGRAM SITE 16
FORMER NCBC DAVISVILLE
NORTH KINGSTOWN, RHODE ISLAND

Parameter	Frequency of Detection	Minimum Detected Concentration[1]	Maximum Detected Concentration[1]	Range of Non-Detects[2]	Mean Concentration	Average of Positive Detects	Sample with Maximum Detection	Ecological Screening Level	HQ	COPC (YES/NO)	Rationale for COPC Selection
1,2,3,4,6,7,8-HPCDF	8/8	7.4	69.2 0	-	30.6	30.6	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
1,2,3,4,7,8,9-HPCDF	6/8	0.96	4 0	4.95 - 5	2.2	2.1	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
1,2,3,4,7,8-HXCDD	7/8	0.66	8.8 0	5 - 5	2.6	2.7	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
1,2,3,4,7,8-HXCDF	6/8	0.98	24.4 0	2.2 - 7.6	5.2	6.1	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
1,2,3,6,7,8-HXCDD	7/8	2.7	36.7 0	5 - 5	9.2	10.1	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
1,2,3,6,7,8-HXCDF	8/8	0.54	10 0	-	2.8	2.8	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
1,2,3,7,8,9-HXCDD	7/8	1.8	38 0	5 - 5	9.4	10.4	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
1,2,3,7,8,9-HXCDF	1/8	0.31	0.31 0	4.88 - 5.03	2.2	0.31	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
1,2,3,7,8-PECDD	5/8	1.1	10 0	5 - 5.03	3.4	3.9	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
1,2,3,7,8-PECDF	4/8	1	20.5 J	4.88 - 5.03	4.7	6.9	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
2,3,4,6,7,8-HXCDF	8/8	1.4	11.5 0	5 - 5	3.9	3.9	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
2,3,4,7,8-PECDF	8/8	0.71	20 J	-	4.5	4.5	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
2,3,7,8-TCDD	4/8	0.26	4 0	0.99 - 1	1	1.6	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
2,3,7,8-TCDF	6/8	0.73	28.3 0	0.57 - 1.4	5.4	7	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
TEQ-mammal	8/8	1.19	48.5	-	11.5	11.5	SB16-25-NSO-062600-00	NA	NA	YES	NSL
TEQ-bird	8/8	2.03	75.3	-	16.2	16.2	SB16-25-NSO-062600-00	NA	NA	YES	NSL
Total HPCDD	8/8	50.8	1220 0	-	321	321	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
Total HPCDF	8/8	17.9	156 0	-	73.4	73.4	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
Total HXCDD	8/8	7.4	340 0	-	84.3	84.3	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
Total HXCDF	8/8	7.8	125 0	14.3 - 14.3	47.5	47.5	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
Total PECDD	5/8	1.8	101 0	5 - 12.6	22.7	34.3	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
Total PECDF	8/8	7	197 0	7.3 - 7.3	52	52	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
Total TCDD	7/8	0.55	54.4 0	1 - 1	11.2	12.7	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
Total TCDF	8/8	4.6	495 0	-	97.2	97.2	SB16-047-SO-0002-AUG	NA	NA	YES	NSL
Inorganics (mg/kg)											
Aluminum	40/40	2570	8590 0	-	5870	5870	SB16-047-SO-0002-AUG	pH [11]	NA	NO	BSL
Antimony	16/40	0.5	17.9 0	0.036 - 0.7	1.9	4.5	SB16-047-SO-0002-AUG	**0.27** [8]	66.3	YES	ASL
Arsenic	38/40	1.3	32.3 0	1.7 - 1.9	5	5.2	SB16-047-SO-0002-AUG	**18** [8]	1.79	YES	ASL
Barium	40/40	10.2	229 0	-	25.7	25.7	SB16-047-SO-0002-AUG	330 [7]	0.694	NO	BSL
Beryllium	29/40	0.078	0.68 0	0.00078 - 0.0009	0.31	0.43	SB16-047-SO-0002-AUG	21 [8]	0.032	NO	BSL
Cadmium	32/40	0.038	4.4 J	0.038 - 0.46	0.57	0.68	SB16-047-SO-0002-AUG	**0.36** [8]	12.2	YES	ASL
Calcium	32/40	33.2	1540 0	5.5 - 550	445	544	SB16-047-SO-0002-AUG	NA	NA	NO	NUT
Chromium	40/40	2.9	24.3 0	-	7.8	7.8	SB16-047-SO-0002-AUG	26 [12]	0.935	NO	BSL
Cobalt	40/40	2	13.6 0	-	5.8	5.8	SB16-047-SO-0002-AUG	**13** [13]	1.05	YES	ASL
Copper	40/40	6.4	143 0	-	19.9	19.9	SB16-047-SO-0002-AUG	**28** [12]	5.11	YES	ASL
Iron	40/40	5930	38800 0	-	13500	13500	SB16-047-SO-0002-AUG	pH [11]	NA	NO	BSL
Lead	40/40	7	424 0	-	38	38	SB16-047-SO-0002-AUG	**11** [12]	38.5	YES	ASL
Magnesium	40/40	540	2990 0	-	1780	1780	SB16-047-SO-0002-AUG	NA	NA	NO	NUT
Manganese	40/40	84.4	398 0	-	168	168	SB16-047-SO-0002-AUG	**220** [13]	1.81	YES	ASL
Mercury	18/40	0.0046	0.26 0	0.0044 - 0.05	0.016	0.029	SB16-047-SO-0002-AUG	**0.1** [14]	2.6	YES	ASL
Nickel	37/40	2.6	20.7 J	4.1 - 7.6	8.2	8.6	SB16-047-SO-0002-AUG	38 [13]	0.545	NO	BSL
Potassium	39/40	356	1960 0	562 - 562	715	727	SB16-047-SO-0002-AUG	NA	NA	NO	NUT
Selenium	11/40	0.88	2.6 J	0.084 - 0.45	0.51	1.6	SB16-047-SO-0002-AUG	**0.52** [13]	5	YES	ASL
Silver	13/40	0.32	4 J	0.012 - 0.51	1	2.9	SB16-047-SO-0002-AUG	4.2 [12]	0.952	NO	BSL
Sodium	32/40	13.4	82 0	17.8 - 35.2	25.8	29.4	SB16-047-SO-0002-AUG	NA	NA	NO	NUT
Thallium	16/40	0.53	3.5 J	0.061 - 1.2	0.71	1.6	SB16-047-SO-0002-AUG	**1** [6]	3.5	YES	ASL
Vanadium	40/40	4.7	16.1 0	-	10.3	10.3	SB16-047-SO-0002-AUG	**7.8** [12]	2.06	YES	ASL

TABLE 7-1

ECOLOGICAL COPC SELECTION
PHASE III SURFACE SOIL - UNDEVELOPED AREA -
PHASE III RI FOR IR PROGRAM SITE 16
FORMER NCBC DAVISVILLE
NORTH KINGSTOWN, RHODE ISLAND

Parameter	Frequency of Detection	Minimum Detected Concentration[1]	Maximum Detected Concentration[1]	Range of Non-Detects[2]	Mean Concentration	Average of Positive Detects	Sample with Maximum Detection	Ecological Screening Level	HQ	COPC (YES/NO)	Rationale for COPC Selection
Zinc	40/40	23.4	616 0	-	57.4	57.4	SB16-047-SO-0002-AUG	**46** [12]	13.4	YES	ASL
Miscellaneous Parameters											
pH (S.U.)	8/8	5.5	7.8 0	-	7	7	SB16-047-SO-0002-AUG	NA	NA	NA	NA
Total Organic Carbon (mg/kg)	8/8	1900	6300 0	-	3500	3500	SB16-047-SO-0002-AUG	NA	NA	NA	NA

TABLE 7-1

ECOLOGICAL COPC SELECTION
PHASE III SURFACE SOIL - UNDEVELOPED AREA -
PHASE III RI FOR IR PROGRAM SITE 16
FORMER NCBC DAVISVILLE
NORTH KINGSTOWN, RHODE ISLAND

Notes:
1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - Value is derived by multiplying criteria for 2,3,7,8-TCDD by World Health Organization Toxicity Equivalent Factor.
4 - Canadian Soil Quality Guidelines (EC, 1999, 2004a, 2004b)
5 - Dutch Target Value (MHSPE, 2000)
6 - Oak Ridge National Laboratory - Plant (Efroymson, 1997a)
7 - Ecological Soil Screening Level - Invertebrate
8 - Ecological Soil Screening Level - Mammal
9 - Value is for diethylphthalate.
10 - Value is for total chlordane
11 - Aluminum is considered a COPC only when the soil pH is less than 5.5; iron is not expected to be toxic to plants with a soil pH between 5 and 8. pH values at the Site range from 5.5 to 7.8; therefore aluminum and iron are not considered COPCs.
12 - Ecological Soil Screening Level - Avian
13 - Ecological Soil Screening Level - Plant
14 - Oak Ridge National Laboratory - Invertebrate (Efroymson, 1997b)

COPC Selection Rationale:

ASL = Above Screening Level
BSL = Below Screening Level
NSL = No Screening Level
NUT = Nutrient

Acronyms:
HQ = Hazard Quotient

NA = Not available
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyl
VOC = Volatile organic compound

Shading indicates that the maximum detected concentration exceeds the screening criterion.

Qualifiers:
J - Estimated value

Associated Samples:

16TP-TP1-0002	28SB-13-NSO-061997-00	SB16-051-SO-0002	SB16-067-SO-0202	SB16-084-SO-0001	SB16-21-NSO-062600-00
16TP-TP2-0002	28SB-14-NSO-062097-00	SB16-052-SO-0002	SB16-068-SO-0002	SB16-085-SO-0002	SB16-21-NSO-062600-00-D
28SB-01A-NSO-042496-00	28SB-14-NSO-062097-00-D	SB16-053-SO-0002	SB16-069-SO-0001	SB16-086-SO-0002	SB16-22-NSO-062700-00
28SB-01B-NSO-042496-00	28SB-15-NSO-062397-00	SB16-054-SO-0002	SB16-069-SO-0002	SB16-087-SO-0002	SB16-23-NSO-062600-00
28SB-01C-NSO-042696-00	28SB-16-NSO-062497-00	SB16-055-SO-0002	SB16-070-SO-0002	SB16-087-SO-0002-D	SB16-24-NSO-062600-00
28SB-01D-NSO-042696-00	28SB-21-NSO-101398-00	SB16-056-SO-0002	SB16-071-SO-0002	SB16-088-SO-0002	SB16-25-NSO-062600-00
28SB-01-NSO-061797-00	28SS-01-NSO-070197-00	SB16-057-SO-0002	SB16-072-SO-0002	SB16-088-SO-0002-OCT	SB16-26-NSO-062300-00
28SB-02-NSO-061897-00	EBS85-SB01-050196-00	SB16-058-SO-0002	SB16-073-SO-0002	SB16-089-SO-0001	SB16-27-NSO-062600-00
28SB-03-NSO-061897-00	SB16-007-SO-0002	SB16-059-SO-0002	SB16-073-SO-0002-D	SB16-089-SO-0002	SB16-28-NSO-062700-00
28SB-04-NSO-061897-00	SB16-007-SO-0002-D	SB16-060-SO-0002	SB16-074-SO-0002	SB16-090-SO-0002	SB16-28-SB-001D0002
28SB-05-NSO-061897-00	SB16-021-SO-0002	SB16-060-SO-0002-AUG	SB16-075-SO-0002	SB16-091-SO-0002	SB16-28-SB-01A0002
28SB-06-NSO-061797-00	SB16-022-SO-0002	SB16-060-SO-0002-D	SB16-076-SO-0002	SB16-092-SO-0002	SB16-A2-01-SO-0102
28SB-07-NSO-061897-00	SB16-028-SO-0002	SB16-061-SO-0002	SB16-077-SO-0002	SB16-093-SO-0002	SB16-A2-01-SO-0102-D
28SB-07-NSO-061897-00-D	SB16-047-SO-0002	SB16-062-SO-0102	SB16-078-SO-0002	SB16-093-SO-0102	SOURCE1-1-NSD-032604
28SB-08-NSO-061897-00	SB16-047-SO-0002-AUG	SB16-063-SO-0002	SB16-079-SO-0002	SB16-094-SO-0002	SOURCE1-2-NSD-032604
28SB-08-NSO-061897-00-D	SB16-048-SO-0002	SB16-063-SO-0002-D	SB16-080-SO-0002	SB16-095-SO-0002	SOURCE2-1-NSD-032604
28SB-09-NSO-061897-00	SB16-049-SO-0002	SB16-064-SO-0002	SB16-081-SO-0002	SB16-096-SO-0002	SOURCE2-2-NSD-032604
28SB-10-NSO-061997-00	SB16-050-SO-0001	SB16-065-SO-0002	SB16-081-SO-0002-D	SB16-098-SO-0002	SOURCE3-1-NSD-032604
28SB-11-NSO-061997-00	SB16-050-SO-0002	SB16-066-SO-0001	SB16-082-SO-0002	SB16-099-SO-0002	SOURCE3-2-NSD-032604
28SB-12-NSO-061997-00	SB16-050-SO-0202	SB16-067-SO-0002	SB16-083-SO-0002	SB16-100-SO-0002	28SS-01-NSO-070197-00

TABLE 7-3

TERRESTRIAL WILDLIFE MODEL NOAEL AND LOAEL HQS-CONSERVATIVE EXPOSURE ASSUMPTIONS
PHASE III SURFACE SOIL - UNDEVELOPED AREA -
PHASE III RI FOR IR PROGRAM SITE 16
FORMER NCBC DAVISVILLE
NORTH KINGSTOWN, RHODE ISLAND

Chemical	Meadow Vole		Bobwhite Quail		Short-Tailed Shrew		American Robin	
	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ
Volatile Organic Compounds								
2-BUTANONE	3.54E-06	1.37E-06	NV	NV	3.41E-06	1.32E-06	NV	NV
ACETONE	2.14E-01	4.28E-02	NV	NV	4.07E-02	8.13E-03	NV	NV
CARBON DISULFIDE	2.85E-05	1.40E-05	NV	NV	1.40E-05	6.87E-06	NV	NV
ETHYLBENZENE	NV	NV	NV	NV	NV	NV	NV	NV
METHYLENE CHLORIDE	5.09E-04	5.95E-05	NV	NV	7.51E-05	8.79E-06	NV	NV
TOLUENE	1.58E-04	1.58E-05	NV	NV	1.52E-04	1.52E-05	NV	NV
TOTAL XYLENES	3.23E-03	2.58E-03	NV	NV	6.93E-04	5.54E-04	NV	NV
Semivolatile Organic Compounds								
BIS(2-ETHYLHEXYL)PHTHALATE	7.88E-05	7.88E-06	NV	NV	9.01E-04	9.01E-05	NV	NV
CARBAZOLE	2.69E-02	4.30E-04	1.10E-02	1.10E-03	9.83E-02	1.57E-03	5.17E-02	5.17E-03
DI-N-BUTYL PHTHALATE	9.79E-07	2.94E-07	NV	NV	1.12E-05	3.36E-06	NV	NV
DIBENZOFURAN	1.77E-03	2.83E-05	8.25E-04	8.25E-05	9.65E-03	1.55E-04	5.07E-03	5.07E-04
Polycyclic Aromatic Hydrocarbons								
BENZO(A)ANTHRACENE	5.80E-02	9.29E-04	4.42E-02	4.42E-03	4.03E-01	6.46E-03	2.39E-01	2.39E-02
BENZO(A)PYRENE	7.57E-02	1.21E-03	3.76E-02	3.76E-03	1.92E-01	3.08E-03	1.19E-01	1.19E-02
BENZO(B)FLUORANTHENE	4.55E-01	7.28E-03	1.76E-01	1.76E-02	9.92E-01	1.59E-02	5.42E-01	5.42E-02
BENZO(G,H,I)PERYLENE	1.63E-01	2.60E-03	5.86E-02	5.86E-03	2.88E-01	4.62E-03	1.55E-01	1.55E-02
BENZO(K)FLUORANTHENE	1.36E-01	2.17E-03	7.51E-02	7.51E-03	8.34E-01	1.34E-02	4.55E-01	4.55E-02
CHRYSENE	7.42E-02	1.19E-03	5.89E-02	5.89E-03	7.79E-01	1.25E-02	4.33E-01	4.33E-02
INDENO(1,2,3-CD)PYRENE	6.91E-02	1.11E-03	3.56E-02	3.56E-03	3.97E-01	6.36E-03	2.14E-01	2.14E-02
PYRENE	1.08E+00	1.73E-02	3.64E-01	3.64E-02	7.39E-01	1.18E-02	4.30E-01	4.30E-02
Pesticides/PCBs								
AROCLOR-1260	1.08E-03	1.08E-04	1.58E-03	1.58E-04	4.75E-01	4.75E-02	2.74E-01	2.74E-02
GAMMA-CHLORDANE	3.99E-06	1.99E-06	2.35E-05	4.70E-06	3.40E-04	1.70E-04	1.13E-03	2.26E-04
Dioxins								
TEQ-mammal	1.94E-01	1.94E-02	NA	NA	1.15E+02	1.15E+01	NA	NA
TEQ-bird	NA	NA	8.15E-02	8.15E-03	NA	NA	1.94E+01	1.94E+00
Inorganics								
ALUMINUM	1.82E+01	1.82E+00	1.19E+00	1.19E-01	7.03E+01	7.03E+00	3.56E+00	3.56E-01
ANTIMONY	1.45E+00	3.11E-02	NV	NV	3.33E+01	7.13E-01	NV	NV
ARSENIC	2.39E-01	5.45E-02	2.69E-01	1.34E-01	3.87E-01	8.86E-02	5.84E-01	2.90E-01
BARIUM	9.18E-02	5.75E-02	NV	NV	5.71E-02	3.57E-02	NV	NV
BERYLLIUM	9.60E-02	7.60E-02	NV	NV	1.02E-02	8.09E-03	NV	NV
CADMIUM	2.21E-01	2.46E-02	1.45E-01	3.34E-02	3.74E+00	4.18E-01	3.04E+00	7.02E-01
COPPER	3.62E-01	2.45E-02	8.79E-01	1.02E-01	1.48E+00	1.01E-01	3.87E+00	4.49E-01
IRON	3.60E+00	3.60E-01	6.11E+00	6.11E-01	8.94E+00	8.94E-01	1.52E+01	1.52E+00
LEAD	5.04E-01	1.27E-02	4.34E+00	1.58E-01	2.70E+00	6.80E-02	1.74E+01	6.35E-01
MANGANESE	9.48E-02	3.34E-02	5.13E-02	2.43E-02	7.94E-02	2.80E-02	8.27E-02	3.92E-02
MERCURY	4.52E+00	9.03E-01	2.21E+01	2.21E+00	2.32E+00	4.63E-01	1.84E+01	1.84E+00
SELENIUM	1.19E+00	2.58E-01	6.64E-01	2.35E-01	1.45E+00	3.15E-01	1.28E+00	4.52E-01
THALLIUM	1.88E+00	1.88E-01	NV	NV	5.20E+01	5.20E+00	NV	NV
VANADIUM	1.58E-02	6.94E-03	7.12E-01	1.44E-01	2.97E-02	1.31E-02	1.56E+00	3.15E-01
ZINC	2.77E-01	7.02E-02	4.08E-01	1.58E-01	1.02E+00	2.58E-01	1.96E+00	7.59E-01

-cells are shade if the EEQ > 1.0
HQ = Ecological Effects Quotient
NV = Value not able to be calculated

TABLE 7-4

COPC REFINEMENT
PHASE III SURFACE SOIL - UNDEVELOPED AREA -
PHASE III RI FOR IR PROGRAM SITE 16
FORMER NCBC DAVISVILLE
NORTH KINGSTOWN, RHODE ISLAND

Parameter	Frequency of Detection	Maximum Detected Concentration[1]	Mean Concentration	Average of Positive Detects	Plants		Soil Invertebrate		Background Comparison
					Screening Level	Source	Screening Level	Source	
Volatile Organic Compounds (ug/kg)									
2-Butanone	4/31	55 J	7	22	NV	NV	NV	NV	NA
Acetone	21/33	3700 J	290	450	NV	NV	NV	NV	NA
Carbon Disulfide	1/35	1.6 J	4	2	NV	NV	NV	NV	NA
Semivolatile Organic Compounds (ug/kg)									
Carbazole	4/47	550 J	110	210	NV	NV	NV	NV	NA
Dibenzofuran	3/67	54 J	72	47	NV	NV	NV	NV	NA
Polycyclic Aromatic Hydrocarbons (ug/kg)									
Benzo(a)anthracene	54/54	4,800	230	230	NV	NV	18000	Eco SSL	NA
Benzo(a)pyrene	50/53	2,700	150	150	NV	NV	18000	Eco SSL	NA
Benzo(b)fluoranthene	54/54	7,400	320	320	NV	NV	18000	Eco SSL	NA
Benzo(g,h,i)perylene	33/73	1,904 J	160	250	NV	NV	18000	Eco SSL	NA
Benzo(k)fluoranthene	28/73	6,221 J	260	540	NV	NV	18000	Eco SSL	NA
Chrysene	43/73	6,549 J	350	530	NV	NV	18000	Eco SSL	NA
Indeno(1,2,3-cd)pyrene	28/73	2,708 J	180	330	NV	NV	18000	Eco SSL	NA
Pyrene	48/73	8,017 J	490	690	NV	NV	18000	Eco SSL	NA
Pesticides/PCBs (ug/kg)									
gamma-Chlordane	1/30	2.9 J	1	3	NV	NV	NV	NV	NA
Dioxins (ng/kg)[2]									
TEQ-mammal	8/8	48.5	11.5	11.5	NV	NV	NV	NV	NA
TEQ-bird	8/8	75.3	16.2	16.2	NV	NV	NV	NV	NA
Inorganics (mg/kg)									
Antimony	16/40	17.9	1.9	4.5	5	ORNL	78	Eco SSL	Greater than
Arsenic	38/40	32.3	5	5.2	18	Eco SSL	60	ORNL	Greater than
Cadmium	32/40	4.4 J	0.57	0.68	32	Eco SSL	140	Eco SSL	Greater than
Cobalt	40/40	13.6	5.8	5.8	13	Eco SSL	NV	NV	Greater than
Copper	40/40	143	19.9	19.9	70	Eco SSL	80	Eco SSL	Greater than
Lead	40/40	424	38	38	120	Eco SSL	1700	Eco SSL	Greater than
Manganese	40/40	398	168	168	220	Eco SSL	450	Eco SSL	Greater than
Mercury	18/40	0.26	0.016	0.029	0.3	ORNL	0.1	ORNL	Less than
Selenium	11/40	2.6 J	0.51	1.6	0.52	Eco SSL	4.1	Eco SSL	Greater than
Thallium	16/40	3.5 J	0.71	1.6	1.4	Canadian SQG	1.4	Canadian SQG	Greater than
Vanadium	40/40	16.1	10.3	10.3	130	Canadian SQG	130	Canadian SQG	Less than
Zinc	40/40	616	57.4	57.4	160	Eco SSL	120	Eco SSL	Greater than

NV = No value/screening value not available
NA = Not available/background concentration not avaialble

-Shading indicates that the maximum detected concentration exceeds both background and the screening level and the chemical was evaluated further in Step 3a. Chemicals with an NV were also evaluated further in Step 3a because screening levels were not available.
1 - Sample and duplicate are considered as two separate samples when determining the maximum concentrations.
2 - Value is derived by multiplying criteria for 2,3,7,8-TCDD by World Health Organization Toxicity Equivalent Factor.

Qualifiers:
J - Estimated value

Eco SSL = Ecological Soil Screening Level (USEPA, 2003, 2005, 2006, 2007, 2008)
Canadian SQG = Canadian Soil Quality Guidelines (EC, 1999, 2004a, 2004b)
ORNL = Oak Ridge National Laboratory - Plant (Efroymson, 1997a)
ORNL = Oak Ridge National Laboratory - Invertebrate (Efroymson, 1997b)

TABLE 7-5

TERRESTRIAL WILDLIFE MODEL NOAEL AND LOAEL HQS-LESS CONSERVATIVE EXPOSURE ASSUMPTIONS
PHASE III SURFACE SOIL - UNDEVELOPED AREA -
PHASE III RI FOR IR PROGRAM SITE 16
FORMER NCBC DAVISVILLE
NORTH KINGSTOWN, RHODE ISLAND

Chemical	Meadow Vole		Bobwhite Quail		Short-Tailed Shrew		American Robin	
	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ
Polycyclic Aromatic Hydrocarbons								
PYRENE	7.96E-02	1.27E-03	3.96E-02	3.96E-03	1.00E-01	1.60E-03	5.31E-02	5.31E-03
Dioxins								
TEQ-mammal	NV	NV	NA	NA	4.43E+00	4.43E-01	NA	NA
TEQ-bird	NA	NA	NV	NV	NA	NA	7.97E-01	7.97E-02
Inorganics								
ALUMINUM	2.39E+00	2.39E-01	2.67E-01	2.67E-02	1.53E+01	1.53E+00	9.17E-01	9.17E-02
ANTIMONY	1.51E-01	3.22E-03	NV	NV	1.25E+01	2.67E-01	NV	NV
CADMIUM	3.90E-02	4.36E-03	3.39E-02	7.84E-03	9.22E-01	1.03E-01	8.09E-01	1.87E-01
COPPER	7.16E-02	4.85E-03	1.73E-01	2.02E-02	2.83E-01	1.92E-02	7.18E-01	8.34E-02
IRON	2.50E-01	2.50E-02	6.92E-01	6.92E-02	1.26E+00	1.26E-01	2.33E+00	2.33E-01
LEAD	4.24E-02	1.07E-03	2.59E-01	9.47E-03	5.42E-01	1.37E-02	3.00E+00	1.09E-01
MERCURY	7.97E-02	1.59E-02	6.83E-01	6.83E-02	1.28E+00	2.56E-01	1.07E+01	1.07E+00
SELENIUM	3.15E-01	6.82E-02	2.51E-01	8.87E-02	8.56E-01	1.85E-01	7.48E-01	2.64E-01
THALLIUM	2.31E-01	2.31E-02	NV	NV	2.66E+01	2.66E+00	NV	NV
VANADIUM	2.19E-03	9.65E-04	1.54E-01	3.12E-02	1.19E-02	5.27E-03	5.05E-01	1.02E-01
ZINC	4.59E-02	1.16E-02	8.59E-02	3.32E-02	4.91E-01	1.24E-01	9.45E-01	3.65E-01

-cells are shade if the EEQ > 1.0
HQ = Ecological Effects Quotient
NV = Value not able to be calculated
NA = Not Applicable

Appendix E
ARARs and To Be Considered Guidance

TABLE E-1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE S-3A – SHALLOW EXCAVATION, OFF-SITE DISPOSAL, COVER, MONITORING, AND LUCs
SITE 16 RECORD OF DECISION
NCBC DAVISVILLE
NORTH KINGSTOWN, RHODE ISLAND

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal				
Cancer Slope Factors (CSFs)	-	TBC	Guidance values used to evaluate the potential carcinogenic hazards caused by exposure to contaminants.	Used to compute the individual incremental cancer risk resulting from exposure to carcinogenic contaminants in site media (Industrial exposure in the NCA and recreational exposure near the marina building). Risks due to carcinogens as assessed with slope factors will be addressed through excavation, maintenance of cover, LUCs, and long-term monitoring by preventing exposure to contaminants.
Reference Doses (RfDs)	-	TBC	Guidance values used to evaluate the potential non-carcinogenic hazards caused by exposure to contaminants.	Used to calculate potential non-carcinogenic hazards caused by exposure to contaminants (Industrial exposure in the NCA and recreational exposure near the marina building). Hazards due to noncarcinogens with EPA RfDs will be addressed through excavation, maintenance of cover, LUCs, and long-term monitoring by preventing exposure to contaminants.
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 (Industrial exposure in the NCA and recreational exposure near the marina building). Hazards due to carcinogens assessed through excavation, maintenance of cover, LUCs, and long-term monitoring by preventing exposure to contaminants.

TABLE E-1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE S-3A – SHALLOW EXCAVATION, OFF-SITE DISPOSAL, COVER, MONITORING, AND LUCs
SITE 16 RECORD OF DECISION
NCBC DAVISVILLE
NORTH KINGSTOWN, RHODE ISLAND

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal (continued)				
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 (Industrial exposure in the NCA and recreational exposure near the marina building). Carcinogenic risks to children assessed through this guidance will be addressed through excavation, maintenance of cover, LUCs, and long-term monitoring by preventing exposure to contaminants.
Draft Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds	-	To Be Considered	The draft report includes significant new analyses on potential cancer and non-cancer human health effects that may result from exposures to dioxins and includes an oral reference dose for what is considered to be the most toxic of the dioxin-like compounds.	Risks from dioxins (Industrial exposure in the NCA) assessed under this guidance will be addressed through excavation, maintenance of cover, LUCs, and long-term monitoring by preventing exposure to contaminants.

TABLE E-1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE S-3A – SHALLOW EXCAVATION, OFF-SITE DISPOSAL, COVER, MONITORING, AND LUCs
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Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal (continued)				
Recommenda-tions of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposure to Lead in Soil	-	To Be Considered	EPA guidance for evaluating the risks posed by lead in soil.	Risks from lead (Industrial exposure in the NCA and recreational exposure near the marina building) assessed under this guidance will be addressed through excavation, maintenance of cover, LUCs, and long-term monitoring by preventing exposure to contaminants.

TABLE E-1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE S-3A – SHALLOW EXCAVATION, OFF-SITE DISPOSAL, COVER, MONITORING, AND LUCs
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Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
State				
State of Rhode Island Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases (Short Title: Remediation Regulations)	DEM-DSR-01-93, Section 8.02(A) and Table 1	Applicable	These regulations set remediation standards to prevent direct contact with contaminated soil resulting from the unpermitted release of hazardous material in Rhode Island.	In the NCA area excavation of the top two feet of contaminated soil exceeding industrial direct exposure criteria, maintenance of a clean 2 foot cover, LUCs to protect the cover and prevent exposure to subsurface soils, and monitoring will meet Industrial exposure standards. LUCs to prevent residential use in the NCA area will address remaining areas that exceed unrestricted use criteria for direct contact. Leachability criteria are addressed with the WMA because groundwater standards do not need to be met within the WMA. In the Marina area excavation of the top two feet of contaminated soil exceeding criteria for recreational use, maintenance of a clean 2 foot cover, LUCs to protect the cover and prevent exposure to subsurface soils under the cover and marina buildings, and monitoring will achieve standards to permit continued recreational use of the Marina area.

TABLE E-1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE S-3A – SHALLOW EXCAVATION, OFF-SITE DISPOSAL, COVER, MONITORING, AND LUCs
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Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
State (continued)				
State of Rhode Island Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases (Short Title: Remediation Regulations)	DEM-DSR-01-93, Section 8.02(A)(ii), 8.02(B), and Table 2	Applicable	These regulations set remediation standards to prevent leaching of soil contaminants into groundwater and sediment/surface water resulting from the unpermitted release of hazardous material in Rhode Island.	The remedy will ensure that soil contaminants exceeding these standards do not migrate past the compliance boundary for the waste management area. These leachability criteria will be used to develop monitoring standards for groundwater and sediment /pore water/surface water at the waste management area compliance boundary.

TABLE E-2

FEDERAL AND STATE LOCATION-SPECIFIC ARARs – ALTERNATIVE S-3A – SHALLOW EXCAVATION, OFF-SITE DISPOSAL, COVER, MONITORING, AND LUCs
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Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal				
Floodplain Management and Protection of Wetlands	44 Code of Federal Regulations (CFR) 9	Relevant and appropriate	FEMA regulations that set forth the policy, procedure and responsibilities to implement and enforce Executive Order 11988, Floodplain Management, and Executive Order 11990, Protection of Wetlands.	Remedial alternatives conducted within the 100-year floodplain of Allen Harbor/Narragansett Bay or within federal jurisdictional wetlands will be implemented in compliance with these standards. The Navy solicited public comment as part of the proposed plan on the measures taken through the remedial action to protect floodplain and wetland resources. No comments were received.
Coastal Zone Management Act	16 United States Code (USC) 1451 et. seq.	Applicable	Requires that any actions must be conducted in a manner consistent with state-approved management programs.	Part of the site is located in a coastal zone management area; therefore, applicable coastal zone management requirements need to be addressed.
Endangered Species Act	16 USC 1531 et seq.	Applicable	Requires consultation with appropriate agencies if a threatened or listed species or their habitat may be affected by a federal action.	The Navy will coordinate with appropriate agencies to consider mitigation measures if any remedial actions adjacent to Allen Harbor may affect the habitat of the federally-listed loggerhead turtle (*Carette caretta*), Kemp's ridley turtle (*Lepidochelys kempii*), and Atlantic sturgeon (*Acipenser oxyrinchus*).

TABLE E-2

FEDERAL AND STATE LOCATION-SPECIFIC ARARs – ALTERNATIVE S-3A – SHALLOW EXCAVATION, OFF-SITE DISPOSAL, COVER, MONITORING, AND LUCs
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Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
State				
Coastal Resources Management	Rhode Island General Laws (RIGL) 46-23-1 et seq. and Coastal Resources Management Program	Applicable	Sets standards for management and protection of coastal resources.	Part of the site is located in a coastal resource management area; therefore, applicable coastal resource management requirements need to be addressed**.**

TABLE E-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs – ALTERNATIVE S-3A – SHALLOW EXCAVATION, OFF-SITE DISPOSAL, COVER, MONITORING, AND LUCs
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Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal				
Resource Conservation and Recovery Act (RCRA) Regulations	42 United States Code (USC) 6901 et seq.	Applicable	Rhode Island has been delegated the authority to administer these RCRA standards through its state hazardous waste management regulations. These provisions have been adopted by the State.	Refer to State ARARs for hazardous waste requirements.
CWA, Phase II Storm Water Standards	40 Code of Federal Regulations (CFR) 122.26 and 123	Applicable if over one acre is disturbed	Storm water control standards for construction projects.	Any remedial action that disturbs more than 1 acre of soil will meet these standards to control storm water runoff and prevent erosion.
Clean Water Act, National Recommended Water Quality Criteria (NRWQC)	33 USC 1251 et seq.; 40 CFR 122.44	Relevant and Appropriate	Used to establish water quality standards for the protection of aquatic life.	Water quality monitoring will be conducted to ensure that these criteria are not exceeded during excavation and other remedial activities or during long-term water quality/sediment monitoring of any waste that is left to be managed on site in a waste management area.
Management of Undesirable Plants on Federal Lands	7 USC 2814	Relevant and Appropriate	Requires federal agencies to establish integrated management systems to control or contain undesirable plant species on federal lands under the agency's jurisdiction.	Measures will be taken to control the establishment of *Phragmites*, or other invasive plants within all remediated areas, particularly along the harbor shoreline. An invasive species control plan will be developed as part of the long-term O&M for this site.

TABLE E-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs – ALTERNATIVE S-3A – SHALLOW EXCAVATION, OFF-SITE DISPOSAL, COVER, MONITORING, AND LUCs
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Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal (continued)				
Clean Water Act - National Pollutant Discharge Elimination System (NPDES)	40 CFR 122	Applicable	Establishes the specifications for discharging pollutants from any point source into the waters of the U.S.	Any water discharged to surface water bodies during remedial activities (including excavation of the marina area and installation of the cover) will comply with this regulation.
Safe Drinking Water Act, National Primary Drinking Water Regulations - Maximum Contaminant Levels (MCLs)	40 Code of Federal Regulations (CFR) 141, Subpart G	Relevant and Appropriate	Establishes maximum contaminant levels (MCLs) for common organic and inorganic contaminants applicable to public drinking water supplies. Used as relevant and appropriate cleanup standards for aquifers and surface water bodies that are potential drinking water sources.	MCLs will be used as soil monitoring standards for the waste management area.
Safe Drinking Water Act; National Primary Drinking Water Regulations - Maximum Contaminant Level Goals (MCLGs)	40 CFR 141, Subpart F	Relevant and Appropriate for non-zero MCLGs only	Establishes maximum contaminant level goals (MCLGs) for public water supplies. MCLGs are health goals for drinking water sources. These unenforceable health goals are available for a number of organic and inorganic compounds.	Non-zero MCLGs will be used as soil monitoring standards for the waste management area.
Safe Drinking Water Act, National Primary Drinking Water Regulations, Control of Copper and Lead	40 CFR 141.80(c)(1) and (c)(2) – Lead and Copper Action Levels	Relevant and Appropriate	The requirements of this subpart constitute the national primary drinking water regulations for lead and copper. Used as relevant and appropriate cleanup standards for aquifers and surface water bodies that are potential drinking water sources.	These action levels will be used as soil monitoring standards for the waste management area.

TABLE E-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs – ALTERNATIVE S-3A – SHALLOW EXCAVATION, OFF-SITE DISPOSAL, COVER, MONITORING, AND LUCs
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Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
State				
State of Rhode Island Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases (Short Title: Remediation Regulations)	DEM-DSR-01-93, Section 8.09 (Institutional Controls)	Applicable	Describes the provisions required for environmental land usage restrictions where levels of hazardous substances remain on site at concentrations greater than those protective of residential use.	The substantive portions of this section will be used in the preparation of the LUCs and deed restrictions which would be provided to RIDEM for review. These provisions are listed in subsections A through E.
Rules and Regulations for Hazardous Waste Management, Definition of Hazardous Waste	DEM OWM-HW01-07, Rule 3	Applicable	Under State regulation hazardous wastes are defined as any hazardous waste as defined in 40 CFR 261.3. The standards also apply to "Rhode Island Wastes" which are defined as any waste meeting the definition of R001 through R005 and R010 under the Rule and which do not meet any of the federal definitions of a hazardous waste.	These regulations would apply when determining whether or not a solid waste is hazardous, either by being listed exhibiting a hazardous characteristic or meeting the definition of a Rhode Island Waste.
Standards for Generators of Hazardous Waste	Rules and Regulations for Hazardous Waste Management, Section 5.00	Applicable	Establishes manifesting, pre-transport, and recordkeeping requirements for hazardous waste.	These regulations would apply to the contaminated soil, if hazardous.

TABLE E-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs – ALTERNATIVE S-3A – SHALLOW EXCAVATION, OFF-SITE DISPOSAL, COVER, MONITORING, AND LUCs
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Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
State (continued)				
Clean Air Act - Fugitive Dust Control	Air Pollution Control Regulation No. 5 – Fugitive Dust	Applicable	Requires that reasonable precaution be taken to prevent particulate matter from becoming airborne.	Control of dust during excavation and handling of soil would be implemented to prevent material from becoming airborne.
Clean Air Act - Emissions Detrimental to Persons or Property	Air Pollution Control Regulation No. 7	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.	Methods would be implemented to prevent material from becoming airborne during handling of contaminated material. Monitoring of air emissions during removal will be used to assess compliance with these standards if threshold levels are reached.
Clean Air Act – Volatile Organic Compounds (VOCs)	Air Pollution Control Regulation No. 22 – Air Toxics	Applicable	Prohibits emissions of contaminants that may be injurious to humans, plant or animal life or cause damage to property or that reasonably interferes with the enjoyment of life and property.	Control of emissions during excavation and handling of soil.
Well Standards	State of Rhode Island Rules and Regulations for Groundwater Quality – Appendix 1	Applicable	Identifies the standards and specification that must be followed for the installation or abandonment of monitoring wells.	Applies to wells installed for monitoring and replacement of abandoned wells.

TABLE E-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs – ALTERNATIVE S-3A – SHALLOW EXCAVATION, OFF-SITE DISPOSAL, COVER, MONITORING, AND LUCs
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Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
State (continued)				
Standards for Storm Water Management and Sediment Reduction	Regulations of Rhode Island Pollutant Discharge Elimination System, Rules 15 and 31	Applicable	Identifies storm water management and sediment control requirements for remedial actions or corrective measures involving land-disturbance activities.	Soil excavation activities would need to meet these regulations.
Storm Drainage System Maintenance	Rhode Island General Law (RIGL) 45-61.1(2)(b)	Relevant and Appropriate	Storm drainage systems prone to flooding or contributing significantly to storm water management problems shall be inspected at least once per year and maintained and cleaned as necessary in order to reduce the risks of flooding and ensure proper functioning of storm drain systems.	Storm drain systems created as part of the remedial alternatives will be maintained in compliance with these standards.
Drilling of Drinking Water Wells; Rules and Regulations Governing the Enforcement of Chapter 46-13.2 Relating to the Drilling of Drinking Water Wells	RIGL 46-13..2 *et seq.*	Applicable	Prohibits installing drinking water wells in contaminated aquifers.	Under these standards drinking water wells are prohibited within areas of contamination.

TABLE E-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs – ALTERNATIVE S-3A – SHALLOW EXCAVATION, OFF-SITE DISPOSAL, COVER, MONITORING, AND LUCs
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Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
State (continued)				
Water Pollution Control - Pollutant Discharge Elimination Systems	Regulations of Rhode Island Pollutant Discharge Elimination System	Applicable	Contains effluent monitoring requirements, and standards and special conditions for discharges.	The substantive provisions of these standards will be satisfied through on-site treatment of water from excavations prior to being discharged to surface waters.
Water Pollution Control - Water Quality	RIGL 42-16 et seq.; CRIR 12-190-001	Applicable	Establishes water use classification and water quality criteria for waters of the state.	Water quality standards used to develop monitoring standards both during the active remedial period such as dewatering excavations and for long-term monitoring.
Solid Waste Landfill Regulations - Monitoring	DEM OWM SW02, 2.1.08(c)(1)(i)(B), (C), and (D).	Relevant and Appropriate	Describes horizontal and vertical placement of monitoring wells relative to location of landfill waste.	Monitoring wells installed as part of the LTM program will be located according to these regulations.

TABLE E-4

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-3B - IN-SITU CHEMICAL OXIDATION (EAST END OF FORMER BUILDING 41), MNA, AND LUC
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Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal				
Cancer Slope Factors (CSFs)	-	To Be Considered	Guidance values used to evaluate the potential carcinogenic hazards caused by exposure to contaminants.	Used to compute the individual incremental cancer risk resulting from exposure to carcinogenic contaminants in site media. Risks due to carcinogens as assessed with slope factors will be addressed through chemical oxidation, MNA, LUCs, and long-term monitoring.
Reference Doses (RfDs)	-	To Be Considered	Guidance values used to evaluate the potential non-carcinogenic hazards caused by exposure to contaminants.	Used to calculate potential non-carcinogenic hazards caused by exposure to contaminants. Hazards due to noncarcinogens with EPA RfDs will be addressed through chemical oxidation, MNA, LUCs, and long-term monitoring.
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. Hazards due to carcinogens assessed through chemical oxidation, MNA, LUCs, and long-term monitoring.
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. Carcinogenic risks to children assessed through this guidance will be addressed through chemical oxidation, MNA, LUCs, and long-term monitoring.

TABLE E-4

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-3B - IN-SITU CHEMICAL OXIDATION (EAST END OF FORMER BUILDING 41), MNA, AND LUC
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Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal (continued)				
Safe Drinking Water Act, National Primary Drinking Water Regulations - Maximum Contaminant Levels (MCLs)	40 Code of Federal Regulations (CFR) 141, Subpart G	Relevant and Appropriate	Establishes maximum contaminant levels (MCLs) for common organic and inorganic contaminants applicable to public drinking water supplies. Used as relevant and appropriate cleanup standards for aquifers and surface water bodies that are potential drinking water sources.	MCLs were considered in development of RGs and will be addressed through chemical oxidation, MNA, LUCs, and long-term monitoring. Since this alternative is paired with Alternative S-3A which manages waste in place, then these standards will be used to establish RGs for groundwater outside of the WMA compliance boundary (and used as Action-specific Performance Standards for inside of the compliance boundary).
Safe Drinking Water Act; National Primary Drinking Water Regulations - Maximum Contaminant Level Goals (MCLGs)	40 CFR 141, Subpart F	Relevant and Appropriate for non-zero MCLGs only	Establishes maximum contaminant level goals (MCLGs) for public water supplies. MCLGs are health goals for drinking water sources. These unenforceable health goals are available for a number of organic and inorganic compounds.	Non-zero MCLGs were considered in development of RGs and will be addressed through chemical oxidation, MNA, LUCs, and long-term monitoring. Since this alternative is paired with Alternative S-3A which manages waste in place, then these standards will be used to establish RGs for groundwater outside of the WMA compliance boundary (and used as Action-specific Performance Standards for inside of the compliance boundary).

TABLE E-4

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-3B - IN-SITU CHEMICAL OXIDATION (EAST END OF FORMER BUILDING 41), MNA, AND LUC
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Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal (continued)				
Safe Drinking Water Act, National Primary Drinking Water Regulations, Control of Copper and Lead	40 CFR 141.80(c)(1) and (c)(2) – Lead and Copper Action Levels	Relevant and Appropriate	The requirements of this subpart constitute the national primary drinking water regulations for lead and copper. Used as relevant and appropriate cleanup standards for aquifers and surface water bodies that are potential drinking water sources.	The lead standards in these regulations were considered in development of RGs and will be addressed through chemical oxidation, MNA, LUCs, and long-term monitoring. Since this alternative is paired with Alternative S-3A which manages waste in place, these standards will be used to establish RGs for groundwater outside of the WMA compliance boundary (and used as Action-specific Performance Standards for inside of the compliance boundary).
OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils	EPA/530-D-02-004	To Be Considered	Used to evaluate potential risks associated with indoor air at buildings near the Site.	Potential risks associated with indoor air at buildings on or near the Site will be evaluated, monitored and corrected, consistent with this guidance. LUCs will be used to address vapor intrusion risks by controlling building design and construction methods.

TABLE E-4

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-3B - IN-SITU CHEMICAL OXIDATION (EAST END OF FORMER BUILDING 41), MNA, AND LUC
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Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
State				
State of Rhode Island Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases (Short Title: Remediation Regulations)	DEM-DSR-01-93, Section 8.03	Applicable	These regulations set remediation standards for contaminated media resulting from the unpermitted release of hazardous material in Rhode Island.	Groundwater will achieve numerical groundwater cleanup standards when the standard for a contaminant is more stringent than federal standards. Remediation standards were considered in development of RGs and will be met through will be addressed through chemical oxidation, MNA, LUCs, and long-term monitoring. Since this alternative is paired with Alternative S-3A which manages waste in place, then these standards will be used to establish RGs for groundwater outside of the WMA compliance boundary (and used as Action-specific Performance Standards for inside of the compliance boundary).

TABLE E-5

FEDERAL AND STATE LOCATION-SPECIFIC ARARs – ALTERNATIVE G-3B - IN-SITU CHEMICAL OXIDATION (EAST END OF FORMER BUILDING 41), MNA, AND LUC
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Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal				
Endangered Species Act	16 United States Code (USC) 1531 et seq.	Applicable	Requires consultation with appropriate agencies if a threatened or listed species or their habitat may be affected by a federal action.	The Navy will coordinate with appropriate agencies to consider mitigation measures if any remedial actions adjacent to Allen Harbor may affect the habitat of the federally-listed loggerhead turtle (*Carette caretta*), Kemp's ridley turtle (*Lepidochelys kempii*), and Atlantic sturgeon (*Acipenser oxyrinchus*).
Coastal Zone Management Act	16 USC 1451 et. seq.	Applicable	Requires that any actions must be conducted in a manner consistent with state approved management programs.	Part of the site is located in a coastal zone management area; therefore, applicable coastal zone management requirements need to be addressed.
Floodplain Management and Protection of Wetlands	44 Code of Federal Regulations (CFR) 9	Relevant and appropriate	FEMA regulations that set forth the policy, procedure and responsibilities to implement and enforce Executive Order 11988, Floodplain Management, and Executive Order 11990, Protection of Wetlands.	Remedial alternatives (such as installation/operation of monitoring/treatment wells) conducted within the 100-year floodplain of Allen Harbor/Narragansett Bay or within federal jurisdictional wetlands will be implemented in compliance with these standards. The Navy solicited public comment as part of the proposed plan on the measures taken through the remedial action to protect floodplain and wetland resources. No comments were received.

TABLE E-5

FEDERAL AND STATE LOCATION-SPECIFIC ARARs – ALTERNATIVE G-3B - IN-SITU CHEMICAL OXIDATION (EAST END OF FORMER BUILDING 41), MNA, AND LUC
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Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
State				
Coastal Resources Management	Rhode Island General Laws (RIGL) 46-23-1 et seq. and Coastal Resources Management Program	Applicable	Sets standards for management and protection of coastal resources.	Part of the site is located in a coastal resource management area; therefore, applicable coastal resource management requirements need to be addressed**.**

TABLE E-6

FEDERAL AND STATE ACTION-SPECIFIC ARARs – ALTERNATIVE G-3B - IN-SITU CHEMICAL OXIDATION (EAST END OF FORMER BUILDING 41), MNA, AND LUCs
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Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal				
Resource Conservation and Recovery Act (RCRA) Regulations,	42 United States Code (USC) 6901 et seq.	Applicable	Rhode Island has been delegated the authority to administer these RCRA standards through its state hazardous waste management regulations. These provisions have been adopted by the State.	Refer to State ARARs for hazardous waste requirements.
CWA, Underground Injection Control	40 Code of Federal Regulations (CFR) 144, 146,147	Applicable	Standards for discharge of treated groundwater back into the ground.	These regulations would apply to remedial actions involving underground injection of an oxidizer.
Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites.	OSWER Directive 9200.4-17P, April 21, 1999.	To Be Considered	Used to evaluate the monitored natural attenuation component of the remedy.	Any proposed monitored natural attenuation remedy will evaluated and monitored consistent with this guidance.

TABLE E-6

FEDERAL AND STATE ACTION-SPECIFIC ARARs – ALTERNATIVE G-3B - IN-SITU CHEMICAL OXIDATION (EAST END OF FORMER BUILDING 41), MNA, AND LUCs
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Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal (continued)				
Safe Drinking Water Act; National Primary Drinking Water Regulations - Maximum Contaminant Levels (MCLs)	42 USC Section 300f et seq.; 40 CFR 141, Subpart G	Relevant and Appropriate	Establishes MCLs for common organic and inorganic contaminants applicable to public drinking water supplies. Used as relevant and appropriate standards for aquifers and surface water bodies that are potential drinking water sources.	Groundwater within the compliance boundary for any waste management area established for the soil component of the remedy will be monitored using the standards to evaluate migration beyond the compliance boundary. Since this alternative is paired with Alternative S-3A which manages waste in place, then these standards will be used as Performance Standards for monitoring inside the compliance boundary for the waste management area. LUCs will prevent consumption of groundwater that exceeds these standards.
Safe Drinking Water Act; National Primary Drinking Water Regulations - Maximum Contaminant Level Goals (MCLGs)	42 USC Section 300f et seq.; 40 CFR 141, Subpart F	Relevant and Appropriate for non-zero MCLGs only	Establishes maximum contaminant level goals (MCLGs) for public water supplies. MCLGs are health goals for drinking water sources. These unenforceable health goals are available for a number of organic and inorganic compounds.	Groundwater within the compliance boundary for any waste management area established for the soil component of the remedy will be monitored using the standards to evaluate migration beyond the compliance boundary. Since this alternative is paired with Alternative S-3A which manages waste in place, then these standards will be used as Performance Standards for monitoring inside the compliance boundary for the waste management area. LUCs will prevent consumption of groundwater that exceeds these standards.

TABLE E-6

FEDERAL AND STATE ACTION-SPECIFIC ARARs – ALTERNATIVE G-3B - IN-SITU CHEMICAL OXIDATION (EAST END OF FORMER BUILDING 41), MNA, AND LUCs
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Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal (continued)				
Safe Drinking Water Act, National Primary Drinking Water Regulations, Control of Copper and Lead	40 CFR 141.80(c)(1) and (c)(2) – Lead and Copper Action Levels	Relevant and Appropriate	The requirements of this subpart constitute the national primary drinking water regulations for lead and copper. Used as relevant and appropriate cleanup standards for aquifers and surface water bodies that are potential drinking water sources.	Groundwater within the compliance boundary for any waste management area established for the soil component of the remedy will be monitored using these standards for lead to evaluate migration beyond the compliance boundary. Since this alternative is paired with Alternative S-3A which manages waste in place, then these standards will be used as Performance Standards for monitoring inside the compliance boundary for the waste management area. LUCs will prevent consumption of groundwater that exceeds these lead standards.
Clean Water Act, National Recommended Water Quality Criteria (NRWQC)	33 USC 1251 et seq.; 40 CFR 122.44	Relevant and Appropriate	Used to establish water quality standards for the protection of aquatic life.	Water quality monitoring will be conducted to ensure that these criteria are not exceeded during remedial activities or during long-term water quality monitoring.

TABLE E-6

FEDERAL AND STATE ACTION-SPECIFIC ARARs – ALTERNATIVE G-3B - IN-SITU CHEMICAL OXIDATION (EAST END OF FORMER BUILDING 41), MNA, AND LUCs
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Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal (continued)				
EPA Groundwater Protection Strategy; Guidelines for Ground-Water Classification (November 1986)	August 1984; NCP Preamble, Vol. 55, No. 46, March 8, 1990, 40 CFR Part 300, p. 8733	To Be Considered	The Groundwater Protection Strategy provides a common reference for preserving clean groundwater and protecting the public health against the effects of past contamination. Guidelines for consistency in groundwater protection programs focus on the highest beneficial use of a groundwater aquifer and define three classes of groundwater. These documents defined Class I, II and III groundwaters.	Since this groundwater alternative is paired with Alternative S-3A which manages waste in place, groundwater outside of the compliance boundary for the waste management area established at the Site needs to attain federal drinking water and risk-based standards. Groundwater monitoring using these standards will be used to evaluate migration beyond the compliance boundary. Exceedances of these standards within the compliance boundary are a basis for establishing prohibitions on the use of groundwater within the compliance boundary. An additional buffer zone beyond the compliance boundary to prevent groundwater wells from being installed that would draw contaminated groundwater beyond the compliance boundary may also be established, if required.
Marine Screening Benchmarks	USEPA Region 3 Biological Technical Assistance Group Marine Screening Benchmarks, July 2006	To Be Considered	Media-specific sets of ecotoxicological benchmarks that should be used in developing a screening level risk assessment. These guidelines are to be used to screen exposure through routes other than food chain exposure.	The benchmarks will be used as a basis for the development of trigger levels to evaluate the results of groundwater samples in the vicinity of Allen Harbor. If the groundwater results are greater than the trigger values, then further action will be evaluated.

TABLE E-6

FEDERAL AND STATE ACTION-SPECIFIC ARARs – ALTERNATIVE G-3B - IN-SITU CHEMICAL OXIDATION (EAST END OF FORMER BUILDING 41), MNA, AND LUCs
SITE 16 RECORD OF DECISION
NCBC DAVISVILLE
NORTH KINGSTOWN, RHODE ISLAND

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
State				
State of Rhode Island Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases (Short Title: Remediation Regulations)	DEM-DSR-01-93, Section 8.09 (Institutional Controls)	Applicable	Describes the provisions required for environmental land usage restrictions where levels of hazardous substances remain on site at concentrations greater than those protective of residential use.	The substantive portions of this section will be used in the preparation of the LUCs and deed restrictions which would be provided to RIDEM for review. These provisions are listed in subsections A through E.
Rules and Regulations for Hazardous Waste Management, Definition of Hazardous Waste	DEM OWM-HW01-07, Rule 3	Applicable	Under State regulation hazardous wastes are defined as any hazardous waste as defined in 40 CFR 261.3. The standards also apply to “Rhode Island Wastes” which are defined as any waste meeting the definition of R001 through R005 and R010 under the Rule and which do not meet any of the federal definitions of a hazardous waste.	These regulations would apply when determining whether or not a solid waste, such as drill cuttings from injection wells is hazardous, either by being listed exhibiting a hazardous characteristic or meeting the definition of a Rhode Island Waste.
Standards for Generators of Hazardous Waste	Rules and Regulations for Hazardous Waste Management, Section 5.00	Applicable	Establishes manifesting, pre-transport, and recordkeeping requirements for hazardous waste.	These regulations would apply to well installation and sampling IDW, if hazardous.

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FEDERAL AND STATE ACTION-SPECIFIC ARARs – ALTERNATIVE G-3B - IN-SITU CHEMICAL OXIDATION (EAST END OF FORMER BUILDING 41), MNA, AND LUCs
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Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
State (continued)				
Underground Injection Control Program Rules and Regulations	Regulations pursuant to the authority of Chapter 42-17.1 and Chapter 46-12 of the Rhode Island General Laws	Applicable	Establishes a State Underground Injection Control Program consistent with federal requirements to preserve the quality of the groundwater of the state.	These regulations apply underground injection of oxidizing chemical.
Rules and Regulations Governing Drilling of Drinking Water Wells	Rules and Regulations Governing the Enforcement of Chapter 46-13.2	Applicable	Establish prohibitions against installing drinking water wells in contaminated aquifers.	Remedial alternatives that leave contaminants in place will include prohibitions on installing drinking water wells.
Well Standards	State of Rhode Island Rules and Regulations for Groundwater Quality – Appendix 1	Applicable	Identifies the standards and specifications that must be followed for the installation or abandonment of monitoring wells.	Applies to wells installed for monitoring.