Final
Remedial Investigation/Feasibility Study Report
Sites 33/29 (SHAD-041)
Sharpe Army Depot, Lathrop, California

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USACE Contract No.	W91238-16-C-0013
Version	Final
Date	May 2019

Document Use and Limitations

Document Title:	**Final— Remedial Investigation/Feasibility Study Report** Sites 33/29 (SHAD-041) Sharpe Army Depot Lathrop, California
Prime Contractor:	Ahtna Environmental, Inc.
Contract:	USACE Contract No. W91238-16-C-0013

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Document Approval

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Acronyms and Abbreviations

°F	Degree Fahrenheit
bgs	Below ground surface
cpm	Counts per minute
ft	Foot/feet
keV	Kiloelectron volts
mg/kg	Milligrams per kilogram
pCi/g	Picocuries per gram
pg/g	Picogram per gram
µg/L	Micrograms per liter
Ra-226	Radium-226
Ahtna	Ahtna Environmental, Inc.
ARAR	Applicable or relevant and appropriate requirement
BHHRA	Baseline human health risk assessment
CAMU	Corrective Action Management Unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Contaminant of concern
COPC	Contaminant of potential concern
COPEC	Contaminant of potential ecological concern
DFG	Department of Fish and Game
DFW	Department of Fish and Wildlife
DGL	Downhole gamma log
DI-WET	Deionized-water waste extraction test
DoD	Department of Defense
DQO	Data quality objectives
DTSC	Department of Toxic Substances Control
DTSC-SLs	DTSC-modified Screening Levels
EC	Engineering control
ESSL	Ecological soil screening level
FFA	Federal Facility Agreement
FRTR	Federal Remediation Technologies Roundtable
FS	Feasibility Study
GPS	Global positioning system
GRA	General response action
GWS	Gamma walkover survey
HHRA	Human health risk assessment
IDW	Investigation derived waste
LOQ	Limit of quantitation

Acronyms and Abbreviations (continued)

LUC	Land use controls
MARSSIM	Multi-Agency Radiation Survey and Site Manual
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
O&M	Operation and maintenance
OU	Operable unit
PAH	Polynuclear aromatic hydrocarbons
PCB	Polychlorinated biphenyls
PCDD	Polychlorinated dibenzodioxin
PCDF	Polychlorinated dibenzofuran
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RAO	Remedial action objective
RBSL	Risk-based screening level
RCOC	Radiological contaminant of concern
RCOPC	Radiological contaminant of potential concern
RCRA	Resource Conservation and Recovery Act
RD	Remedial design
RI	Remedial investigation
ROD	Record of Decision
RPD	Relative percent difference
RSL	Regional screening level
SHAD-041	Sites 33/29
Sharpe	Sharpe Army Depot
SLERA	Screening level ecological risk assessment
SOP	standard operating procedure
SSJIDC	South San Joaquin Irrigation District Canal
TCRA	Time Critical Removal Action
TEQ	Toxicity equivalence
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
UU/UE	Unlimited use/unrestricted exposure
VOC	Volatile organic compound

ES-1.0 Executive Summary

This Remedial Investigation (RI) and Feasibility Study (FS) Report presents the methods and findings of an investigation to define the nature and extent of soil contamination and the evaluation of remedial alternatives for Sites 33/29 (SHAD-041) at the Sharpe Army Depot (Sharpe) in Lathrop, California.

ES-1.1 Remedial Investigation

The SHAD-041 RI was conducted pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by Superfund Amendments and Authorization Act of 1986. The RI Work Plan (Ahtna, 2017) documents the regulatory-approved RI plans and procedures.

Activities conducted during the RI were in general accordance with the RI Work Plan. The purpose of this RI was to collect data to characterize the site and determine if further remedial action is necessary. The RI/FS objectives included:

- Define the nature and extent of soil contamination
- Assess the risk to human health and the environment
- Evaluate the need for remedial action
- Develop and evaluate effective remedial action alternatives

ES-1.1.1 Site Background

Sharpe is an Army distribution depot located in Lathrop, California. SHAD-041 is located in the southern portion of the installation within the South Balloon area and is the location of former burn pits used to dispose of wood, paper, empty paint and solvent cans, waste paint, waste solvents, waste oil, and used hydraulic fluid. Radium paint, dials, gauges and other commodities may have also been disposed of at the SHAD-041 burn pits.

Soil sampling completed in 1993 and 1994 indicated elevated lead and chromium concentrations at SHAD-041. In 1996, the Sharpe Operable Unit (OU) 2 Record of Decision (ROD) was signed, and cleanup levels for both lead and chromium in soil were established. Soil sampling completed at SHAD-041 in 1996 and 1998 indicated concentrations of both metals were below cleanup levels, but land use controls (LUC) were implemented as an additional measure to protect human health and the environment.

A radiological survey of SHAD-041, consisting of a walkover survey and collection of two soil samples, was conducted in 2012. Radium-226 (Ra-226) was the only radiological contaminant identified at the site. As a temporary safety measure, a fence was installed around the area of highest potential radiological concern, and warning signs were installed.

ES-1.1.2 Approach and Data Evaluation

Field activities were conducted in October 2017 and included the collection of lithologic data, radiological data, and surface and subsurface soil samples (118 samples were collected from 21 borings). Surface, downhole, and core radiological scans were completed. Samples were analyzed for contaminants of potential concern (COPC) and one radiological contaminant of potential concern (RCOPC). COPCs included chromium, hexavalent chromium, lead, polychlorinated biphenyls (PCB), polychlorinated dibenzodioxin/furans (PCDD/PCDF), polynuclear aromatic hydrocarbons (PAH), and volatile organic compounds (VOC) and the RCOPC Ra-226.

ES-1.1.3 Nature and Extent of Soil Contamination

No chromium, VOCs, or PAHs were detected at concentrations exceeding regional screening levels (USEPA RSLs for residential soil TR=1×10^{-6} THQ=1.0, November 2018) or the recommended screening levels from DTSC HERO HHRA Note 3 (June 2018) at SHAD-041. PCBs were detected in a single soil sample but at levels below the RSL. Lead, hexavalent chromium, and PCDD/PCDF were detected in surface and shallow subsurface soils at concentrations greater than RSLs or the established cleanup level although hexavalent chromium and PCDD/PCDF exceedances were limited. The vertical extent of detected COPCs above the RSLs is limited to a depth of 5 feet (ft) below ground surface (bgs), except for one hexavalent chromium exceedance at 10 ft bgs.

Ra-226 was detected in surface and subsurface soil at SHAD-041 at concentrations above the risk-based screening level (RBSL) at multiple locations and sampling depths. The majority of Ra-226 detections above the RBSL are limited to surface and shallow subsurface sampling depths less than 5 ft bgs. However, Ra-226 was detected just above the RBSL at locations between 9 and 12 ft bgs and well above the screening level at one location at 14 ft bgs; however, the result appears to be an anomaly.

ES-1.1.4 Fate and Transport

Site-related contaminants in soil at SHAD-041 appear to have not substantially migrated and are limited to the area of the burn pits. Site-related contaminants including metals (chromium and lead), PAHs, PCBs, PCDD/PCDF, and Ra-226 share similar properties of adsorbing to the soil (low mobility) and are for all intents and purposes insoluble, non-volatile, and resistant to biodegradation. Dissolution, volatilization, and biodegradation processes are not anticipated to affect the longevity or persistence of these contaminants in soil. Dissimilarly, other site-related contaminants including hexavalent chromium and VOCs are mobile; however, these contaminants were either not detected (i.e., PCBs) or were found to be co-located with low mobility contaminants. Therefore, soil contamination is believed to be stable and is not anticipated to migrate much further than it has since site operations ceased.

Groundwater was not encountered at SHAD-041 during the RI. Depths to groundwater measured in the vicinity of SHAD-041 ranged from 14 to 18.5 feet bgs during the 2014 through 2017 groundwater monitoring events, and flows predominantly to the west-northwest at a gradient of approximately 0.05 ft/ft.

ES-1.1.5 Protection of Human Health and the Environment

A baseline human health risk assessment (BHHRA) quantified the risks of exposure to COPC and radiological contaminants of potential concern (RCOPC) of hypothetical future industrial workers, construction workers, and residents in soil at the SHAD-041.

Non-radiological COPCs, except lead, evaluated at SHAD-041 indicate the calculated total cancer risks and noncancer hazards were within the risk management range of 1×10^{-6} to 1×10^{-4} and less than the threshold of 1 for noncancer hazard for exposure scenarios to the resident, commercial/industrial worker, and construction worker.

Lead and Ra-226 in the soil were the risk drivers for human receptors at SHAD-041. The lead concentrations at SHAD-041 are not protective of the resident, commercial/industrial worker, and the construction worker and the fetuses of adult workers. For Ra-226, the BHHRA levels exceed the risk management range of 1×10^{-6} to 1×10^{-4}. Cancer risks derived for the hypothetical future industrial workers, construction workers, and residents also exceeded the low end of the risk management range.

A tiered (Tier 1 and Tier 2) screening level ecological risk assessment (SLERA) was also performed to evaluate risks from potential exposure of ecological receptors (i.e., burrowing owls) to COPCs and RCOPC in soil at the SHAD-041. The ecological risk assessment for RCOPC passed the Tier 2 (and thus Tier 1) evaluation indicating that no further evaluation is necessary.

Based on a comparison of the average detected concentration of Ra-226 in soil at SHAD-041 to a conservatively derived ecological safe value ratio, ecological risks from exposure are unlikely. Ecological risks from exposure to lead and PCDD/PCDF are likely as ecological soil screening level (ESSL) exceedances for lead, and PCDD/PCDF (990 mg/kg and 0.29 picograms per gram [pg/g], respectively) were detected.

ES-1.1.6 Remedial Investigation Conclusions and Recommendations

The RI was conducted to investigate and characterize the nature and extent of contamination at SHAD-041. Except for lead and a limited number of hexavalent chromium and PCDD/PCDF concentrations, COPCs are not present in the soil at concentrations above the RSLs or established OU 2 ROD cleanup levels.

Ra-226 was detected in surface and subsurface soil at SHAD-041 at concentrations above the RBSL at multiple locations and sampling depths. Also, complete or potentially complete exposure pathways to human and ecological receptors were identified. In its current state, soil concentrations at SHAD-041 are not protective of human health and the environment, and there is a risk to human health from lead and Ra-226 and a risk to ecological receptors from PCDD/PCDF.

Based on the findings of this RI Report, and the risk to the human health and the environment from residual levels of site-specific COCs (lead and PCDD/PCDF) and RCOC (Ra-226), remedial action is required.

ES-1.2 Feasibility Study

An FS was performed to address the risks associated with lead and Ra-226 contaminated surface and subsurface soil to potential human receptors and lead and PCDD/PCDF contaminated surface and subsurface soil to potential ecological receptors. The objectives of the FS are to evaluate remedial alternatives and recommend the most appropriate remedial approach to address the impact to surface and subsurface soil resulting from the historical site use. To meet these objectives, the scope of the FS includes the following:

- Summarize site characteristics and describe the conceptual site model
- Develop remedial action objectives (RAO)
- Identify remedial alternatives that address the RAOs
- Conduct a detailed analysis of the identified remedial alternatives according to the U.S. Environmental Protection Agency's (USEPA) evaluation criteria
- Recommend the remedial alternative that best satisfies the RAOs

ES-1.2.1 Current and Expected Future Land Use

Sharpe contains various buildings and facilities including an Army and Air Force Exchange Services distribution center, Marine reserve center, and California Army National Guard center. Current land use at Sharpe is limited to industrial. Except for a portion of the California Army National Guard center, the future land use at Sharpe is expected to remain industrial. Specifically, SHAD-041 is expected to remain industrial.

ES-1.2.2 Site Characteristics and Conceptual Site Model

Based on the RI results, surface and subsurface soil were identified as the medium of concern at SHAD-041. Lead and Ra-226 were identified as the COC and RCOC to potential human receptors, and lead and PCDD/PCDF were identified as the COCs to potential ecological receptors. Groundwater was not encountered at SHAD-041 during the RI. Depths to groundwater measured in the vicinity of SHAD-041 ranged from 14 to 18.5 feet bgs during the 2014 through 2017 groundwater monitoring events.

Conceptual Site Model

The primary sources of potential COCs and RCOCs at SHAD-041 are related to historical site use, consisting of former burn pits reportedly used to incinerate waste generated at Sharpe. The primary exposure pathways for human and ecological receptors are surface soil handled or tread underfoot and contact with COCs and RCOCs during intrusive activities. Some pathways of human and ecological receptors to COCs and RCOCs, such as exposure of terrestrial and aquatic biota via soil, sediment, surface water, and the food chain, are considered potentially complete. Groundwater was not evaluated during the RI.

Site Characteristics

COC concentrations exceeding RSLs or ROD cleanup levels were limited to surface and subsurface soil in the following areas:

- 0 to 5 ft bgs ......Central-eastern portion of the site for lead and PCDD/PCDF
- 0 to 2.5 ft bgs ...Northwestern portion of the site for lead and hexavalent chromium
- 10 ft bgs ....Southern portion of the site for an isolated hexavalent chromium exceedance

RCOC concentrations exceed the Ra-226 RBSL were limited to surface and subsurface soil in the following areas:

- 0 to 5 ft bgs ......Across the majority of the site
- 0 to 12 ft bgs ....Eastern portion of SHAD-041
- 14 ft bgs ....Isolated location in the east/northeastern portion
- 12 ft bgs ....Isolated and discontinuous areas in the northwest
- 11 to 12 ft bgs ..South-central portion

COC concentrations exceeding ESSLs for lead and PCDD/PCDF were limited to surface and subsurface soil in the following areas:

- 0 to 5 ft bgs ......Eastern portion of SHAD-041 for PCDD/PCDF
- 0 to 5 ft bgs ......Northwest corner, one exceedance for PCDD/PCDF
- 0 to 5 ft bgs ......Sitewide lead exceedances

Soils were likely impacted because of contaminants from the burn pits leach into the soil surface and subsurface. The approximate extent of existing waste and debris at SHAD-041 was delineated during the RI based on field observations during drilling and survey measurements. At borings with analyte exceedances; waste, debris, and ash were observed in shallow soils during drilling. The approximate horizontal extent of shallow impacted soil across the site (between approximately 0 and 5 ft bgs) is about 250 ft on the north-south axis and 300 ft east-west. The approximate extent of deeper impacted soils includes five isolated areas; four are estimated to be 20 × 20 ft and a fifth area 50 × 50 ft.

Based on the RI results, site-related contaminants in soil at SHAD-041 have not substantially migrated, and are contamination is limited to the area of the original burn pits. Site-related contaminants in soil include Ra-226, lead, and PCDD/PCDF, which share similar properties of adsorbing to the soil (low mobility) and are for all intents and purposes insoluble, non-volatile, and resistant to biodegradation. Dissolution, volatilization, and biodegradation processes are not anticipated to affect the longevity or persistence of these contaminants in soil. Dissimilarly, other site-related contaminants including hexavalent chromium, VOCs, and PCBs are mobile; however, these contaminants were either not detected (i.e., PCBs) or were found to be co-located with low mobility contaminants. Therefore, soil contamination is believed to be stable and is not anticipated to migrate much further than it has since site operations ceased.

ES-1.3 Remedial Action Objectives

Remedial action objectives (RAO) are developed to identify media-specific goals for protecting human health and the environment. Concentrations of contaminants in soil currently exceed RSLs, RBSL, and ROD cleanup levels. Therefore, the following RAOs were developed for SHAD-041:

- Restore soil to conditions suitable for industrial/commercial site use by meeting the OU 2 ROD cleanup level for lead (1,000 mg/kg) and a risk-based cleanup level for Ra-226 (2.18 pCi/g).
- Prevent exposure to ecological receptors from lead and PCDD/PCDF in surface and subsurface soils at concentrations above the ecological RBSLs of 990 mg/kg and 1.6 pg/g, respectively.

ES-1.3.1 Remedial Action Alternatives

The initial screening of general response actions (GRA), remedial technologies, and process options, identified the following six remedial alternatives:

- Alternative 1 .... No Action
- Alternative 2.......... Land Use Controls
- Alternative 3.......... On-Site Treatment and Land Use Controls
- Alternative 4A .... Excavation and Off-Site Disposal, Industrial Use
- Alternative 4B .... Excavation and Off-Site Disposal, Unlimited Use/Unrestricted Exposure
- Alternative 5.......... Excavation, On-Site Containment, and Land Use Controls

ES-1.3.2 Analysis of Remedial Action Alternatives

The National Contingency Plan (NCP) lists three screening criteria by which each remedial alternative must be assessed. The NCP screening criteria are:

- **Threshold Criteria** which must be met for alternative acceptance: protection of human health and the environment, and compliance with applicable or relevant and appropriate requirements (ARAR).
- **Balancing Criteria** which are used to weigh major tradeoffs among alternatives: long-term effectiveness and permanence; reduction of toxicity, mobility or volume through short-term treatment; short-term effectiveness; implementability; and cost.
- **Modifying Criteria** which are evaluated and assessed upon comments on the FS and the proposed plan: State of California and community acceptance.

Alternative 1 — No Action: The NCP requires a “no-action” alternative to be developed for the FS. This alternative is included to provide a baseline for evaluation of other alternatives in accordance with the NCP and CERCLA requirements. This alternative does not meet the threshold criteria.

Alternative 2 — Land Use Controls: This alternative would use LUCs to prevent human exposure to unacceptable risk from lead, PCDD/PCDF, and Ra-226 in surface and subsurface soil. This alternative would meet all identified chemical-, location-, and action-specific ARARs and would be effective in achieving the RAOs for the protection of human health. However, this alternative does not meet the threshold criteria as LUCs will not be effective in protecting ecological receptors.

Alternative 3 — On-Site Treatment and Land Use Controls: This alternative would employ stabilization to prevent exposure to humans and wildlife from an unacceptable risk from lead, PCDD/PCDF, and Ra-226 in surface and subsurface soil. A treatment to solidify the soil, creating a solid mass, would be used to reduce the overall toxicity and mobility. However, stabilization of the soil would cause a 50 percent increase in volume. This alternative would meet all identified chemical-, location-, and action-specific ARARs and would be protective of human health and the environment. In addition, this alternative would provide long-term effectiveness and permanence by stabilizing contaminated surface and subsurface soils. LUCs would be required to ensure continued protectiveness of human health and the environment.

Alternative 4A — Excavation and Off-Site Disposal, Industrial Use: This alternative includes excavation and off-site disposal of surface and subsurface soil posing an unacceptable risk to human and ecological receptors under the industrial/commercial land use scenario. Excavated soil would be transported to an appropriately licensed or permitted off-site disposal facility. This alternative would meet all identified chemical-, location-, and action-specific ARARs and would be protective of human health and the environment. In addition, this alternative provides long-term effectiveness and permanence by removing contaminated soil from the site. However, maintenance or monitoring and LUCs would be required. This alternative does not provide for unrestricted exposure and unlimited use of the site.

Alternative 4B — Excavation and Off-Site Disposal, Unlimited Use/Unrestricted Exposure: This alternative includes excavation and off-site disposal of surface and subsurface soil posing an unacceptable risk to human and ecological receptors under the potential future residential use scenario. Excavated soil would be transported to an appropriately licensed or permitted off-site disposal facility. This alternative would meet all identified chemical-, location-, and action-specific ARARS and would be protective of human health and the environment. In addition, this alternative provides long-term effectiveness and permanence by removing contaminated soil from the site. No maintenance or monitoring and no LUCs would be required. This alternative provides unlimited use and unrestricted exposure (UU/UE) of the site.

Alternative 5 — Excavation, On-Site Containment, and Land Use Controls: This alternative includes excavation and on-site containment of surface and subsurface soil posing an unacceptable risk to humans and ecological receptors. Excavated soil would be consolidated in an on-site corrective action management unit (CAMU). This alternative includes long-term maintenance and monitoring of the CAMU and LUCs to prevent exposure of potential future residents. This alternative would meet all identified chemical-, location-, and action-specific ARARS and would be protective of human health and the environment. LUCs would be required to ensure continued protectiveness of human health and the environment.

ES-1.3.3 Recommended Remedial Alternative

Alternative 4A is the preferred alternative for SHAD-041. Alternative 4A meets all identified chemical-, location-, and action-specific ARARS and is protective of human health and the environment. In addition, this alternative provides long-term effectiveness and permanence by removing contaminated soil from the site and is cost-effective. After the soil removal, confirmation samples are collected, and COCs/RCOC measured to document the RAOs have been met.

Alternative 4A may be implemented either through the CERCLA Time or non-time Critical Removal Action (TCRA) or the conventional CERCLA Proposed Plan and ROD process. The Army recommends implementing Alternative 4A through the TCRA process as property transfer is pending.

1.0 Introduction

On behalf of the U.S. Army Environmental Command and the U.S. Army Corps of Engineers (USACE) Sacramento District, per Contract W91238-16-C-0013, and in accordance with the U.S. Environmental Protection Agency's (USEPA) *Guidance for Conducting Remedial Investigations and Feasibility Studies Under Comprehensive Environmental Response, Compensation, and Liability Act* (USEPA, 1988), Ahtna Environmental, Inc. (Ahtna) has prepared this Remedial Investigation/Feasibility Study (RI/FS) Report for the Sharpe Army Depot (Sharpe) Sites 33/29 (SHAD-041).

The need for radiological assessment at SHAD-041 was identified in the *Final 3rd Five-Year Review Report* (URS, 2014a). This RI/FS Report summarizes investigation and sampling activities completed at SHAD-041 to characterize the nature and extent of contamination in the soil, assess the risk to human health and the environment, and develop and evaluate effective remedial alternatives.

1.1 Purpose and Scope

The purpose of the RI/FS is to determine whether a response action is necessary for surface and subsurface soil at SHAD-041, and if so, evaluate remedial alternatives to address contamination that poses an unacceptable risk to human health and the environment. Surface and shallow subsurface soil is the medium of concern for this RI/FS. Other media (e.g., groundwater, soil vapor, and plant tissue) were not investigated, and they are not addressed in the FS.

This RI/FS was prepared in accordance with the National Contingency Plan (NCP), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and USEPA guidance (USEPA, 1988). The NCP states that remediation should be accomplished using cost-effective remedial alternatives that effectively lessen threats to and provide adequate protection of public health, welfare, and the environment (USEPA, 1998).

During the FS process, remedial alternatives were developed by incorporating media-specific technologies into cleanup alternatives. The process consists of the following general steps:

- Develop remedial action objectives (RAO) specifying the chemicals and media of concern, exposure pathways, and remedial goals that permit a range of treatment and containment alternatives to be developed. The RAOs are developed based on chemical-specific applicable or relevant and appropriate requirements (ARAR) and results of the human health risk assessment (HHRA).
- Develop general response actions (GRA) for each medium, singly or in combination that may be taken to satisfy the RAOs for the site. Identify volumes or areas to which GRAs would apply.
- Identify and screen remedial technologies for each GRA to identify which technologies could be implemented technically and cost effectively at the site.
- Identify and screen process options for each remedial technology that is most appropriate for use at the site.
- Develop remedial alternatives by combining retained process options.
- Evaluate the alternatives against the evaluation criteria established by the NCP and against each other.

2.0 History and Environmental Setting

This section presents a brief history and setting for SHAD-041. A comprehensive discussion of the Sharpe history and setting is reported in the *Remedial Investigation/Feasibility Study at Sharpe Site, Soils Feasibility Study Report* (ESE, 1994a).

2.1 Location

Sharpe is located in the primarily agricultural San Joaquin Valley, east of the San Joaquin River and southeast of the Sacramento-San Joaquin Delta. Sharpe is located in San Joaquin County, within the city limits of Lathrop. The unincorporated community of French Camp borders Lathrop to the northwest, and the city of Manteca borders Lathrop to the east. Nearby large urban communities include the city of Stockton approximately nine miles to the north and the city of Modesto approximately 20 miles south of the depot (Figure 1). Properties surrounding Sharpe include a mixture of light industrial, agricultural, commercial, and residential properties. Railroad rights-of-way parallel the eastern and western boundaries of the installation, with Roth and Lathrop Road paralleling the northern and southern boundaries. Sharpe ranges in elevation from approximately 15 to 23 feet above mean sea level.

The future land use at Sharpe, and specifically SHAD-041, is expected to remain industrial/storage. SHAD-041 is located inside the secure Sharpe installation boundary (Figure 2). The surface of SHAD-041 is relatively flat with sparsely vegetated soil. No structures are present at SHAD-041.

2.2 Facility Description and History

For most of Sharpe’s existence, the installation’s principal missions were to store, ship, and package general supplies and maintain equipment. These tasks required the use of petroleum hydrocarbon fuels and a variety of industrial chemicals. Inadvertent releases of these chemicals contaminated installation soil, soil vapor, and groundwater through a variety of fate and transport processes.

Currently, the Army and Air Force Exchange Service operates a distribution center in the southern portion of the depot, the Marines conduct military reserve training in the northwestern corner of Sharpe, and the California Army National Guard leases approximately 53 acres in the northern portion of Sharpe.

Wastes generated at Sharpe were primarily a result of former maintenance operations such as paint stripping, metal finishing, and painting. Other waste-generating activities included engine overhauls; hydraulic and electrical repairs; airframe and bodywork; and component repair and reconditioning. These activities required the use of petroleum hydrocarbon fuels and a variety of other industrial chemicals (e.g., chlorinated solvents). Releases of these chemicals contaminated installation soil and groundwater through a variety of fate and transport processes.

Radiological materials were also previously stored at Sharpe. Buildings 482, 483, and 484 and outside paved areas surrounding Buildings 482, 483, 484, and 485 were used as the primary storage location for radioactive commodities from the 1960s until 2001, while sealed sources were stored in Building 403 from August 1996 until August 1997 (Weston, 2002). Building 485 housed the radioactive material packing area and the counting laboratory. Sensitive commodities containing radioactive material were stored at the Building 404 vault, and radioactive commodities were also stored at Building 691 (Tidewater, 2012). All of the radioactive storage areas were classified as Class 3 locations. Interviews with personnel during the Environmental Baseline Survey in 2002 indicated there had been no reported releases of radioactivity to the storage locations (Weston, 2002). Radiological surveys of the Sharpe buildings were conducted in 2002 (Weston, 2002). Since October 2001, all radioactive commodities have been stored elsewhere, while waste consolidation for disposal was performed at Sharpe (Tidewater, 2012).

Placed on the National Priorities List in 1987, Sharpe entered into a four-party Federal Facilities Agreement (FFA) in 1989. As described in the FFA (USEPA, 1994), authority for environmental restoration decision-making rests with a team of remedial project managers from the California Environmental Protection Agency including Department of Toxic Substances Control (DTSC) and Central Valley Regional Water Quality Control Board, USEPA Region 9, and Sharpe. The Defense Logistics Agency transitioned Sharpe back to the Army effective October 1, 2014. The Army is the lead agency responsible for funding and implementing remedial actions at Sharpe.

The FFA established two operable units (OU) to facilitate environmental restoration at Sharpe. OU 1 addresses groundwater in four saturated monitoring zones (designated as A, B, C, and D) and is primarily contaminated with volatile organic compounds (VOC). The *DDRW-Sharpe Site Record of Decision, Operable Unit 1* (ROD; ESE, 1993) documents groundwater extraction, treatment, and discharge of treated effluent as the selected remedy for contaminated groundwater. The *Explanation of Significant Differences to the Record of Decision Operable Unit 1* (URS, 2014b), which adds in situ treatment of high levels of subsurface contamination and land use controls (LUC), was signed and approved by the regulatory agencies and the Army in September 2014. OU 2 addresses soil and soil gas above the water table. The OU 2 ROD "*Final Record of Decision Basewide Remedy for DDRW – Sharpe Site*" (ESE, 1996) documents extraction and treatment of VOC-contaminated soil vapor and no further action at multiple sites. In June 2011, the *Final Amendment to the Record of Decision Basewide Remedy for Defense Distribution Depot San Joaquin – Sharpe Site, Operable Unit 2—Soils* (URS, 2011a) modified the no further action decision to ensure protectiveness by adding LUCs at ten sites and biological monitoring at two sites for the burrowing owl (*Athene cunicularia*), a California species of special concern.

2.3 Site History

Waste from paint stripping operations at Sharpe was disposed of at the industrial wastewater treatment plant and SHAD-041 (Figure 2). Waste sludge was routinely trucked to the industrial wastewater treatment plant, where liquids were discharged into the oxidation ponds for treatment and solids were spread on the ground in the South Balloon area (i.e., SHAD-041). The solids were then turned into the ground during tests of refurbished heavy equipment in an attempt at bioremediation. Tests called for four hours of continuous operation; therefore, it is presumed that the waste was thoroughly mixed with the soil (ESE, 1994a).

Other wastes disposed of at the SHAD-041 burn pits included wood, paper, empty paint and solvent cans, waste paint, waste solvents, waste oil, used hydraulic fluid, and "anything else that would burn" (ESE, 1994a). Radium paint, dials, gauges and other commodities may have also been disposed of at the SHAD-041 burn pits. Contaminated fuel reportedly was not disposed of in the pits.

Sampling conducted in 1993 indicated the presence of elevated lead and chromium concentrations in soil (ESE, 1994a). In 1993, 22 soil samples were field-analyzed using X-ray fluorescence at SHAD-041 during the 1994 RI (ESE, 1994b). The maximum concentrations of chromium and lead were 329 milligrams per kilogram (mg/kg) and 1,542 mg/kg, respectively. The OU 2 ROD required excavation/off-site disposal of soil at SHAD-041 with concentrations that exceeded the cleanup standards (300 mg/kg for chromium and 1,000 mg/kg for lead) in soil from 0 to 2 ft below ground surface (bgs). The OU 2 ROD also established soluble action levels for chromium (50 micrograms per liter [µg/L]) and lead (150 µg/L) in deionized-water waste extraction test (DI-WET) extracts from soil (ESE, 1996).

Additional soil sampling was conducted in April 1994 at SHAD-041 to delineate and characterize potential lead and chromium contamination (ESE, 1994a). Among other metal constituents, lead and chromium were detected in the burn pit soils. Additionally, geophysical methods were used to map the location of eight burial trenches and pits at SHAD-041, which indicated that the trenches and pits might contain buried metals (ESE, 1994a).

After the OU 2 ROD was signed in 1996, additional soil samples were collected at SHAD-041 to delineate soils contaminated with chromium and lead at concentrations exceeding the cleanup standards. In the 1996 post-ROD investigation, both surface and subsurface soil samples (2 to 12.5 ft bgs) were collected. The maximum concentrations of chromium (32 mg/kg) and lead (670 mg/kg) were less than the cleanup standards. In addition, all DI-WET extraction results indicated that concentrations of lead and chromium did not exceed their soluble action levels.

In 1998, additional site characterization soil sampling was conducted at the request of the Central Valley Regional Water Quality Control Board. Maximum concentrations of chromium (59.9 mg/kg) and lead (509 mg/kg) were both less than the cleanup standards. Soluble chromium was detected in a groundwater sample collected from one location at 50.8 µg/L, which slightly exceeded the action level of 50 µg/L but was the only exceedance at SHAD-041. Soluble lead concentrations in DI-WET extracts were less than the 150 µg/L action level. Figures 3 and 4 depict chromium and lead concentrations, respectively.

Results of samples collected in 1996 and 1998 indicated that there was no threat to on-site adult workers or groundwater quality at SHAD-041 because all chromium and lead concentrations were less than the cleanup standards and soluble action levels (except one soluble chromium concentration, as noted above). Sample density was considered sufficient to decide that soil removal and disposal would not be necessary at the site (Radian International, 2000a).

Concentrations of chromium and lead in soil at SHAD-041 were less than the OU 2 ROD industrial-based cleanup standards. However, those cleanup standards do not allow for UU/UE (e.g., residential use) and LUCs were implemented to protect human health and the environment. The majority of post-ROD investigation samples were collected from 0 to 2 ft bgs based on the OU 2 ROD remedial excavation requirements for metals sites. A conservative evaluation of the need for LUCs at SHAD-041 was based on the results of pre-ROD samples collected from depths below 2 ft bgs and all post-ROD sample results.

In 2012, low-level radiological activity was detected at SHAD-041. A radiological survey, consisting of a walkover survey and two soil samples, conducted in January 2012, determined the radiation at SHAD-041 was above the background level of 0.5 picocuries per gram (pCi/g) and that a worker within the site would likely receive a radiation dose less than a standard chest X-ray during an 8-hour day (Tidewater, 2012). The surveyed area at SHAD-041 was approximately 150 feet along the eastern edge, 320 feet along the southern edge, 160 feet along the western edge, and 340 feet along the northern edge next to Parameter Road.

Tritium was not detected above screening levels in 2012. Although multiple radionuclides were evaluated, including cobalt-60, americium-241, plutonium-239, uranium and thorium isotopes, nickel-63, and cesium-137, the only radiological contaminant of concern identified during the 2012 survey was Ra-226. The source of the radiation was suspected to be radium paint, dials, gauges, and other commodities in the ground surface, perhaps associated with a prior burn pit, although characterization of the site was not completed. As a temporary safety measure, a fence was installed around the area of highest potential radiological concern, and warning signs were installed reading “Caution: Radioactive Material.”

Historical investigations at Sharpe and SHAD-041 revealed that contamination of soil and groundwater resulted primarily from releases of industrial cleaning solvents, petroleum fuels, metals, and pesticides. Additionally, chromium and lead in surface soils at SHAD-041 resulted from the operation of open debris burn pits used to dispose of empty paint containers, wood, paper, hydraulic fluid, and other combustible material (ESE, 1994a). Other contaminants of potential concern (COPC) at SHAD-041 include polychlorinated dibenzodioxin/furans (PCDD/PCDF), polychlorinated biphenyls (PCB), VOCs, polynuclear aromatic hydrocarbons (PAH), and radiological contamination (Ra-226).

2.4 Climate

The climate at Sharpe is characterized by dry, hot summers and wet, mild winters. Summer temperatures range from approximately 60 degrees Fahrenheit (°F) to more than 100°F and winter temperatures range from approximately 30°F to 50°F. The majority of the precipitation occurs between December and April, and annual rainfall since 1976 has averaged 12.94 inches (median of 11.69 inches). Rainfall varies from as much as 27 inches in wetter years to as little as 6 inches in drier years. The only surface water is present at SHAD-041 occurs during and immediately following precipitation events.

2.5 Geology

Sharpe is located in the broad, low-lying Central Valley of the Great Valley Geomorphic Province. The uppermost portion of the valley is filled with lacustrine, alluvial, and fluvial deposits of Pliocene through Holocene age. Surficial fan, interfan, and flood-basin deposits overlie discontinuous layers and lenses of alluvial fan and stream deposits of the Victor Formation (also known as the Modesto/Riverbank Formation) and the underlying Laguna Formation. The fan and interfan deposits consist of unconsolidated sands, silts, and clays with the fan deposits also containing gravels. Fine sand and clay in flood-basin deposits occur near a paleochannel of the San Joaquin River. Both the Victor and Laguna Formations are heterogeneous, containing interbedded gravels, sands, silts, and clays. The contact between the Victor and Laguna Formations is not readily apparent. The lithologic units (i.e., sand or gravel lenses, silt or clay layers) within these formations are discontinuous and generally do not correlate over areas greater than approximately 0.2 square miles (130 acres). More continuous clay layers within the Laguna Formation have been noted and are discussed in Section 2.6.

The soils at SHAD-041 are primarily composed of silty sands, clayey sands, sandy silts, silts and clays (Appendix A).

2.6 Hydrogeology

Sharpe is located in the Eastern San Joaquin Subbasin of the San Joaquin Valley Groundwater Basin. In Stockton and Lathrop, groundwater is first encountered in the Victor Formation deposits at approximately 15 to 20 ft bgs. The saturated Victor deposits are approximately 55 ft thick and typically are coarser grained and more permeable than the underlying Laguna deposits. The Laguna deposits are reported to average 1,400 ft thick near Stockton (DWR, 2006).

The Laguna Formation is the time-stratigraphic equivalent of the Tulare Formation, which occurs in other portions of the San Joaquin Valley Groundwater Basin. At Sharpe, clay layers from 20 to 40 ft thick occur within the depth interval of 180 to 250 ft bgs. These clay layers are sufficiently continuous to serve as confining layers. A discontinuous “blue clay” has been reported at depths ranging from 230 to 280 ft bgs within the Laguna deposits in logs for certain wells at and near Sharpe. These blue clays may represent the lacustrine deposits identified elsewhere in the San Joaquin Valley Groundwater Basin. However, the regionally extensive Corcoran Clay member of the Tulare Formation, which separates that formation into an upper and lower aquifer, is not observed in the Eastern San Joaquin Subbasin, on which Sharpe is situated (Hotchkiss, 1972; DWR, 2006). Beneath the clay deposits, the Laguna Formation contains interbedded gravel, sand, silt, and clays above its boundary with the Mehrten Formation. Both the deep Laguna Formation and the Mehrten Formation (approximately 250 and 800 ft bgs, respectively) produce groundwater for agricultural, private, and municipal water wells.

The deepest freshwater aquifer in the Eastern San Joaquin Subbasin is in the Mehrten Formation, which consists of stream-deposited semiconsolidated to consolidated clays, silts, sands, and gravels that coarsen downward. Because of extensive water supply pumping, the Mehrten and Laguna Formation deposits have been affected by the encroachment of saline water from west of Sharpe (Brown and Caldwell Consulting Engineers, 1985).

In the Sharpe area, there is one complex, heterogeneous aquifer system in which four hydrostratigraphic zones have been identified in the hydrogeologic system between 14 and 270 ft bgs. These hydrostratigraphic zones are considered distinct zones to monitor hydraulic gradients and contaminant migration. The zones include several saturated transmissive layers (sands) 5 to 12 ft thick in the following depth intervals:

- A Zone—water table to 40 ft bgs
- B Zone—40 to 90 ft bgs
- C Zone—90 to 170 ft bgs
- D Zone—170 to 270 ft bgs

In the A Zone, groundwater is generally unconfined; however, the fine-grained deposits in the Lower A Zone and Upper B Zone (also known as the A/B aquitard) locally create confining conditions. Although there is good continuity of the confining layer across Sharpe, groundwater and dissolved contaminants can move from the A Zone through the B Zone and into the C Zone because the confining layer in some areas is thinner and contains more sand and because there have been strong vertical hydraulic gradients caused by pumping of on-depot and off-depot water supply wells. The B, C, and D Zones have hydraulic characteristics of leaky confined aquifers.

Subsurface soils vary from clay and silt to coarse sand. Within each of the zones, deposits containing each of the soil types can be found; however, the deposits vary in thickness vertically and horizontally across Sharpe. Silt and clay are the dominant soil types beneath Sharpe, and those deposits are interbedded with sands. The deposit that apparently has the greatest continuity consists of a mix of clay and silt with thin silty sands in the Lower A Zone and the Upper B Zone (approximately 30 ft bgs to 70 ft bgs). This fine-grained deposit (also known as the A/B aquitard) slows the horizontal and vertical migration of groundwater and contaminants. Sands are generally thicker and more abundant in the C and D Zones. Because the transmissivities of the sands in those zones allow groundwater to move at a higher velocity, agricultural and domestic supply wells were installed in those two zones, and in some cases, deeper zones in the area of Sharpe.

Depths to groundwater measured in the vicinity of SHAD-041 range from 14 to 18.5 feet bgs during the 2014 through 2017 groundwater monitoring events.

Groundwater generally flows from the east to the west-southwest in the South Balloon and SHAD-041 area in the A, B, and C Zones. In the D Zone, groundwater generally flows from the south to the north-northwest. Horizontal hydraulic gradient ranges in the A, B, C, and D hydrostratigraphic zones include:

- A Zone: 0.0021 – 0.0027 foot per foot (ft/ft)
- B Zone: 0.0011 – 0.0023 ft/ft
- C Zone: 0.0009 – 0.0039 ft/ft
- D Zone: 0.0006 – 0.0008 ft/ft

Horizontal hydraulic gradients calculated from water levels measured in 1Q17 and 3Q17 relative to the gradients calculated for 2016 were generally the same or greater in the A and C Zones, the same or smaller in the B Zone, and the same in the D Zone.

Vertical hydraulic gradients calculated from A and B Zone wells indicate predominantly fluctuating or downward gradients between the A and B Zones. Vertical gradients between the A and B Zones ranged from -0.36 ft/ft to 0.19 ft/ft during the 2017 monitoring period. The range of vertical gradients between the A and B Zones calculated with data from the 2017 monitoring period was slightly larger than the range of gradients calculated for the 2016 monitoring period (-0.39 to 0.034 ft/ft).

In the South Balloon area, vertical hydraulic gradients range from -0.412 ft/ft to 0.351 ft/ft between the B and C Zones during the 2017 monitoring period. The range of vertical gradients between the B and C Zones calculated with data from the 2017 monitoring period was much larger than the range of gradients calculated for the 2016 monitoring period (0.040 to 0.041 ft/ft). The steepest downward gradient was calculated from water levels measured in 3Q17 at well pair MW445B/MW445C, adjacent to EWC4 in the South Balloon area. The downward hydraulic gradient is likely the result of extraction at EWCB5. The greatest upward vertical hydraulic gradient was calculated from water levels measured in 1Q17 at well pair MW441B/MW441C in the South Balloon area. The cause of the upward hydraulic gradient is unknown and will continue to be evaluated during future sampling events.

The direction of vertical gradients between the C and D Zones was predominantly either downward or fluctuating. Vertical gradients between the C and D Zones range from 0.078 ft/ft to 0.040 ft/ft. The magnitude of the greatest upward vertical hydraulic gradient was very similar in the 2017 and 2016 monitoring periods (0.040 ft/ft and 0.048 ft/ft, respectively).

2.7 Surface Water

No surface water bodies are present at SHAD-041. The only surface water at SHAD-041 occurs during and immediately following precipitation events.

Most surface water runoff at Sharpe and at SHAD-041 is collected by the stormwater drainage system (detention ponds and stormwater drains throughout the installation), which discharges to the South San Joaquin Irrigation District Canal (SSJIDC) located approximately 1,200 feet east from SHAD-041, parallel to Sharpe’s eastern boundary. The SSJIDC drains north into French Camp Slough located several miles north of SHAD-041, a tributary of the San Joaquin River, and discharges into the California Delta (west of Stockton).

Water that infiltrates the ground surface and percolates from the unlined stormwater lines, wastewater treatment effluent lines, and remedial-system percolation ponds migrates toward the water table.

2.8 Ecological Setting

The currently open land over the majority of Sharpe, and specifically SHAD-041, consists primarily of barren or fallow lands occupied by ruderal (weedy) plants, and limited landscaped areas. Non-landscaped areas are periodically mowed for fire suppression and invasive plant management (i.e., control of yellow star thistle, *Centaurea solstitialis*), and in accordance with the burrowing owl management plan (Albion Environmental, Inc., 1997). In general, the open landscape conditions at Sharpe and SHAD-041 do not constitute unique or ecologically valued habitats, and such conditions are generally common among developed/disturbed/managed lands throughout the region.

In a 2010 memorandum addressing protection of ecological resources at OU 2 soils affected by residual VOCs, DTSC and the California Department of Fish and Game (currently, Department of Fish and Wildlife) concluded that burrowing owls (*Athene cunicularia*), a California species of special concern, are present at Sharpe (DTSC and CDFG, 2010). Several areas of the Army Depot are occupied by colonies of burrowing owl: the southwestern comer of Sharpe, west, north, and northwest of Site S-36 (SHAD-044), the western central property boundary, and between Sites S-26 (SHAD-034) and S-3 (SHAD-011). No evidence of the presence of burrowing owls has been observed at SHAD-041.

Burrowing owls occupy burrows excavated by California ground squirrels (*Spermophilus beecheyi*) or other animals and, as a result, are subjected to subsurface environmental conditions for portions of their life cycle. The 2010 memorandum concluded that there is *de minimis* (inconsequential) inhalation risk to the California ground squirrel; a surrogate burrow-occupying receptor (DTSC and California Department of Fish and Game, 2010). However, any burrowing owls that could theoretically occupy burrows at the SHAD-041 could be exposed to residual contamination in soil.

In a 2010 memorandum addressing protection of ecological resources at OU 2 soils affected by residual VOCs, DTSC and the California Department of Fish and Game (currently, Department of Fish and Wildlife) concluded that burrowing owls are present at Sharpe, burrowing owls are successfully reproducing on-site (P-3A), and that there is de minimis (inconsequential) inhalation risk to the California ground squirrel; a surrogate burrow-occupying receptor (DTSC and California Department of Fish and Game, 2010).

In 2011, the potential effects of residual concentrations of lead and chromium on burrowing owls at five OU 2 sites, including SHAD-041, were evaluated. It was determined that chromium does not pose an ecological hazard, and although some individual lead results exceeded screening levels, the conservatism of the exposure and toxicity assessments concluded that concentrations of lead did not pose site wide ecological threats to a mobile species such as the burrowing owl (URS, 2011b).

3.0 Remedial Investigation

The following sections briefly describe the RI approach including objectives, data quality objectives (DQO), sampling methods, and screening criteria. Boring and well construction logs are presented in Appendix A. Field documentation is presented in Appendix B. Laboratory reports and data quality reports are presented in Appendix C and D, respectively.

3.1 Remedial Investigation Objectives

The SHAD-041 RI objectives include:

- Define the nature and extent of soil contamination
- Assess the risk to human health and the environment
- Evaluate the need for remedial action

To meet these objectives, DQOs were developed in the RI/FS Work Plan (Ahtna, 2017). DQOs are qualitative and quantitative statements developed through the seven-step DQO process (USEPA, 2006). DQOs clarify the study objective, define the most appropriate data to collect, establish the conditions under which to collect the data, and specify tolerable limits on decision errors used as the basis for establishing the quantity and quality of data needed to support decision-making. The DQOs are used to develop a scientific and resource-effective design for data collection. The SHAD-041 RI/FS DQOs are outlined in the Work Plan (Ahtna, 2017).

3.2 Remedial Investigation Fieldwork

The RI field activities were performed in October 2017 in general accordance with the Work Plan (Ahtna, 2017). A Radiological Control Technician was present to conduct radiological monitoring/screening of personnel and equipment during all field activities. RI activities included investigation of both COPCs and a radiological contaminant of potential concern (RCOPC). COPCs included chromium, hexavalent chromium, lead, PCBs, PCDD/PCDF, PAHs, and VOCs and the RCOPC Ra-226.

3.2.1 Baseline Radiological Exposure and Air Particulate Monitoring

Before field activities began, previous investigation data were reviewed to identify areas of elevated radiological activity. Baseline exposure rates were then determined in the field using a Ludlum Model 19 exposure rate detector. Survey and previous investigation results were used to establish radiation work permits controls.

Air particulate samples were collected in accordance with the Work Plan. Two low-volume air particulate samplers (LV-1) were used at SHAD-041. A sampler was placed upwind, and another was placed downwind according to the predominant wind direction of the day. The upwind sampler was used to monitor the natural (ambient) levels of radioactivity. The downwind sampler was used to determine the airborne concentration as a result of site activities.

Samplers were placed and started each day prior to the beginning of activities at SHAD-041 and were operated for the entire workday (minimum of 8 hours). The air samplers were operated at the maximum flow rate to ensure that a sufficient volume was collected to obtain the level of sensitivity required to detect the project action level.

Analysis count times were adjusted as necessary to meet the minimum detectable activity requirements. Air particulate samples were analyzed following 12-hour decay, and again at 72 hours if necessary to allow for decay of radon, and gross alpha and gross beta using a Ludlum Model 2929 Dual Channel Scaler.

The results of the air samples were compared to project action levels derived from U.S. Nuclear Regulatory Commission published limits identified in Appendix B, Table 2 of 10 CFR Part 20, "Standards for Protection Against Radiation." These concentration values are equivalent to the radionuclide concentrations which if inhaled continuously over the course of a year would produce a total effective dose equivalent of 50 millirems per year. The limiting air concentration for radium effluents is 9×10-13 microcuries per milliliter. SHAD-041 air monitoring data is included in Appendix B.

3.2.2 Utility Clearance

Utility clearance was performed at each proposed soil boring location before drilling activities commenced to avoid encountering underground utilities and other potential obstructions. Clearance activities included notification of utility agencies and utility protection organizations as appropriate, and performing on-site surveys using the geophysical ground penetrating radar equipment. Locations of utilities were marked on the ground surface with indications of the assumed type of utility. Prior to initiating intrusive activities, utility location information was reviewed, including field markings and available drawings. Additionally, the soil borings were hand-augered for the first 5 ft bgs.

3.2.3 Gamma Walkover Survey

Two gamma walkover surveys (GWS) were performed using the most sensitive instrumentation suitable for field use and radiation type. Instrumentation includes a 3-inch × 3-inch sodium iodide detector connected to a Ludlum Model 2221 and coupled with a Trimble Geo 7x Global Positioning System (GPS) to give differentially corrected coordinate based positional data. The nearest governmental base station or base station with an equivalent error was utilized for differential correction.

The GWSs used unidirectional transects across the defined areas. Key elements of the GWSs include:

- Data point (latitude, longitude, and count rate) collection frequency of one every two seconds
- Walking pace—0.5 meters per second
- Instrument (probe) height—from 4 to 6 inches above the ground surface
- Transect lanes—1 meter wide based on the field of view of the detector
- Survey area—100 percent of the accessible surface area

The first survey was performed on a non-impacted area with a similar matrix to SHAD-041 and where no known contamination was present to establish background datum. Background readings were collected west of SHAD-041 and ranged from 26,044 counts per minute (cpm) to 34,017 cpm with a mean of 31,599 cpm. The background GWS results are included in Appendix E.

The second survey was performed on SHAD-041. Results for the GWS of SHAD-041 ranged from 26,588 cpm to 999,960 cpm with a mean of 68,289 cpm. The mean of 68,289 cpm was over twice the mean background result of 31,599 cpm. The maximum reading of 999,690 cpm was due to detector saturation when surveying over a known elevated location. Figure 5 includes GWS results, color-coded to ease identification of elevated locations. Results are discussed in Section 4.2. The SHAD-041 GWS results are included in Appendix E.

3.2.4 Borehole Advancement and Downhole Gamma Logging

Figure 5 shows the thirty boring locations proposed in the RI/FS Work Plan (25 systematic and 5 biased), chosen to define the extent of contamination (Ahtna, 2017). Results from the downhole gamma logging (DGL) obtained during the RI fieldwork were evaluated, and nine of the systematic locations were eliminated. Additional samples were collected at lower depths in some boring locations (VSP-08, VSP-11, VSP-12, VSP-13, VSP-18, VSP-26, VSP-28, VSP-29, and VSP-30).

Section 5.3.1 of the RI/FS Work Plan describes the Multi-Agency Radiological Site and Survey Manual (MARSSIM) equations and the calculations used to determine the minimum number of boring locations (15 locations) needed to define the lateral and vertical extent of radiological contamination. However, 21 boring locations were established and sampled during the RI to provide a higher degree of confidence the extent of contamination would be defined.

Twenty-one borings were drilled at SHAD-041, 4 borings to 10 ft bgs and another 17 to 15 ft bgs, to delineate site contamination. Five biased soil borings (VSP26 through VSP30) were advanced based on the SHAD-041 GWS results (Figure 5). Each soil boring was advanced by direct push technology with 2-inch borehole diameter.

DGL was performed at each borehole to characterize in situ soils and provide data on radiation levels by depth. A one-minute static measurement was performed using a Model 44-2 1-inch×1-inch sodium iodide detector attached to a Ludlum Model 2221 suspended from a nylon cord with depth markings to ensure accurate depth interval measurements were recorded. Measurements were collected at one-foot intervals, starting at the top of the borehole and working toward the bottom. DGL was performed until the presence of groundwater, refusal, or the bottom of the boring was encountered.

Results from the DGL revealed five locations (VSP-11, 12, 18, 26, and 28) with results significantly above the mean recorded for each location. Each of the elevated results was located at the surface (0 to 1 ft bgs). The DGL results are included in Appendix E.

The borings were completed under the supervision of the Project Geologist, and soil logging was conducted in accordance with ASTM D1586-84. The depth at which the transition from fill to native material occurred and observations of discernable odors and soil staining were noted on the boring logs (Appendix A).

3.2.5 Soil Core Scanning and Radium 226 Sample Collection

Soil cores were scanned for beta-gamma activity with a Ludlum 44-9 attached to a Ludlum Model 12 Geiger-Mueller detector and beta activity with a Ludlum 43-93 attached to a Ludlum Model 3002 to identify intervals of elevated radiological activity in relation to depth.

The Ludlum 44-9 attached to a Ludlum Model 12 Geiger-Mueller detector is a small area probe used for scanning difficult to reach locations. The detector window has thin mica protected by a mesh screen allowing greater instrument response to beta particles and attenuated gamma rays.

The 43-93 detector attached to a Ludlum Model 3002 is a 100 square centimeter area detector used for alpha and beta measurements. A Ludlum 43-93 plastic scintillation detector coupled to a Ludlum 3002 was used to collect beta measurements of each core.

An area of three square meters was scanned around each of the systematic or biased sampling locations using a Ludlum 44-20 attached to a Ludlum Model 2221 to identify or verify elevated gamma measurement locations and find locations with measurements closer to background measurements to lay out the core. These measurements are included in Appendix E. Each soil core was placed on visqueen, and the acetate sleeve was cut open to expose the subsurface soils. The detector was then moved over the surface of the core slowly, with the average observed count rate for each one-foot interval recorded on a log sheet (Appendix E). The results of the core scan were compared with the DGL results to determine if a correlation existed between the two measurements to assist in selecting the soil sample depth. Soil samples were collected for Ra-226 analysis at four to six depths intervals per location for a total of 118 soil samples. Sample depth intervals varied at each location based on the results of the core and DGL scans. Soil from each depth interval was homogenized in clean stainless steel mixing bowls and collected in accordance with the Work Plan. The soil samples were transferred directly to the appropriate laboratory-prepared containers, labeled, and placed immediately into a chilled cooler for storage and transport to an off-site laboratory under the chain of custody protocol.

Exposure rates were collected at all sample locations using a Ludlum Model 19 held at waist height to collect a general area exposure rate and to ensure worker exposures were kept as low as reasonably achievable. Exposure rate measurements are included in Appendix E.

Results from the beta core scan (core scan utilizing a Ludlum Model 43-93) indicated three locations (VSP-11, 24, and 26) with elevated maximum measurement when compared to instrument background and other observed maximums. Two of the three (VSP-11 and 26) elevated readings were at the surface. These two surface anomalies were correlated with the DGL and beta/gamma core scans. Samples were collected for Ra-226 analysis from these three locations, and the results are listed in Appendix C.

Results from the beta/gamma core scans, utilizing the Ludlum Model 44-9, indicated two locations (VSP-11 and 26) with elevated measurements above the project action level. Both measurements were located at the surface, and these locations were sampled as described above. The summary of the results of the core scanning is included in Appendix E.

3.2.6 Soil Sample Collection for Chemical Analysis

Soil samples were collected at six depth intervals (0.5, 2.5, 5.0, 10.0, 12.5, and 15.0 ft bgs) at 17 locations and four depth intervals (0.5, 2.5, 5.0, and 10.0 ft bgs) at four locations for a total of 118 soil samples. VOC soil samples were collected directly from the core using TerraCore sample kits. For the remainder of the samples, soil from each depth interval was homogenized in clean stainless steel mixing bowls and collected in accordance with the Work Plan. The soil samples were transferred directly to the appropriate laboratory-prepared containers, labeled, and placed immediately into a chilled cooler for storage and transport to an off-site laboratory under the chain of custody protocol. Samples were collected for lead, chromium, hexavalent chromium, PCBs, PCDD/PCDF, VOCs, and PAHs analysis.

Quality control samples were collected to assess the representativeness of the field samples. Field quality control samples collected for the RI included field duplicates, matrix spike/matrix spike duplicates, and trip blanks. Duplicate and matrix spike/matrix spike duplicates samples were collected at a rate of 1 per 10 normal field samples.

3.2.7 Borehole Destruction and Site Restoration

Soil borings were destroyed in accordance with procedures outlined in the *Sharpe Comprehensive Field Work Plan* (URS, 2014c) and Work Plan (Ahtna, 2017). Following soil sampling, all borings were filled with neat, non-shrinking cement grout to the surface. All surfaces at SHAD-041 were restored to original conditions.

3.2.8 Borehole Surveying

Boring locations were geo-located using a handheld Trimble Geo 7x GPS unit attached to a zephyr antenna for increased accuracy (sub-centimeter). Terrasync software was utilized to collect approximately 15 seconds of data. Each second the software recorded one data point. The data was then processed and corrected to obtain the sample location northing and easting. Data was collected in the coordinate system, California State Plane 3 NAD83. The nearest governmental base station or base station with an equivalent error was utilized for differential correction.

3.2.9 Investigation Derived Waste Management

Investigation derived waste (IDW) was generated during RI at SHAD-041. Soil IDW was generated during drilling, and water IDW was generated during decontamination of field equipment. IDW also included used personal protective equipment and used sampling equipment.

IDW was stored according to type in 55-gallon drums, labeled, and placed in the fenced area of SHAD-041 pending disposal. Upon completion of fieldwork, soil and water IDW samples were collected and characterized to determine an appropriate disposal method in accordance with applicable laws and regulations.

Each soil IDW drum was assayed by collecting a high-resolution gamma spectrum for ten minutes per quadrant of the drum using an HPGe Ortec TransSpec portable gamma spectroscopy system. Each quadrant result was combined into one spectrum creating a single 40-minute spectrum. The efficiency of the detector was calculated over the range of the gamma-ray spectrum collected and the characteristic gamma rays used for identification and quantification (45 to 3,000 kiloelectron volts [keV]) using an appropriate model and a source-to-detector distance of 15.24 centimeters.

Quantification of Ra-226 was determined from the average concentrations of the radium decay progeny, lead-214 energy of 351 KeV, and bismuth-214 energy of 609 KeV based on the secular equilibrium of Ra-226 with its progeny in the soil while being assayed by in situ instrumentation. Results from the IDW drums showed two drums to have results distinguishable from background. The in situ gamma spectroscopy results for each drum of IDW are included in Appendix E.

Disposal of the soil and water IDW as low-level radiological waste is being coordinated with Department of Defense Executive Agency and will be transported by a licensed transporter under a uniform low-level radiological waste manifest to a licensed disposal facility in Texas.

3.3 Analytical Results

Laboratory reports are included in Appendix C. Chemical results are summarized in Tables 2 through 7, and Ra-226 results are summarized in Tables 8 through 11. The following laboratory tests were performed:

- EPA901.1 ....Ra-226
- SW6010C..........Chromium and lead
- SW7196A..........Hexavalent chromium
- SW8290A..........PCDD/PCDF
- SW8082A..........PCBs
- SW8260C..........VOCs
- SW8270C SIM...PAHs

A total of 118 soil samples and 22 quality control samples were collected from systematic and biased locations for analysis. Laboratory gamma spectroscopy was performed to quantify Ra-226 after a 21-day in-growth to allow its gamma emitting progeny (bismuth-214 and lead-214) to reach secular equilibrium. Due to the interference with gamma emissions from uranium-235 (185.7 keV), which is naturally occurring in soils and the low gamma yield from the decay of Ra-226 (3.28 percent) the 186.2 keV peak was not used.

3.3.1 Quality Control Review

To ensure that scientifically sound data of known and documented quality are used in making environmental decisions. The following three-step data review was performed. Step I (verification) was performed to confirm that all specified activities involved in collecting and analyzing samples have been completed and documented and that the necessary records (objective evidence) was available to proceed to data validation. Step II (validation) was performed to assess whether the sampling and analytical processes comply with the contract-specific and the Quality Assurance Project Plan (QAPP) project-specific requirements. Step III (usability assessment) was performed to determine whether the resulting data are suitable as a basis for the decision being made. The project-specific QAPP established processes, requirements and procedures were followed during data verification, validation and usability assessment.

The field generated data review/verification included verification of field logbooks, boring logs, sample chain of custody forms, shipping documents, sampling observations, sample labels, and other field observations. All field measurements and or field log information entered into field logbooks was reviewed daily by the field team leader or designee. The designee was a qualified field geologist, engineer, environmental scientist, and/or technician.

All analytical data generated by the laboratory was verified before submittal to the project chemist. The internal data review process, which is multitier, included all aspects of data generation, reduction, and quality control (QC) assessment. In each analytical section, the analyst performing the tests reviewed 100 percent of the definitive data. After the analyst's review had been completed, 100 percent of the data was reviewed independently by a senior analyst or by the supervisor of the respective analytical section using the same criteria.

Elements for review or verification at each level included, but was not restricted to, the following:

- Sample receipt procedures and conditions
- Sample preparation
- Appropriate standard operating procedures (SOPs) and analytical methodologies
- Accuracy and completeness of analytical results
- Correct interpretation of all raw data, including all manual integrations
- Appropriate application of QC samples and compliance with established control limits
- Documentation completeness (for example, anomalies in the preparation and analysis have been identified, appropriate corrective actions have been taken and documented in the case narrative[s], associated data have been appropriately qualified, and anomaly forms are complete)
- Accuracy and completeness of data deliverables (electronic)

Laboratory data evaluation was performed to include the calibration, QC, corrective actions, and flagging requirements for definitive data established in the QAPP. The laboratory applied data qualifiers based on its review or added a note in the laboratory case narrative. The definitions of any data qualifiers applied by the laboratory was defined in the case narrative. The data qualifiers were reviewed by the supervisor of the respective analytical sections after the first and second level reviews of the laboratory data had been performed.

The laboratory assessment of the data quality was reviewed and verified for completeness and accuracy. Data review and verification was done manually and included, but was not limited to, the following:

- Sampling documentation (such as the chain of custody form)
- Preservation summary and technical holding times
- Presence of all analyses and analytes requested

- Use of the required sample preparation and analysis procedures
- The method detection and reporting limits will be evaluated against the project requirements
- The correctness of the concentration units
- Case narrative

The laboratory data validation process was based on data review and verification. Project data was validated as part of the data assessment for this project. The review was performed on an analytical batch basis by assessing QC samples and associated field sample results. Data validation guidelines have been developed in accordance with the method requirements, professional judgment, and general USEPA National Functional Guidelines requirements.

Laboratory data review, verification and validation was performed including as follows:

- Chain of custody documentation
- Holding time
- QC sample frequencies
- Method Blank
- Laboratory Control Sample
- Surrogate spikes
- Matrix Spike and Matrix Spike Duplicate
- Initial and continuing calibration information
- Field duplicate precision
- Case narrative review and other method-specific criteria

The manual verification/validation process included data flagging for issues related to method blank, laboratory control sample, matrix spike and matrix spike duplicate samples, field duplicates, surrogate recoveries, holding time, and reconciliation of dilutions and re-extractions. Data flags, as well as the reason for each flag, was entered into an electronic database and made available to the data users. A final flag was applied to the data by the Ahtna project chemist/team after evaluating all flags entered into the database and selecting the most conservative of the verification/validation flags. Project-specific final data qualifier definitions/conventions were used as defined and summarized in the QAPP.

If a systematic problem or another major issue with the data was identified during the data review, verification and validation process, the project chemist is contacted by the laboratory's project manager or Quality Assurance (QA) Manager and problems or issues are corrected. No systematic problems or other major issues were identified during this project.

A data validation report was prepared (Appendix D) to summarize the findings and discuss the impact on the overall data quality and usability.

One hundred percent of the analytical data for soil samples were reviewed by Stage 2B validation procedures, and 10 percent was reviewed as Stage 3/4 as described in the *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (USEPA 540-R-08-005, January 2009). Appendix D contains a copy of the chemical quality control/chemical data validation reports. The collected and validated data were reviewed by the laboratory and project personnel in accordance with the QAPP data review tasks and applicable requirements to assess total measurement errors and determine the overall usability of the data for project purposes.

Laboratory data was qualified as summarized below:

- **Lead/Chromium**: Seventy-six results were qualified as estimated based on QC outliers. Sixty-six results were qualified as estimated because concentrations were quantified below the limit of quantitation (LOQ). Six results were qualified as estimated (either a high, low, or an undetermined bias) based on matrix spike or relative percent difference (RPD) outliers. One result was qualified estimated based on a serial dilution outlier. Four results were qualified as estimated based on field duplicate result outliers.
- **Hexavalent chromium**: Eighty-five results were qualified as estimated based on QC outliers. Seventy-seven results were qualified as estimated because concentrations were quantified below the LOQ. Seven results were qualified as estimated with a low-bias due to matrix spike recoveries. One result was qualified as estimated non-detect based on a holding time exceedance.
- **PCBs**: Four results were qualified as estimated because concentrations were quantified below the LOQ.
- **PCDD/PCDF**: Nine hundred sixty-seven results were qualified as estimated based on QC outliers. Four hundred and ten results were qualified as estimated because concentrations were quantified below the LOQ. Two hundred and thirty-one results were qualified as non-detect due to the compound present in the method blank. Similarly, 274 results were qualified as non-detect due to the compound present in the equipment blank. Twenty-eight results were qualified as estimated (with either a high, low, or an undetermined bias) due to matrix spike or RPD outliers. Thirty-three results were qualified as estimated (high-bias or non-detect) due to internal standard outliers. Twenty-eight results were qualified as estimated or estimated non-detect due to field duplicate outliers. Two hundred and forty-two results were qualified as estimated (low, or indeterminate bias, or non-detect) due to laboratory control sample outliers.
- **PAHs**: Three hundred sixteen results were qualified based on QC outliers. Ninety-four results were qualified as estimated because concentrations were quantified below the LOQ. Twenty-four results were qualified as estimated non-detect based on internal standard outliers. One hundred and ninety-eight results were qualified as estimated non-detect based on low surrogate recovery outliers.
- **VOCs**: Three hundred seventy-seven results were qualified as estimated based on QC outliers. Twenty-eight results were qualified as estimated because concentrations were quantified below the LOQ. One hundred and seventy-five results were qualified as either estimated (either low-bias, high-bias, or non-detect) due to low surrogate recovery outliers. Four results were qualified as estimated (either high-bias, undetermined, or non-detect) based on matrix spike/duplicate or RPD outliers. Sixteen results were qualified as estimated non-detect based on continuing calibration verification outliers. Two results were qualified as estimated based on field duplicate results. Two hundred and twenty-four results were qualified as estimated (either high-bias or non-detect) based on internal standard outliers.

In addition, the data usability assessment was performed based on the results of data verification and validation in the context of the overall project decisions or objectives. The data were evaluated in accordance with the site-specific QAPP precision, accuracy, representativeness, comparability, and completeness criteria. The assessment determined that the project execution and resulting data met the project-specific DQOs. Both the sampling and analytical activities were considered, with the goal of assessing whether the final, qualified results support the decisions to be made with the data. The following information summarize the processes which were used to determine whether the collected data are of the right type, quality, and quantity to support the environmental decision-making for the project and describes how data quality issues were addressed and how limitations of the use of the data was handled. The project team and the laboratory ensured that the data meet the detection limits and laboratory QC limits listed in the project-specific QAPP. During the data verification assessment, non-conformances were documented, and data were qualified for use in decision-making. The data were determined to be usable by the project chemist based on the requirements of the QAPP. Data gaps were determined to be present if a sample was not collected, the sample was not analyzed for the requested parameters, or the data was determined to be unusable.

All data were usable as qualified by the data validation, and no data was rejected. Estimated and/or biased results were determined to be usable for their intended purpose. Outliers were addressed on a case-by-case basis. It should be noted that there is no generic formula for determining whether a result is an outlier. Potential outliers were evaluated to determine which formulas were appropriate for classifying data points in a statistically appropriate and defendable manner.

Additionally, in-depth assessment was performed during the data verification process. The verification process assessed conformance of data with the requirements of the methods, SOPs, and objectives of the project-specific QAPP. The findings of the data verification process generated qualifiers that were applied to the data considered in context to assess overall usability of the data.

All project-specific data was collected and analyzed in accordance with a project-specific QAPP. All data quality goals stated in the project-specific QAPP were met. A detailed evaluation of the data was performed and collected data answered the principal questions of the investigation by meeting DQOs and the data set is representative of site conditions and fully support project-specific analysis, conclusions and decisions.

Further, 47 QC samples were collected during the project execution. Results for the QC samples were acceptable (e.g., equipment blanks, rinsate blanks, trip blanks, and field duplicates). The QC samples were collected and analyzed at the required sample collection and analysis frequencies. The results and collection frequencies of the QC samples did not adversely affect data quality and usability.

For some data, results were qualified as estimated based on internal standard outliers. However, no data was rejected. The non-detected data with internal standard recoveries below the acceptance criteria was used and qualified as estimated. Data validation/qualifier summary is included in Appendix D (Attachment 2).

In addition, all chemical and radiological laboratory data were reviewed and compared against the QAPP project-specific QC/QA requirements. During data evaluation, qualification, verification, and validation processes, no significant overall biases and trends in the data set were noted that would adversely affect SHAD-041 DQOs, QAPP requirements and procedures, and the RI/FS project-specific analysis, evaluations and decisions.

4.0 Nature and Extent of Soil Contamination

4.1 Soil Screening Criteria

Metals (chromium, hexavalent chromium, and lead), PCBs, PCDD/PCDF, PAHs, VOCs, and Ra-226 screening levels are summarized in Table 1. The lowest screening level value (i.e., most protective) was derived from the values listed in the USEPA Regional Screening Levels (RSLs), HERO DTSC-modified Screening Levels (DTSC-SLs), and established ROD cleanup levels. [1,2,3] The USEPA RSLs and DTSC-SLs are referred to as risk-based screening levels (RBSLs). The Ra-226 RBSL is also a risk based screening level which was calculated using modified USEPA preliminary remediation goals for residential scenario criteria and includes a contribution from the background.

4.2 Nature and Extent of Contamination

4.2.1 Non-Radiological Contaminants of Potential Concern

Non-radiological COPCs were evaluated by analyte group. Tables 2 through 7 provide a summary of detected concentrations for COPCs at 0.5, 2.5, 5.0, 10.0, 12.5, and 15 ft bgs. Figures 6 through 12 show the detected concentrations of COPCs.

Metals

Chromium was not detected above the RSL and OU 2 ROD cleanup level of 300 mg/kg in the soil samples (Tables 2 through 7 and Figure 6). However, hexavalent chromium was detected above the RBSL of 6.3 mg/kg at two locations: VSP-2 at 10 ft bgs and VSP-25 at 0.5 ft bgs (Tables 2 through 7 and Figure 7).

Lead was detected at multiple locations (VSP-11, 12, 15, 17, 18, 20, 22, 25, 26, 27, and 28) in 0.5 and 2.5 ft bgs soils at concentrations greater than RSLs (Tables 2 through 7 and Figure 8). The detected concentrations above the RBSL ranged from 320 mg/kg (VSP-22) to 3,300 mg/kg (VSP-11). Lead concentrations exceeding the OU 2 ROD cleanup level of 1,000 mg/kg were limited to VSP-11, 12, 17, 18, and 28. The vertical extent of lead exceeding the RSL and ROD cleanup level is limited to soils from 0 to 5 ft bgs.

PCDD/PCDF

PCDD/PCDF were detected at concentrations greater than the RBSL of 22 picograms per gram (pg/g) at four locations, VSP-11, 12, 17, and 18 (Tables 2 through 7 and Figure 9). The detected concentrations ranged from 24 to 67 pg/g. The vertical extent of PCDD/PCDF exceeding the RSL is limited to soils from 0 to 5 ft bgs.

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[1] November 2018 USEPA RSLs for Residential Soil (TR=1E-06, THQ=1.0) and HERO, HHRA Note 3 (June 2018)

[2] Cleanup levels for chromium and lead are defined in the OU 2 ROD (ESE, 1996).

[3] The RBSL for Ra-226 was determined using a combination of residual dose and risk. The RBSL for Ra-226 is 2.0 pCi/g, which includes a contribution from the background. The risk was calculated using modified USEPA preliminary remediation goals for residential scenario criteria. The only modification was removing the fruit and vegetable pathway from the scenario, which resulted in a concentration of 1.33 pCi/g for risk of 1 × 10-6. The contribution from background (0.64 pCi/g) was obtained from the Revised Reference Area Survey Report (Cabrera, 2002) for the disturbed soil of McClellan Air Force Base in Sacramento. The combination of the risk value and the background reference area value resulted in a total concentration of approximately 2.0 pCi/g. The Radiological Dose and Risk Assessment Computer Program known as RESRAD (RESidual RADioactive) version 7.2 was used to convert the proposed action level to a dose to the critical population.

PCBs

Except for VSP-6 at 0.5 ft bgs, PCBs were not detected in any of the soil samples collected (Tables 2 through 7 and Figure 10). The concentration of PCBs at VSP-06 is below the RBSLs

VOCs

VOCs were not detected above RBSLs in any of the soil samples collected (Tables 2 through 7 and Figure 11).

PAHs

PAHs were not detected above RBSLs in any of the soil samples collected (Tables 2 through 7 and Figure 12).

Summary

Chromium, PCBs, PAHs, and VOCs, and were not detected at concentrations exceeding RBSLs at SHAD-041. Lead, hexavalent chromium, and PCDD/PCDF were detected in surface and shallow subsurface (less than 5 ft bgs) soils at concentrations greater than RSLs though the hexavalent chromium and PCDD/PCDF exceedances were limited. The vertical extent of detected COPCs exceeding the RBSLs is limited to soils from 0 to 5 ft bgs, except for an isolated hexavalent chromium exceedance at 10 ft bgs.

4.2.2 Radium 226

Ra-226 results for the site were reviewed and evaluated as four data sets including surface soil, 1 to 5 ft bgs, 5 to 10 ft bgs, and 10 to 15 ft bgs. Surface data was reviewed using GWS, DGL, soil sample, and beta and beta/gamma core scanning data. Evaluation of subsurface data was performed by using DGL, soil sample, and beta and beta/gamma core scanning data but did not use the GWS data as it was not applicable (sensitivity of less than 1 ft bgs).

Evaluation of the laboratory data was performed using Surfer version 13.0. Contouring of data was performed using the inverse distance to a power process. This method allows for weighted data results during interpolation such that the influence of one-point relative to another decline with distance from the grid node. Weighting is assigned to data through the use of a weighting power that controls how the weighting factors drop off as the distance from a grid node increase. The greater the weighting power, the less effect points far from the grid node have during interpolation. As the power increases, the grid node value approaches the value of the nearest point. Analyzing the data graphically using the inverse distance to a power method allows for visual identification of the areas that showed results greater than the screening level throughout the investigation area.

Results from the laboratory gamma spectroscopy analysis show concentrations that exceed the RBSL 2.0 pCi/g. These exceedances ranged in depth from the round surface to 12 ft bgs, with one exceedance at 14 ft bgs. Laboratory results are shown in Tables 8 through 11 and Figures 13 through 16.

Surface

A GWS was performed which identified areas of elevated gross activity at the surface (less than 1 ft bgs). The entire SHAD-041 site shared the same matrix (soil) at the surface level. A mean background of 31,598 cpm was observed in a non-impacted area of the site. Twenty-three percent (929 of the 3,970 data points collected) exceeded 50,000 cpm. A surface contamination layer that extends east to west across the entire northern portion of the site is visible when the data is plotted (Figure 5). Beta and beta/gamma soil core scanning results indicated elevated activity at the surface. Because there is known contamination north of SHAD-041 (Tidewater, 2012) and a GWS has not been performed west of this location it is unknown whether the layer continues further.

Surface soil samples indicated Ra-226 concentrations above the RBSL of 2.0 pCi/g in the eastern and northern portions of the SHAD-041 (Table 8 and Figure 13). Ra-226 was detected at seven locations (VSP-12, 15, 17, 18, 20, 26, and 28) at concentrations greater than the RBSL. The detected concentrations ranged from 2.48 pCi/g at VSP-15 to 79.6 pCi/g at VSP-26.

1 to 5 ft bgs

A contamination layer is present from 1 to 5 ft bgs. Ra-226 was detected at four locations (VSP-11, 18, 26, and 28) at concentrations greater than the RBSL of 2.0 pCi/g (Table 9 and Figure 14). The detected concentrations ranged from 2.04 to 11.5 pCi/g at VSP-26 at 4 and 1 ft bgs, respectively.

The soil sample results indicate the entire eastern portion of SHAD-041 (VSP-11, 18, and 26) has Ra-226 concentrations above the RBSL (Figure 14), some of which is located inside of the previously identified fenced portion of SHAD-041. A small portion in the northwestern corner (VSP-28) has Ra-226 concentrations elevated above the RBSL as well. However, the beta and beta/gamma soil core scanning results did not indicate elevated activity at the same depth interval.

5 to 10 ft bgs

A small and limited contamination layer between 5 and 10 feet bgs is present inside the previously identified fenced portion of SHAD-041. Ra-226 concentrations above the RBSL of 2.0 pCi/g were detected in the 5 and 9 ft bgs measurements at VSP-11 (Table 10 and Figure 15). The detected concentrations ranged from 2.02 to 3.09 pCi/g. The beta and beta/gamma soil core scanning results did not indicate elevated activity at this depth interval.

10 to 15 ft bgs

A small and limited contamination layer is located between 10 and 13 ft bgs. Ra-226 was detected at six locations (VSP-8, 11, 13, 18, 26, and 28) at concentrations greater than the RBSL of 2.0 pCi/g (Table 11 and Figure 16). The detected concentrations ranged from 2.04 pCi/g to 75.40 pCi/g at VSP-28 and VSP-18, respectively.

The soil sample results show elevated Ra-226 concentrations above the RBSL of 2.0 pCi/g located on the eastern side (VSP-26 and 11) of SHAD-041 at 11 and 12 ft bgs. A separate small area and limited contamination layer were identified near the southwestern portion of the SHAD-041 (VSP-8 and 13) at 11 and 12 ft bgs (Table 11 and Figure 16). Finally, a small area in the northwestern portion of the site with a Ra-226 concentration at the RBSL of 2.0 pCi/g was identified (VSP-28; Table 11 and Figure 16). The beta and beta/gamma soil core scanning results did not indicate elevated activity at this depth interval.

At VSP-18, located on the eastern portion of SHAD-041, one sample collected at 14 ft bgs had Ra-226 at 75.4 pCi/g; an order of magnitude above the screening level. This concentration of Ra-226 is anomalous and is not representative of site conditions because elevated Ra-226 and DGL measurements are not present at similar depths at other sub-surface locations across the site; thus, the detection is unlikely. Except for VSP-18, Ra-226 concentrations are below the RBSL and ranged from 1.0 to 2.6 pCi/g in the 10 to 15-foot soils. Additionally, no other COPCs were detected above screening or action levels at depth. Cross-contamination from the surface is a potential source of the anomalous Ra-226 detection, or the detection may indicate dispersion of discreet particles through environmental media. For purposes of the FS, the result is included in the vertical extent of Ra-226 at the east-northeastern portion of the site.

Summary

Ra-226 was detected in surface and subsurface soil at SHAD-041 at concentrations above the RBSL at locations across the site and from the surface to 14 ft bgs. Most Ra-226 detections above the RBSL were limited to surface and shallow subsurface sampling depths (0 to 5 ft bgs) and just above the RBSL at several locations between 5 and 12 ft bgs.

At VSP-18 in the east/northeastern portion of the site, the 14 ft bgs soil sample exceeds the RBSL, but the result appears to be an anomaly based on results from other soils at this depth. For purposes of the FS, the Ra-226 result is considered in the screening of remedial technologies and development and evaluation of remedial alternatives (Section 10), and will also be further evaluated during the remedial design phase of work.

The approximate horizontal extent of shallow impacted soil (between approximately 0 and 5 ft bgs) is 250 ft from north to south by 300 ft from east to west across the site. The approximate extent of deeper impacted soils includes five isolated areas at the following approximate size:

- The east-central portion from 5 to 9 ft bgs (20×20 ft)
- The northwestern portion at 12 ft bgs (20×20 ft)
- The south-central portion from 11 to 12 ft bgs (50×50 ft)
- The northeastern portion at 11 to 14 ft bgs (20×20 ft)
- The east-central portion at 12 to 14 ft bgs (20×20 ft)

5.0 Human Health Risk Assessment

A baseline human health risk assessment (BHHRA) was performed to determine potential risks from exposure to COPCs and RCOPC in soil at SHAD-041. The risk assessment includes exposure and toxicity assessments as well as a risk evaluation.

The methodology used for the risk evaluation was based on the *Risk Assessment Guidance for Superfund, Volumes I and II, Human Health Evaluation Manual Part A* (USEPA, 1989a and 1989b), DTSC's Office of Human and Ecological Risk guidance "HERO HHRA Note Number: 1" (DTSC, 2014), and the U.S. Nuclear Regulatory Commission's NUREG 5512, Volume 4 for performing HHRA (USNRC, 1992).

For COPCs, potential human health exposures to a hypothetical resident, commercial/industrial worker, and construction worker were evaluated. Cancer and noncancer risks associated with COPC concentrations in soil were estimated by the ratio method using calculated 95 UCLs and regulatory RBSLs. Additionally, soil lead concentrations were evaluated by comparison to soil concentrations that correspond to the soil concentration at the 90th percentile that is protective of children and fetuses of adult workers.

For the receptors (hypothetical resident, commercial/industrial worker, and construction worker) evaluated at SHAD-041, the calculated total cancer risks and noncancer hazards are within the risk management range of 1×10^{-6} to 1×10^{-4} and less than the threshold of 1 for noncancer hazard.

Calculated Receptor Risks

	Exposure Depth (ft bgs)					
	0–0.5		0–3		0–10	
Receptor	Total Cancer Risk	Hazard Index	Total Cancer Risk	Hazard Index	Total Cancer Risk	Hazard Index
Hypothetical Resident	$4\text{x}10^{-5}$	0.5	$1\text{x}10^{-5}$	0.3	$1\text{x}10^{-5}$	0.2
Commercial/Industrial Worker	$3\text{x}10^{-6}$	0.04	$1\text{x}10^{-6}$	0.02	$1\text{x}10^{-6}$	0.01
Construction Worker	$4\text{x}10^{-6}$	0.1	$8\text{x}10^{-7}$	0.08	$1\text{x}10^{-6}$	0.05

Based on the results of the HHRA for non-radiological COPCs, remediation of lead appears to be warranted for the protection of human health. The lead concentrations used as exposure point concentrations for the evaluation of the resident, commercial/industrial worker, and construction worker exceeded the soil concentrations that are protective of children and the fetuses of adult workers. Lead concentrations at SHAD-041 are elevated primarily in the eastern portion of the site. The need for remediation of other non-radiological analytes with cancer risks greater than 1×10^{-6}, the point of departure, will be determined in conjunction with risk management decision-making.

For Ra-226, the risk evaluation indicates that the BHHRA levels exceed the USEPA risk management range of 1×10^{-6} to 1×10^{-4}. Cancer risks derived for the resident, industrial worker, and the construction worker all exceeded the USEPA risk management range, and there is a risk to human health under any potential future use scenario.

A conceptual site model for human health exposure pathways is shown in Figure 17. BHHRA reports for SHAD-041 are included in Appendix F.

6.0 Screening Level Ecological Risk Assessment

A screening level ecological risk assessment (SLERA) was performed to determine potential ecological risks from exposure to COPCs and RCOPC in soil at SHAD-041. The risk assessment includes exposure and toxicity assessments as well as risk evaluation.

The SLERA was prepared primarily in accordance with the *Ecological Risk Assessment Guidance for Superfund* (USEPA, 1997), *Wildlife Exposure Factors Handbook* (USEPA, 1993c), *Guidance for Ecological Risk Assessment at Hazardous Waste Sites and Permitted Facilities* (DTSC, 1996), and OSWER 9285.6-20 "*Radiation Risk Assessment at CERCLA Sites: Q&A*" (USEPA, 2014). Tier 1 and Tier 2 SLERA evaluations were performed.

Of the COPCs, only 2,3,7,8-tetrachlorodibenzo-p-dioxin (hereinafter "TCDD") toxicity equivalency (TEQ) is identified as a contaminant of potential ecological concern (COPEC) at SHAD-041. The lateral and vertical distribution of TCDD TEQs is illustrated in Figures F2-3 (Appendix F2). TCDD TEQs were detected above the ecological screening value of 1.6 pg/g in the 0 to 2.5 depth interval of seven soil borings (VSP-2, VSP-11, VSP-12, VSP-17, VSP-18, VSP-26, and VSP-28).

The total chromium was also evaluated as an ecological COPC. Total chromium was present in concentrations greater than the most stringent ESV of 23 mg/kg in 14 of the 21 soil borings. The most stringent LANL NOAEL-based ESL for avian species, the American robin an avian insectivore (*Turdus migratorius*), was selected as the ESV for total chromium because it is the most receptor specific ESV for total chromium. The HQ for the 0–5 ft and 0–10 ft bgs 95 UCL is not greater than 1, indicating that adverse ecological effects to burrowing owls as a result of exposure to chromium and hexavalent chromium at the Sharpe Army Depot are not expected to occur.

DTSC's *Soil Remedial Goals for Dioxins and Dioxin-like Compounds for Consideration at California Hazardous Waste Sites* (DTSC, 2017) provides human health remedial action goals for TCDD TEQs; however, these goals are not necessarily protective of ecological receptors. Protectiveness is variable depending on the ecological receptors of concern at the site. Invertebrates and plants are generally not sensitive to PCDD/PCDFs, while some wildlife receptors can be markedly susceptible and could drive a risk-based cleanup. The guidance recommends consulting with a DTSC Ecological Risk Assessor from the Office of Human and Ecological Risk if the site contains habitat or could release PCDD/PCDFs to off-site habitat(s). SHAD-041 is not an ecological habitat; however, migration of TCDD TEQs via wind transport of dust or stormwater runoff is a complete transport pathway. Therefore, a conservative NOAEL-based environmental screening level was used as the ecological screening value to calculate the potential for adverse effects.

The cleanup level for lead, previously established in the OU 2 ROD (ESE, 1996), is 1,000 mg/kg and was based on the criteria used for the protection of human health at the time (in 1996). Lead was not identified as a COPEC based on results of the SLERA. Lead was detected in concentrations greater than the facility-wide cleanup level of 1,000 mg/kg in the 0 to 2.5-foot depth interval of five soil borings (VSP-11, VSP-12, VSP-17, VSP-18, and VSP-28); the same boring locations with elevated TCDD TEQs. The lateral and vertical distribution of lead is illustrated in Figure F2-2 (Appendix F2).

For the RCOPC, the ecological risk assessment passed the Tier 2 (and thus Tier 1) evaluation indicating that no further evaluation is necessary. Based on a comparison of the average detected concentration of Ra-226 to a conservatively derived ecological safe value ratio, ecological risks from exposure to the Ra-226 are unlikely, and there is no risk to ecological receptors (burrowing owl) from Ra-226 at SHAD-041.

A conceptual site model for ecological exposure pathways is shown in Figure 18. The SLERA report for SHAD-041 is included in Appendix F2.

7.0 Conceptual Site Model and Contaminant Fate and Transport

Historically, SHAD-041 was used for industrial and waste disposal operations, including disposal of solids from paint stripping operations and burning of other wastes including wood, paper, empty paint and solvent cans, waste paint, waste solvents, waste oil, used hydraulic fluid, and "anything else that would burn" (ESE, 1994a). Radium paint, dials, gauges and other commodities may have also been disposed of at SHAD-041. Contaminated fuel reportedly was not disposed of in the pits. Currently, the site is not used and it is anticipated that the future land use will be commercial/industrial.

The primary sources of potential COPCs and RCOPC at SHAD-041 are related to historical site use, consisting of former burn pits reportedly used to incinerate waste generated at Sharpe. The primary exposure pathways for human and ecological receptors are surface soil handled or tread underfoot and contact with COPCs during intrusive activities.

Some pathways of human and ecological receptors to COPCs are considered potentially complete (Figures 17 and 18). Exposure of terrestrial and aquatic biota via soil, sediment, surface water, and the food chain is considered potentially complete (Figure 18).

7.1 Site Characteristics

COPC concentrations exceeding RSLs, RBSLs, and ROD cleanup levels were limited to soils from 0 to 5 ft bgs in the central-eastern portion of the site for lead and PCDD/PCDF, 0 to 2.5 ft bgs in the northwestern portion of the site for lead and hexavalent chromium, and at 10 ft bgs in the southern portion of the site for an isolated hexavalent chromium exceedance. RCOPC concentrations exceed the Ra-226 RBSL from 0 to 12 ft bgs on the eastern portion of SHAD-041, with an isolated and discontinuous area of contamination at 14 ft bgs in the east-northeast corner, and isolated and discontinuous areas of contamination in the northwest at 12 ft bgs and a south-central portion between 11 to 12 ft bgs.

COPC concentrations exceeding scenario-specific ecological soil screening level (ESSL) for lead and NOAEL-based ecological screening levels for TCDD TEQ were limited to 0 to 5 ft bgs. PCDD/PCDF ESSL exceedances were generally limited to the eastern portion of SHAD-041, with one exceedance in the northwest corner. Lead scenario-specific ESSL exceedances were sitewide.

Soils were likely impacted because of contaminants from the burn pits leaching into the soil surface and subsurface. The approximate extent of existing waste and debris at SHAD-041 was delineated during the RI based on field observations during drilling and survey measurements. In borings with analyte exceedances, waste, debris, and ash within shallow soils were observed during drilling. The approximate horizontal extent of shallow impacted soil across the site (between approximately 0 and 5 ft bgs) is about 250 ft on the north-south axis and 300 ft east-west. The approximate extent of deeper impacted soils includes five isolated areas; four are estimated to be 20 × 20 ft and a fifth area 50 × 50 ft.

Based on the RI results, site-related contaminants in soil at SHAD-041 have not substantially migrated, and contamination is limited to the area of the original burn pits. Site-related contaminants in soil include Ra-226, lead, and PCDD/PCDF, which share similar properties of adsorbing to the soil (low mobility) and are for all intents and purposes insoluble, non-volatile, and resistant to biodegradation. Dissolution, volatilization, and biodegradation processes are not anticipated to affect the longevity or persistence of these contaminants in soil. Dissimilarly, other site-related contaminants including hexavalent chromium and VOCs are mobile; however, these contaminants were found to be co-located with low mobility contaminants. Therefore, soil contamination is believed to be stable and is not anticipated to migrate much further than it has since site operations ceased. A hydrogeologic conceptual site model is depicted in Figure 19.

Migration pathways for human health exposure to SHAD-041 contaminants include potential leaching of chemicals into the surface water, underlying soil, and to groundwater and volatilization of chemicals into the air from soil. Other potential migration pathways include transport of sediments via wind or disturbance during construction activities.

Migration pathways for ecological exposure to SHAD-041 contaminants include the pathways listed above for human health exposure, as well as contact or ingestion by birds, animals, and uptake by vegetation.

Groundwater was not encountered at SHAD-041 during the RI. Depths to groundwater measured in the vicinity of SHAD-041 ranged from 14 to 18.5 feet bgs during the 2014 through 2017 groundwater monitoring events, and flows predominantly to the west-northwest at a gradient of approximately 0.05 ft/ft.

8.0 Remedial Investigation Conclusions and Recommendations

The RI was conducted to investigate and characterize the nature and extent of contamination and evaluate potential risk to human and ecological receptors at SHAD-041. Except for lead and a limited number of hexavalent chromium and PCDD/PCDF concentrations, COPCs are not present in the soil at concentrations above the RSLs or OU 2 ROD cleanup levels.

Ra-226 was detected in surface and subsurface soil at SHAD-041 at concentrations above the RBSL at multiple locations and sampling depths. Also, complete or potentially complete exposure pathways to human and ecological receptors were identified. Based on soil sampling results, soils at SHAD-041 pose an unacceptable risk to human health from lead and Ra-226 under the potential future residential use scenario and from Ra-226 under the potential future industrial/commercial use scenario. In addition, elevated concentrations of lead and PCDD/PCDF pose a risk to ecological receptors.

Based on the findings of this RI for SHAD-041, an FS to evaluate remedial alternatives to reduce the risk to human health and the environment was prepared. The following sections include the FS for SHAD-041.

9.0 Remedial Action Objectives and General Response Actions

This section identifies the remedial action objectives (RAO) for soil at SHAD-041 and the potential GRAs that would be protective of human health and the environment. Although the future reuse is identified as industrial or commercial for SHAD-041, this FS Report evaluates remedial alternatives to reduce, eliminate, or control risk to potential future site occupants and current and future wildlife.

9.1 Remedial Action Objectives and Remedial Goals

RAOs are medium-specific (soil, groundwater, or air) and designed to protect human health and the environment. According to USEPA guidance (USEPA, 1988), an RAO should specify:

- COCs
- Exposure routes and receptors
- An acceptable chemical level or range of levels for each exposure route (i.e., a remedial goal)

Remedial goals are usually chemical concentration limits that provide a quantitative means of identifying areas for potential remedial action, screening the types of appropriate technologies, and assessing a remedial action's potential for achieving the RAO. Remedial goals are also the performance requirements and the main basis for measuring the success of the response actions.

Existing site conditions are not considered protective of human health under the current land use at SHAD-041 or for the potential future residents, commercial/industrial and construction workers. Evaluation of risk for the commercial/industrial use scenario is considered conservative enough to assess risk for park/recreational use, and evaluation of risk for the construction worker scenario is conservative enough to assess risk to utility and landscape workers.

Groundwater at SHAD-041 was not addressed in the RI.

9.1.1 Human Health Remedial Action Objectives

Based on the RI results, surface and subsurface soils were identified as the medium of concern at SHAD-041. Lead and Ra-226 were identified as the COC and RCOC to future potential residents. The Army made a risk management decision that cancer risks from Ra-226 and elevated lead concentrations in surface and subsurface soil at SHAD-041 were unacceptable. Ra-226 contributed 99 percent of the cancer risk. In addition, the noncancer hazard index associated with exposure of the potential future resident to soil exceeded 1, with Ra-226 contributing most of the risk. These results conservatively assumed 100 percent of the lead and Ra-226 detected in the soil are bioavailable to humans. The risk evaluation process is described in detail in Appendix F1.

Risk-based concentrations of lead, 80 mg/kg and 320 mg/kg were developed based on target lead concentrations that correspond to the blood lead concentration of 1 µg/dL in children (hypothetical resident) and the fetus of a pregnant adult industrial/commercial worker, respectively. The OU 2 ROD (ESE, 1996) defined the industrial use cleanup level for lead to 1,000 mg/kg in surface and subsurface soil. However, current scientific evidence shows that the lead cleanup goal of 1,000 mg/kg is not protective of children or the fetus of an adult worker (USEPA, 2016).

The risk-based concentrations for Ra-226, without a background level contribution, for residential reuse were established at 1.33 pCi/g (cancer risk) and 2.18 pCi/g (cancer risk-based on the industrial/commercial exposure scenario). These risk-based concentrations are based on a target cancer risk of 1×10-6 and a target cancer risk of 1×10-4, respectively.

The RAO for SHAD-041, for a potential future industrial land use scenario, is the restoration of soil to conditions suitable for industrial/commercial site use by meeting the OU 2 ROD cleanup level for lead (1000 mg/kg) and risk-based cleanup level for Ra-226 (2.18 pCi/g).

9.1.2 Ecological Health Remedial Action Objectives

Risk-based ecological remedial goals were calculated for the burrowing owl, the most sensitive receptor in the SHAD-041 SLERA. The development of the risk-based remedial goals is described in detail in Appendix F2.

PCDD/PCDF is the only contaminant of ecological concern identified for SHAD-041 based on the potential for wildlife to be exposed to surface and subsurface soils.

The RAO for SHAD-041 is the prevention of exposure to ecological receptors from PCDD/PCDF in surface and subsurface soils at concentrations above the ecological RBSLs of 1.6 pg/g.

9.2 General Response Actions

GRAs are broad classes of responses or remedial actions intended to meet the RAOs. Similar to RAOs, GRAs are medium-specific; therefore, they are developed in relation to contamination of soil, groundwater, or air. GRAs are derived based on engineering judgment and experience with response actions proven successful for the COCs and RCOC at SHAD-041.

GRAs may include no action, containment, treatment, institutional actions, removal, or a combination of these (EPA, 1988). In some cases, response actions may stand alone as complete remedial alternatives, but in many cases, combinations of response actions are necessary to address soil contamination and meet RAOs effectively.

Four GRAs were identified to achieve the RAOs developed for surface and subsurface soil at SHAD-041:

- **No Action**: The NCP requires that the no-action alternative is carried through the detailed analysis of alternatives. Under the no-action alternative, no response actions will be taken at the site. Soil would be left in-place without implementing LUCs, engineering controls (EC), containment, removal, treatment, or other mitigating actions.
- **Engineering Control**: ECs, such as exposure prevention covers, are physical barriers used to reduce or eliminate the pathway for potential human exposure to contaminated surface and subsurface soil. Typically, ECs are used in conjunction with some form of LUCs to ensure proper monitoring and maintenance of the EC.
- **Land Use Control**: LUCs are legal and administrative mechanisms to implement land use and access restrictions limiting the exposure of hypothetical landowners or users of the property to the contaminated surface and subsurface soil. LUCs can also be used to maintain the integrity of a response action. Monitoring and inspections are conducted to assure the land use restrictions are being followed and are effective. LUCs include restrictive covenants, access restrictions, and land use restrictions.
- **Active Remediation**: Remediation includes the removal or treatment of contamination to minimize or eliminate the potential exposure of humans and wildlife to the contaminated surface and subsurface soil. Treatment processes can directly reduce the toxicity, mobility, or volume of chemicals. Active remediation technologies applicable for COC and RCOC contamination in soil include removal, in situ biological treatment, in situ physical/chemical treatment, and ex situ physical/chemical treatment.

These GRAs are discussed further in Section 10.0 and may be developed into remedial alternatives for SHAD-041.

10.0 Screening of Remedial Technologies and Process Options and Development of Remedial Alternatives

This section analyzes the technology types and process options for each GRA in terms of three broad screening criteria (USEPA, 1988):

- Effectiveness
- Implementability
- Cost

Remedial technologies refer to general categories, such as in situ biological treatment, and process options refer to specific treatment trains (i.e., phytoremediation). The range of remedial technologies and process options was reduced with respect to technical practicability, site conditions, waste characteristics, and chemical properties, as well as the ability of the technology to meet the requirements of the NCP and the RAOs.

This section discusses:

- Screening criteria used to evaluate the remedial technologies and process options
- Identification and screening of remedial technologies and process options for COCs and RCOCs in surface and subsurface soil
- Remedial technologies and process options retained for development and analysis of potential remedial alternatives

Remedial technologies for lead-contaminated soil were identified for evaluation based on the information provided in the screening matrix on remedial technologies compiled by the 2007 Federal Remediation Technologies Roundtable (FRTR) and in *Metals Treatment Technologies for Soil, Waste, and Water* (USEPA, 2002).

Remedial technologies for Ra-226 contaminated soil were identified by reviewing information from the Multi-Agency Radiation Survey and Site Manual, known as “MARSSIM” (USEPA, et al., 2000), and the USEPA Contaminated Site Clean-Up Information (CLU-IN) on-line characterization and remediation database (USEPA, 2017).

10.1 Screening Criteria

The screening process evaluates the various technologies that fall within each of the four GRAs identified in Section 9.2 for effectiveness, implementability, and cost. The three criteria are described in detail in the following subsections.

10.1.1 Effectiveness

Effectiveness is the ability of a remedial technology to achieve RAOs within a reasonable timeframe. When evaluating effectiveness, three primary factors are considered:

- The ability to treat the estimated volume or area of contaminated media (i.e., surface and subsurface soil)
- The protectiveness of the technology to the environment during implementation
- The reliability of the technology to reduce the toxicity and mobility of chemicals at the site and provide long-term protection

10.1.2 Implementability

The evaluation of implementability encompasses both the technical and the administrative feasibility of implementing a remedial technology. Technical feasibility includes:

- Compatibility with site-specific conditions
- The availability of equipment
- The ease of constructing the remediation system
- The labor intensiveness required by the system
- The availability of vendors that can design, construct, and maintain the system

Administrative feasibility includes the ease of obtaining approvals from other offices and agencies and the requirements for and availability of specific equipment and technical specialists.

10.1.3 Cost

The evaluation of cost addresses direct and indirect capital costs and annual operation and maintenance (O&M) costs. The relative cost for each process option is described qualitatively as low, moderate, or high. The cost ranges are based on a review of the literature, vendor quotations, professional or engineering judgment, or data prepared for other studies.

10.2 Preliminary Screening of Remedial Technologies and Process Options

Technology types and process options were evaluated with respect to the three preliminary screening criteria (effectiveness, implementability, and cost) described in Section 10.1. A summary of the screening process for remedial technologies and process options for lead and Ra-226 in surface and subsurface soil is presented in Table 13.

Sources of remedial technology descriptions in this section include:

- The FRTR remediation technology screening matrix (2007)
- Metals Treatment Technologies for Soil, Waste, and Water (USEPA, 2002)
- Reference Guide to Non-Combustion Technologies for Remediation of Persistent Organic Pollutants in Soil (USEPA, 2010)
- Contaminated Site Clean-Up Information online database (USEPA, 2017)
- Institutional Controls: A Guide to Implementing, Monitoring and Enforcing Institutional Controls at Contaminated Sites (USEPA, 2012)
- Policy on Land Use Controls Associated with Environmental Restoration Activities (DoD, 2001)

The following sections describe the evaluations of the potential remedial technologies and process options, which were identified within each of the GRAs for SHAD-041.

10.2.1 No Action

The NCP requires that the no-action alternative is carried through the detailed analysis of alternatives as it provides a baseline comparison with the other remedial alternatives [Title 40 Code of Federal Regulations (CFR) Section () 300.430(e)(6)]. Under this GRA, no response action is taken. Soil would be left as is without implementing LUCs, containment, removal, treatment, or other mitigating actions. Because surface and subsurface soil at SHAD-041 poses a risk to human health under the current and unrestricted use scenario, the no-action alternative would not be an effective response action that meets CERCLA requirements. No cost is associated with this option because no action is taken. The no-action alternative will be retained for further evaluation as a remedial alternative for comparison only, as required under the NCP.

10.2.2 Engineering Controls

ECs, such as engineered covers or containment units, are used to reduce or eliminate the pathway for potential human exposure to the contaminated material by providing a barrier to the contamination. The NCP indicates that “EPA expects to use ECs, such as containment, for waste that poses a relatively low risk or where treatment is impractical” (40 CFR 300.430). The following sections describe the engineering control technologies and process options that were screened for possible use at SHAD-041.

Covers

The purpose of covers, which can be constructed of soil, concrete, or asphalt, is to prevent a complete exposure pathway to a receptor. Covers differ from containment technologies because containment also prevents the lateral or vertical migration of chemicals (i.e., non-aqueous-phase liquids in soil). The components of a cover may include existing or new building foundations and floors, parking lots, sidewalks, other paved areas, vapor barriers, subsurface vapor control systems, and landscaped areas. LUCs would be required to maintain the covers and allow for appropriate precautions to be taken should the need to penetrate the cover be required, as might be encountered with utility repair.

Covers can be highly effective when the integrity of the barrier is maintained. Soil, concrete, or asphalt covers would require long-term maintenance and inspection to ensure effectiveness. In addition, LUCs would be required to maintain the long-term effectiveness of the cover. Soil covers would require revegetation of the area to prevent wind and rain erosion; however, erosion still may occur under extreme weather conditions. Soil, asphalt, or concrete covers would require covering or paving of a large area, which may limit future land uses. In addition, the radiological contaminant component of soil at SHAD-041 (approximately 2 acres) would require a specialized cover to eliminate or restrict external alpha and gamma radiation or x-rays and to prevent human health and ecological receptors from exposure to radiological and chemical contaminants of concern, making the cost of installing and maintaining a cover moderate to high. The lead-contaminated area (approximately 400 square ft) is much smaller and would be more conducive to installing a cover; however, burrowing mammals would likely dig under the cover at the edges. This process option was not retained because of the potential low effectiveness and required long-term maintenance of covers to prevent exposure.

On-Site Containment

Containment technologies are intended to isolate contaminated soil to prevent direct exposure and migration of chemicals. Surface and subsurface soil contaminated with lead and Ra-226 above remedial goals would be excavated and consolidated into an on-site engineered containment cell or corrective action management unit (CAMU). The CAMU may include a geosynthetic liner and a compacted soil cover.

On-site containment is highly effective at preventing human exposure to chemicals in the soil when the integrity of the CAMU cover and liners is maintained. However, the engineered CAMU would require long-term maintenance and monitoring to maintain its effectiveness. LUCs would also be required in combination with this process option to maintain long-term effectiveness. However, LUCs would only be required in the CAMU area; the rest of the site would be available for unrestricted use. Construction and long-term maintenance of a large CAMU would require the demolition of site features, such as underground utilities and roads, and excavation of a large volume of contaminated soil. Therefore, the implementability of this process option is moderate, and the cost would be high. However, the cost of constructing and maintaining a CAMU may be less than off-site disposal of the contaminated soil. On-site containment was retained as a viable process option for both lead and Ra-226 because of its effectiveness and possible cost savings over off-site disposal of soil.

10.2.3 Land Use Controls

LUCs are legal and administrative mechanisms implemented land use and access restrictions that are used to limit the exposure of future landowner(s) and user(s) of the property to hazardous substances present on the property and to maintain the integrity of the response action. LUCs generally are not protective of ecological health because it is difficult to restrict animals' ability to access the site, particularly birds. LUCs are required on a property where the selected remedial goal results in contamination remaining at the property above levels that allow for UU/UE. LUCs would likely remain in-place unless the response action taken allowed for the unrestricted use of the property. Implementation of LUCs includes requirements for monitoring and inspections and reporting to ensure compliance with land use or activity restrictions.

Legal mechanisms include proprietary controls such as restrictive covenants, negative easements, equitable servitudes, lease restrictions, and deed notices. Administrative mechanisms include notices, adopted local land use plans and ordinances, construction permitting, or other existing land use management systems that are intended to ensure compliance with land use restrictions. LUCs are frequently effective if they are layered or implemented in series. Layering means using several LUCs at the same time to enhance the protectiveness of the remedy. Implementation of LUCs in series may be applied to enhance both the short- and long-term effectiveness of the remedy. Monitoring and inspections would be conducted to ensure that the LUCs were being followed.

LUCs would limit the exposure of users of the property to hazardous substances and protect and maintain the integrity of the remedial action. The LUC objectives would be to prohibit residential use of the property until the Army and regulatory agencies conclude LUCs are no longer necessary.

LUCs are effective, not through actively treating contaminants, but by preventing human exposure to contaminants through signs, fences, and legal restrictions to prevent exposure to chemicals. LUCs are easily implemented at a low cost; therefore, access restrictions, land use restrictions, and covenants to restrict the use of property are all retained as viable process options for lead, PCDD/PCDF and Ra-226 in surface and subsurface soil. LUCs are not protective of potential ecological receptors.

Conveyance to a Federal Department or Agency

If SHAD-041 is transferred by the Army to a federal department or agency, the LUC objectives set forth above would be incorporated into a memorandum of agreement or similar agreement.

Implementation and Oversight

Monitoring and inspections would be conducted to assure that the LUCs were being followed. The Army and FFA signatories and their authorized agents, employees, contractors and subcontractors would have the right to enter SHAD-041 to conduct investigations, tests, or surveys; inspect field activities; or construct, operate, and maintain any response or remedial action as required or necessary under the cleanup program. These access restrictions would be included in the deed and covenant for property conveyed to a nonfederal entity and in the memorandum of agreement if the property is conveyed to a federal entity.

The Army would address LUC implementation and maintenance actions, including periodic inspections, in the draft and final remedial design (RD) reports to be developed and submitted to the FFA signatories for review and concurrence pursuant to the FFA. The draft and final RD reports are primary documents under the FFA.

The preliminary and final RD reports would include a section to describe required LUC implementation and actions, including:

- Requirements for CERCLA five-year review
- Requirements prohibiting construction of schools, daycare centers, hospitals, or convalescent homes
- Requirements prohibiting construction of offices, industrial buildings or residences without a vapor intrusion evaluation and risk assessment using the applicable risk parameters
- Frequency and requirements for periodic monitoring or visual inspections and reporting results from monitoring and inspections
- Notification procedures to the regulators for planned property conveyance, changes, and corrective action required for the remedy
- Development of wording for LUCs and parties to be provided copies of the deed language once executed
- Identification of responsibilities for Army, USEPA, DTSC, Central Valley Regional Water Quality Control Board, and other government agencies, and the new property owner for implementation, monitoring, reporting, and enforcing LUCs
- A list of LUCs with their expected duration
- Maps identifying where LUCs are to be implemented

The Army would be responsible for implementing, inspecting, reporting, maintaining, and enforcing the necessary LUCs described in the ROD in accordance with the final RD report. Although the Army might later transfer these procedural responsibilities to another party by contract, property transfer agreement, or other means, the Army would retain ultimate responsibility for remedy integrity. Should any of the LUCs fail, the Army would ensure that appropriate actions were taken to reestablish protectiveness of the remedy and might initiate legal action to either compel action by a third party or recovery the Army's costs for mitigating any discovered LUCs violations.

10.2.4 Active Remediation

Active remediation involves addressing COCs and RCOCs at the site using removal versus containing or preventing exposure. DoD policy requires an evaluation of an alternative permitting unrestricted use of the site to be in any FS where LUCs are considered (DoD, 2003). The purpose of the active remediation evaluation is, in part, to fulfill this requirement.

The active remediation of lead, PCDD/PCDF and Ra-226 in surface and subsurface soil at SHAD-041 may include removal, in situ bioremediation, in situ physical/chemical remediation, and ex situ physical/chemical remediation. These four technologies and their associated process options are discussed in the following sections.

Removal

Removal involves the excavation of contaminated surface and subsurface soil and disposal at an off-site appropriately licensed or permitted disposal facility. Some pretreatment, such as stabilization, may be required or preferred to meet land disposal restrictions so the most economical disposal option can be applied. Important considerations for excavation and disposal include excavation volume, fugitive emissions, hauling distance, and the type of treatment and disposal facility available for final disposition. Excavation depths at SHAD-041 would vary based on COC and RCOC concentrations, but the maximum depth is expected to be 14 ft bgs.

Excavation and disposal of lead, PCDD/PCDF and Ra-226 contaminated surface and subsurface soil is highly effective because the lead, PCDD/PCDF and Ra-226 would be permanently removed from the site. Excavation and disposal is a common response action, and vendors and disposal facilities are readily available. Excavation of the surface and subsurface soil is easily implemented; however, the costs are high because of the large volume of soil to be excavated and transported off-site, and due to the disposal of radiological media. Additionally, excavation may cause an adverse impact to ecological receptors during implementation, but mitigation may be used to minimize such impacts. Excavation and disposal are retained as a viable process option for both lead, PCDD/PCDF and Ra-226 contaminated surface and subsurface soil at SHAD-041 because it is highly effective and easy to implement.

In Situ Biological Treatment

Biological treatment includes destruction technologies directed toward stimulating microorganisms in the soil to grow and use chemicals as a food and energy source by creating a favorable environment for the microorganisms. Generally, biological treatment entails providing a combination of oxygen, nutrients, and moisture, and controlling the temperature and pH. Sometimes, microorganisms adapted for degradation of the specific chemicals are applied to enhance the process (FRTR, 2007). The only biological treatment identified for lead, PCDD/PCDF and Ra-226 in soil is phytoremediation (USEPA, 2002).

Phytoremediation is an in situ biological treatment technology where plants are used to remove, transfer, stabilize, or destroy contaminants in soil. Phytoremediation is an emerging technology and experimental research into identifying appropriate plant species is ongoing (USEPA, 2002). Treatment can take many years, and COCs and RCOCs that bind to soil or are otherwise not available to the roots would not be removed. To treat contaminants with phytoremediation at SHAD-041, a large number of plants or grasses would be required to cover the treatment area, which would need regular water and maintenance to establish growth. This technology would not cause a significant adverse impact to ecological receptors during implementation. Because of the long-term maintenance of the plants, the costs are expected to be moderate. Phytoremediation was not retained as a viable process option for lead, PCDD/PCDF and Ra-226 because of its low effectiveness and implementability.

In Situ Physical/Chemical Treatment

In situ physical or chemical treatment involves the reduction of the chemical’s toxicity, mobility, or volume through physical or chemical processes that are conducted on the soil in situ (defined as “in-place”). Four process options targeting lead or Ra-226 were evaluated for this remedial technology:

- In situ stabilization
- In situ soil flushing
- In situ electrokinetic treatment
- In situ vitrification

These options are discussed below.

In Situ Stabilization

With in situ stabilization, chemicals are physically or chemically bound or enclosed within the soil matrix. The process involves mixing the soil in-place with binders, such as Portland cement, lime, fly ash, cement kiln dust, or polymers to immobilize the lead, PCDD/PCDF and Ra-226 and reduce the leachability of contamination (USEPA, 2002). However, the added binder material may increase the volume by more than 100 percent and blending of the binding material may be difficult in situ. The solidified area could be covered with soil and landscaped. The hazard potential of the soil is reduced by this process option because the mobility of the chemicals is reduced. LUCs would be required to monitor and maintain the treated area and restrict access. In situ stabilization is easily implemented for surface and subsurface soils and the costs are moderate.

In situ treatment would be moderately effective for lead and PCDD/PCDF at SHAD-041 because the treatment area is small (approximately 400 to 2,500 square ft) and shallow (less than 5 ft bgs), so the effect on the environment would be minimal. This technology may have an adverse impact on environmental receptors during implementation. However, this process was not retained as a viable process option because Ra-226 contamination at SHAD-041 covers a larger footprint, with depths up to 14 ft bgs.

In Situ Soil Flushing

In situ soil flushing is a process option that extracts chemicals from soil using water, a solution of chemicals in water, or an extractant without excavating the material itself. The solution is injected into or sprayed onto the area of contamination, causing the chemicals to become mobilized. After passing through the contaminated soil, the flushing fluid (carrying the chemical) is collected by downgradient wells or trenches and pumped to the surface for removal, treatment, and discharge or reinjection (USEPA, 2002).

Flushing lead, PCDD/PCDF or Ra-226 from the surface soil may contaminate subsurface soil or groundwater at SHAD-041. In addition, flushing may cause COCs or RCOCs to precipitate and obstruct the soil pore structure, inhibiting the flow through soil. Because of the large area slated for Ra-226 remediation at SHAD-041, this process option would be difficult to implement and may require a large amount of fluid and a large number of recovery wells. In situ soil flushing could be a viable option for lead because the treatment area is small. However, COCs and RCOCs are relatively immobile in soil because they bind (or adsorb) to soil particles. The substantial clay and silty clay content in soil at SHAD-041 have likely further limited the mobility of COCs and RCOCs in the soil. This process may cause an adverse impact to the environment by using the materials that present a risk to environmental receptors through direct exposure or mobilization of contaminants. No cost data were available for this process option (USEPA, 2002). In situ soil flushing was not retained as a viable option for treatment of lead, PCDD/PCDF or Ra-226 because of its low effectiveness and low implementability.

In Situ Electrokinetic Treatment

In situ electrokinetic treatment of chemicals uses the natural conductivity of the soil (created by pore water and dissolved salts) to affect the movement of water, ions, and particulates through the soil. Electrodes are inserted into the soil, and an electrical current is passed between electrodes to cause water, ions, and particulates to move through the soil. Chemicals at the electrodes can be removed by electroplating or electrodeposition, precipitation or co-precipitation, adsorption, complexing with ion exchange resins, or by pumping of water (or other fluid) near the electrode (USEPA, 2002). The effectiveness of this process option is low. This process option requires adequate soil moisture and is most effective for saturated soil, so fluid would need to be applied to the surface and subsurface soil.

The implementability of electrokinetics for lead, PCDD/PCDF and Ra-226 treatment at SHAD-041 is also low because it would be difficult to implement for such a large treatment area (approximately 2 acres) and there are very few applications of the technology for the treatment of lead and no applications for treatment of Ra-226. This treatment technology is not effective for removal of Ra-226 from the soil because of the chemical structure of the compound. The cost of this process option is expected to be moderate to high. This technology may cause an adverse impact to the environment during implementation by mobilization of contaminants that may present a risk to environmental receptors. In situ electrokinetic treatment was not retained as a viable process option for lead, PCDD/PCDF and Ra-226 contaminated surface and subsurface soil because of its low effectiveness, low implementability, and moderate to high costs.

In Situ Vitrification

During in situ vitrification treatment, chemicals in the soil are surrounded by a glass matrix and become physically bonded inside the matrix. Vitrification is a high-temperature treatment aimed at reducing the mobility of inorganic chemicals by incorporating them into a chemically durable, leach-resistant, vitreous mass. The treatment may also cause inorganic chemicals to volatilize or undergo thermal destruction (USEPA, 2002).

Vitrification is moderately effective at reducing the mobility of lead, PCDD/PCDF and Ra-226; however, off-gas treatment may be necessary to remove metals or volatilized compounds by the process. The process may also inhibit the future land use of SHAD-041 because the surface soil may be transformed into a solid mass that would not support vegetation; topsoil may need to be imported before the site can be revegetated. In situ vitrification may be difficult to implement over the large treatment area for Ra-226; the implementability of this process option is low. The small area of lead-contaminated soil could be treated with vitrification, but costs are high because it requires large amounts of energy. This technology would cause a significant adverse impact to environment receptors during implementation. Vitrification treatment was not retained as a viable process option for lead, PCDD/PCDF or Ra-226 because of its moderate effectiveness, low implementability, and high costs.

Ex Situ Physical/Chemical Treatment

Ex situ treatment includes excavation of contaminated soil, physical or chemical treatment of soil to reduce the mobility, toxicity, or volume of chemicals, and off-site disposal of the treated soil or replacement of the soil on-site. Three process options were identified for ex situ treatment of lead, PCDD/PCDF or Ra-226 in soil:

- Soil washing/acid extraction
- Pyrometallurgical treatment
- Ex situ stabilization

These process options and their effectiveness, implementability, and cost are discussed below.

Soil Washing/Acid Extraction

Soil washing/acid extraction is based on the concept that most chemicals tend to bind to the finer soil particles (clay or silt) than larger particles (sand or gravel). For this process, the contaminated soil is excavated, and the soil is screened to remove oversized particles. The soil is mixed with a wash solution to help remove organic chemicals and heavy metals. The particles are separated by size, and the chemicals are concentrated with the fine particles. The coarse-grained soil is relatively clean and can be replaced on-site. However, the fine particles and the wash solution require further treatment to remove metals (USEPA, 2002). The effectiveness of this process option is low because the metals are concentrated in the fines but are not destroyed or immobilized in the fine particles and wash solution. Furthermore, this technology has been used to treat metals-contaminated soil in only a limited number of applications.

The implementability of this process option is moderate, and the costs are expected to be high because the process includes excavation of surface soil, ex situ treatment, further treatment of fines and wash solution to remove or immobilize the metals, and replacement of treated soil. Additionally, due to excavation of the contaminated soil, this technology may cause an adverse impact to ecological receptors during implementation. Ex situ soil washing/acid treatment was not retained as a viable process option for lead at SHAD-041. This treatment technology is not effective for Ra-226 because it is concentrated in fine-grained soil at concentrations that would not be destroyed or immobilized, and treatment costs are very high.

Pyrometallurgical Treatment

Pyrometallurgical treatment uses heat to convert COC and RCOC contaminated soil into a product with high COC and RCOC concentrations that can be sold. However, the use of this technology is limited because the cost of importing metals generally is much lower than the cost of reclaiming metals from contaminated material. The effectiveness of this process option is low. In addition, the technology may produce treatment residuals such as slag, flue dust, and baghouse dust that may require further treatment.

The implementability of this process option is low, and the cost for reclaiming metals is high because of the low concentration of metals in surface soil at SHAD-041. In addition, due to excavation of the contaminated soil, this technology may cause an adverse impact to ecological receptors during implementation. Pyrometallurgical treatment was not retained as a viable process option for either lead, PCDD/PCDF or Ra-226 contaminated soil.

Ex Situ Stabilization

Ex situ stabilization includes the same process as in situ stabilization; however, soil is excavated before it is treated. The goal of ex situ stabilization is to reduce the leaching potential of lead, PCDD/PCDF and Ra-226 so that the soil can be disposed of more economically at an off-site disposal facility. Stabilization is highly effective at reducing the mobility of lead, PCDD/PCDF and Ra-226 in soil; however, it may increase the volume of contaminated soil as much as 50 percent.

The implementability of this process option is moderate, and the cost is high because the technology includes excavation of the surface and subsurface soil, treatment, and off-site disposal at a permitted facility. Due to excavation of the contaminated soil, this technology may cause an adverse impact to ecological receptors during implementation. Ex situ stabilization was retained as a viable process option for lead, PCDD/PCDF and Ra-226 treatment; and, excavation and off-site disposal is also retained, and this process option (excavation and off-site disposal) may include pretreatment, such as ex situ stabilization, which may be conducted at an off-site treatment or disposal facility to obtain the most economical disposal option. This process option was retained for removal of lead, PCDD/PCDF, and Ra-226 impacted soils in areas ranging in size from 400 to 2,500 square feet.

10.3 Summary of Retained Remedial Technologies and Process Options

Based on the preliminary screening, the following remedial technologies and process options were retained:

- No action
- Access restrictions
- Land use restrictions
- Covenants to restrict the use of the property
- On-site treatment of Ra-226, PCDD/PCDF and lead-contaminated soil
- Excavation and on-site containment
- Excavation and disposal at an off-site treatment/disposal facility

These process options will be combined into remedial alternatives. These alternatives are described in the following section and are evaluated against the NCP criteria in Section 11.0.

10.4 Development of Remedial Alternatives

The retained technologies and process options were assembled into remedial alternatives for lead, PCDD/PCDF and Ra-226 in surface and subsurface soil at SHAD-041 that would be protective of human and ecological health, satisfy the RAOs and meet the ARARs. The remedial alternatives were derived using experience and engineering judgment to formulate process options into the most plausible site-specific remedial action alternatives. Five remedial alternatives were developed:

- Alternative 1—No Action
- Alternative 2—Land Use Controls
- Alternative 3—On-Site Treatment and Land Use Controls
- Alternative 4 A—Excavation and Off-Site Disposal, Industrial Use
- Alternative 4B—Excavation and Off-Site Disposal, Unlimited Use/Unrestricted Exposure
- Alternative 5—Excavation, On-Site Containment, and Land Use Controls

One of the above alternatives must be selected as the remedial alternative for SHAD-041.

The remedial alternatives for the protection of human health and ecological receptors including potential future UU/UE (residential use) are described in more detail below. General assumptions made in developing cost estimates for these alternatives are discussed in Appendix G.

10.4.1 Remedial Alternatives

Alternative 1—No Action

The no-action alternative is required for analysis by the NCP (40 CFR 300.430[e][6]). The no-action alternative provides a baseline for comparison with the other remedial alternatives. Under this alternative, no response actions would be conducted at SHAD-041. No attempts would be made to monitor or control exposure to chemicals in soil.

Alternative 2—Land Use Controls

Under Alternative 2, LUCs would be implemented using access restrictions, land use restrictions, and covenants to restrict the use of the property. The LUCs will prohibit the use of SHAD-041 for future residential development without further response action. A LUC RD would be prepared to describe the specific LUC implementation actions (DoD, 2003), including:

- CERCLA and Superfund Amendments and Authorization Act of 1986 requirements for 5-year remedy reviews
- Frequency and requirements for periodic maintenance or visual inspection
- Notification procedures to the regulatory agencies for planned property conveyance
- Corrective action requirements or responses to actions inconsistent with the LUCs
- A list of LUCs with expected durations
- Maps identifying where the LUCs are to be implemented

Long-term O&M will include 5-year reviews to evaluate the protectiveness of the alternative.

Alternative 3—On-Site Treatment and Land Use Controls

Under Alternative 3, on-site treatment would be implemented to remediate COC and RCOC concentrations in surface and subsurface soil to below industrial use human health cleanup goals (1,000 mg/kg for lead and 2.18 pCi/g for Ra-226) and ecological cleanup goals (990 mg/kg for lead and 1.9 pg/g for TCDD TEQ). Stabilization was selected to treat the COC and RCOC impacted areas because of its short-term effectiveness, low cost, and ability to treat surface and subsurface soil contamination successfully. Contaminated surface and subsurface soil would be excavated to 5 ft bgs over the 75,000 square ft of Ra-226 impacted area (which includes shallow lead and PCDD/PCDF impacted areas) and up to 13 ft bgs at the five isolated Ra-226 impacted areas (approximately 400 to 2,500 square ft areas). Excavated soil would be mixed with Portland cement, which would increase the volume of soil by 50 percent.

Following excavation of impacted soil, soil samples would be collected around the lateral extent of the excavation and on the excavation floor and sidewalls and analyzed for COCs and RCOCs to confirm concentrations are below the remedial goals. If the confirmation samples show concentrations are below the cleanup goals, the excavation would be backfilled with the concrete/soil mixture. If concentrations are above the remedial goals, the excavations would be expanded laterally and vertically, and additional confirmation samples would be collected. This process would be repeated until the remedial goals are met, or groundwater is encountered. The excavated area would then be backfilled with stabilized soil consisting of a concrete/soil mixture. LUCs are required to monitor and maintain the treated areas and restrict access to humans because the treated material contains COCs and RCOCs.

Alternative 4A — Excavation and Off-Site Disposal, Industrial Use

This alternative involves excavation and off-site disposal of impacted surface and subsurface soil posing an unacceptable risk to industrial use human receptors. Lead and Ra-226 at concentrations in impacted surface and subsurface soil above the cleanup goals (1000 mg/kg for lead and 2.18 pCi/g for Ra-226) and ecological cleanup goals (990 mg/kg for lead and 1.9 pg/g for TCDD TEQ) would be excavated. Soil would be excavated to 5 ft bgs over the 75,000 square ft of Ra-226 impacted area (which includes shallow lead and PCDD/PCDF impacted areas) and up to 13 ft bgs at the five isolated Ra-226 impacted areas (approximately 400 to 2,500 square ft areas). Contaminated soil would be transported off-site to an appropriately licensed or permitted disposal facility.

Approximately 7,000 cubic yards of impacted soil would be excavated over a two-acre area. The area of excavation would be further defined in the RD if this alternative is chosen for remediation. More detailed assumptions for excavation are included in Appendix G.

Following excavation of impacted soil, soil samples would be collected around the lateral extent of the excavation and on the excavation floor and sidewalls and analyzed for COCs and RCOCs to confirm concentrations are below the remedial goals. If the confirmation samples show concentrations are below the remedial goals, the excavation would be backfilled with clean soil. If concentrations are above the remedial goals, the excavations would be expanded laterally and vertically, and additional confirmation samples would be collected. This process would be repeated until the remedial goals are met. The excavated areas would be backfilled with clean material and returned to existing grades. However, costs for backfilling with clean fill material are substantial, and other approaches may be feasible, including locating an on-site source of fill.

A statistical analysis may be conducted to evaluate whether concentrations at the bottom and sidewalls of the excavations are above the cleanup goals concentrations. If the results of these confirmation samples and statistical analysis indicate the next 0.5 feet of soil contains COCs or the RCOC at or below the cleanup goals, backfill of the excavation with clean fill may not be required. While this approach may be an option for future discussion if this alternative is chosen for remediation, this FS assumes the excavation would be backfilled with clean material.

Samples would be collected from the impacted stockpiled soil for waste characterization before transport via trucks to an appropriately licensed or permitted disposal facility outside the Sharpe facility. The contaminated soil may be pretreated at the treatment/disposal facility to achieve the most economical disposal option. Pretreatment may include stabilization to reduce the leaching potential of COCs and RCOCs. More detailed assumptions for this alternative are provided in Appendix G.

The intent of Alternative 4A is to eliminate the risk and achieve industrial use of the site. Following completion of this alternative, LUCs to ensure industrial use would be required.

Alternative 4B — Excavation and Off-Site Disposal, Unlimited Use/Unrestricted Exposure

This alternative involves excavation and off-site disposal of impacted surface and subsurface soil posing an unacceptable risk to human receptors and would allow for UU/UE. Lead and Ra-226 at concentrations in surface and subsurface impacted soil above UU/UE cleanup goals of 80 mg/kg and 1.33 pCi/g, respectively, and ecological cleanup goals (990 mg/kg for lead and 1.9 pg/g for TCDD TEQ) would be excavated. Contaminated soil would be transported off-site to an appropriately licensed or permitted disposal facility.

Approximately 14,622 cubic yards of impacted soil would be excavated over a two-acre area. The area of excavation would be further defined in the RD if this alternative is chosen for remediation. More detailed assumptions for excavation are included in Appendix G.

After the impacted soil is excavated, soil samples would be collected around the lateral extent of the excavation on the excavation floor and sidewalls and analyzed for COCs and RCOCs to confirm concentrations are below the remedial goals. If the confirmation samples show concentrations are below the remedial goals, the excavations would be backfilled with clean soil. If concentrations are above the remedial goals, the excavations would be expanded laterally, and additional confirmation samples would be collected. This process would be repeated until the remedial goals are met. The excavated areas would be backfilled with clean material and returned to existing grades. However, costs for backfilling with clean fill material are substantial, and other approaches may be feasible, including locating an on-site source of fill.

A statistical analysis may be conducted to evaluate whether COC and RCOC concentrations at the bottom and sidewalls of the excavations are above the cleanup goals concentrations. If the results of these confirmation samples and statistical analysis indicate the next 0.5 feet of soil contains concentrations at or below the cleanup goals, backfill of the excavation with clean fill may not be required. While this approach may be an option for future discussion if this alternative is chosen for remediation, this FS Report assumes the excavation would be backfilled with clean material.

Samples would be collected from the impacted stockpiled soil for waste characterization before transport via trucks to an appropriately licensed or permitted disposal facility outside the Sharpe facility. The contaminated soil may be pretreated at the treatment/disposal facility to achieve the most economical disposal option. Pretreatment may include stabilization to reduce the leaching potential of COCs and RCOCs. More detailed assumptions for this alternative are provided in Appendix G.

Alternative 4B intends to eliminate the risk and achieve UU/UE of the site. Following completion of this alternative, the RAOs would be achieved without the need for ECs or LUCs.

Alternative 5 — Excavation, On-Site Containment, and Land Use Controls

In Alternative 5, surface and subsurface soil that poses an unacceptable risk to humans under the industrial use scenario would be excavated and placed in an on-site containment cell or CAMU. Lead and Ra-226 impacted soil at concentrations above the industrial use cleanup goals (1,000 mg/kg for lead and 2.18 pCi/g for Ra-226) and ecological cleanup goals (990 mg/kg for lead and 1.9 pg/g for TCDD TEQ) would be excavated. This alternative includes the same excavation and confirmation sampling methods as

Alternative 3. A CAMU would be constructed on-site for permanent storage and management of the excavated soil. LUCs would be implemented for the CAMU to maintain the effectiveness of the alternative. Excavated areas of the site would be available for industrial use. This alternative also includes long-term maintenance, monitoring, and 5-year reviews of the CAMU.

Excavated impacted soil would be hauled to the proposed CAMU location (the actual CAMU location and size would be determined in the RD) and placed on the existing grade. The CAMU would extend approximately 10 ft above the existing grade, and the sides would be sloped to promote drainage outward. The CAMU would not require a liner or leachate collection system, in accordance with the potential ARARs identified in Section 11.1.1, because COCs and RCOCs are relatively immobile in soil and will not migrate into groundwater or surface water at SHAD-041. The cover of the CAMU would consist of 0.5 ft of clean soil to prevent exposure of humans to contaminated soil. Because of the large volume of excavated soil (approximately 14,622 cubic yards) and the slope of the soil cover, the CAMU would cover approximately 2 to 3 acres, plus additional space required during construction for staging and stockpiling of demolition debris.

Construction of the CAMU may require the demolition of site features, including existing roads, and utilities. More detailed assumptions for the volume and area needed for the CAMU are included in Appendix G.

Construction of the CAMU would require the installation of and periodic collection of samples from groundwater monitoring wells within or around the CAMU. While COCs and RCOCs in surface and subsurface soil at SHAD-041 are believed to be relatively immobile and would not migrate to groundwater, a groundwater monitoring program is required by the Resource Conservation and Recovery Act (RCRA) CAMU regulations, Cal. Code Regs. tit. 22 (CCR, Title 22), 66264.552(c) and (e). Five new groundwater monitoring wells would be installed (two downgradient, one upgradient, and two cross-gradient), and samples would be collected from the wells once every 5 years.

The CAMU would require long-term maintenance, monitoring, and 5-year reviews. LUCs would be implemented to restrict the future use of the area surrounding the CAMU to protect the integrity of the CAMU. The description and location of the CAMU would be recorded in the geographic information system database for Sharpe facility so that the LUCs can be tracked and enforced. Appendix G contains more detailed assumptions used to develop cost estimates for this alternative.

11.0 Detailed Analysis of Remedial Action Alternatives

Each remedial alternative retained in Section 10.0 was evaluated against the evaluation criteria that are based on the statutory requirements of CERCLA 121, as amended by the Superfund Amendments and Authorization Act of 1986; the NCP; and *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988). This information will be used to develop, define, and select a final remedy for SHAD-041. This section includes a description of the nine evaluation criteria and the detailed analysis of the remedial alternatives.

11.1 Remedial Alternative Screening Criteria

The NCP details the expectations for remedy selection in 40 CFR 300.430(a)(1)(iii). In accordance with the NCP, each remedial alternative was developed and evaluated in comparison with two threshold, five balancing, and two modifying NCP evaluation criteria. The evaluation criteria have been divided into three groups based on the function of the criteria in remedy selection.

The threshold criteria relate to statutory requirements that each alternative must satisfy in order to be eligible for selection and include:

- Overall protection of human health and the environment
- Compliance with Applicable or Relevant and Appropriate Requirements (ARARs).

The primary balancing criteria are the technical criteria upon which the detailed analysis is primarily based and include:

- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost.

The third group is made up of the modifying criteria and includes:

- State/Support agency acceptance
- Community acceptance.

11.1.1 Threshold Criteria

Two criteria relate directly to statutory findings that must ultimately be made in the ROD: (1) overall protection of human health and the environment and (2) compliance with ARARs. These criteria are categorized as threshold criteria because each alternative must meet them. They are described below.

Overall Protection of Human Health and the Environment

This criterion assesses whether each alternative adequately protects human health and the environment. The overall assessment of protection draws on evaluations of long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs. Protectiveness focuses on how risks are reduced, eliminated, or controlled by each alternative. Risk reductions are associated with the effectiveness of an alternative in meeting the RAOs. This criterion is considered a threshold that the selected alternative must meet. Soil at SHAD-041 poses an unacceptable risk from lead and Ra-226 to potential future residential use an unacceptable risk from lead and PCDD/PCDF to ecological receptors, and unacceptable risk from Ra-226 to potential future industrial use.

Compliance with ARARs

This criterion is used to evaluate whether each alternative meets all identified federal and state ARARs (chemical-specific, action-specific, and location-specific), or whether justification exists for waiving one or more ARARs. This criterion is also a threshold that the selected alternative must meet unless an ARAR is waived. Potential ARARs for SHAD-041 and the remedial alternatives are identified in the following sections.

Potential Applicable or Relevant and Appropriate Requirements

CERCLA 121(d)(l) requires response actions attain (or the decision document must justify the waiver of) ARARs, which include environmental regulations, standards, or criteria, promulgated under federal or more stringent state laws. An ARAR may be either applicable or relevant and appropriate, but not both. The NCP (40 CFR Part 300) defines applicable and relevant and appropriate as follows:

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

Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site (relevant) that their use is well suited (and appropriate) to the particular site.

CERCLA 121(e) exempts any response action conducted entirely on-site from having to obtain a federal, state, or local permit when the action is carried out in compliance with CERCLA 121. In addition, on-site actions need only comply with the substantive aspects of ARARs, not with the corresponding administrative procedures, such as administrative reviews and record-keeping requirements. Off-site actions must comply with all legally applicable requirements, both substantive and administrative.

The identification of ARARs is based on a number of site-specific factors, including potential response actions, chemicals, and compounds found at the site; physical characteristics of the site; and the location of the site. ARARs are usually divided into three categories: chemical-specific, location-specific, and action-specific.

USEPA guidance recommends that the lead federal agency, the Army, consult with the state when identifying state ARARs for response actions (USEPA, 1988). CERCLA and NCP requirements (40 CFR 300.515) for response actions indicate the lead federal agency will request that the state (in this case, State of California) identify chemical- and location-specific ARARs after completion of site characterization. The requirements also indicate the lead federal agency should request identification of all categories of state ARARs (chemical-, location-, and action-specific) upon completion of identification of remedial alternatives for detailed analysis. The state must respond within 30 days of receipt of the lead federal agency's requests.

To qualify as a state ARAR under CERCLA and the NCP, a state requirement must be

- A standard, requirement, criterion, or limitation under a state environmental or facility siting law
- Promulgated (of general applicability and legally enforceable)
- Substantive (not procedural or administrative)

- More stringent than the federal requirement
- Identified by the state promptly
- Consistently applied

The requirements that the state identified as potential ARARs are described in detail in Appendix H. The following sections summarize potential federal and State of California ARARs for SHAD-041.

Potential Chemical-Specific Applicable or Relevant and Appropriate Requirements

Chemical-specific ARARs are health- or risk-based numerical values or methods that, when applied to site-specific conditions, result in the establishment of numerical cleanup values. Appendix H (Tables H-1 and H-2) summarize the potential chemical-specific ARARs.

There are potential federal and state chemical-specific ARARs for any remedial alternative that will generate waste, such as excavation and off-site disposal of soil. The potential federal chemical-specific ARARs are the substantive provisions of:

- Uranium Mill Tailings Radiation Control Act 40 CFR 192.12(a)
- U.S. Nuclear Regulatory Commission Standards for Protection of Radiation at 10 CFR 20.1301 and 20.1402
- U.S. Nuclear Regulatory Commission Criteria relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentrations of Source Material from Ores Processed Primarily for Their Source Material Content at 10 CFR Part 40 Appendix A Criterion 6(6)
- Clean Air Act requirements for radionuclides at 40 CFR 61.92 and 61.102
- RCRA requirements at Cal. Code Regs., tit. 22 (CCR, Title 22), Sections 66261.21, 66261.22(a)(1), 66261.23, 66261.24(a)(1), and 66261.100, which define RCRA hazardous waste

The potential state chemical-specific ARARs are the substantive provisions of:

- Cal. Code Regs. tit. 22 (CCR, Title 22), 66261.22(a)(3) and (a)(4), 66261.24(a)(2) through (a)(8), 66261.101, 66261.3(a)(2)(C) and (a)(2)(F), which define a non-RCRA, state-regulated hazardous waste;
- Cal. Code Regs. tit. 27 (CCR, Title 27), 20210, 20220 and 20230 which define designated, nonhazardous and inert waste.

In addition, for any alternative that affects groundwater, California Water Code 13234 and 13269 are potential ARARs. Chapters 2 and 3 of the Comprehensive Water Quality Control Plan for the Central Valley Region (Basin Plan) are also potential ARARs.

Potential Location-Specific Applicable or Relevant and Appropriate Requirements

The potential federal location-specific ARARs for SHAD-041 include the substantive provisions of 703 of the Migratory Bird Treaty Act (16 United States Code 703-712). This act prohibits at any time, using any means or manner, the pursuit, hunting, capturing, and killing or attempting to take, capture, or kill any migratory bird.

In response to the Army’s request for state ARARs, the California Department of Fish and Game, now Department of Fish and Wildlife (DFG/DFW) provided a list of ARARs to the Army (ARARs included in Appendix H). The Army determined that of those provided by the DFG, the substantive provisions of the requirements listed below are potentially relevant and appropriate location-specific ARARs. Although these requirements are not enforceable by DFG at Army facilities, the Army will take into account specific standards of control so that state-protected species will be protected when practicable and will coordinate with appropriate state authority if conflicts arise.

The following are potential location-specific ARARs:

- California Fish and Game Code 3005: Birds and mammals will be protected by achieving the identified RAOs. Further, the scope of the remedial actions does not include the intentional taking of birds and mammals with unlawful devices. State-protected species will be protected when practicable, and the appropriate state authority will be consulted if conflicts arise.
- California Fish and Game Code 3503: This requirement includes specific standards of control. The Army will take all reasonable steps to avoid the needless destruction of any nest or eggs. State-protected species will be protected when practicable, and the appropriate state authority will be consulted if conflicts arise.
- California Fish and Game Code 3503.5: This requirement includes specific standards of control. The Army will take all practicable steps to protect birds of prey. State-protected species will be protected when practicable, and the appropriate state authority will be consulted if conflicts arise.
- California Fish and Game Code 3511: This requirement includes specific standards of control that may apply to any fully protected birds found at the site. Vegetation clearance activities should occur outside the nesting seasons for these protected birds. State-protected species will be protected when practicable, and the appropriate state authority will be consulted if conflicts arise.
- California Fish and Game Code 3800: This requirement includes specific standards of control that may apply to any nongame birds found at the site. Vegetation clearance activities should occur outside the nesting seasons for nongame birds. State-protected species will be protected when practicable, and the appropriate state authority will be consulted if conflicts arise.
- California Fish and Game Code 4150: This requirement includes specific standards of control that may apply to any nongame mammals found at the site. State-protected species will be protected when practicable, and the appropriate state authority will be consulted if conflicts arise.
- California Fish and Game Code 5650(a) and (b): The Army will take all practicable steps to avoid depositing, or place where it can pass into waters of the state, any substance deleterious to fish, plant life, or bird life.
- Cal. Code Regs. tit. 14 (CCR, Title 14), 40: This requirement includes specific standards of control that may apply to any native reptiles or amphibians found at the site. State-protected species will be protected when practicable, and the appropriate state authority will be consulted if conflicts arise.
- Cal. Code Regs. tit. 14, (CCR, Title 14) 472(a): This requirement includes specific standards of control that may apply to any nongame birds found at the site. Vegetation clearance activities should occur outside the nesting seasons for nongame birds. State-protected species will be protected when practicable, and the appropriate state authority will be consulted if conflicts arise.

Potential Action-Specific Applicable or Relevant and Appropriate Requirements

Action-specific ARARs are technology- or activity-based requirements or limitations for response activities. These requirements are triggered by the particular response activities conducted at the site and indicate how a selected remedial alternative should be achieved. The following sections detail the potential action-specific ARARs for Alternatives 2, 3, 4, and 5 (see detailed descriptions in Section 10.4). There is no need to identify potential action-specific ARARs for the no-action alternative because ARARs apply to any removal or remedial action conducted entirely on-site and "no action" is not removal or remedial action.

Alternative 2 — Land Use Controls

There are no federal ARARs for LUCs. The substantive provisions of the following are potential state action-specific ARARs for LUCs:

- California Civil Code 1471 – which allows property owners to make a hazardous material covenant that runs with the land
- California Health and Safety Code 25202.5 – which allows DTSC to enter into agreements with property owners to restrict the use of the property
- California Health and Safety Code 25222.1 – which provides a streamlined process to be used to enter into an agreement to restrict the specific use of the property to implement the substantive use restrictions of California Health and Safety Code 25232(b)(1)(A)-(E)
- California Health and Safety Code 25232(b)(1)(A)-(E) – which prohibits construction of residences, hospitals for humans, schools for persons under 21 years of age, day care centers, or any permanently occupied human habitation on the hazardous waste property. Restrictions will apply to areas zoned for open space, maritime/industrial, and educational/cultural reuses
- California Health and Safety Code 25233(c) – which provides criteria for obtaining variances from land use restrictions
- California Health and Safety Code 25234 – which provides criteria for removing land use restrictions
- California Health and Safety Code 25355.5(a)(1)(C) – which provides the authority for DTSC to enter into agreements with property owners to restrict the use of the property
- Cal. Code Regs. tit. 22, (CCR, Title 22) 67391.1 – which requires DTSC and the federal government execute an appropriate land use covenant that is recorded in the county in which the land is located

Alternative 3 — On-Site Treatment and Land Use Controls

The Army has identified the following substantive provisions of the potential federal and state ARARs and "to be considered" criteria for excavation and on-site treatment of any waste, including IDW, generated during implementation of the remedial alternatives for soil:

- Cal. Code Regs. tit. 22, (CCR, Title 22) 66262.10(a) and 66262.11 – which require a generator to determine if the generated waste is hazardous waste
- Cal. Code Regs. tit. 22, (CCR, Title 22)66264.13(a) and (b) – which requires analysis of waste to determine if it is hazardous
- 40 CFR 264.554 (d)(1)(i-ii) and (d)(2), (e), (f), (h), (i), (j), and (k) – which allows the temporary staging of RCRA hazardous waste in piles
- RCRA waste pile requirements at Cal. Code Regs. tit. 22, (CCR, Title 22)66264.251 (except 251[j], 251[e][11]), and 66264.252(c) and (e) and (f)
- RCRA waste pile closure requirements Cal. Code Regs. tit. 22, (CCR, Title 22)66264.258(a) and (b), except references to procedural requirements

- Cal. Code Regs. tit. 27, (CCR, Title 27)20200(c) – which requires accurate characterization of wastes
- Cal. Code Regs. tit. 27, (CCR, Title 27)20210 – which requires the discharge of designated waste to Class I or Class II waste management units
- Cal. Code Regs. tit. 27, (CCR, Title 27)20220(b), (c), and (d) – which requires the discharge of nonhazardous solid waste to classified units
- Uranium Mill Tailings Radiation Control Act 40 CFR 192.12(a)
- U.S. Nuclear Regulatory Commission Standards for Protection of Radiation at 10 CFR 20.1301 and 20.1402
- Clean Air Act requirements for radionuclides at 40 CFR 61.92 and 61.102
- U.S. Nuclear Regulatory Commission Criteria relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentrations of Source Material from Ores Processed Primarily for Their Source Material Content at 10 CFR Part 40 Appendix A Criterion 6(6)

In addition, the same state ARARs identified for Alternative 2 are potential ARARs for Alternative 3.

<u>Alternative 4A — Excavation and Off-Site Disposal of Soil, Industrial Use</u>

The Army has identified the following substantive provisions of the potential federal and state ARARs and "to be considered" criteria for excavation and off-site disposal of soil and off-site disposal of any waste, including IDW, generated during implementation of the remedial alternatives for soil:

- Cal. Code Regs. tit. 22, (CCR, Title 22) 66262.10(a) and 66262.11 – which require a generator to determine if the generated waste is hazardous waste
- Cal. Code Regs. tit. 22, (CCR, Title 22) 66264.13(a) and (b) – which requires analysis of waste to determine if it is hazardous
- 40 CFR 264.554 (d)(1)(i-ii) and (d)(2), (e), (f), (h), (i), (j), and (k) – which allows the temporary staging of RCRA hazardous waste in piles
- RCRA waste pile requirements at Cal. Code Regs. tit. 22, (CCR, Title 22) 66264.251 (except 251[j], 251[e][11]), and 66264.252(c) and (e) and (f)
- RCRA waste pile closure requirements Cal. Code Regs. tit. 22, (CCR, Title 22)66264.258(a) and (b), except references to procedural requirements
- Cal. Code Regs. tit. 27, (CCR, Title 27) 20200(c) – which requires accurate characterization of wastes
- Cal. Code Regs. tit. 27, (CCR, Title 27) 20210 – which requires the discharge of designated waste to Class I or Class II waste management units
- Cal. Code Regs. tit. 27, (CCR, Title 27) 20220(b), (c), and (d) – which requires the discharge of nonhazardous solid waste to classified units
- Clean Water Act stormwater requirements at 40 CFR 122.44(k)(2) and (4) – which sets forth requirements to use best management practices to prevent construction pollutants from contacting stormwater
- State Water Resources Control Board Order 99-08 – which sets forth California stormwater discharge permit requirements ("to be considered")
- Uranium Mill Tailings Radiation Control Act 40 CFR 192.12(a)

- U.S. Nuclear Regulatory Commission Standards for Protection of Radiation at 10 CFR 20.1301 and 20.1402
- Clean Air Act requirements for radionuclides at 40 CFR 61.92 and 61.102
- U.S. Nuclear Regulatory Commission Criteria relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentrations of Source Material from Ores Processed Primarily for Their Source Material Content at 10 CFR Part 40 Appendix A Criterion 6(6)

<u>Alternative 4B — Excavation and Off-Site Disposal of Soil, Unlimited Use/Unrestricted Exposure</u>

The Army has identified the following substantive provisions of the potential federal and state ARARs and "to be considered" criteria for excavation and off-site disposal of soil and off-site disposal of any waste, including IDW, generated during implementation of the remedial alternatives for soil:

- Cal. Code Regs. tit. 22, (CCR, Title 22)66262.10(a) and 66262.11 – which require a generator to determine if the generated waste is hazardous waste
- Cal. Code Regs. tit. 22, (CCR, Title 22)66264.13(a) and (b) – which requires analysis of waste to determine if it is hazardous
- 40 CFR 264.554 (d)(1)(i-ii) and (d)(2), (e), (f), (h), (i), (j), and (k) – which allows the temporary staging of RCRA hazardous waste in piles
- RCRA waste pile requirements at Cal. Code Regs. tit. 22, 66264.251 (except 251[j], 251[e][11]), and 66264.252(c) and (e) and (f)
- RCRA waste pile closure requirements Cal. Code Regs. tit. 22, 66264.258(a) and (b), except references to procedural requirements
- Cal. Code Regs. tit. 27, (CCR, Title 27)20200(c) – which requires accurate characterization of wastes
- Cal. Code Regs. tit. 27, (CCR, Title 27)20210 – which requires the discharge of designated waste to Class I or Class II waste management units
- Cal. Code Regs. tit. 27, (CCR, Title 27)20220(b), (c), and (d) – which requires the discharge of nonhazardous solid waste to classified units
- Clean Water Act stormwater requirements at 40 CFR 122.44(k)(2) and (4) – which sets forth requirements to use best management practices to prevent construction pollutants from contacting stormwater
- State Water Resources Control Board Order 99-08 – which sets forth California stormwater discharge permit requirements ("to be considered")
- Uranium Mill Tailings Radiation Control Act 40 CFR 192.12(a)
- U.S. Nuclear Regulatory Commission Standards for Protection of Radiation at 10 CFR 20.1301 and 20.1402
- U.S. Nuclear Regulatory Commission Criteria relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentrations of Source Material from Ores Processed Primarily for Their Source Material Content at 10 CFR Part 40 Appendix A Criterion 6(6)
- Clean Air Act requirements for radionuclides at 40 CFR 61.92 and 61.102

Alternative 5 — Excavation, On-Site Containment, and Land Use Controls

The same ARARs identified for Alternatives 4A and 4B are potential ARARs for Alternative 5.

The potential federal action-specific ARARs for excavation and on-site containment are as follows:

- Cal. Code Regs. tit. 22, (CCR, Title 22) 66264.552(c) and (e) – which are the RCRA CAMU requirements that allow consolidation of waste into a permanent disposal unit
- 40 CFR 264.554 (d)(1)(i-ii) and (d)(2), (e), (f), (h), (i), (j), and (k) – which allows the temporary staging of RCRA hazardous waste in piles
- RCRA waste pile requirements at Cal. Code Regs. tit. 22, (CCR, Title 22) 66264.251 (except 251[j], 251[e][11]), and 66264.252(c) and (e) and (f)
- RCRA waste pile closure requirements Cal. Code Regs. tit. 22, (CCR, Title 22) 66264.258(a) and (b), except references to procedural requirements
- RCRA groundwater detection monitoring requirements at Cal. Code Regs, tit. 22, (CCR, Title 22) 66264.91 and 66264.98
- RCRA General water quality monitoring and system requirements at Cal. Code Regs. tit. 22 (CCR, Title 22) 66264.97(a)(b)(1)(A) and (B)
- RCRA container requirements at Cal. Code Regs, tit. 22, (CCR, Title 22) 66264.171-178
- Clean Water Act requirement to use best management practices to control stormwater runoff from construction activities that disturb one or more acres, at Clean Water Act 402 and its implementing regulations at 40 CFR 122.44(k)(2) and (4)
- RCRA groundwater detection monitoring requirements at Cal. Code Regs tit. 22, (CCR, Title 22) 66264.98
- Uranium Mill Tailings Radiation Control Act 40 CFR 192.12(a)
- U.S. Nuclear Regulatory Commission Standards for Protection of Radiation at 10 CFR 20.1301 and 20.1402
- U.S. Nuclear Regulatory Commission Criteria relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentrations of Source Material from Ores Processed Primarily for Their Source Material Content at 10 CFR Part 40 Appendix A Criterion 6(6)
- Clean Air Act requirements for radionuclides at 40 CFR 61.92 and 61.102

The same LUC ARARs identified for Alternative 2 are potential ARARs for Alternative 5.

11.1.2 Balancing Criteria

Five balancing criteria represent the primary basis for this analysis:

- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost

Long-Term Effectiveness and Permanence

Each alternative is evaluated in terms of the risk remaining at the site after the RAO has been met. The primary focus of this evaluation is the extent and effectiveness of controls used to manage the risk posed by treatment residuals or untreated wastes. This criterion addresses the long-term adequacy, reliability, and permanence of the response action. This analysis includes the following components:

- Expected long-term reduction in risk posed by the site
- Level of effort needed to maintain the remedy and monitor the area for changes in site conditions
- Compatibility of the remedy with planned future use of the site

Reduction in Toxicity, Mobility, or Volume through Treatment

This evaluation criterion addresses the statutory preference for treatment options that permanently and significantly reduce toxicity, mobility, or volume of chemicals. This preference is satisfied when treatment reduces the principal threats through the following:

- Destruction of toxic chemicals
- Reduction in chemical mobility
- Reduction of the total mass of toxic chemicals
- Reduction of total volumes of contaminated media

Short-Term Effectiveness

This evaluation criterion addresses the effects of the alternative during the construction and implementation phase until the RAO is met. Under this criterion, alternatives are evaluated in terms of their effects on human health and the environment during implementation of the response action. The following factors are considered:

- Protection of the community during the response action, including the effects of potential releases from the site, transport of contaminated materials, and effect on air quality from on-site treatment
- Exposure of workers during construction
- Potential environmental effects of the response action and the effectiveness and reliability of protective measures
- The time required to achieve the RAOs

Implementability

This criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. The following factors are considered in assessing this criterion.

<u>Technical Feasibility</u>

- Construction and operation – technical difficulties and unknowns associated with construction and operation of a technology
- Reliability of the technology – the likelihood technical problems associated with implementation would lead to schedule delays
- Ease of undertaking additional response actions
- Ability to monitor the effectiveness of the remedy

Availability of Materials

- Availability of adequate off-site treatment, storage capacity, and disposal capacity and services
- Reliability of the technology – the likelihood technical problems associated with implementation would delay the schedule
- Availability of services and materials
- Availability of prospective technologies

Administrative Feasibility

- Implementability with current and future operations
- Activities needed to coordinate with other offices and regulatory agencies
- Ability and time required to obtain any necessary approvals and permits from those regulatory agencies

Cost

The cost analysis for each alternative is based on estimates of capital, annual O&M, and periodic cost elements in combination with a calculation of net present value of these cost elements. Capital costs consist of direct and indirect costs. Direct costs include the purchase of equipment, contractor and subcontractor labor, and materials necessary for construction under the remedial alternative. Indirect costs include those for engineering, legal, construction management, and other technical and professional services such as testing and monitoring. Annual O&M costs for each alternative include maintenance materials, supplies, and utilities, as well as operating labor. Periodic costs are those that occur only once every few years. These costs may be capital or O&M, but because of their periodic nature are considered separately from other capital or O&M costs.

The cost estimates for the remedial alternatives are generally based on costs derived from the following sources:

- Remedial Action Cost Engineering and Requirements System (Earth Tech, 2006)
- Historical cost data
- Estimates from similar projects
- Engineering judgment
- Current cost data from vendors
- Specific quantities and information for SHAD-041

A present value analysis of each alternative is presented in Appendix G. The present value analysis is a method to evaluate expenditures, either capital or O&M, occurring over different future periods. Real discount rates were used in the present value analysis because Sharpe is a federal facility. The real discount rate used for this project is 3 percent; the suggested rate for projects at least 30 years in duration (Office of Management and Budget, 2017). The same discount rate was used for all present value analyses, regardless of actual future project duration, to maintain consistency between alternatives.

The accuracy of the cost estimate for each alternative is intended to be within the range of plus 50 percent to minus 30 percent of actual costs (USEPA, 1988). The level of detail used in developing these estimates is considered appropriate for making choices between alternatives, but the cost estimates are not intended for use in detailed budgetary planning. Costs for each alternative are presented in Appendix G.

Refinements in the RD may result in cost savings that are not anticipated to influence the relative comparison of remedial alternatives in this FS.

11.1.3 Modifying Criteria

Two criteria will be evaluated following review of this FS and the forthcoming proposed plan: state acceptance and community acceptance. These criteria are categorized as modifying criteria because they will be addressed after a review of the FS and proposed plan and receipt of public comments on the proposed plan.

State Acceptance

This criterion evaluates the technical and administrative issues and concerns the state may have about each alternative. For SHAD-041, the USEPA is the lead regulatory agency. The state's acceptance of the proposed remedial alternatives will be assessed and incorporated to the extent possible during development and review of this FS. The state's acceptance will be evaluated after the public comment period for the proposed plan [40 CFR 300.430(e)(iii)(H)]. The state's concerns may include:

- The state's position and key concerns related to the preferred alternative and other proposed alternatives
- State comments on ARARs

Community Acceptance

This criterion evaluates the issues and concerns the public may have about each alternative. The assessment involves identifying community support for, reservations about, or opposition to various components of the alternatives. This criterion will not be assessed until public comments on the proposed plan are received [40 CFR 300.430(e)(iii)(I)].

11.2 Detailed Evaluation of Remedial Action Alternatives

In this section, each of the retained alternatives for protection of human health and the environment is compared with seven (threshold and balancing) of the nine NCP criteria listed in Section 11.1. State acceptance will be evaluated after comments on the FS have been received from the state and regulatory agencies. Community acceptance will be evaluated after public comments on the proposed plan have been received. Community comments and concerns will be considered before the final decision is made on the preferred human health and ecological health alternatives for implementation of the response actions at SHAD-041. A Responsiveness Summary of the public comments received on the proposed plan will be included in the ROD Report.

11.2.1 Evaluation of Alternative 1—No Action

Under the no-action alternative for the protection of human health, no response action would occur at SHAD-041. No effort would be made to contain, remove, monitor, or treat contaminated soil at the site. An evaluation of the no-action alternative is required under CERCLA to provide a baseline for comparison with the other alternatives. A detailed analysis of Alternative 1 against the first seven NCP criteria is provided below.

Overall Protection of Human Health and the Environment

Lead and Ra-226 in surface and subsurface soil at SHAD-041 poses an unacceptable risk to human health under the potential future residential use scenario, and Ra-226 poses an unacceptable risk to human health under the industrial use scenario. Additionally, lead and PCDD/PCDF pose an unacceptable risk to ecological receptors. This alternative would not reduce, eliminate, or control the potential risks; therefore, Alternative 1 is not protective of human health or the environment under the potential future residential use scenario.

Compliance with ARARs

There is no need to identify ARARs for the no-action alternative for humans because ARARs apply to any removal or remedial action conducted entirely on-site and no action is neither a removal action nor a remedial action. CERCLA 121 (42 United States Code 9621) cleanup standards for selection of a remedy, including the requirement to meet ARARs, are not triggered by the no-action alternative (USEPA, 1991). Therefore, a discussion of compliance with ARARs is not appropriate for this alternative.

Long-Term Effectiveness and Permanence

Under the no-action alternative, surface soil containing concentrations of lead and Ra-226 above the remedial goal would not be addressed. No controls would be implemented to prevent potential exposure to humans or wildlife from the surface and subsurface soil and no long-term management measures, such as LUCs, would restrict the land use of the site. Therefore, Alternative 1 would not provide an effective long-term solution for the permanent protection of human health and the environment.

Reduction in Toxicity, Mobility, or Volume through Treatment

Alternative 1 would not reduce the toxicity, mobility, or volume of contaminants in soil at SHAD-041 because no action would be taken. COCs and RCOCs in surface and subsurface soil would not be treated or removed.

Short-Term Effectiveness

The four factors considered as part of the short-term effectiveness criteria are assessed below.

- No response action would occur, and the on-site community would not be exposed to additional risks from soil; the risks would remain as presented in the RI. The off-site community would be protected in the short-term because soils posing an unacceptable risk are located on the secure installation and would not be disturbed.
- No workers would be exposed to health risks during the implementation of Alternative 1 because no response action would be taken.
- No adverse environmental effects would result from construction and implementation of Alternative 1 because no response action would be taken.
- No time would be required to complete Alternative 1 because no response action would be taken.

Implementability

No action, including implementation of LUCs or construction and operation of a remedial system, would be required to implement this alternative. Therefore, Alternative 1 would be easily implemented; however, this alternative does not meet the threshold criteria (protection of human health and ARARs) and cannot be implemented.

Cost

No capital or O&M costs are associated with Alternative 1.

11.2.2 Evaluation of Alternative 2—Land Use Controls

Alternative 2 would use LUCs to prevent humans from exposure to unacceptable risk from COCs and RCOCs in surface and subsurface soil. LUCs would restrict the future use of SHAD-041 and prohibit future residential use. Description of Alternative 2 is provided in Section 10.4.1. A detailed analysis of Alternative 2 against the first seven of the nine NCP criteria is provided below.

Overall Protection of Human Health and the Environment

Alternative 2 would protect human health by prohibiting the future residential use of SHAD-041, thereby controlling the exposure of future residents to contamination in surface and subsurface soil. This alternative would be effective in achieving the RAOs for the protection of human health. However, Alternative 2 would not protect potential ecological receptors.

Compliance with ARARs

The ARARs for this alternative are summarized in Section 11.1.1 and detailed in Appendix H. Alternative 2 would meet all identified chemical-, location-, and action-specific ARARs.

Long-Term Effectiveness and Permanence

LUCs would effectively control risk to potential future humans at the site. Long-term enforcement of the LUCs would be required to maintain the effectiveness of the land use restrictions, access restrictions, and covenants. A LUC RD would be prepared to guide implementation of the LUCs and inspection for compliance, maintenance, reporting, and enforcement. In accordance with California law, the land use covenant would be recorded, and future owners would be notified through a title search of deed restrictions. Although a reuse plan has not been finalized for the site, residential use would be prohibited by the LUCs. LUCs would not have any long-term effectiveness or permanence related to existing contamination but would only limit contact by restricting land use options.

Reduction in Toxicity, Mobility, or Volume through Treatment

Alternative 2 does not include treatment of contaminated surface and subsurface soil at SHAD-041. Therefore, this alternative would not destroy COCs or RCOCs, or reduce the overall toxicity, mobility, or volume of contamination.

Short-Term Effectiveness

This alternative would be highly effective in the short-term for protection of human health from lead and Ra-226. However, Alternative 2 would not protect potential ecological receptors from lead and PCDD/PCDF.

The four factors considered as part of the short-term effectiveness criteria are assessed below.

- The on-site community would not be exposed to additional risks from surface and subsurface soil; the risks would remain as presented in the RI. The off-site community would be protected because soils presenting unacceptable risk are located on the secure installation would not be disturbed.
- No workers would be exposed to health risks during the implementation of Alternative 2 because the soil would not be disturbed.
- No adverse environmental effects would result from implementation of Alternative 2 because soils posing an unacceptable risk would not be disturbed.
- The estimated time required to implement Alternative 2 is 1 year or less to develop the LUC RD, and the effects of implementing this alternative would be nearly immediate.

Implementability

This alternative would be administratively feasible and easily implemented because the LUCs proposed for this alternative are easily established. Procedures for implementing LUCs are already in-place, and delays or difficulties coordinating with other regulatory agencies are not likely. LUCs would affect the future use of SHAD-041 because they would prohibit residential development unless additional remediation is conducted.

Cost

The estimated 30-year total cost for Alternative 2 is $763,000 (Table 14) and is detailed in Appendix G. The detailed cost analysis for Alternative 2 includes an estimate of capital, O&M, and periodic costs. Capital costs include preparation of the LUC RD and other legal documents to implement the LUCs ($174,000). O&M and periodic costs include monitoring and enforcement of the LUCs and 5-year reviews ($589,000).

11.2.3 Evaluation of Alternative 3—On-Site Treatment and Land Use Control

Alternative 3 would employ stabilization to prevent exposure of humans and wildlife to unacceptable risk from COCs and RCOCs in surface and subsurface soil. Description of Alternative 3 is provided in Section 10.4.1 A detailed analysis of Alternative 3 against the first seven of the nine NCP criteria is provided below.

Overall Protection of Human Health and the Environment

Alternative 3 would include excavation and stabilization of COC and RCOC contaminated surface and subsurface soil, which would solidify the soil, creating a solid mass, thereby eliminating the risk of exposure to humans and wildlife. This alternative would be effective in achieving the RAOs for the protection of human health and the environment.

Compliance with ARARs

The ARARs for this alternative are summarized in Section 11.1.1 and detailed in Appendix H. Alternative 3 would meet all identified chemical-, location-, and action-specific ARARS.

Long-Term Effectiveness and Permanence

Alternative 3 provides long-term effectiveness and permanence by stabilizing the COC and RCOC contaminated surface and subsurface soil, which would solidify the soil, creating a solid mass.

Reduction in Toxicity, Mobility, or Volume through Treatment

Alternative 3 would include excavation and stabilization, which would solidify the soil, creating a solid mass from which COCs and RCOCs cannot migrate. This alternative results in a reduction of the overall toxicity and mobility; however, stabilization of the soil will cause a 50 percent increase in volume.

Short-Term Effectiveness

Stabilization is effective in the short-term for protection of humans and wildlife. The four factors considered as part of the short-term effectiveness criteria are assessed below.

- The wildlife and humans may be exposed to additional risks from surface and subsurface soil during on-site treatment. After treatment, wildlife and humans would be protected. The local residential community would not be impacted by on-site treatment of COC and RCOC contaminated soil.
- Workers would be exposed to health risks during the implementation of Alternative 3 because the contaminant concentrations in soil are harmful to humans.
- Construction efforts for soil excavation, mixing, and backfilling would affect a large area at SHAD-041. The surrounding environment would be negatively affected by these activities. Best management practices for construction would be used to minimize the effects on the local

environment. Effects to the natural resources on-site are expected to be temporary, and vegetation is expected to recover.

- Once the RD and remedial action work plan is complete, the estimated time required to implement the on-site treatment portion of Alternative 3 would be approximately 12 months; 3 months for mobilization and preparation, 6 months for removal and stabilization of approximately 14,622 cubic yards of soil, and 3 months to complete backfilling and project closeout. The short-term effects are considered to be nearly immediate because work would begin within 3 months of an approved work plan and exposure risk would be eliminated as soon as work is completed.

Implementability

This alternative is technically and administratively feasible because stabilization technologies are well studied, and designs are standardized. Vendors who specialize in stabilization are available, and technology is available in California. This alternative is implementable. On-site treatment of surface and subsurface soil may temporarily adversely affect the wildlife inhabiting the treatment area in the short-term.

Cost

The estimated 30-year total cost for Alternative 3 is $ 8,408,000 (Table 14) and is detailed in Appendix G. The detailed cost analysis for Alternative 3 includes an estimation of capital, O&M, and periodic costs. Costs include the design of the treatment area, excavation, stabilization treatment, and backfilling. Additional costs include 5-year reviews, which could be produced along with the 5-year reviews for other sites at Sharpe facility. Because the same soil is contaminated with COCs and RCOCs, LUCs would be required for protection of humans. Capital costs include RD, Remedial Action Work Plan, and Remedial Action Completion Report, excavation, stabilization, transportation, and disposal of the contaminated soil ($6,896,000).O&M and periodic costs include monitoring and enforcement of the LUCs and 5-year reviews ($1,512,000).

11.2.4 Evaluation of Alternative 4A — Excavation and Off-Site Disposal, Industrial Use

Alternative 4A includes excavation and off-site disposal of surface and subsurface soil at SHAD-041 posing an unacceptable risk to human health and the environment under the industrial use scenario. Excavated soil would be transported to an appropriately licensed or permitted off-site disposal facility. LUCs would be required to prohibit residential use. Description of Alternative 4A is provided in Section 10.4.1. A detailed analysis of Alternative 4A against the first seven of the nine NCP criteria is provided below.

Overall Protection of Human Health and the Environment

Alternative 4A would protect human health because surface and subsurface soil posing an unacceptable risk under the potential future industrial use scenario would be removed. This alternative would permanently eliminate risk at SHAD-041 for humans and wildlife and meet the RAOs. The potential risk to workers (agricultural, commercial/industrial, and construction) was calculated to be within the acceptable risk management range.

Compliance with ARARs

The ARARs for Alternative 4A are summarized in Section 11.1.1 and detailed in Appendix H. Alternative 4 would meet all identified chemical-, location-, and action-specific ARARs.

Long-Term Effectiveness and Permanence

Contaminated surface and subsurface soil posing an unacceptable risk to humans under the potential future industrial use scenario would be removed and disposed of off-site. Lateral excavation of surface and subsurface soil would continue until results of the confirmation samples indicate the remedial goals for COC and RCOC have been met. These excavations would effectively and permanently remove COCs and RCOCs posing an unacceptable risk to human health and the environment. Maintenance or monitoring would be needed to ensure continued protectiveness for human health and the environment.

Reduction in Toxicity, Mobility, or Volume through Treatment

Alternative 4A does not include treatment of COC and RCOC contaminated surface and subsurface soil. While the volume of COCs and RCOCs in surface and subsurface soil at SHAD-041 would be reduced through excavation and off-site disposal, the total volume of contaminated soil would not be reduced because the soil would only be moved to an off-site location. Therefore, this alternative would not reduce the overall toxicity, mobility, or volume of contamination through treatment and would not meet the statutory preference for treatment options.

Short-Term Effectiveness

Alternative 4A is moderately effective in the short-term. The four factors considered under the short-term effectiveness criteria are assessed below.

- The community would be protected during excavation and transportation activities by implementing containment controls, such as dust suppression during excavation and covers over the hauling trucks during off-site transportation. There would also be additional traffic during removal of the contaminated soil. A traffic control plan and temporary traffic controls would be implemented as necessary to prevent accidents, minimize congestion, and protect local residents.
- Workers would be protected during soil excavation by implementing containment controls, such as dust suppression during excavation, stockpiling, and loading; and following health and safety protocols, including personal protective equipment and decontamination procedures.
- Construction efforts for soil excavation would affect approximately 2 to 3 acres at SHAD-041 as well as the surrounding area. Best management practices for construction would minimize the effects on the local environment. Effects to the natural resources on-site are expected to be temporary, and vegetation is expected to recover.
- Once the RD and remedial action work plan are complete, the estimated time required to implement Alternative 4A would be approximately 12 months. This time frame is based on 3 months for mobilization and site preparation, 6 months for removal of 7,000 cubic yards of soil, plus 3 months to complete backfilling and project closeout. The short-term effects are considered to be nearly immediate because work would begin within 3 months and exposure risk would be eliminated as soon as work is completed.

Implementability

This alternative is technically and administratively feasible because excavation and disposal are considered conventional and commonplace technologies. Vendors who specialize in excavation and transportation of contaminated soil are readily available, and several permitted treatment/disposal facilities exist in California and outside California. This alternative is moderately implementable because a large volume of soil would be excavated and transported off-site for disposal and because of the large volume of clean fill material that would be required. Excavation of surface and subsurface soil at SHAD-041 would not adversely affect the future reuse of the property.

Cost

The estimated 30-year total cost for Alternative 4A is $6,707,000 (Table 14) and is detailed in Appendix G. The detailed cost analysis for Alternative 4A includes an estimation of capital, O&M, and periodic costs. Capital costs include RD, Remedial Action Work Plan, and Remedial Action Completion Report, excavation, transportation, and disposal of the contaminated soil ($5,195,000). O&M and periodic costs include monitoring and enforcement of the LUCs and 5-year reviews ($1,512,000).

11.2.5 Evaluation of Alternative 4B—Excavation and Off-Site Disposal, Unrestricted Use/Unlimited Exposure

Alternative 4B includes excavation and off-site disposal of surface and subsurface soil at SHAD-041 posing an unacceptable risk to human health and the environment under the potential future residential use scenario. Excavated soil would be transported to an appropriately licensed or permitted off-site disposal facility. Description of Alternative 4B is provided in Section 10.4.1. A detailed analysis of Alternative 4B against the first seven of the nine NCP criteria is provided below.

Overall Protection of Human Health and the Environment

Alternative 4B would protect human health and the environment because surface and subsurface soil posing an unacceptable risk to human and ecological receptors under the potential future residential use scenario would be removed. This alternative would permanently eliminate risk to humans and wildlife at SHAD-041 and meet the RAOs. The potential risk to workers (agricultural, commercial/industrial, and construction) was calculated to be within the acceptable risk management range.

Compliance with ARARs

The ARARs for Alternative 4B are summarized in Section 11.1.1 and detailed in Appendix H. Alternative 4B would meet all identified chemical-, location-, and action-specific ARARs.

Long-Term Effectiveness and Permanence

Contaminated surface and subsurface soil posing an unacceptable risk to human health and the environment under the potential future residential use scenario would be removed and disposed of off-site. Lateral excavation of surface and subsurface soil would continue until results of the confirmation samples indicate the remedial goals for COCs and RCOCs have been met. These excavations would effectively and permanently remove COCs and RCOCs posing an unacceptable risk to human health and the environment. No maintenance or monitoring would be needed to ensure continued protectiveness for human health and the environment. This alternative provides for the unrestricted use of the site.

Reduction in Toxicity, Mobility, or Volume through Treatment

Alternative 4B does not include treatment of COCs and RCOCs contaminated surface and subsurface soil. While the volume of contaminants in surface and subsurface soil at SHAD-041 would be reduced through excavation and off-site disposal, the total volume of contaminated soil would not be reduced because the soil would only be moved to an off-site location. Therefore, this alternative would not reduce the overall toxicity, mobility, or volume of contamination through treatment and would not meet the statutory preference for treatment options.

Short-Term Effectiveness

Alternative 4B is moderately effective in the short-term. The four factors considered under the short-term effectiveness criteria are assessed below.

- The community would be protected during excavation and transportation activities by implementing containment controls, such as dust suppression during excavation and covers over the hauling trucks during off-site transportation. There would also be additional traffic during removal of the contaminated soil. A traffic control plan and temporary traffic controls would be implemented as necessary to prevent accidents, minimize congestion, and protect local residents.
- Workers would be protected during soil excavation by implementing containment controls, such as dust suppression during excavation, stockpiling, and loading; and following health and safety protocols, including personal protective equipment and decontamination procedures.
- Construction efforts for soil excavation would affect approximately 2 to 3 acres at SHAD-041 as well as the surrounding area. Best management practices for construction would minimize the effects on the local environment. Effects to the natural resources on-site are expected to be temporary, and vegetation is expected to recover.
- Once the RD and remedial action work plan are complete, the estimated time required to implement Alternative 4 would be approximately 12 months. This time frame is based on 3 months for mobilization and site preparation, 6 months for removal of 16,622 cubic yards of soil, plus 3 months to complete backfilling and project closeout. The short-term effects are considered to be nearly immediate because work would begin within 3 months and exposure risk would be eliminated as soon as work is completed.

Implementability

This alternative is technically and administratively feasible because excavation and disposal are considered conventional and commonplace technologies. Vendors who specialize in excavation and transportation of contaminated soil are readily available, and several permitted treatment/disposal facilities exist in California and outside California. This alternative is moderately implementable because a large volume of soil would be excavated and transported off-site for disposal and because of the large volume of clean fill material that would be required. Excavation of surface and subsurface soil at SHAD-041 would not adversely affect the future reuse of the property.

Cost

The estimated 30-year total cost for Alternative 4B is $11,455,000 (Table 14) and is detailed in Appendix G. The detailed cost analysis for Alternative 4B includes an estimation of capital, O&M, and periodic costs. Capital costs include RD, Remedial Action Work Plan, and Remedial Action Completion Report, excavation, transportation, and disposal of the contaminated soil ($11,455,000). O&M or periodic costs would not be required because surface and subsurface soil posing an unacceptable risk to humans would be permanently removed.

11.2.6 Evaluation of Alternative 5 — Excavation, On-Site Containment, and Land Use Controls

Alternative 5 includes excavation and on-site containment of surface and subsurface soil at SHAD-041 posing an unacceptable risk to human health and the environment under the potential future residential use scenario and LUCs to maintain the effectiveness of the alternative. Excavated soil would be consolidated in an on-site CAMU. This alternative includes long-term maintenance and monitoring of the CAMU to prevent exposure of potential future residents to contaminated soil. Description of Alternative

5 is provided in Section 10.4.1. A detailed analysis of Alternative 5 against the first seven of the nine NCP criteria is provided below.

Overall Protection of Human Health and the Environment

Alternative 5 would protect human health and the environment because surface and subsurface soil posing an unacceptable risk to human health and the environment under the potential future residential use scenario would be excavated and contained within a CAMU. The CAMU cover would be maintained, and LUCs would be implemented to prevent exposure to the soil. Alternative 5 provides overall protection of human health and the environment and meets the RAOs.

Compliance with ARARs

The ARARs for Alternative 5 are summarized in Section 11.1.1 and detailed in Appendix H. Alternative 5 would meet all identified chemical-, location-, and action-specific ARARs.

Long-Term Effectiveness and Permanence

Contaminated soil posing an unacceptable risk to human health and the environment under the potential future residential use scenario would be excavated and contained in an on-site CAMU. Excavation of the contaminated soil would continue until the results of confirmation samples indicate the remedial goals have been met. The CAMU cover would effectively prevent exposure of humans and wildlife to the contaminated soil. LUCs would be implemented at the CAMU for this alternative to reduce the potential risk, and long-term enforcement of the LUCs would be required to maintain the effectiveness of this alternative.

Reduction in Toxicity, Mobility, or Volume through Treatment

While the mobility of COCs and RCOCs in surface and subsurface soil at SHAD-041 would be reduced by this alternative through containment, Alternative 5 does not include treatment of the contaminated soil. Therefore, this alternative would not reduce the overall toxicity, mobility, or volume of contamination through treatment and would not meet the statutory preference for treatment options.

Short-Term Effectiveness

Alternative 5 is moderately effective in the short-term. The four factors considered under the short-term effectiveness criteria are assessed below.

- The community would be protected during excavation, demolition, and construction of the CAMU by implementing containment controls, such as dust suppression and covers over the hauling trucks during off-site transportation of construction debris.
- Workers would be protected during construction activities by implementing containment controls, such as dust suppression during excavation, stockpiling, demolition, and spreading and compaction of soil; and following health and safety protocols, including personal protective equipment and decontamination procedures.
- Construction efforts for soil excavation and construction of the CAMU would affect a large area at SHAD-041. The surrounding environment would be negatively affected by these activities. Best management practices for construction would be used to minimize the effects on the local environment. Effects to the natural resources on-site are expected to be temporary, and vegetation is expected to recover.
- Once the RD and remedial action work plan are complete, the estimated time required to implement Alternative 4 would be approximately 12 months. This time frame is based on 3 months for

mobilization and site preparation, 6 months for removal of 14,622 cubic yards of soil, plus 3 months to complete backfilling and project closeout. The short-term effects are considered to be nearly immediate because work would begin within 3 months and exposure risk would be eliminated as soon as work is completed.

Implementability

This alternative is technically and administratively feasible because excavation, demolition of site features, and construction and maintenance of a CAMU require conventional and commonplace technologies. Vendors who specialize in excavation and consolidation of contaminated soil are readily available. LUCs proposed for this alternative are easily established administratively. However, this alternative is moderately implementable because it requires the excavation of a large volume of contaminated soil, demolition of site features, construction of an on-site CAMU, and long-term maintenance and monitoring of the CAMU. In addition, the presence of the on-site CAMU may adversely affect the future reuse of the property because the integrity of the CAMU cover must be maintained and LUCs would be in-place that may restrict the future residential development of a portion of SHAD-041.

Cost

The estimated 30-year total cost for Alternative 5 is $9,411,000 (Table 14) and is detailed in Appendix G. The detailed cost analysis for Alternative 5 includes an estimate of capital, O&M, and periodic costs. Capital costs include RD, Remedial Action Work Plan, and Remedial Action Completion Report, and construction activities, such as the excavation of contaminated soil, demolition of site features, and construction of the CAMU ($7,899,000). O&M and periodic costs include long-term maintenance and monitoring of the CAMU, monitoring, enforcement of the LUCs, and 5-year reviews ($1,512,000).

12.0 Comparative Analysis of Remedial Alternatives

This section presents a comparative analysis of the remedial alternatives with respect to the NCP criteria. The purpose of this comparative analysis is to identify the relative advantages and disadvantages of each alternative and thereby provide a sound basis for remedy selection consistent with the NCP. The NCP states, "The national goal of the remedy selection process is to select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste" (USEPA, 1990).

This section compares the remedial alternatives that meet the threshold criteria (overall protection of human health and the environment and compliance with ARARs). Alternatives 1 (no action) and 2 (LUCs) do not meet the threshold criteria because the unacceptable risk to human health (Alternative 1) and the environment (Alternatives 1 and 2) would not be reduced. The other four alternatives for the protection of both human health and the environment meet the threshold criteria by eliminating, controlling, or reducing risk to humans and wildlife and meeting ARARs. The remaining alternatives for both human health and ecological protection are compared to each other using the balancing criteria to assess the relative performance of the alternatives with respect to those criteria.

The remedial alternatives are compared against the five balancing criteria below. The discussion of each evaluation criterion generally proceeds from the alternative(s) that best satisfies the criterion to the one that least satisfies the criterion. Section 12.1.6 summarizes this evaluation and presents recommendations based on the results of the comparative analysis of each alternative. One preferred alternative each for protecting human health and wildlife will be selected in the proposed plan, and in the ROD after comments are received from the community and regulatory agencies.

12.1 Comparative Analysis of Remedial Alternatives for Protection of Human Health and Environment

The following sections present a comparative analysis of the remaining five alternatives presented for protection of human health from lead and Ra-226 and protection of the environment from lead and PCDD/PCDF in surface and subsurface soil at SHAD-041.

12.1.1 Long-Term Effectiveness and Permanence

Alternative 4B is the most effective and permanent in the long-term because surface and subsurface soil posing a risk to human health under the potential future residential use scenario and to ecological receptors would be excavated and removed from the site, allowing for UU/UE. Alternative 4A would be slightly less effective, but as permanent in the long-term, since soil would be remediated to industrial use remediation goals. Alternative 4B does not rely on LUCs to restrict the future land use and does not require any additional maintenance and monitoring to ensure its effectiveness. Alternatives 3, 4A and 5 would not be as effective as Alternative 4B because they would rely on LUCs to restrict the use of SHAD-041 and prohibit residential development of the site. The LUCs for Alternatives 3 and 4A would prohibit residential development over the entire site, while the LUCs for Alternative 5 would only prohibit residential development of the CAMU area. However, the CAMU in Alternative 5 must be monitored and maintained to sustain the protectiveness of the remedial alternative.

12.1.2 Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternative 3 would reduce the mobility of contaminated soil through treatment. The process of stabilization renders COCs and RCOCs immobile, which would be maintained as long as the solid structure does not break. Alternatives 4A, 4B, and 5 do not reduce the toxicity, mobility or volume through treatment. As a result, Alternatives 4A, 4B, and 5 do not satisfy the statutory preference for treatment.

12.1.3 Short-Term Effectiveness

Alternatives 3, 4A, 4B, and 5 would expose workers, the environment, and the community to the contaminated soil during excavation and stockpile activities. In addition, Alternatives 4A and 4B (excavation and off-site disposal) would require transport of the contaminated soil through the community to the disposal facility. Alternative 5 would require the construction of an on-site CAMU, extending the period required to achieve the RAOs. Best management practices and health and safety protocols would be used during implementation of Alternatives 3, 4A, 4B, and 5 to minimize the exposure of the community, workers, and the environment to contaminated soil.

12.1.4 Implementability

Alternatives 4A and 4B include surface and subsurface soil excavation, transportation, and disposal at an off-site appropriately licensed or permitted disposal facility; these activities are relatively common, and vendors and equipment are available. The implementation of Alternatives 4A and 4B, however, would include excavation of a large amount of soil (approximately 7,000 and 14,622 cubic yards, respectively), which may increase the difficulty of this alternative. Alternative 4A would also require implementation of LUCs. Alternatives 3 and 5 would be the most difficult to implement because they would involve soil excavation, soil stabilization, demolition of underground structures, construction of a CAMU (Alternative 5) at SHAD-041, long-term maintenance, monitoring, and LUCs. While these construction technologies are common, the increased complexity of Alternatives 3 and 5 makes them moderately implementable.

12.1.5 Cost

The present value costs for the alternatives are listed in Table 14 and are detailed in Appendix G. The approximate present value costs, from least to most expensive are:

- Alternative 2........... $ 536,000 (about 5 percent of the cost of Alternative 4A)
- Alternative 3........... $ 7,584,000
- Alternative 4A .... $ 6,148,000
- Alternative 5........... $ 8,018,000
- Alternative 4B .... $ 11,123,166

12.1.6 Summary of Comparative Analysis of Remedial Alternatives

Surface and subsurface soil at SHAD-041 pose an unacceptable risk to human health from lead and Ra-226 under the potential future residential use scenario and from Ra-226 under the industrial/commercial and construction use scenario and unacceptable risk to the environment from lead and PCDD/PCDF. This FS evaluates six remedial alternatives to reduce potential risk to humans and ecological receptors:

- Alternative 1........... No Action
- Alternative 2........... Land Use Controls
- Alternative 3........... On-Site Treatment and Land Use Controls
- Alternative 4A .... Excavation and Off-Site Disposal, Industrial Use
- Alternative 4B .... Excavation and Off-Site Disposal, Unlimited Use/Unrestricted Exposure
- Alternative 5........... Excavation, On-Site Containment, and Land Use Controls

These six alternatives were evaluated against seven of the nine NCP criteria in Section 11.0. Alternatives 1 and 2 do not meet the threshold criteria. Thus they cannot be selected as the preferred alternative.

Alternatives 3, 4A, 4B, and 5 meet the threshold criteria and are compared to each other above. The remedial alternatives ranking using the NCP criteria is summarized in Table 15.

Alternative 4A, excavation and off-site disposal for industrial use, is the preferred alternative as it would permanently eliminate risk at SHAD-041 for humans and wildlife while maintaining the current and expected future land use for the site and installation. Additionally, this alternative meets the RAOs, complies with ARARs, is effective in the short- and long-term, and is implementable.

Alternative 4A may be implemented either through the CERCLA Time Critical Removal Action (TCRA) or the conventional CERCLA Proposed Plan and Record of Decision (ROD) process. The Army recommends implementing Alternative 4A through the TCRA process as property transfer is pending.

13.0 References

Ahtna, 2017. Remedial Investigation/Feasibility Study Work Plan Sites 33/29 (SHAD-041), Sharpe Army Depot, Lathrop, California. Final. September

Albion Environmental, Inc., 1997. *Burrowing Owl Management Plan*, Sharpe Depot. November.

Brown and Caldwell Consulting Engineers, 1985. *Eastern San Joaquin County Groundwater Study*. Final Report. Prepared for San Joaquin County Flood Control and Water Conservation District.

Cabrera, 2002. *Revised Reference Area Survey Report.* McClellan Air Force Base, Sacramento.

Department of Defense (DOD), 2001. *"Policy on Land Use Controls Associated with Environmental Restoration Activities."* January.

DTSC, 2014. Office of Human and Ecological Risk (HERO) HHRA Note 1. September 30.

DTSC, 2018. HERO HHRA Note Number 3, DTSC-modified Screening Levels (DTSC-SLs). June.

DTSC and California Department of Fish and Game, 2010. Ecological Risk Evaluation for Burrowing Owls at Site P-3A; PCA 14741, Site Code: 100131-47. Memorandum to: Chris Sherman, Project Manager, Brownfields and Environmental Restoration Program, DTSC, Sacramento, CA. Memorandum prepared by: D.J. Lauren (DTSC) and C. Rech (CDFG). 9 September.

DTSC, 1996. *Guidance for Ecological Risk Assessment at Hazardous Waste Sites and Permitted Facilities.*

California Department of Water Resources (DWR), 2006 (Update). San Joaquin Valley Basin, East San Joaquin Subbasin in California's Groundwater. Bulletin 118.

ESE, 1996. Final Record of Decision Basewide Remedy for DDRW – Sharpe Site. February.

ESE, 1994a. *Remedial Investigation/Feasibility Study at Sharpe Site, Soils Feasibility Study Report*. Final. December.

ESE, 1994b. *Remedial Investigation/Feasibility Study at Sharpe Site, Soils Risk Assessment, Volume I and II*. Final. December.

ESE, 1993. *DDRW-Sharpe Site, Record of Decision, Operable Unit 1*. Final. January.

FRTR, 2007. *Federal Remediation Technologies Roundtable Meeting, Arlington, Virginia*. November 15.

Hotchkiss, 1972. *Generalized Subsurface Geology of the Water-Bearing Deposits, Northern San Joaquin Valley, California*. U.S. Geological Survey Open-File Report

Tidewater, Inc., 2012. P*hase I Historical Review, Scoping Survey, and Remedial Recommendations Report for the DLA Defense Depot Joaquin Center Sharpe Site Lathrop, CA*. Final. February.

URS, 2014a. *Final 3rd Five-Year Review Report*. September.

URS, 2014b. *Explanation of Significant Differences to the Record of Decision Operable Unit 1, Defense Distribution Depot San Joaquin–Sharpe Site*. Final. September.

URS, 2014c. *Comprehensive Field Work Plan, Defense Distribution Depot San Joaquin–Sharpe Site*. Final. April.

URS, 2011a. *Final Amendment to the Record of Decision Basewide Remedy for Defense Distribution Depot San Joaquin – Sharpe Site (Operable Unit 2 – Soils)*. June.

URS, 2011b. *Ecological Risk Evaluation of Burrowing Owls at the Metals Sites, Defense Distribution Depot San Joaquin – Sharpe Site*. Final. May.

USEPA, 2017. Contaminated Site Clean-Up Information (CLU-IN). https://clu-in.org. Accessed January 2018.

USEPA, 2018. Regional Screening Levels (RSLs). https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables. Accessed on November 19, 2018.

USEPA, 2014. *OSWER 9285.6-20, Radiation Risk Assessment at CERCLA Sites: Q&A. June 13.*

USEPA, 2012. *Institutional Controls: A Guide to Implementing, Monitoring and Enforcing Institutional Controls at Contaminated Sites*. EPA-540-R-09-001. December.

USEPA, 2010. *Reference Guide to Non-Combustion Technologies for Remediation of Persistent Organic Pollutants in Soil*. Second Edition. EPA 542-R-09-007. September.

USEPA, 2009. *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use.* EPA 540-R-08-005. January.

USEPA, 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process*. EPA/240/B-06/001. February.

USEPA, 2002. *Metals Treatment Technologies for Soil, Waste, and Water*. EPA-542-R-02-004. September.

USEPA, DoD, DoE, NRC, 2000. *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM). EPA-402-R-97-016, Rev. 1. August.

USEPA, 1997. *Ecological Risk Assessment Guidance for Superfund.*

USEPA, 1994. *Defense Distribution Region West, Sharpe, California Federal Facility Agreement*. July.

USEPA, 1993. *USEPA Wildlife Exposure Factors Handbook.*

USEPA, 1991. *"ARARs Q's and A's: General Policy, RCRA, CWA, SDWA, Post-ROD Information, and Contingent Waivers." OSWER Directive No. 9234.2-01/FS-A, Washington, DC.* June.

USEPA, 1990. *"National Oil and Hazardous Substances Pollution Contingency Plan." Federal Register. Volume 55, No. 46, p. 8,666.* April.

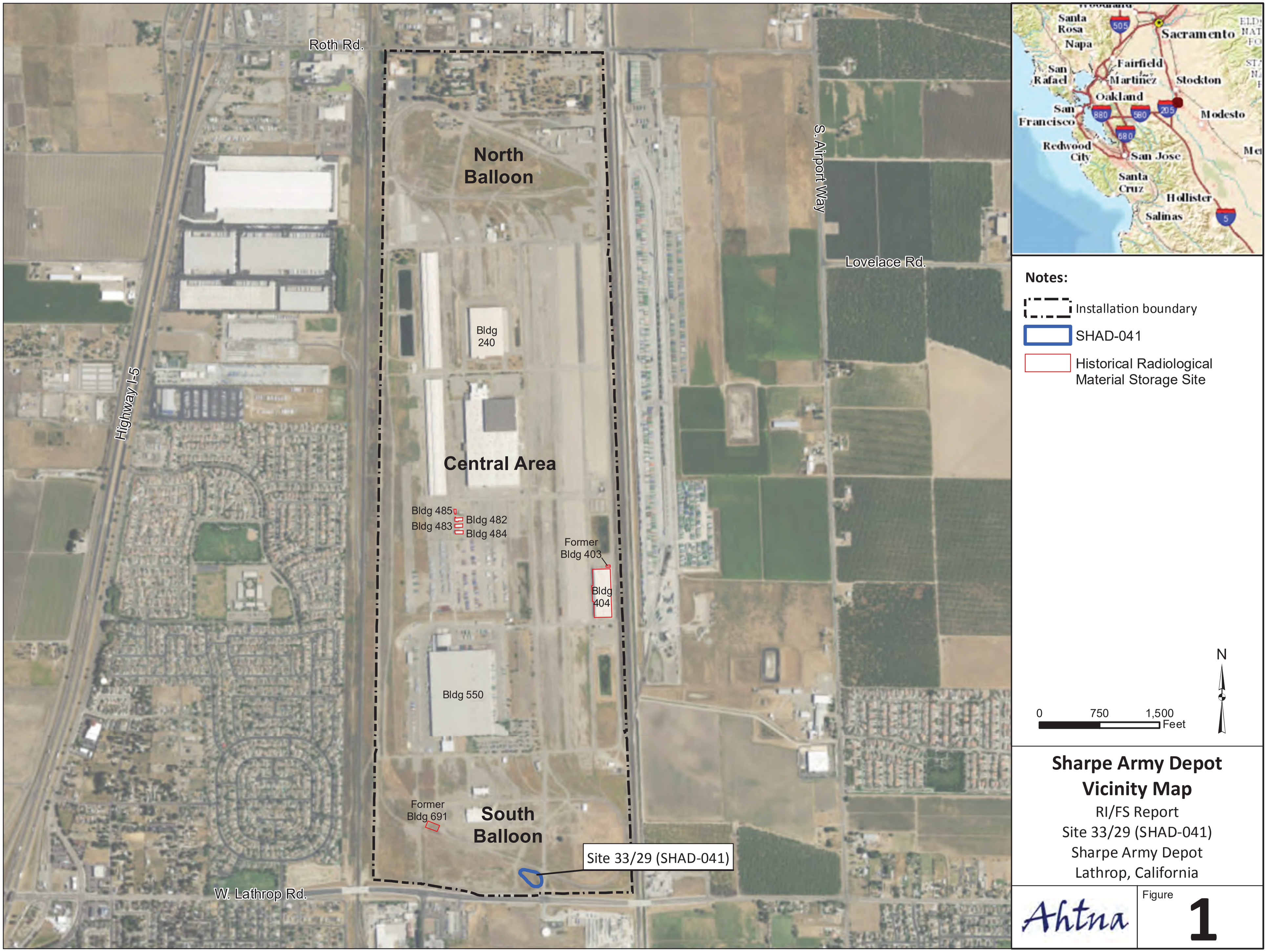
USEPA, 1989a and 1989b. *Risk Assessment Guidance for Superfund, Volumes I and II, Human Health Evaluation Manual Part A*.

USEPA, 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*. October.

USNRC, 1992. *Residual Radioactive Contamination from Decommissioning, NUREG 5512, Volume 4*.

Weston, 2002. *Environmental Baseline Survey for the Defense Distribution Depot, San Joaquin Sharpe Site, Lathrop, CA, Volumes 1 and 2*. May.

Figures



Notes:

- Installation boundary
- SHAD-041
- Historical Radiological Material Storage Site

Sharpe Army Depot
Vicinity Map
RI/FS Report
Site 33/29 (SHAD-041)
Sharpe Army Depot
Lathrop, California

Ahtna

Figure
1

Notes:

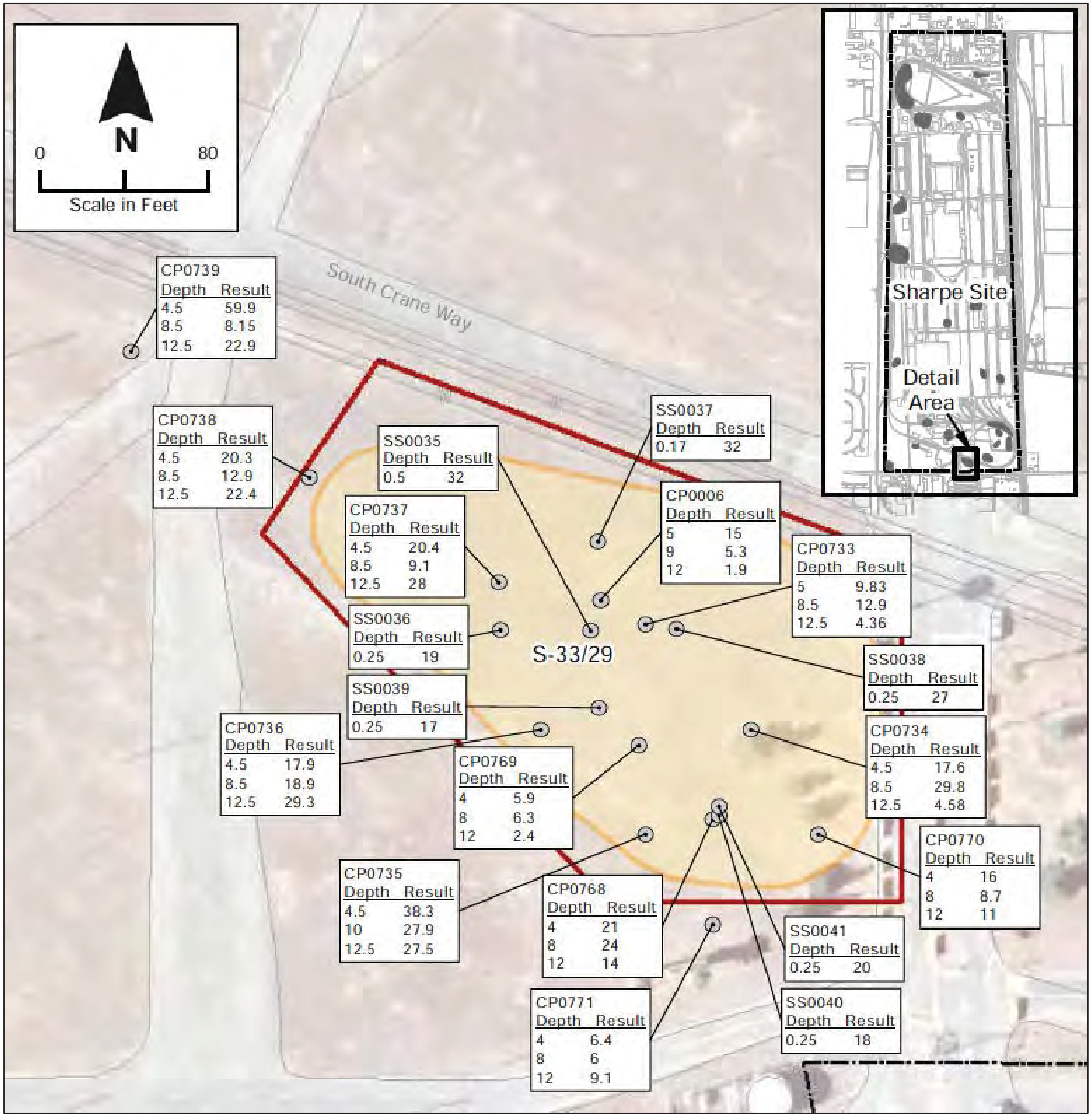
- Installation boundary
- Site SHAD-041 (Sites 33/29) Boundary

SHAD-041 Location Map

RI/FS Report
Site 33/29 (SHAD-041)
Sharpe Army Depot
Lathrop, California

Ahtna

Figure 2



Notes:

⊙ Post-ROD Soil Sampling Location (1996 and 1998)

230 Chromium Concentration (mg/kg)

— — — Sharpe Site Boundary

▭ Land Use Control Area

▭ Metals Site

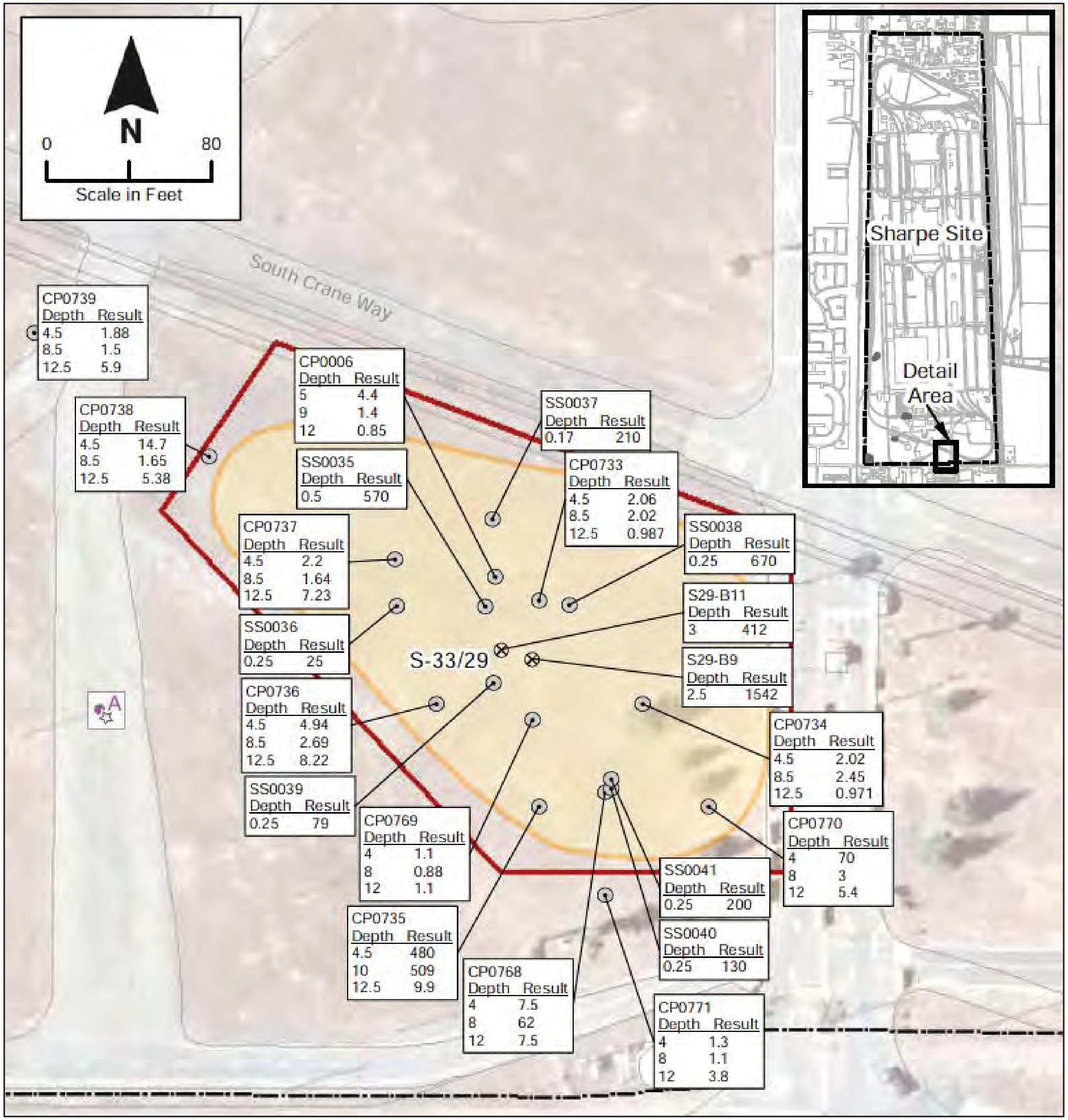
All sample depths are feet below ground surface.

Historical Chromium Concentrations in Soil

RI/FS Report
Sites 33/29 (SHAD-041)
Sharpe Army Depot
Lathrop, California

Ahtna

Figure
3



Notes:

- ⊗ Pre-ROD Soil Sampling Location (1994)
- ⊙ Post-ROD Soil Sampling Location (1996 and 1998)
- 230 Lead Concentration (mg/kg)
- ━ ━ ━ Sharpe Site Boundary
- 🟥 Land Use Control Area
- 🟨 Metals Site

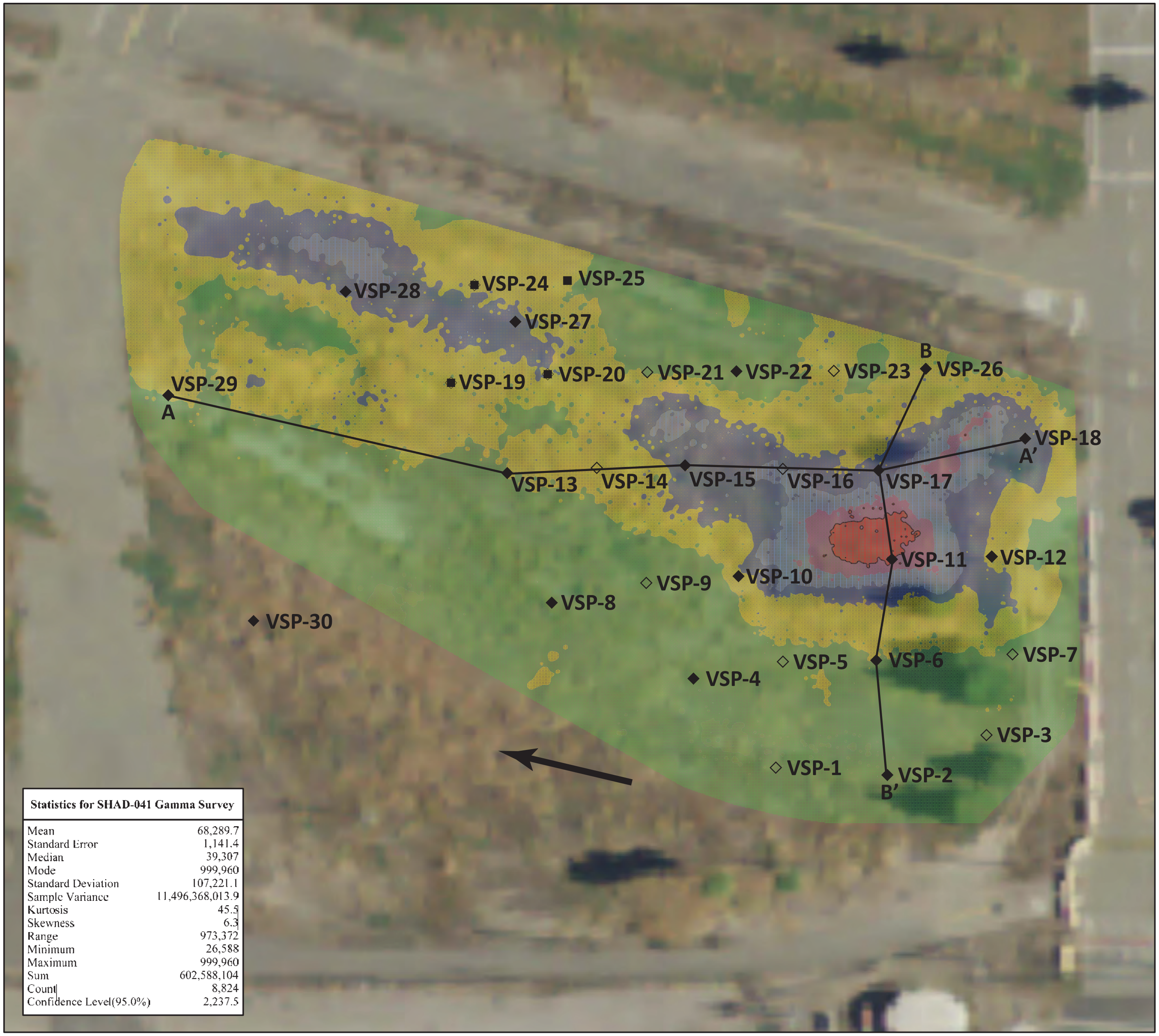
All sample depths are feet below ground surface.

Historical Lead Concentrations in Soil

RI/FS Report
Sites 33/29 (SHAD-041)
Sharpe Army Depot
Lathrop, California

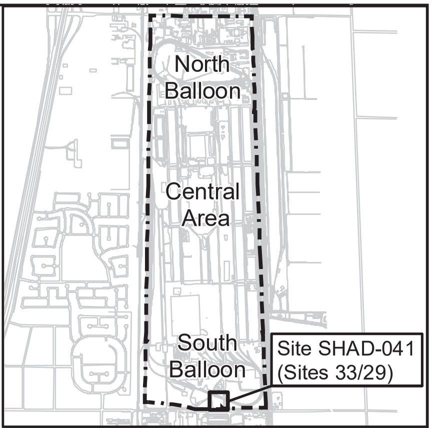
Ahtna

Figure
4



Statistics for SHAD-041 Gamma Survey

Mean	68,289.7
Standard Error	1,141.4
Median	39,307
Mode	999,960
Standard Deviation	107,221.1
Sample Variance	11,496,368,013.9
Kurtosis	45.5
Skewness	6.3
Range	973,372
Minimum	26,588
Maximum	999,960
Sum	602,588,104
Count	8,824
Confidence Level(95.0%)	2,237.5



Notes:

- ◆ Completed boring (Total depth = 15 ft bgs)
- ■ Completed boring (Total depth = 10 ft bgs)
- ◇ Eliminated boring location
- ← Groundwater Flow Direction
- — Cross Section Line (see Figure19)

Gamma Walkover Survey
(<1 ft bgs sensitivity):
Count Rate Ranges

🟥	1,000,000
🟥	500,000
🟪	200,000
🟦	100,000
🟦	60,000
🟨	40,000
🟩	30,000
🟩	20,000

N

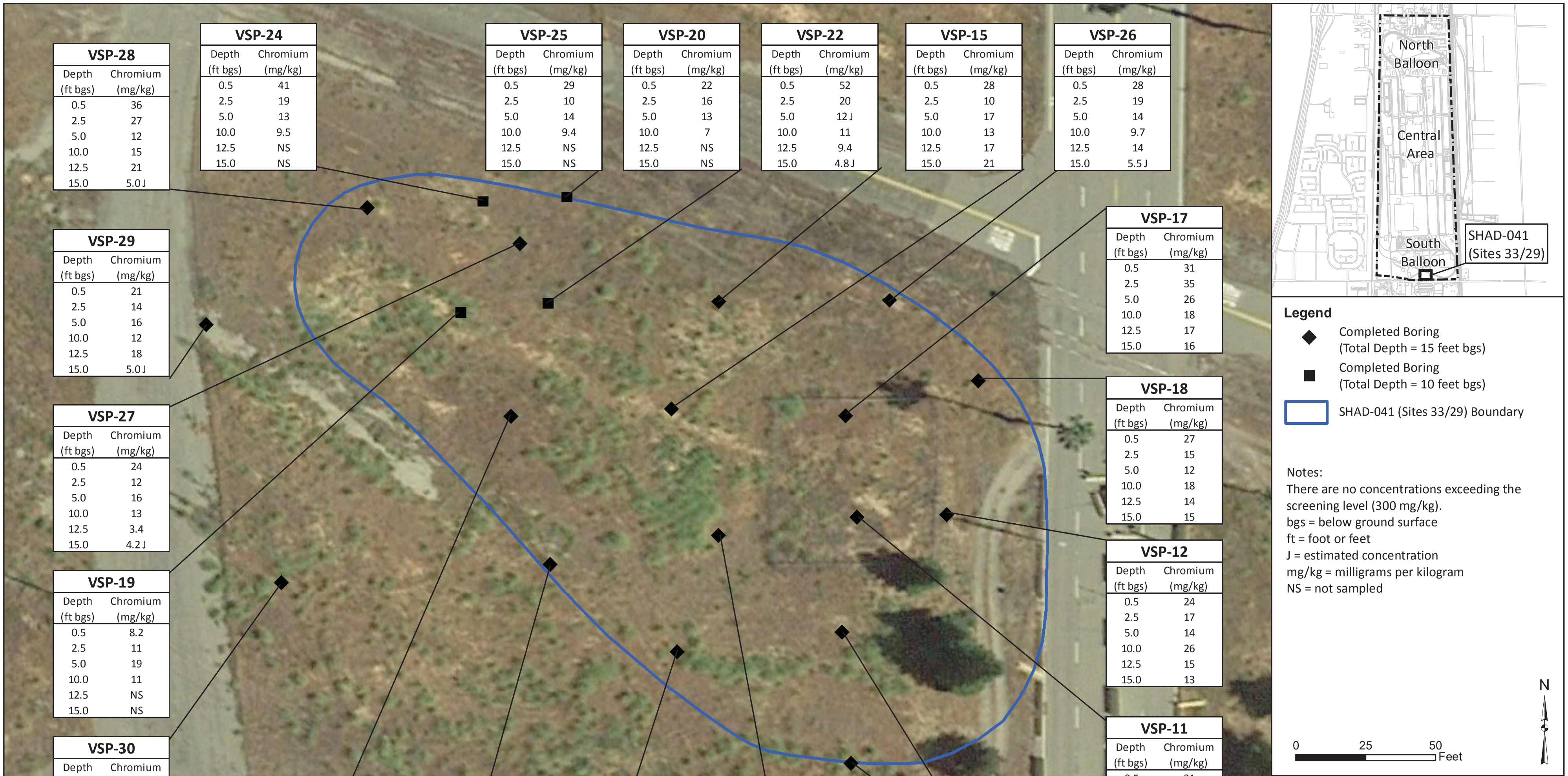
Boring Locations and Gamma Walkover Survey

RI/FS Report
Sites 33/29 (SHAD-041)
Sharpe Army Depot
Lathrop, California

Ahtna

Figure

5



VSP-28

Depth (ft bgs)	Chromium (mg/kg)
0.5	36
2.5	27
5.0	12
10.0	15
12.5	21
15.0	5.0 J

VSP-24

Depth (ft bgs)	Chromium (mg/kg)
0.5	41
2.5	19
5.0	13
10.0	9.5
12.5	NS
15.0	NS

VSP-25

Depth (ft bgs)	Chromium (mg/kg)
0.5	29
2.5	10
5.0	14
10.0	9.4
12.5	NS
15.0	NS

VSP-20

Depth (ft bgs)	Chromium (mg/kg)
0.5	22
2.5	16
5.0	13
10.0	7
12.5	NS
15.0	NS

VSP-22

Depth (ft bgs)	Chromium (mg/kg)
0.5	52
2.5	20
5.0	12 J
10.0	11
12.5	9.4
15.0	4.8 J

VSP-15

Depth (ft bgs)	Chromium (mg/kg)
0.5	28
2.5	10
5.0	17
10.0	13
12.5	17
15.0	21

VSP-26

Depth (ft bgs)	Chromium (mg/kg)
0.5	28
2.5	19
5.0	14
10.0	9.7
12.5	14
15.0	5.5 J

VSP-29

Depth (ft bgs)	Chromium (mg/kg)
0.5	21
2.5	14
5.0	16
10.0	12
12.5	18
15.0	5.0 J

VSP-17

Depth (ft bgs)	Chromium (mg/kg)
0.5	31
2.5	35
5.0	26
10.0	18
12.5	17
15.0	16

VSP-18

Depth (ft bgs)	Chromium (mg/kg)
0.5	27
2.5	15
5.0	12
10.0	18
12.5	14
15.0	15

VSP-27

Depth (ft bgs)	Chromium (mg/kg)
0.5	24
2.5	12
5.0	16
10.0	13
12.5	3.4
15.0	4.2 J

VSP-12

Depth (ft bgs)	Chromium (mg/kg)
0.5	24
2.5	17
5.0	14
10.0	26
12.5	15
15.0	13

VSP-19

Depth (ft bgs)	Chromium (mg/kg)
0.5	8.2
2.5	11
5.0	19
10.0	11
12.5	NS
15.0	NS

VSP-11

Depth (ft bgs)	Chromium (mg/kg)
0.5	31
2.5	9.2
5.0	15 J
10.0	11
12.5	15
15.0	15

VSP-30

Depth (ft bgs)	Chromium (mg/kg)
0.5	12
2.5	9.1
5.0	13
10.0	13
12.5	13
15.0	3.4 J

VSP-13

Depth (ft bgs)	Chromium (mg/kg)
0.5	13
2.5	9.4
5.0	15
10.0	9.8
12.5	17
15.0	15

VSP-8

Depth (ft bgs)	Chromium (mg/kg)
0.5	21
2.5	8.3
5.0	12
10.0	13
12.5	16
15.0	13

VSP-4

Depth (ft bgs)	Chromium (mg/kg)
0.5	19
2.5	8.8
5.0	14
10.0	11
12.5	12
15.0	20

VSP-10

Depth (ft bgs)	Chromium (mg/kg)
0.5	35
2.5	11
5.0	17
10.0	18
12.5	9.3
15.0	23

VSP-2

Depth (ft bgs)	Chromium (mg/kg)
0.5	30
2.5	25
5.0	25
10.0	25
12.5	14
15.0	13

VSP-6

Depth (ft bgs)	Chromium (mg/kg)
0.5	21
2.5	10
5.0	11
10.0	13
12.5	16
15.0	15

Legend

◆	Completed Boring (Total Depth = 15 feet bgs)
■	Completed Boring (Total Depth = 10 feet bgs)
▭	SHAD-041 (Sites 33/29) Boundary

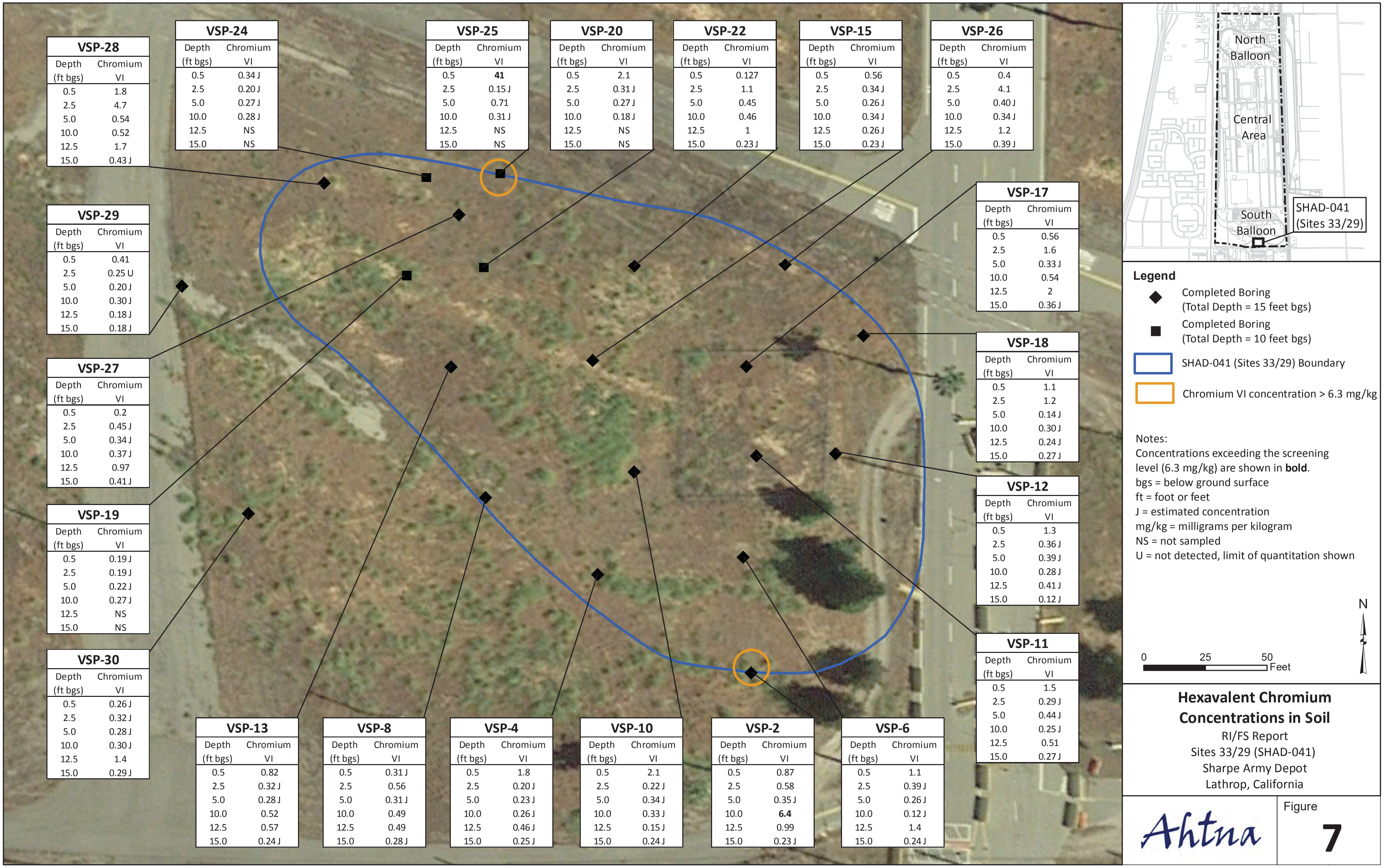
Notes:
There are no concentrations exceeding the screening level (300 mg/kg).
bgs = below ground surface
ft = foot or feet
J = estimated concentration
mg/kg = milligrams per kilogram
NS = not sampled

Chromium Concentrations in Soil

RI/FS Report
Sites 33/29 (SHAD-041)
Sharpe Army Depot
Lathrop, California

Ahtna

Figure
6



VSP-28

Depth (ft bgs)	Chromium VI
0.5	1.8
2.5	4.7
5.0	0.54
10.0	0.52
12.5	1.7
15.0	0.43 J

VSP-24

Depth (ft bgs)	Chromium VI
0.5	0.34 J
2.5	0.20 J
5.0	0.27 J
10.0	0.28 J
12.5	NS
15.0	NS

VSP-25

Depth (ft bgs)	Chromium VI
0.5	**41**
2.5	0.15 J
5.0	0.71
10.0	0.31 J
12.5	NS
15.0	NS

VSP-20

Depth (ft bgs)	Chromium VI
0.5	2.1
2.5	0.31 J
5.0	0.27 J
10.0	0.18 J
12.5	NS
15.0	NS

VSP-22

Depth (ft bgs)	Chromium VI
0.5	0.127
2.5	1.1
5.0	0.45
10.0	0.46
12.5	1
15.0	0.23 J

VSP-15

Depth (ft bgs)	Chromium VI
0.5	0.56
2.5	0.34 J
5.0	0.26 J
10.0	0.34 J
12.5	0.26 J
15.0	0.23 J

VSP-26

Depth (ft bgs)	Chromium VI
0.5	0.4
2.5	4.1
5.0	0.40 J
10.0	0.34 J
12.5	1.2
15.0	0.39 J

VSP-29

Depth (ft bgs)	Chromium VI
0.5	0.41
2.5	0.25 U
5.0	0.20 J
10.0	0.30 J
12.5	0.18 J
15.0	0.18 J

VSP-17

Depth (ft bgs)	Chromium VI
0.5	0.56
2.5	1.6
5.0	0.33 J
10.0	0.54
12.5	2
15.0	0.36 J

VSP-27

Depth (ft bgs)	Chromium VI
0.5	0.2
2.5	0.45 J
5.0	0.34 J
10.0	0.37 J
12.5	0.97
15.0	0.41 J

VSP-18

Depth (ft bgs)	Chromium VI
0.5	1.1
2.5	1.2
5.0	0.14 J
10.0	0.30 J
12.5	0.24 J
15.0	0.27 J

VSP-19

Depth (ft bgs)	Chromium VI
0.5	0.19 J
2.5	0.19 J
5.0	0.22 J
10.0	0.27 J
12.5	NS
15.0	NS

VSP-12

Depth (ft bgs)	Chromium VI
0.5	1.3
2.5	0.36 J
5.0	0.39 J
10.0	0.28 J
12.5	0.41 J
15.0	0.12 J

VSP-30

Depth (ft bgs)	Chromium VI
0.5	0.26 J
2.5	0.32 J
5.0	0.28 J
10.0	0.30 J
12.5	1.4
15.0	0.29 J

VSP-11

Depth (ft bgs)	Chromium VI
0.5	1.5
2.5	0.29 J
5.0	0.44 J
10.0	0.25 J
12.5	0.51
15.0	0.27 J

VSP-13

Depth (ft bgs)	Chromium VI
0.5	0.82
2.5	0.32 J
5.0	0.28 J
10.0	0.52
12.5	0.57
15.0	0.24 J

VSP-8

Depth (ft bgs)	Chromium VI
0.5	0.31 J
2.5	0.56
5.0	0.31 J
10.0	0.49
12.5	0.49
15.0	0.28 J

VSP-4

Depth (ft bgs)	Chromium VI
0.5	1.8
2.5	0.20 J
5.0	0.23 J
10.0	0.26 J
12.5	0.46 J
15.0	0.25 J

VSP-10

Depth (ft bgs)	Chromium VI
0.5	2.1
2.5	0.22 J
5.0	0.34 J
10.0	0.33 J
12.5	0.15 J
15.0	0.24 J

VSP-2

Depth (ft bgs)	Chromium VI
0.5	0.87
2.5	0.58
5.0	0.35 J
10.0	**6.4**
12.5	0.99
15.0	0.23 J

VSP-6

Depth (ft bgs)	Chromium VI
0.5	1.1
2.5	0.39 J
5.0	0.26 J
10.0	0.12 J
12.5	1.4
15.0	0.24 J

Legend

◆	Completed Boring (Total Depth = 15 feet bgs)
■	Completed Boring (Total Depth = 10 feet bgs)
▭	SHAD-041 (Sites 33/29) Boundary
○	Chromium VI concentration > 6.3 mg/kg

Notes:
Concentrations exceeding the screening level (6.3 mg/kg) are shown in **bold**.
bgs = below ground surface
ft = foot or feet
J = estimated concentration
mg/kg = milligrams per kilogram
NS = not sampled
U = not detected, limit of quantitation shown

Hexavalent Chromium Concentrations in Soil
RI/FS Report
Sites 33/29 (SHAD-041)
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Lathrop, California

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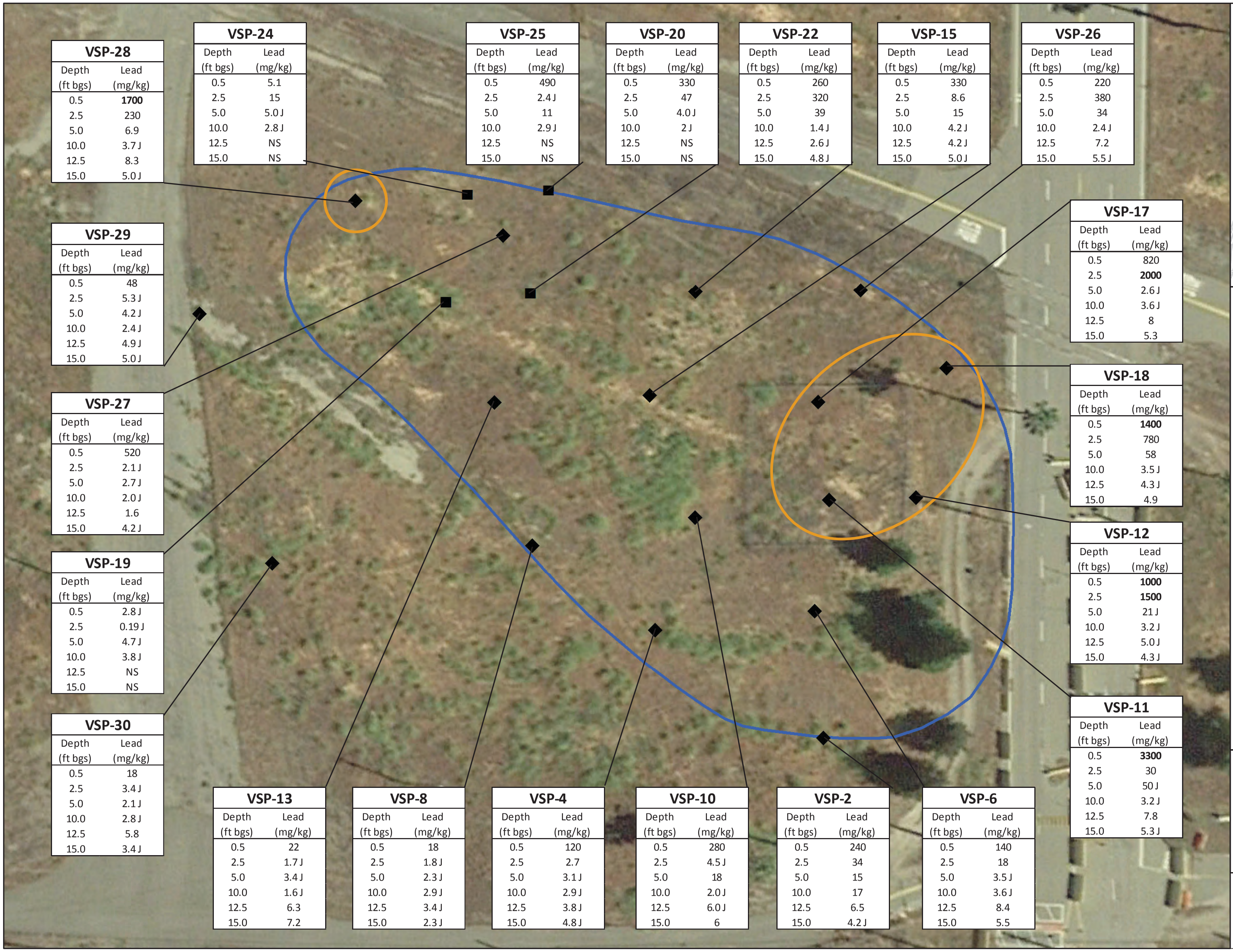
Figure
7



VSP-28

Depth (ft bgs)	Lead (mg/kg)
0.5	**1700**
2.5	230
5.0	6.9
10.0	3.7 J
12.5	8.3
15.0	5.0 J

VSP-29

Depth (ft bgs)	Lead (mg/kg)
0.5	48
2.5	5.3 J
5.0	4.2 J
10.0	2.4 J
12.5	4.9 J
15.0	5.0 J

VSP-27

Depth (ft bgs)	Lead (mg/kg)
0.5	520
2.5	2.1 J
5.0	2.7 J
10.0	2.0 J
12.5	1.6
15.0	4.2 J

VSP-19

Depth (ft bgs)	Lead (mg/kg)
0.5	2.8 J
2.5	0.19 J
5.0	4.7 J
10.0	3.8 J
12.5	NS
15.0	NS

VSP-30

Depth (ft bgs)	Lead (mg/kg)
0.5	18
2.5	3.4 J
5.0	2.1 J
10.0	2.8 J
12.5	5.8
15.0	3.4 J

VSP-24

Depth (ft bgs)	Lead (mg/kg)
0.5	5.1
2.5	15
5.0	5.0 J
10.0	2.8 J
12.5	NS
15.0	NS

VSP-25

Depth (ft bgs)	Lead (mg/kg)
0.5	490
2.5	2.4 J
5.0	11
10.0	2.9 J
12.5	NS
15.0	NS

VSP-20

Depth (ft bgs)	Lead (mg/kg)
0.5	330
2.5	47
5.0	4.0 J
10.0	2 J
12.5	NS
15.0	NS

VSP-22

Depth (ft bgs)	Lead (mg/kg)
0.5	260
2.5	320
5.0	39
10.0	1.4 J
12.5	2.6 J
15.0	4.8 J

VSP-15

Depth (ft bgs)	Lead (mg/kg)
0.5	330
2.5	8.6
5.0	15
10.0	4.2 J
12.5	4.2 J
15.0	5.0 J

VSP-26

Depth (ft bgs)	Lead (mg/kg)
0.5	220
2.5	380
5.0	34
10.0	2.4 J
12.5	7.2
15.0	5.5 J

VSP-17

Depth (ft bgs)	Lead (mg/kg)
0.5	820
2.5	**2000**
5.0	2.6 J
10.0	3.6 J
12.5	8
15.0	5.3

VSP-18

Depth (ft bgs)	Lead (mg/kg)
0.5	**1400**
2.5	780
5.0	58
10.0	3.5 J
12.5	4.3 J
15.0	4.9

VSP-12

Depth (ft bgs)	Lead (mg/kg)
0.5	**1000**
2.5	**1500**
5.0	21 J
10.0	3.2 J
12.5	5.0 J
15.0	4.3 J

VSP-11

Depth (ft bgs)	Lead (mg/kg)
0.5	**3300**
2.5	30
5.0	50 J
10.0	3.2 J
12.5	7.8
15.0	5.3 J

VSP-13

Depth (ft bgs)	Lead (mg/kg)
0.5	22
2.5	1.7 J
5.0	3.4 J
10.0	1.6 J
12.5	6.3
15.0	7.2

VSP-8

Depth (ft bgs)	Lead (mg/kg)
0.5	18
2.5	1.8 J
5.0	2.3 J
10.0	2.9 J
12.5	3.4 J
15.0	2.3 J

VSP-4

Depth (ft bgs)	Lead (mg/kg)
0.5	120
2.5	2.7
5.0	3.1 J
10.0	2.9 J
12.5	3.8 J
15.0	4.8 J

VSP-10

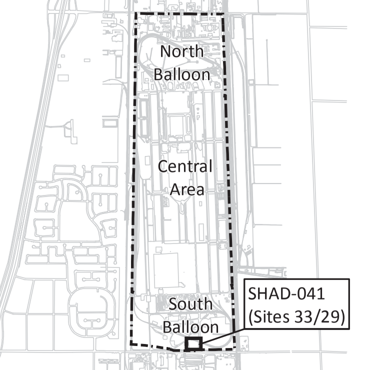
Depth (ft bgs)	Lead (mg/kg)
0.5	280
2.5	4.5 J
5.0	18
10.0	2.0 J
12.5	6.0 J
15.0	6

VSP-2

Depth (ft bgs)	Lead (mg/kg)
0.5	240
2.5	34
5.0	15
10.0	17
12.5	6.5
15.0	4.2 J

VSP-6

Depth (ft bgs)	Lead (mg/kg)
0.5	140
2.5	18
5.0	3.5 J
10.0	3.6 J
12.5	8.4
15.0	5.5



Legend

◆	Completed Boring (Total Depth = 15 feet bgs)
■	Completed Boring (Total Depth = 10 feet bgs)
▭	SHAD-041 (Sites 33/29) Boundary
▭	Lead concentration > 1000 mg/kg

Notes:
Concentrations exceeding the cleanup level (1000 mg/kg) are shown in **bold**.
bgs = below ground surface
ft = foot or feet
J = estimated concentration
mg/kg = milligrams per kilogram
NS = not sampled

0 25 50 Feet

N

Lead Concentrations in Soil

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Figure
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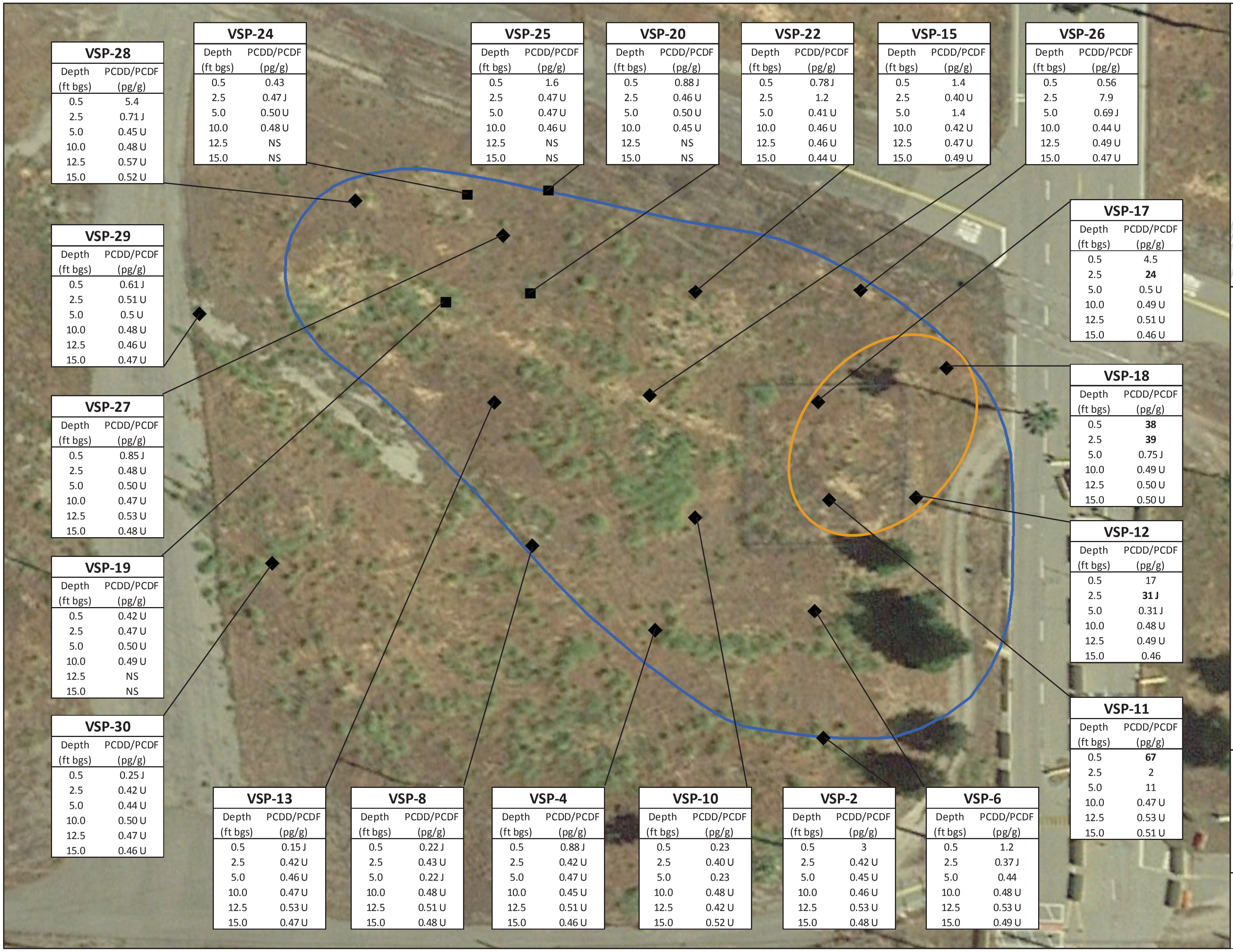


VSP-28

Depth (ft bgs)	PCDD/PCDF (pg/g)
0.5	5.4
2.5	0.71 J
5.0	0.45 U
10.0	0.48 U
12.5	0.57 U
15.0	0.52 U

VSP-24

Depth (ft bgs)	PCDD/PCDF (pg/g)
0.5	0.43
2.5	0.47 J
5.0	0.50 U
10.0	0.48 U
12.5	NS
15.0	NS

VSP-25

Depth (ft bgs)	PCDD/PCDF (pg/g)
0.5	1.6
2.5	0.47 U
5.0	0.47 U
10.0	0.46 U
12.5	NS
15.0	NS

VSP-20

Depth (ft bgs)	PCDD/PCDF (pg/g)
0.5	0.88 J
2.5	0.46 U
5.0	0.50 U
10.0	0.45 U
12.5	NS
15.0	NS

VSP-22

Depth (ft bgs)	PCDD/PCDF (pg/g)
0.5	0.78 J
2.5	1.2
5.0	0.41 U
10.0	0.46 U
12.5	0.46 U
15.0	0.44 U

VSP-15

Depth (ft bgs)	PCDD/PCDF (pg/g)
0.5	1.4
2.5	0.40 U
5.0	1.4
10.0	0.42 U
12.5	0.47 U
15.0	0.49 U

VSP-26

Depth (ft bgs)	PCDD/PCDF (pg/g)
0.5	0.56
2.5	7.9
5.0	0.69 J
10.0	0.44 U
12.5	0.49 U
15.0	0.47 U

VSP-29

Depth (ft bgs)	PCDD/PCDF (pg/g)
0.5	0.61 J
2.5	0.51 U
5.0	0.5 U
10.0	0.48 U
12.5	0.46 U
15.0	0.47 U

VSP-17

Depth (ft bgs)	PCDD/PCDF (pg/g)
0.5	4.5
2.5	**24**
5.0	0.5 U
10.0	0.49 U
12.5	0.51 U
15.0	0.46 U

VSP-27

Depth (ft bgs)	PCDD/PCDF (pg/g)
0.5	0.85 J
2.5	0.48 U
5.0	0.50 U
10.0	0.47 U
12.5	0.53 U
15.0	0.48 U

VSP-18

Depth (ft bgs)	PCDD/PCDF (pg/g)
0.5	**38**
2.5	**39**
5.0	0.75 J
10.0	0.49 U
12.5	0.50 U
15.0	0.50 U

VSP-12

Depth (ft bgs)	PCDD/PCDF (pg/g)
0.5	17
2.5	**31 J**
5.0	0.31 J
10.0	0.48 U
12.5	0.49 U
15.0	0.46

VSP-19

Depth (ft bgs)	PCDD/PCDF (pg/g)
0.5	0.42 U
2.5	0.47 U
5.0	0.50 U
10.0	0.49 U
12.5	NS
15.0	NS

VSP-11

Depth (ft bgs)	PCDD/PCDF (pg/g)
0.5	**67**
2.5	2
5.0	11
10.0	0.47 U
12.5	0.53 U
15.0	0.51 U

VSP-30

Depth (ft bgs)	PCDD/PCDF (pg/g)
0.5	0.25 J
2.5	0.42 U
5.0	0.44 U
10.0	0.50 U
12.5	0.47 U
15.0	0.46 U

VSP-13

Depth (ft bgs)	PCDD/PCDF (pg/g)
0.5	0.15 J
2.5	0.42 U
5.0	0.46 U
10.0	0.47 U
12.5	0.53 U
15.0	0.47 U

VSP-8

Depth (ft bgs)	PCDD/PCDF (pg/g)
0.5	0.22 J
2.5	0.43 U
5.0	0.22 J
10.0	0.48 U
12.5	0.51 U
15.0	0.48 U

VSP-4

Depth (ft bgs)	PCDD/PCDF (pg/g)
0.5	0.88 J
2.5	0.42 U
5.0	0.47 U
10.0	0.45 U
12.5	0.51 U
15.0	0.46 U

VSP-10

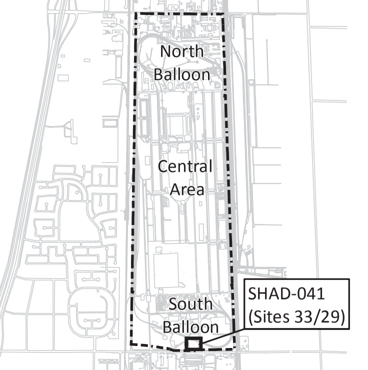
Depth (ft bgs)	PCDD/PCDF (pg/g)
0.5	0.23
2.5	0.40 U
5.0	0.23
10.0	0.48 U
12.5	0.42 U
15.0	0.52 U

VSP-2

Depth (ft bgs)	PCDD/PCDF (pg/g)
0.5	3
2.5	0.42 U
5.0	0.45 U
10.0	0.46 U
12.5	0.53 U
15.0	0.48 U

VSP-6

Depth (ft bgs)	PCDD/PCDF (pg/g)
0.5	1.2
2.5	0.37 J
5.0	0.44
10.0	0.48 U
12.5	0.53 U
15.0	0.49 U



Legend

◆	Completed Boring (Total Depth = 15 feet bgs)
■	Completed Boring (Total Depth = 10 feet bgs)
▭	SHAD-041 (Sites 33/29) Boundary
▭	PCDD/PCDF concentration > 22 pg/g

Notes:
Concentrations exceeding the screening level (22 pg/g) are shown in **bold**.
bgs = below ground surface
ft = foot or feet
J = estimated concentration
NS = not sampled
pg/g = picogram per gram
U = not detected, limit of quantitation shown

N

0 25 50 Feet

PCDD/PCDF Concentrations in Soil

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Lathrop, California

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Figure
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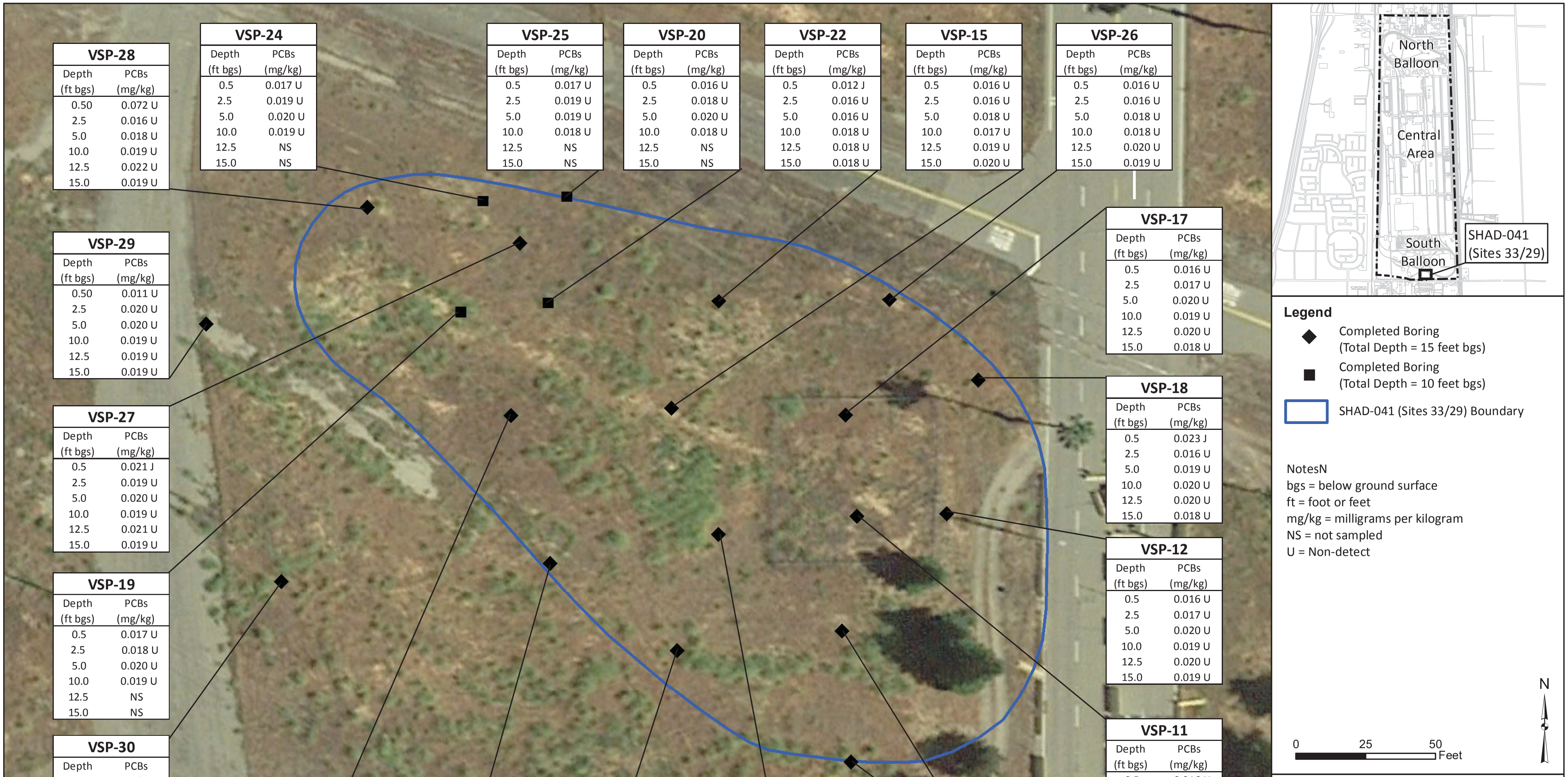

Legend

- ◆ Completed Boring (Total Depth = 15 feet bgs)
- ■ Completed Boring (Total Depth = 10 feet bgs)
- ▭ SHAD-041 (Sites 33/29) Boundary

NotesN
bgs = below ground surface
ft = foot or feet
mg/kg = milligrams per kilogram
NS = not sampled
U = Non-detect

VSP-28

Depth (ft bgs)	PCBs (mg/kg)
0.50	0.072 U
2.5	0.016 U
5.0	0.018 U
10.0	0.019 U
12.5	0.022 U
15.0	0.019 U

VSP-24

Depth (ft bgs)	PCBs (mg/kg)
0.5	0.017 U
2.5	0.019 U
5.0	0.020 U
10.0	0.019 U
12.5	NS
15.0	NS

VSP-25

Depth (ft bgs)	PCBs (mg/kg)
0.5	0.017 U
2.5	0.019 U
5.0	0.019 U
10.0	0.018 U
12.5	NS
15.0	NS

VSP-20

Depth (ft bgs)	PCBs (mg/kg)
0.5	0.016 U
2.5	0.018 U
5.0	0.020 U
10.0	0.018 U
12.5	NS
15.0	NS

VSP-22

Depth (ft bgs)	PCBs (mg/kg)
0.5	0.012 J
2.5	0.016 U
5.0	0.016 U
10.0	0.018 U
12.5	0.018 U
15.0	0.018 U

VSP-15

Depth (ft bgs)	PCBs (mg/kg)
0.5	0.016 U
2.5	0.016 U
5.0	0.018 U
10.0	0.017 U
12.5	0.019 U
15.0	0.020 U

VSP-26

Depth (ft bgs)	PCBs (mg/kg)
0.5	0.016 U
2.5	0.016 U
5.0	0.018 U
10.0	0.018 U
12.5	0.020 U
15.0	0.019 U

VSP-29

Depth (ft bgs)	PCBs (mg/kg)
0.50	0.011 U
2.5	0.020 U
5.0	0.020 U
10.0	0.019 U
12.5	0.019 U
15.0	0.019 U

VSP-17

Depth (ft bgs)	PCBs (mg/kg)
0.5	0.016 U
2.5	0.017 U
5.0	0.020 U
10.0	0.019 U
12.5	0.020 U
15.0	0.018 U

VSP-27

Depth (ft bgs)	PCBs (mg/kg)
0.5	0.021 J
2.5	0.019 U
5.0	0.020 U
10.0	0.019 U
12.5	0.021 U
15.0	0.019 U

VSP-18

Depth (ft bgs)	PCBs (mg/kg)
0.5	0.023 J
2.5	0.016 U
5.0	0.019 U
10.0	0.020 U
12.5	0.020 U
15.0	0.018 U

VSP-12

Depth (ft bgs)	PCBs (mg/kg)
0.5	0.016 U
2.5	0.017 U
5.0	0.020 U
10.0	0.019 U
12.5	0.020 U
15.0	0.019 U

VSP-19

Depth (ft bgs)	PCBs (mg/kg)
0.5	0.017 U
2.5	0.018 U
5.0	0.020 U
10.0	0.019 U
12.5	NS
15.0	NS

VSP-11

Depth (ft bgs)	PCBs (mg/kg)
0.5	0.016 U
2.5	0.016 U
5.0	0.019 U
10.0	0.019 U
12.5	0.021 U
15.0	0.020 U

VSP-30

Depth (ft bgs)	PCBs (mg/kg)
0.5	0.016 U
2.5	0.016 U
5.0	0.018 U
10.0	0.020 U
12.5	0.019 U
15.0	0.018 U

VSP-13

Depth (ft bgs)	PCBs (mg/kg)
0.5	0.016 U
2.5	0.017 U
5.0	0.018 U
10.0	0.019 U
12.5	0.021 U
15.0	0.019 U

VSP-8

Depth (ft bgs)	PCBs (mg/kg)
0.5	0.011 U
2.5	0.017 U
5.0	0.017 U
10.0	0.019 U
12.5	0.020 U
15.0	0.019 U

VSP-4

Depth (ft bgs)	PCBs (mg/kg)
0.5	0.016 U
2.5	0.016 U
5.0	0.019 U
10.0	0.018 U
12.5	0.020 U
15.0	0.018 U

VSP-10

Depth (ft bgs)	PCBs (mg/kg)
0.5	0.010 U
2.5	0.017 U
5.0	0.018 U
10.0	0.019 U
12.5	0.017 U
15.0	0.021 U

VSP-2

Depth (ft bgs)	PCBs (mg/kg)
0.5	0.016 U
2.5	0.017 U
5.0	0.018 U
10.0	0.018 U
12.5	0.021 U
15.0	0.019 U

VSP-6

Depth (ft bgs)	PCBs (mg/kg)
0.5	0.21
2.5	0.017 U
5.0	0.017 U
10.0	0.019 U
12.5	0.021 U
15.0	0.019 U

PCBs Concentrations in Soil

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Figure
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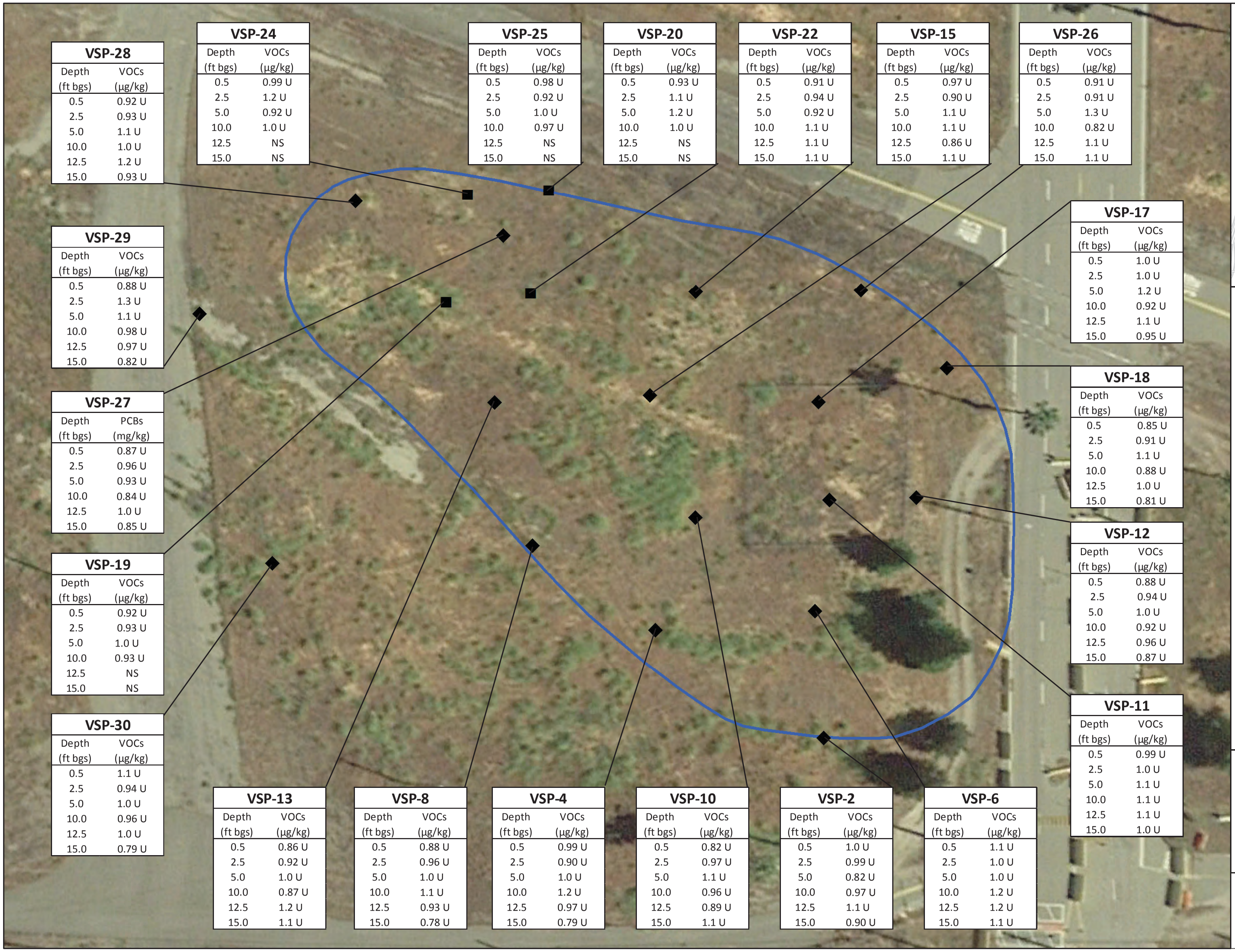


VSP-28

Depth (ft bgs)	VOCs (µg/kg)
0.5	0.92 U
2.5	0.93 U
5.0	1.1 U
10.0	1.0 U
12.5	1.2 U
15.0	0.93 U

VSP-24

Depth (ft bgs)	VOCs (µg/kg)
0.5	0.99 U
2.5	1.2 U
5.0	0.92 U
10.0	1.0 U
12.5	NS
15.0	NS

VSP-25

Depth (ft bgs)	VOCs (µg/kg)
0.5	0.98 U
2.5	0.92 U
5.0	1.0 U
10.0	0.97 U
12.5	NS
15.0	NS

VSP-20

Depth (ft bgs)	VOCs (µg/kg)
0.5	0.93 U
2.5	1.1 U
5.0	1.2 U
10.0	1.0 U
12.5	NS
15.0	NS

VSP-22

Depth (ft bgs)	VOCs (µg/kg)
0.5	0.91 U
2.5	0.94 U
5.0	0.92 U
10.0	1.1 U
12.5	1.1 U
15.0	1.1 U

VSP-15

Depth (ft bgs)	VOCs (µg/kg)
0.5	0.97 U
2.5	0.90 U
5.0	1.1 U
10.0	1.1 U
12.5	0.86 U
15.0	1.1 U

VSP-26

Depth (ft bgs)	VOCs (µg/kg)
0.5	0.91 U
2.5	0.91 U
5.0	1.3 U
10.0	0.82 U
12.5	1.1 U
15.0	1.1 U

VSP-29

Depth (ft bgs)	VOCs (µg/kg)
0.5	0.88 U
2.5	1.3 U
5.0	1.1 U
10.0	0.98 U
12.5	0.97 U
15.0	0.82 U

VSP-17

Depth (ft bgs)	VOCs (µg/kg)
0.5	1.0 U
2.5	1.0 U
5.0	1.2 U
10.0	0.92 U
12.5	1.1 U
15.0	0.95 U

VSP-27

Depth (ft bgs)	PCBs (mg/kg)
0.5	0.87 U
2.5	0.96 U
5.0	0.93 U
10.0	0.84 U
12.5	1.0 U
15.0	0.85 U

VSP-18

Depth (ft bgs)	VOCs (µg/kg)
0.5	0.85 U
2.5	0.91 U
5.0	1.1 U
10.0	0.88 U
12.5	1.0 U
15.0	0.81 U

VSP-19

Depth (ft bgs)	VOCs (µg/kg)
0.5	0.92 U
2.5	0.93 U
5.0	1.0 U
10.0	0.93 U
12.5	NS
15.0	NS

VSP-12

Depth (ft bgs)	VOCs (µg/kg)
0.5	0.88 U
2.5	0.94 U
5.0	1.0 U
10.0	0.92 U
12.5	0.96 U
15.0	0.87 U

VSP-11

Depth (ft bgs)	VOCs (µg/kg)
0.5	0.99 U
2.5	1.0 U
5.0	1.1 U
10.0	1.1 U
12.5	1.1 U
15.0	1.0 U

VSP-30

Depth (ft bgs)	VOCs (µg/kg)
0.5	1.1 U
2.5	0.94 U
5.0	1.0 U
10.0	0.96 U
12.5	1.0 U
15.0	0.79 U

VSP-13

Depth (ft bgs)	VOCs (µg/kg)
0.5	0.86 U
2.5	0.92 U
5.0	1.0 U
10.0	0.87 U
12.5	1.2 U
15.0	1.1 U

VSP-8

Depth (ft bgs)	VOCs (µg/kg)
0.5	0.88 U
2.5	0.96 U
5.0	1.0 U
10.0	1.1 U
12.5	0.93 U
15.0	0.78 U

VSP-4

Depth (ft bgs)	VOCs (µg/kg)
0.5	0.99 U
2.5	0.90 U
5.0	1.0 U
10.0	1.2 U
12.5	0.97 U
15.0	0.79 U

VSP-10

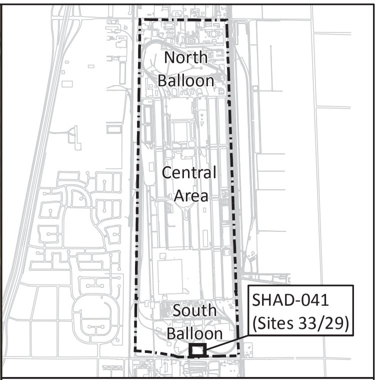
Depth (ft bgs)	VOCs (µg/kg)
0.5	0.82 U
2.5	0.97 U
5.0	1.1 U
10.0	0.96 U
12.5	0.89 U
15.0	1.1 U

VSP-2

Depth (ft bgs)	VOCs (µg/kg)
0.5	1.0 U
2.5	0.99 U
5.0	0.82 U
10.0	0.97 U
12.5	1.1 U
15.0	0.90 U

VSP-6

Depth (ft bgs)	VOCs (µg/kg)
0.5	1.1 U
2.5	1.0 U
5.0	1.0 U
10.0	1.2 U
12.5	1.2 U
15.0	1.1 U



Legend

◆	Completed Boring (Total Depth = 15 feet bgs)
■	Completed Boring (Total Depth = 10 feet bgs)
☐	SHAD-041 (Sites 33/29) Boundary

Notes:
bgs = below ground surface
ft = foot or feet
mg/kg = milligrams per kilogram
NS = not sampled
U = Non-detect

VOCs Concentrations in Soil

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Sharpe Army Depot
Lathrop, California

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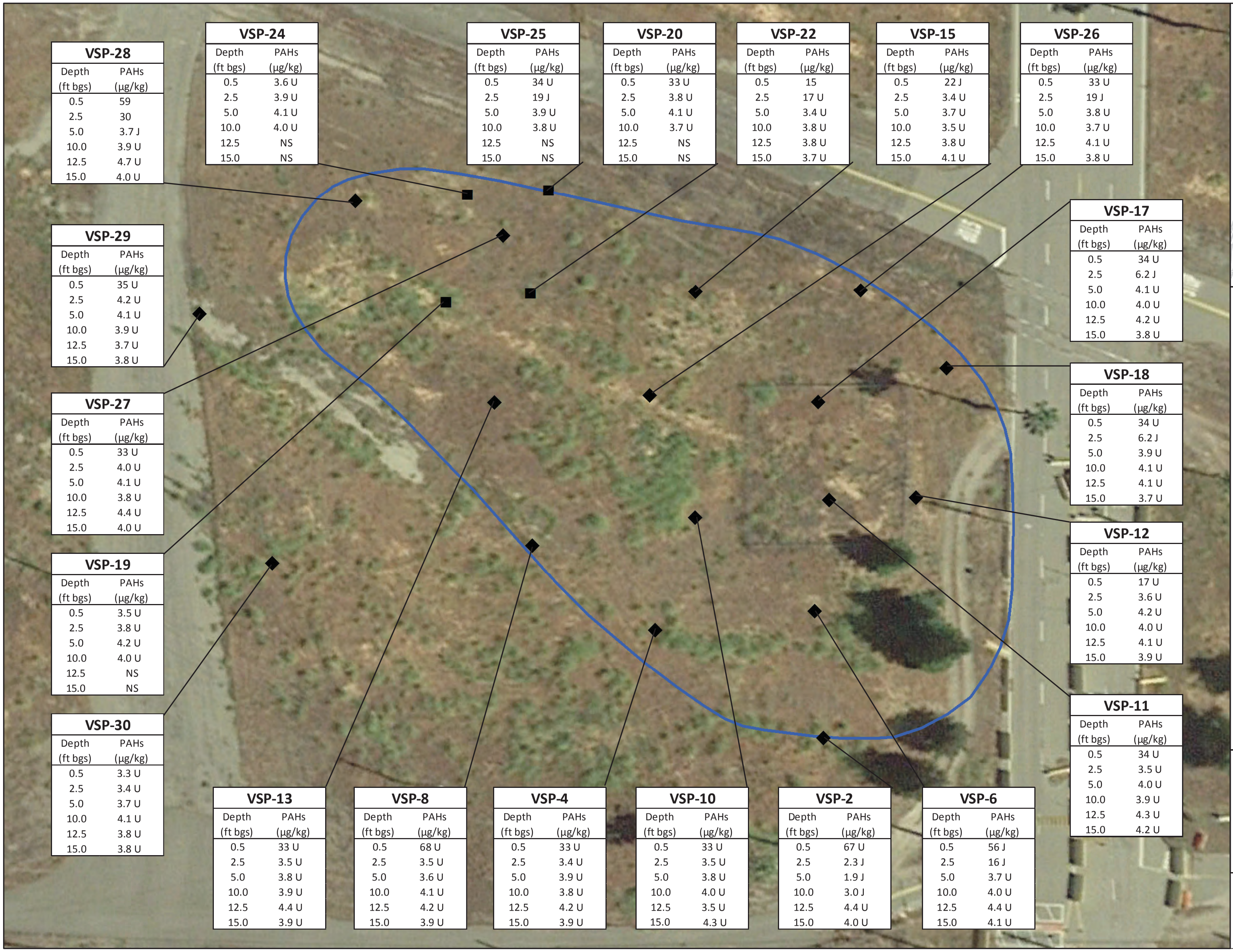
Figure
11



VSP-28

Depth (ft bgs)	PAHs (µg/kg)
0.5	59
2.5	30
5.0	3.7 J
10.0	3.9 U
12.5	4.7 U
15.0	4.0 U

VSP-29

Depth (ft bgs)	PAHs (µg/kg)
0.5	35 U
2.5	4.2 U
5.0	4.1 U
10.0	3.9 U
12.5	3.7 U
15.0	3.8 U

VSP-27

Depth (ft bgs)	PAHs (µg/kg)
0.5	33 U
2.5	4.0 U
5.0	4.1 U
10.0	3.8 U
12.5	4.4 U
15.0	4.0 U

VSP-19

Depth (ft bgs)	PAHs (µg/kg)
0.5	3.5 U
2.5	3.8 U
5.0	4.2 U
10.0	4.0 U
12.5	NS
15.0	NS

VSP-30

Depth (ft bgs)	PAHs (µg/kg)
0.5	3.3 U
2.5	3.4 U
5.0	3.7 U
10.0	4.1 U
12.5	3.8 U
15.0	3.8 U

VSP-24

Depth (ft bgs)	PAHs (µg/kg)
0.5	3.6 U
2.5	3.9 U
5.0	4.1 U
10.0	4.0 U
12.5	NS
15.0	NS

VSP-25

Depth (ft bgs)	PAHs (µg/kg)
0.5	34 U
2.5	19 J
5.0	3.9 U
10.0	3.8 U
12.5	NS
15.0	NS

VSP-20

Depth (ft bgs)	PAHs (µg/kg)
0.5	33 U
2.5	3.8 U
5.0	4.1 U
10.0	3.7 U
12.5	NS
15.0	NS

VSP-22

Depth (ft bgs)	PAHs (µg/kg)
0.5	15
2.5	17 U
5.0	3.4 U
10.0	3.8 U
12.5	3.8 U
15.0	3.7 U

VSP-15

Depth (ft bgs)	PAHs (µg/kg)
0.5	22 J
2.5	3.4 U
5.0	3.7 U
10.0	3.5 U
12.5	3.8 U
15.0	4.1 U

VSP-26

Depth (ft bgs)	PAHs (µg/kg)
0.5	33 U
2.5	19 J
5.0	3.8 U
10.0	3.7 U
12.5	4.1 U
15.0	3.8 U

VSP-17

Depth (ft bgs)	PAHs (µg/kg)
0.5	34 U
2.5	6.2 J
5.0	4.1 U
10.0	4.0 U
12.5	4.2 U
15.0	3.8 U

VSP-18

Depth (ft bgs)	PAHs (µg/kg)
0.5	34 U
2.5	6.2 J
5.0	3.9 U
10.0	4.1 U
12.5	4.1 U
15.0	3.7 U

VSP-12

Depth (ft bgs)	PAHs (µg/kg)
0.5	17 U
2.5	3.6 U
5.0	4.2 U
10.0	4.0 U
12.5	4.1 U
15.0	3.9 U

VSP-11

Depth (ft bgs)	PAHs (µg/kg)
0.5	34 U
2.5	3.5 U
5.0	4.0 U
10.0	3.9 U
12.5	4.3 U
15.0	4.2 U

VSP-13

Depth (ft bgs)	PAHs (µg/kg)
0.5	33 U
2.5	3.5 U
5.0	3.8 U
10.0	3.9 U
12.5	4.4 U
15.0	3.9 U

VSP-8

Depth (ft bgs)	PAHs (µg/kg)
0.5	68 U
2.5	3.5 U
5.0	3.6 U
10.0	4.1 U
12.5	4.2 U
15.0	3.9 U

VSP-4

Depth (ft bgs)	PAHs (µg/kg)
0.5	33 U
2.5	3.4 U
5.0	3.9 U
10.0	3.8 U
12.5	4.2 U
15.0	3.9 U

VSP-10

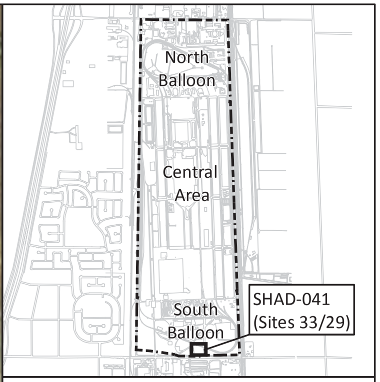
Depth (ft bgs)	PAHs (µg/kg)
0.5	33 U
2.5	3.5 U
5.0	3.8 U
10.0	4.0 U
12.5	3.5 U
15.0	4.3 U

VSP-2

Depth (ft bgs)	PAHs (µg/kg)
0.5	67 U
2.5	2.3 J
5.0	1.9 J
10.0	3.0 J
12.5	4.4 U
15.0	4.0 U

VSP-6

Depth (ft bgs)	PAHs (µg/kg)
0.5	56 J
2.5	16 J
5.0	3.7 U
10.0	4.0 U
12.5	4.4 U
15.0	4.1 U



Legend

◆	Completed Boring (Total Depth = 15 feet bgs)
■	Completed Boring (Total Depth = 10 feet bgs)
☐	SHAD-041 (Sites 33/29) Boundary

NotesN
bgs = below ground surface
ft = foot or feet
mg/kg = milligrams per kilogram
NS = not sampled
U = Non-detect
J = Estimated

0 25 50 Feet

N

PAHs Concentrations in Soil

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Lathrop, California

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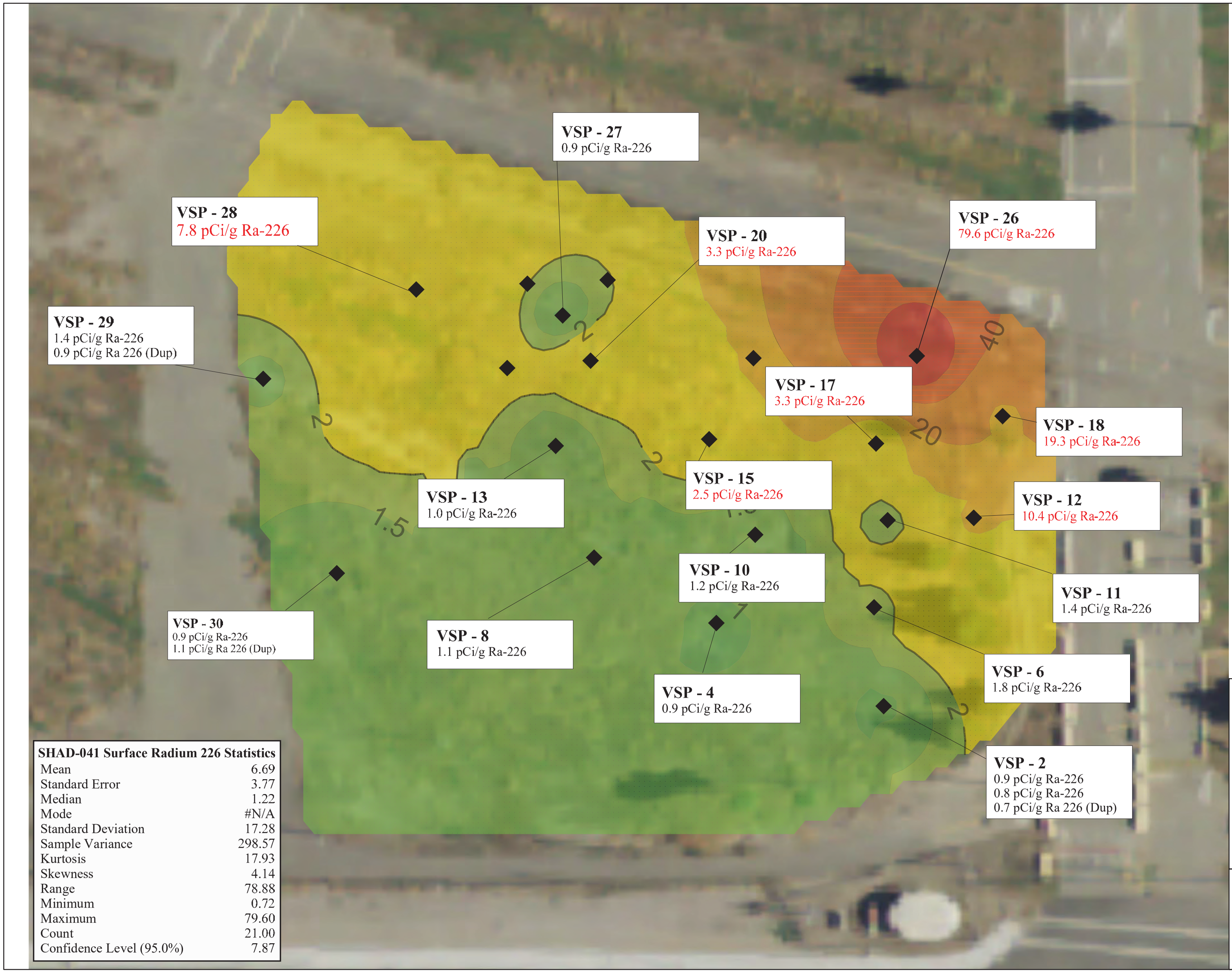
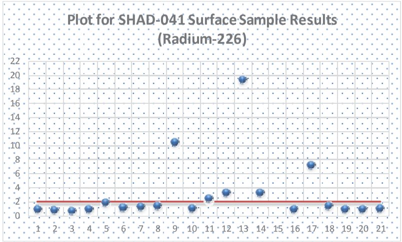
Figure
12



SHAD-041 Surface Radium 226 Statistics	
Mean	6.69
Standard Error	3.77
Median	1.22
Mode	#N/A
Standard Deviation	17.28
Sample Variance	298.57
Kurtosis	17.93
Skewness	4.14
Range	78.88
Minimum	0.72
Maximum	79.60
Count	21.00
Confidence Level (95.0%)	7.87



Note: Location VSP-26 result of 79.6 pCi/g not included in graph to show results better.

◆ Soil boring location

Note: Results exceeding 2.0 pCi/g are shown in red.

- 🟥 60
- 🟧 40
- 🟧 20
- 🟨 10
- 🟨 2
- 🟩 1.5
- 🟩 1
- 🟩 0.5

0 25 50 Feet

N

Ra-226 Concentrations Surface

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Lathrop, California

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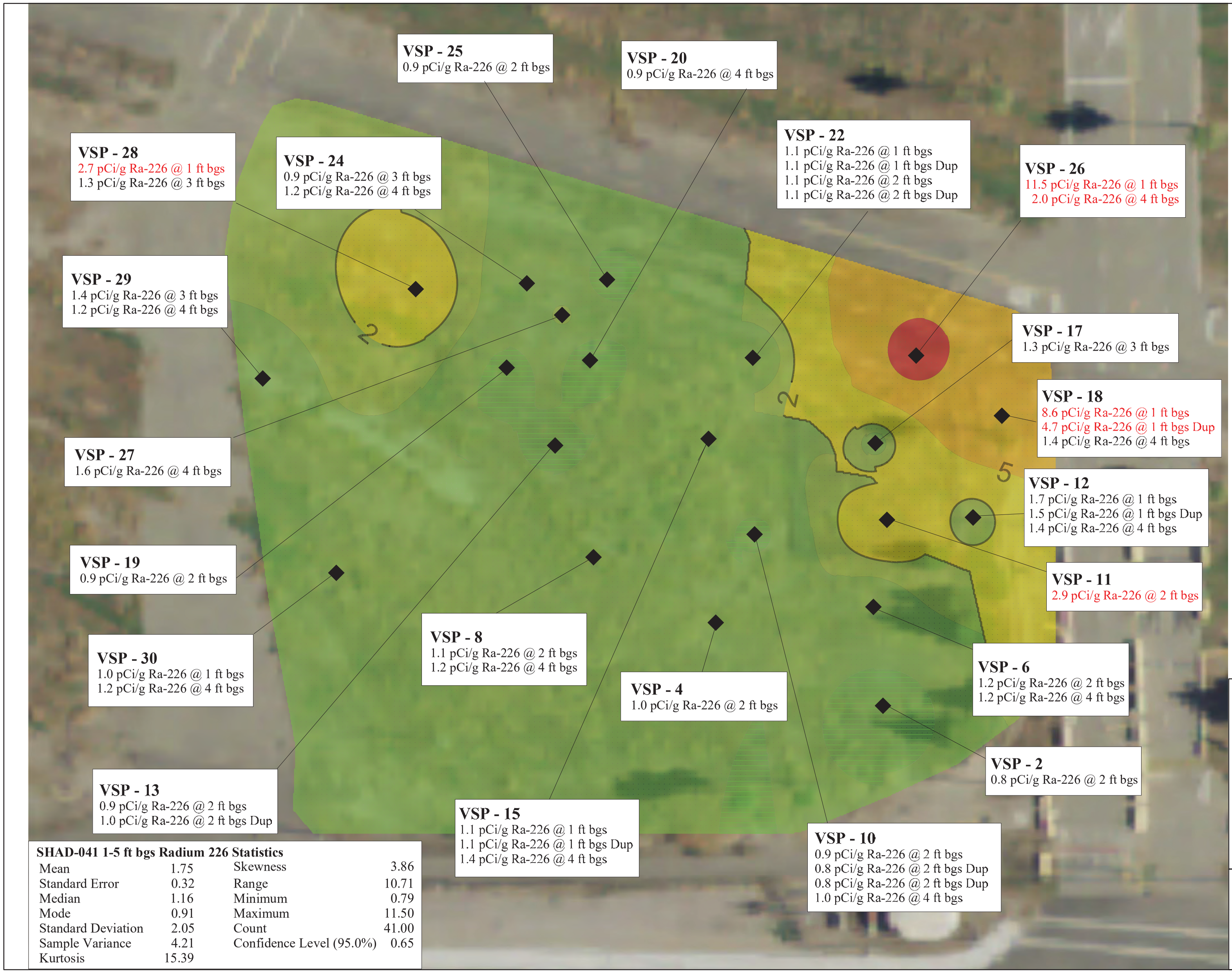
Figure
13



VSP - 25
0.9 pCi/g Ra-226 @ 2 ft bgs

VSP - 20
0.9 pCi/g Ra-226 @ 4 ft bgs

VSP - 28
2.7 pCi/g Ra-226 @ 1 ft bgs
1.3 pCi/g Ra-226 @ 3 ft bgs

VSP - 24
0.9 pCi/g Ra-226 @ 3 ft bgs
1.2 pCi/g Ra-226 @ 4 ft bgs

VSP - 22
1.1 pCi/g Ra-226 @ 1 ft bgs
1.1 pCi/g Ra-226 @ 1 ft bgs Dup
1.1 pCi/g Ra-226 @ 2 ft bgs
1.1 pCi/g Ra-226 @ 2 ft bgs Dup

VSP - 26
11.5 pCi/g Ra-226 @ 1 ft bgs
2.0 pCi/g Ra-226 @ 4 ft bgs

VSP - 29
1.4 pCi/g Ra-226 @ 3 ft bgs
1.2 pCi/g Ra-226 @ 4 ft bgs

VSP - 17
1.3 pCi/g Ra-226 @ 3 ft bgs

VSP - 18
8.6 pCi/g Ra-226 @ 1 ft bgs
4.7 pCi/g Ra-226 @ 1 ft bgs Dup
1.4 pCi/g Ra-226 @ 4 ft bgs

VSP - 27
1.6 pCi/g Ra-226 @ 4 ft bgs

VSP - 12
1.7 pCi/g Ra-226 @ 1 ft bgs
1.5 pCi/g Ra-226 @ 1 ft bgs Dup
1.4 pCi/g Ra-226 @ 4 ft bgs

VSP - 19
0.9 pCi/g Ra-226 @ 2 ft bgs

VSP - 11
2.9 pCi/g Ra-226 @ 2 ft bgs

VSP - 8
1.1 pCi/g Ra-226 @ 2 ft bgs
1.2 pCi/g Ra-226 @ 4 ft bgs

VSP - 30
1.0 pCi/g Ra-226 @ 1 ft bgs
1.2 pCi/g Ra-226 @ 4 ft bgs

VSP - 6
1.2 pCi/g Ra-226 @ 2 ft bgs
1.2 pCi/g Ra-226 @ 4 ft bgs

VSP - 4
1.0 pCi/g Ra-226 @ 2 ft bgs

VSP - 2
0.8 pCi/g Ra-226 @ 2 ft bgs

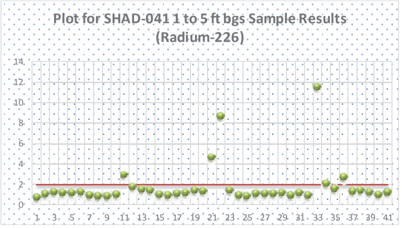
VSP - 13
0.9 pCi/g Ra-226 @ 2 ft bgs
1.0 pCi/g Ra-226 @ 2 ft bgs Dup

VSP - 15
1.1 pCi/g Ra-226 @ 1 ft bgs
1.1 pCi/g Ra-226 @ 1 ft bgs Dup
1.4 pCi/g Ra-226 @ 4 ft bgs

VSP - 10
0.9 pCi/g Ra-226 @ 2 ft bgs
0.8 pCi/g Ra-226 @ 2 ft bgs Dup
0.8 pCi/g Ra-226 @ 2 ft bgs Dup
1.0 pCi/g Ra-226 @ 4 ft bgs

SHAD-041 1-5 ft bgs Radium 226 Statistics

Mean	1.75	Skewness	3.86
Standard Error	0.32	Range	10.71
Median	1.16	Minimum	0.79
Mode	0.91	Maximum	11.50
Standard Deviation	2.05	Count	41.00
Sample Variance	4.21	Confidence Level (95.0%)	0.65
Kurtosis	15.39		


Plot for SHAD-041 1 to 5 ft bgs Sample Results (Radium-226)

◆ Soil boring location

Note: Results exceeding 2.0 pCi/g are shown in red.

🟥	10
🟧	5
🟨	2
🟩	1.5
🟩	1
🟩	0.5

0 25 50 Feet

N

Ra-226 Concentrations
1 to 5 ft bgs
RI/FS Report
Sites 33/29 (SHAD-041)
Sharpe Army Depot
Lathrop, California

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Figure
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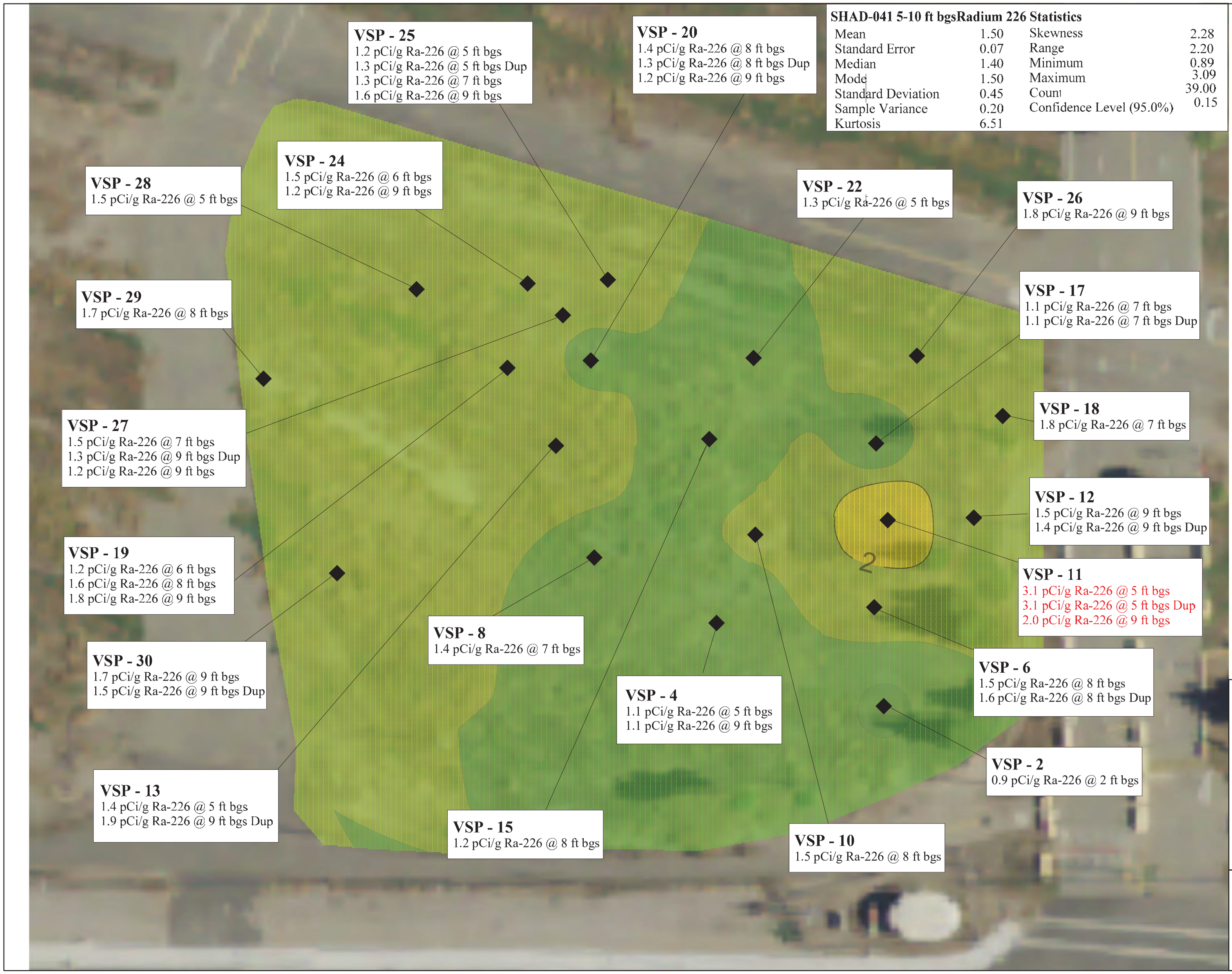
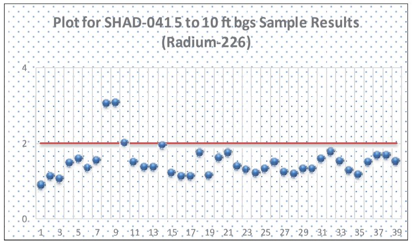


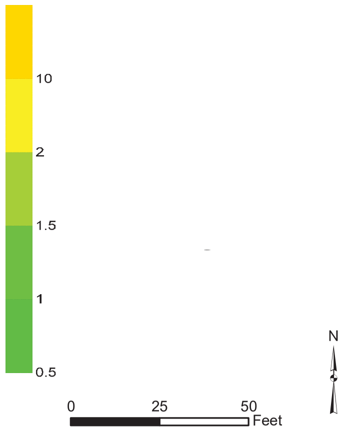
SHAD-041 5-10 ft bgsRadium 226 Statistics

Mean	1.50	Skewness	2.28
Standard Error	0.07	Range	2.20
Median	1.40	Minimum	0.89
Mode	1.50	Maximum	3.09
Standard Deviation	0.45	Count	39.00
Sample Variance	0.20	Confidence Level (95.0%)	0.15
Kurtosis	6.51		



◆ Soil boring location

Note: Results exceeding 2.0 pCi/g are shown in red.



Ra-226 Concentrations
5 to 10 ft bgs
RI/FS Report
Sites 33/29 (SHAD-041)
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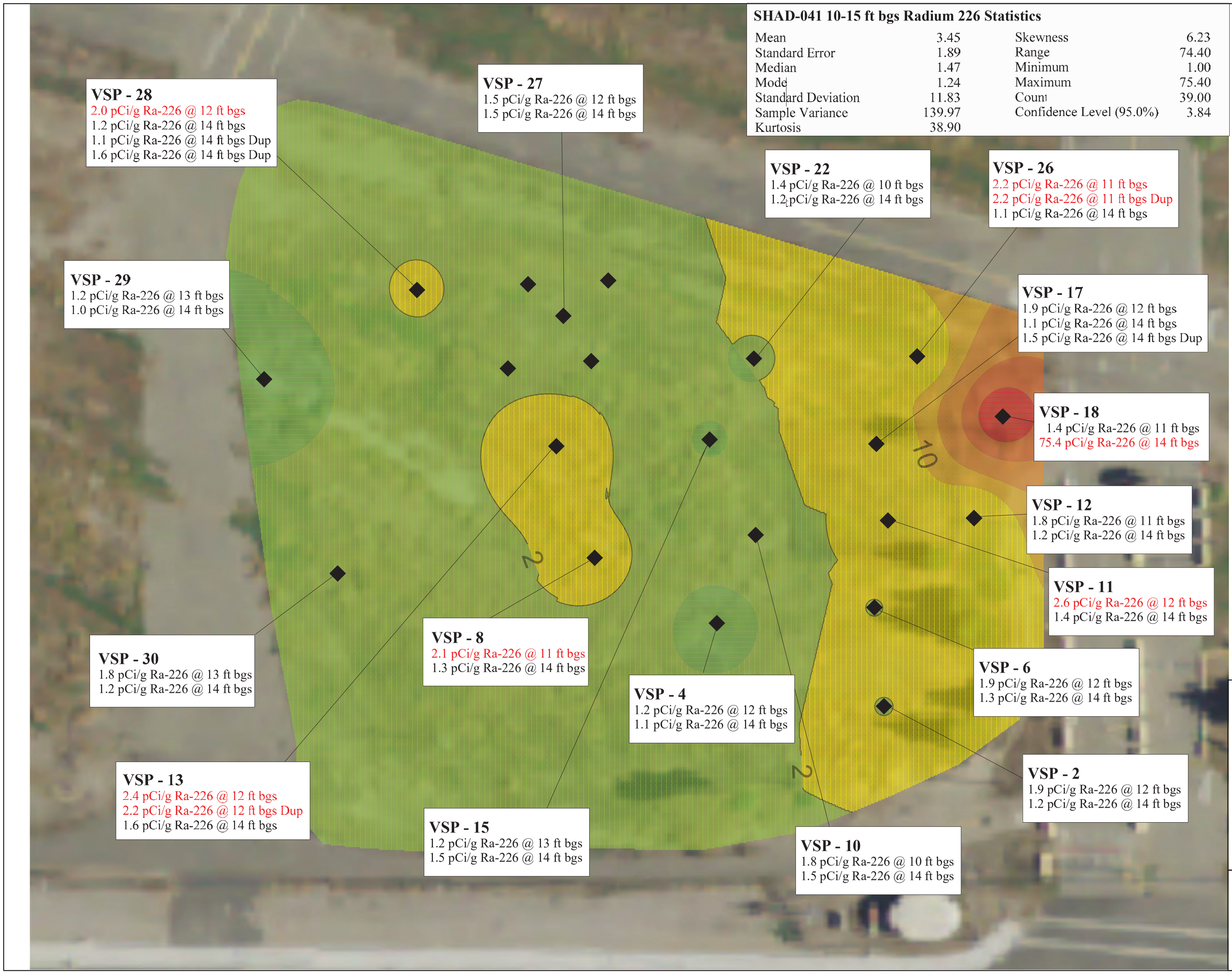
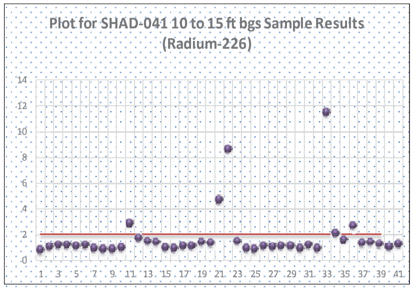
Figure
15



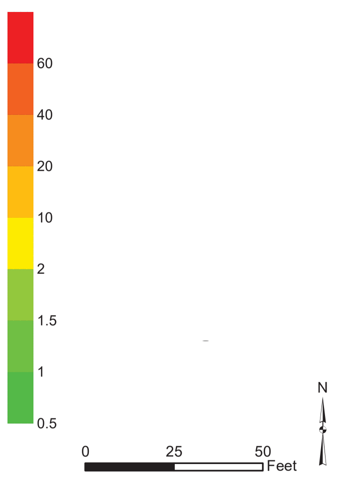
SHAD-041 10-15 ft bgs Radium 226 Statistics

Mean	3.45	Skewness	6.23
Standard Error	1.89	Range	74.40
Median	1.47	Minimum	1.00
Mode	1.24	Maximum	75.40
Standard Deviation	11.83	Count	39.00
Sample Variance	139.97	Confidence Level (95.0%)	3.84
Kurtosis	38.90		



◆ Soil boring location

Note: Results exceeding 2.0 pCi/g are shown in red.



Ra-226 Concentrations
10 to 15 ft bgs
RI/FS Report
Sites 33/29 (SHAD-041)
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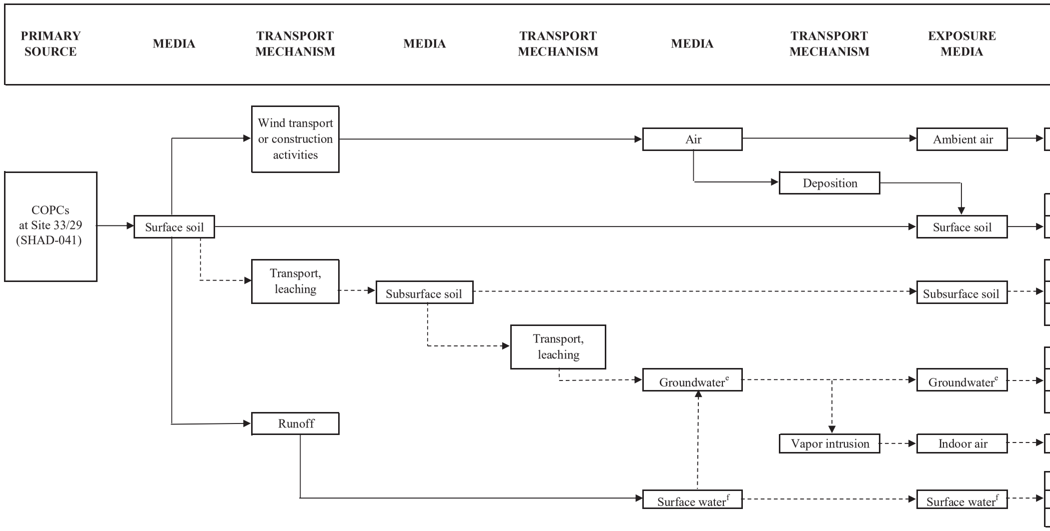
Figure
16



EXPOSURE MEDIA	EXPOSURE ROUTE	POTENTIAL RECEPTORS Current Hypothetical Resident	Future Hypothetical Resident	Current On-site Worker/Visitor[a]	Future On-site Worker/Visitor[b]	Current On-site Construction Worker	Future On-site Construction Worker
Ambient air	INHALATION	$O^{a,c}$	X^{b}	$O^{a,c}$	X^{b}	O	X
Surface soil	INGESTION	O^{a}	X^{d}	O^{a}	X^{d}	O	X^{d}
	DERMAL	O^{a}	X^{d}	O^{a}	X^{d}	O	X^{d}
Subsurface soil	INGESTION	O^{a}	X^{a}	O^{a}	X^{a}	O	X
	DERMAL	O^{a}	X^{a}	O^{a}	X^{a}	O	X
	INHALATION	$O^{a,c}$	$X^{a,c}$	$O^{a,c}$	$X^{a,c}$	O	X
Groundwater[c]	INGESTION	$O^{a,e}$	O^{e}	$O^{a,e}$	X^{e}	O	O^{e}
	DERMAL	$O^{a,e}$	O^{e}	$O^{a,e}$	X^{e}	O	O^{e}
	INHALATION	$O^{a,c}$	O^{c}	$O^{a,e}$	X^{c}	O	O^{c}
Indoor air	INHALATION	$O^{a,c}$	$X^{b,c}$	$O^{a,c}$	$X^{b,c}$	O	O
Surface water[f]	INGESTION	$O^{a,f}$	O^{f}	$O^{a,f}$	O^{f}	O	O^{f}
	DERMAL	$O^{a,f}$	O^{f}	$O^{a,f}$	O^{f}	O	O^{f}
	INHALATION	$O^{a,c}$	$O^{c,f}$	$O^{a,c}$	$O^{e,f}$	O	$O^{e,f}$

Notes:

COPCs - Contaminants of Potential Concern, non-radiological

X Potentially complete exposure pathway

O Potentially insignificant or incomplete exposure pathway

→ Exposure pathway potentially complete

⇢ Exposure pathway potentially insignificant or incomplete

[a] There are currently no structures or regular human use at the site.

[b] Although not planned, it is assumed hypothetically that future buildings may be constructed on the site. Potential receptors would be construction workers, full-time workers and visitors. The hypothetical resident was also evaluated.

[c] First and second inhalation exposure pathway designations are for inhalation of particulates and chemicals with volatile characteristics (based on molecular weight and Henry's Law constant). Inhalation of chemicals with volatile characteristics in ambient air is considered to be insignificant or incomplete for all receptors as volatiles released from soil will be considerably diluted in abmient air.

[d] Direct contact with soil through incidental ingestion and dermal contact may be possible.

[e] It is not known whether constituents at the site have impacted groundwater; however, depth to groundwater is sufficiently deep that direct contact through incidental ingestion and dermal contact are considered insignificant or incomplete exposure pathways.

[f] Surface water is present at the site from runoff only during and immediately following precipitation events; therefore, exposure to surface water is not quantified and exposure pathways for all receptors are considered insignificant or incomplete.

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Conceptual Site Model for Human Health Exposure Pathways

Sites 33/29 (SHAD-041)
Remedial Investigation/Feasibility Study Report
Sharpe Army Depot, Lathrop, California

Figure

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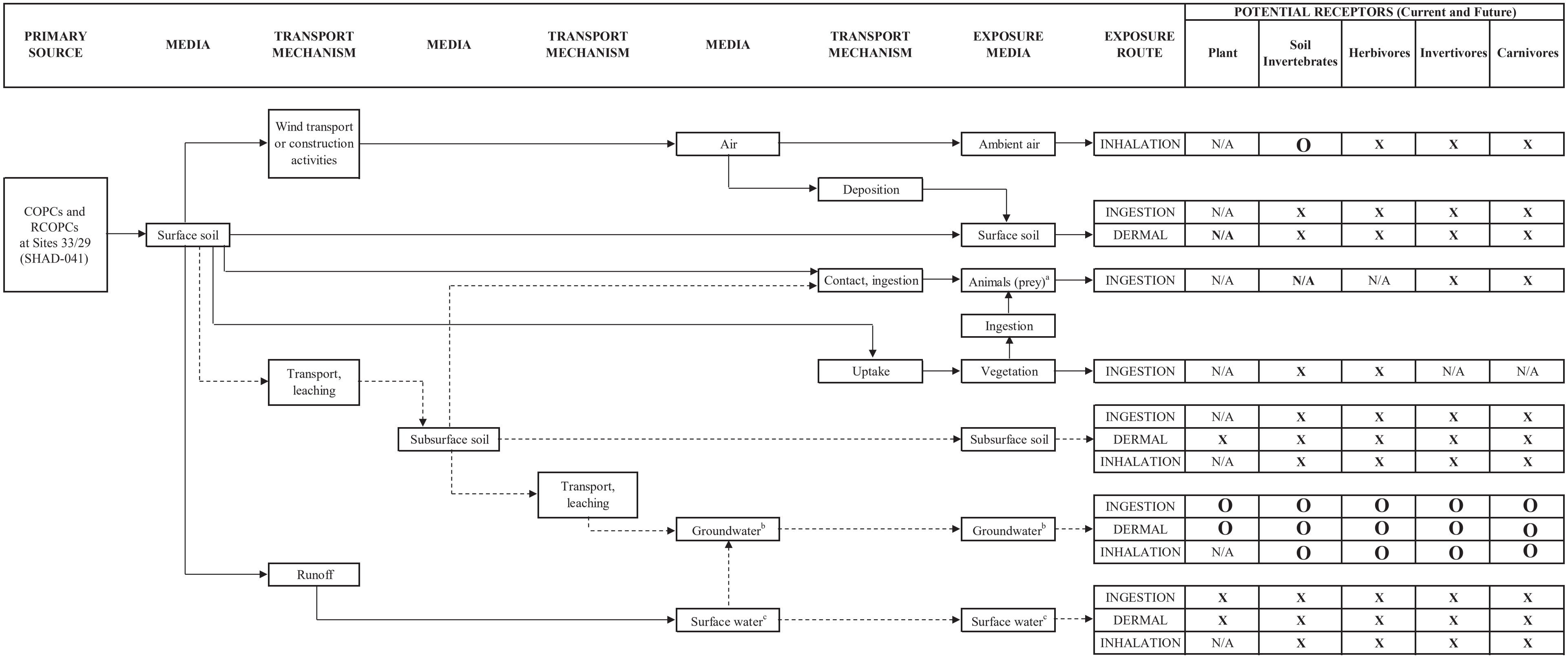

EXPOSURE MEDIA	EXPOSURE ROUTE	Plant	Soil Invertebrates	Herbivores	Invertivores	Carnivores
Ambient air	INHALATION	N/A	O	X	X	X
Surface soil	INGESTION	N/A	X	X	X	X
	DERMAL	N/A	X	X	X	X
Animals (prey)[a]	INGESTION	N/A	N/A	N/A	X	X
Vegetation	INGESTION	N/A	X	X	N/A	N/A
Subsurface soil	INGESTION	N/A	X	X	X	X
	DERMAL	X	X	X	X	X
	INHALATION	N/A	X	X	X	X
Groundwater[b]	INGESTION	O	O	O	O	O
	DERMAL	O	O	O	O	O
	INHALATION	N/A	O	O	O	O
Surface water[c]	INGESTION	X	X	X	X	X
	DERMAL	X	X	X	X	X
	INHALATION	N/A	X	X	X	X

Notes:
COPCs - Contaminants of Potential Concern
RCOPCs - Radiological Contaminants of Potential Concern
X Potentially complete exposure pathway
O Potentially insignificant or incomplete exposure pathway
N/A Not Applicable

→ Exposure pathway potentially complete
⇢ Exposure pathway potentially insignificant or incomplete

[a] Animal prey can include soil invertebrates or wildlife (small birds and mammals).
[b] It is not known whether constituents at the site have impacted groundwater; however, depth to groundwater is sufficiently deep that direct contact through incidental ingestion and dermal contact or inhalation contact are considered insignificant or incomplete exposure pathways. [c] Surface water is present at the site from runoff only during and immediately following precipitation events; therefore, exposure to surface water is not quantified.

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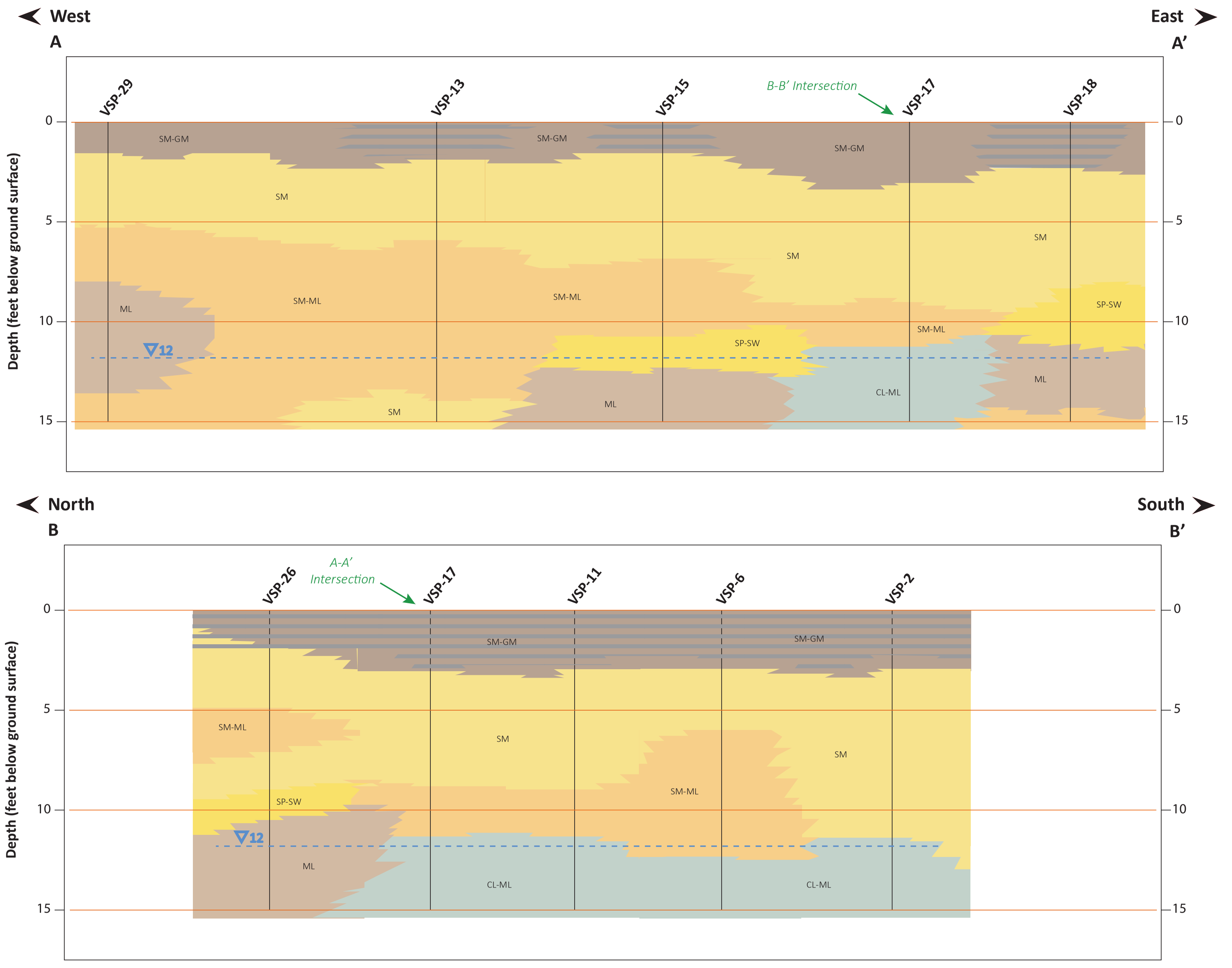
Conceptual Site Model for Ecological Exposure Pathways

Sites 33/29 (SHAD-041)
Remedial Investigation/Feasibility Study Report
Sharpe Army Depot, Lathrop, California

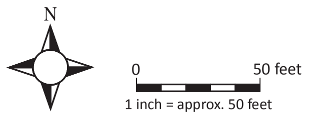
Figure
18



Legend

- ▨ SM-GM: silty sand with gravel
- ▨ SM: silty sand
- ▨ SM-ML: sandy silt
- ▨ SP-SW: sand, well-graded sand
- ▨ ML: sandy, clayey silt
- ▨ CL-ML: silty clay
- ═ Debris (e.g., glass, rusty nails, ash)
- ▽ Approximate groundwater level

Notes:
See Figure 5 for cross-section locations.



Hydrogeologic Conceptual Site Model
RI/FS Report
SHAD-041 (Sites 33/29)
Sharpe Army Depot
Lathrop, California

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Figure
19

Tables

Table 1. Contaminants of Potential Concern, Laboratory Limits, Screening Levels, Cleanup Goals, and Analytical Methods

Chemical of Concern	Matrix	Units	Reporting Limit	Cleanup Level [1]	Residential Screening Level [2]	Commercial/ Industrial Screening Level [3]	Analytical Method
Inorganic Metals							
Chromium, Hexavalent	18540-29-9	mg/Kg	0.40	n/a	0.3	6.3	SW7196A
Chromium	7440-47-3	mg/Kg	1.0	300	36,000	170,000	SW6010C
Lead	7439-92-1	mg/Kg	1.0	1000	80	320	SW6010C
SVOC—PAH							
Acenaphthene	83-32-9	µg/Kg	6.6	n/a	3,600,000	45,000,000	SW8270C-SIM
Anthracene	120-12-7	µg/Kg	6.6	n/a	18,000,000	230,000,000	SW8270C-SIM
Benzo[a]anthracene	56-55-3	µg/Kg	6.6	n/a	1,100	13,000	SW8270C-SIM
Benzo[a]pyrene	50-32-8	µg/Kg	6.6	n/a	110	1,300	SW8270C-SIM
Benzo[b]fluoranthene	205-99-2	µg/Kg	6.6	n/a	1,100	13,000	SW8270C-SIM
Benzo[k]floranthene	207-08-9	µg/Kg	6.6	n/a	11,000	130,000	SW8270C-SIM
Chrysene	218-01-9	µg/Kg	6.6	n/a	110,000	1,300,000	SW8270C-SIM
Dibenz[a,h]anthracene	53-70-3	µg/Kg	6.6	n/a	110	1,300	SW8270C-SIM
Fluoranthene	206-44-0	µg/Kg	6.6	n/a	2,400,000	30,000,000	SW8270C-SIM
Fluorene	86-73-7	µg/Kg	6.6	n/a	2,400,000	30,000,000	SW8270C-SIM
Indeno[1,2,3-cd]pyrene	193-39-5	µg/Kg	6.6	n/a	1,100	13,000	SW8270C-SIM
1-Methylnaphthalene	90-12-0	µg/Kg	6.6	n/a	18,000	73,000	SW8270C-SIM
2-Methylnaphthalene	91-57-6	µg/Kg	6.6	n/a	240,000	3,000,000	SW8270C-SIM
Naphthalene	91-20-3	µg/Kg	6.6	n/a	3,800	17,000	SW8270C-SIM
Pyrene	129-00-0	µg/Kg	6.6	n/a	1,800,000	23,000,000	SW8270C-SIM
SVOC—PCB							
PCB-1016	12674-11-2	µg/Kg	33	n/a	4,100	27,000	SW8082A
PCB-1221	11104-28-2	µg/Kg	33	n/a	200	830	SW8082A
PCB-1232	11141-16-5	µg/Kg	33	n/a	170	720	SW8082A
PCB-1242	53469-21-9	µg/Kg	33	n/a	230	950	SW8082A
PCB-1248	12672-29-6	µg/Kg	33	n/a	230	950	SW8082A
PCB-1254	11097-69-1	µg/Kg	33	n/a	240	970	SW8082A

Table 1. Contaminants of Potential Concern, Laboratory Limits, Screening Levels, Cleanup Goals, and Analytical Methods

Chemical of Concern	Matrix	Units	Reporting Limit	Cleanup Level [1]	Residential Screening Level [2]	Commercial/ Industrial Screening Level [3]	Analytical Method
PCB-1260	11096-82-5	µg/Kg	33	n/a	240	990	SW8082A
SVOC—PCDD/PCDF							
2,3,7,8-TCDD Toxicity Equivalent	n/a	pg/g	1.0-10	n/a	4.8	22	SW8290A
Radiological							
Radium-226 (226Ra)	13892-63-3	pCi/g	0.50	2.18 [4]	1.33	2.00 [5]	EPA 901.1
VOCs							
1,1,1-Trichloroethane	71-55-6	µg/Kg	5.0	n/a	1,700,000	7,300,000	SW8260C
1,1,2,2-Tetrachloroethane	79-34-5	µg/Kg	5.0	n/a	600	2,700	SW8260C
1,1,2-Trichloroethane	79-00-5	µg/Kg	5.0	n/a	1,100	5,000	SW8260C
1,1-Dichloroethane	75-34-3	µg/Kg	5.0	n/a	3,600	16,000	SW8260C
1,1-Dichloroethene	75-35-4	µg/Kg	5.0	n/a	230,000	1,000,000	SW8260C
1,2-Dichlorobenzene	95-50-1	µg/Kg	5.0	n/a	1,800,000	9,300,000	SW8260C
1,2-Dichloroethane	107-06-2	µg/Kg	5.0	n/a	460	2,000	SW8260C
1,2-Dichloropropane	78-87-5	µg/Kg	5.0	n/a	2,500	11,000	SW8260C
1,4-Dichlorobenzene	106-46-7	µg/Kg	5.0	n/a	2,600	11,000	SW8260C
Benzene	71-43-2	µg/Kg	5.0	n/a	330	1,400	SW8260C
Bromodichloromethane	75-27-4	µg/Kg	5.0	n/a	290	1,300	SW8260C
Bromoform	75-25-2	µg/Kg	5.0	n/a	19,000	86,000	SW8260C
Carbon Tetrachloride	56-23-5	µg/Kg	5.0	n/a	99	430	SW8260C
Chlorodibromomethane	124-48-1	µg/Kg	5.0	n/a	940	4,100	SW8260C
Ethylbenzene	100-41-4	µg/Kg	5.0	n/a	5,800	25,000	SW8260C
Chloroform	67-66-3	µg/Kg	5.0	n/a	320	1,400	SW8260C
Chloromethane	74-87-3	µg/Kg	10	n/a	110,000	460,000	SW8260C
cis-1,2-Dichloroethene	156-59-2	µg/Kg	5.0	n/a	19,000	86,000	SW8260C
cis-1,3-Dichloropropene	542-75-6	µg/Kg	5.0	n/a	580	2,600	SW8260C
Methylene chloride	75-09-2	µg/Kg	10	n/a	1,900	24,000	SW8260C
Tetrachloroethene	127-18-4	µg/Kg	5.0	n/a	590	2,700	SW8260C

Table 1. Contaminants of Potential Concern,
Laboratory Limits, Screening Levels, Cleanup Goals, and Analytical Methods

Chemical of Concern	Matrix	Units	Reporting Limit	Cleanup Level [1]	Residential Screening Level [2]	Commercial/ Industrial Screening Level [3]	Analytical Method
Toluene	108-88-3	µg/Kg	5.0	n/a	1,100,000	5,400,000	SW8260C
trans-1,2-Dichloroethene	156-60-5	µg/Kg	5.0	n/a	130,000	600,000	SW8260C
trans-1,3-Dichloropropene	542-75-6	µg/Kg	5.0	n/a	580	2,600	SW8260C
Trichloroethene	79-01-6	µg/Kg	5.0	n/a	940	6,000	SW8260C
Vinyl chloride	75-01-4	µg/Kg	10	n/a	8.8	150	SW8260C
Xylenes	1330-20-7	µg/Kg	10	n/a	580,000	2,500,000	SW8260C

Notes:

[1] Cleanup standards for total chromium and total lead are established in the OU 2 ROD (ESE, 1996). Ra-226 cleanup level was establised at 2.18 pCi/g.

[2] The lower of the residential soil values from the November 2018 USEPA Regional Screening Level (where TR=1E-06; THQ=1.0) and HERO HHRA Note 3 DTSC-modified Screening Levels (June 2018).

[3] The lower of the commercial/industrial soil values from the November 2018 USEPA Regional Screening Levels (where TR=1E-06; THQ=1.0) and HERO HHRA Note 3 (June 2018).

[4] Industrial/commercial $1x10^{-4}$ risk level. The risk based industrial/commercial cleanup level was establised at 2.18 pCi/g.

[5] The screening level for ^{226}Ra was determined by using a combination of residual dose and risk. The initial action level for 226Ra is 2.0 pCi/g, which includes the contribution from the background. The risk was calculated using modified USEPA preliminary remediation goals (PRG) for radionuclides; residential scenario criteria (https://epa-prgs.ornl.gov/radionuclides/). The only modification made was to remove the fruit and vegetable pathway from the scenario. Background was obtained from the Revised Reference Area Survey Report (Cabrera, 2002) for the disturbed soil of 0.64 pCi/g at McClellan Air Force Base in Sacramento.

µg/Kg=microgram per kilogram
mg/Kg = milligrams per kilogram
n/a = not applicable
PAH = Polynucluear Aromatic Hydrocarbons
PCB = Polychlorinated Biphenyls
PCDD/PCDF = Polychlorinated Dibenzodioxin/ Polychlorinated Dibenzofurans

pCi/g = picocuries per gram
pg/g = picogram per gram (parts per trillion)
SVOC = Semivolatile Organic Compounds
VOC = Volatile Organic Compounds

Table 2. Contaminants of Potential Concern Results, 0.5 ft bgs

Analyte	Screening Level[1]	Lab Sample ID:	160-24848-19	160-24917-6	160-24848-25	160-24917-13	160-24925-5	160-24851-1	160-24917-29
		Sample Name:	SHAD041DP002SS01NS	SHAD041DP004SS01NS	SHAD041DP006SS01NS	SHAD041DP008SS01NS	SHAD041DP010SS01NS	SHAD041DP011SS01NS	SHAD041DP012SS01NS
		Location:	VSP-2	VSP-4	VSP-6	VSP-8	VSP-10	VSP-11	VSP-12
		Units							
Inorganic Metals									
Chromium, Hexavalent	0.3	mg/kg	**0.87**	**1.8**	**1.1**	**0.31 J (0.33 J)**	**2.100**	**1.5**	**1.3**
Chromium	36,000	mg/kg	30	19	21	21 (17)	35	31	24
Lead	80	mg/kg	**240**	**120**	**140**	18 (21)	**280**	**3300**	**1000**
SVOC—PAH									
Naphthalene	3,800	µg/kg	67 U	33 U	34 U	68 U	33 U	34 U	17 U
2-Methylnaphthalene	240,000	µg/kg	67 U	33 U	34 U	68 U	33 U	34 U	17 U
1-Methylnaphthalene	18,000	µg/kg	67 U	33 U	34 U	68 U	33 U	34 U	17 U
Acenaphthene	3,600,000	µg/kg	67 U	33 U	34 U	68 U	33 U	34 U	17 U
Fluorene	2,400,000	µg/kg	67 U	33 U	34 U	68 U	33 U	34 U	17 U
Anthracene	18,000,000	µg/kg	67 U	33 U	34 U	68 U	33 U	34 U	17 U
Fluoranthene	2,400,000	µg/kg	67 U	33 U	39 J	68 U	33 U	34 U	17 U
Pyrene	1,800,000	µg/kg	67 U	33 U	36 J	68 U	33 U	34 U	17 U
Benzo[a]anthracene	1,100	µg/kg	67 U	33 U	34 U	68 U	33 U	34 U	17 U
Chrysene	110,000	µg/kg	67 U	33 U	64 J	68 U	33 U	34 U	17 U
Benzo[b]fluoranthene	1,100	µg/kg	67 U	33 U	41 J	68 U	33 U	34 U	17 U
Benzo[k]floranthene	11,000	µg/kg	67 U	33 U	20 J	68 U	33 U	34 U	17 U
Benzo[a]pyrene	110	µg/kg	67 U	33 U	56 J	68 U	33 U	34 U	17 U
Indeno[1,2,3-cd]pyrene	1,100	µg/kg	67 U	33 U	34 U	68 U	33 U	34 U	17 U
Dibenz[a,h]anthracene	110	µg/kg	67 U	33 U	34 U	68 U	33 U	34 U	17 U
SVOC—PCB									
Aroclor 1016	4,100	mg/kg	0.016 U	0.016 U	0.016U	0.011 U	0.016 U	0.016 U	0.016 U
Aroclor 1221	200	mg/kg	0.016 U	0.016 U	0.016U	0.021 U	0.019 U	0.016 U	0.016 U
Aroclor 1232	170	mg/kg	0.016 U	0.016 U	0.016U	0.011 U	0.010 U	0.016 U	0.016 U
Aroclor 1242	230	mg/kg	0.016 U	0.016 U	0.016U	0.011 U	0.010 U	0.016 U	0.016 U
Aroclor 1248	230	mg/kg	0.016 U	0.016 U	0.016U	0.011 U	0.010 U	0.016 U	0.016 U
Aroclor 1254	240	mg/kg	0.016 U	0.016 U	0.016U	0.011 U	0.010 U	0.016 U	0.016 U
Aroclor 1260	240	mg/kg	0.016 U	0.010 U	0.21	0.011 U	0.010 U	0.016 U	0.010 U
SVOC-PCDD/PCDF									
2,3,7,8-TCDD	4.8	pg/g	3.0	0.88 J	1.2	0.22 J (0.17 J)	0.23	**67**	**17**

Table 2. Contaminants of Potential Concern Results, 0.5 ft bgs

Analyte	Screening Level[1]	Lab Sample ID:	160-24848-19	160-24917-6	160-24848-25	160-24917-13	160-24925-5	160-24851-1	160-24917-29
		Sample Name:	SHAD041DP 002SS01NS	SHAD041DP0 04SS01NS	SHAD041DP0 06SS01NS	SHAD041DP0 08SS01NS	SHAD041DP0 10SS01NS	SHAD041DP0 11SS01NS	SHAD041DP0 12SS01NS
		Location: Units	VSP-2	VSP-4	VSP-6	VSP-8	VSP-10	VSP-11	VSP-12
VOCs									
1,1,1-Trichloroethane	1,700,000	µg/kg	1.0 U	0.99 U	1.1 U	0.88 U	0.82 U	0.99 U	0.88 U
1,1,2,2-Tetrachloroethane	600	µg/kg	1.0 U	0.99 U	1.1 U	0.88 U	0.82 U	0.99 U	0.88 U
1,1,2-Trichloroethane	1,100	µg/kg	1.0 U	0.99 U	1.1 U	0.88 U	0.82 U	0.99 U	0.88 U
1,1-Dichloroethane	3,600	µg/kg	1.0 U	0.99 U	1.1 U	0.88 U	0.82 U	0.99 U	0.88 U
1,1-Dichloroethene	230,000	µg/kg	5.0 U	5.0 U	5.3 U	4.4 U	4.1 U	4.9 U	4.4 U
1,2-Dichlorobenzene	1,800,000	µg/kg	1.0 U	0.99 U	1.1 U	0.88 U	0.82 U	0.99 U	0.88 U
1,2-Dichloroethane	460	µg/kg	1.0 U	0.99 U	1.1 U	0.88 U	0.82 U	0.99 U	0.88 U
cis-1,2-Dichloroethene	18,000	µg/kg	1.0 U	0.99 U	1.1 U	0.88 U	0.82 U	0.99 U	0.88 U
trans-1,2-Dichloroethene	130,000	µg/kg	1.0 U	0.99 U	1.1 U	0.88 U	0.82 U	0.99 U	0.88 U
1,2-Dichloropropane	2,500	µg/kg	1.0 U	0.99 U	1.1 U	0.88 U	0.82 U	0.99 U	0.88 U
cis-1,3-Dichloropropene	18,000	µg/kg	1.0 U	0.99 U	1.1 U	0.88 U	0.82 U	0.99 U	0.88 U
trans-1,3-Dichloropropene	580	µg/kg	1.0 U	0.99 U	1.1 U	0.88 U	0.82 U	0.99 U	0.88 U
1,4-Dichlorobenzene	2,600	µg/kg	1.0 U	0.99 U	1.1 U	0.88 U	0.82 U	0.99 U	0.88 U
Benzene	330	µg/kg	1.0 U	0.99 U	1.1 U	0.88 U	0.82 U	0.99 U	0.88 U
Bromodichloromethane	290	µg/kg	1.0 U	0.99 U	1.1 U	0.88 U	0.82 U	0.99 U	0.88 U
Bromoform	19,000	µg/kg	1.0 U	0.99 U	1.1 U	0.88 U	0.82 U	0.99 U	0.88 U
Carbon Tetrachloride	98	µg/kg	1.0 U	0.99 U	1.1 U	0.88 U	0.82 U	0.99 U	0.88 U
Chloroform	320	µg/kg	1.0 U	0.99 U	1.1 U	0.88 U	0.82 U	0.99 U	0.88 U
Chloromethane	110,000	µg/kg	5.0 U	5.0 U	1.1 U	4.4 U	4.1 U	4.9 U	4.4 U
Dibromochloromethane	940	µg/kg	1.0 U	0.99 U	1.1 U	0.88 U	0.82 U	0.99 U	0.88 U
Ethylbenzene	5,800	µg/kg	0.81 J	0.94 J	5.3 J+	0.47 J	1.5 J	0.99 U	0.88 U
Methylene Chloride	1,800	µg/kg	5 U	0.99 U	5.3 U	2.6 J (2.4 J)	4.1 U	4.9 U	4.4 U
Tetrachloroethene	590	µg/kg	1.0 UJ	0.99 U	1.1 U	0.88 U	0.82 U	0.99 U	0.88 U
Toluene	1,100,000	µg/kg	1.0 UJ	0.99 U	1.1 U	0.88 U	0.82 U	0.99 U	0.88 U
Trichloroethene	940	µg/kg	1.0 UJ	0.99 U	1.1 U	0.88 U	0.82 U	0.99 U	0.88 U
Vinyl Chloride	8.7	µg/kg	1.0 UJ	0.99 U	1.1 U	0.88 U	0.82 U	0.99 U	0.88 U
m-p-Xylene	580,000	µg/kg	5.8 J	6.5 J	37 J +	4.3 J	12 J-	4.9 U	4.4 U
o-Xylene			5.8 J	6.5 J	37 J +	4.3 J	12 J-	4.9 U	4.4 U

Table 2. Contaminants of Potential Concern Results, 0.5 ft bgs

		Lab Sample ID:	160-24924-13	160-24925-12	160-24917-16	160-2491723	160-24848-10	160-24848-14	160-24924-7
		Sample Name:	SHAD041DP013SS01NS	SHAD041DP015SS01NS	SHAD041DP017SS01NS	SHAD041DP018SS01NS	SHAD041DP019SS01NS	SHAD041DP020SS01NS	SHAD041DP022SS01NS
Analyte	**Screening Level[1]**	**Location: Units**	**VSP-13**	**VSP-15**	**VSP-17**	**VSP-18**	**VSP-19**	**VSP-20**	**VSP-22**
Inorganic Metals									
Chromium, Hexavalent	0.3	mg/kg	**0.82**	**0.56**	**0.56**	**1.1**	0.19 J	**2.1**	0.127
Chromium	36,000	mg/kg	13	28	31	27	8.2	22	52
Lead	80	mg/kg	22	**330**	**820**	**1400**	2.8 J	**330**	**260**
SVOC—PAH									
Naphthalene	3,800	µg/kg	33 U	33 U	34 U	34 U	3.5 U	33 U	33 U
2-Methylnaphthalene	240,000	µg/kg	33 U	33 U	34 U	34 U	3.5 U	33 U	33 U
1-Methylnaphthalene	18,000	µg/kg	33 U	33 U	34 U J	34 U	3.5 U	33 U	33 U
Acenaphthene	3,600,000	µg/kg	33 U	33 U	34 U	34 U	3.5 U	33 U	33 U
Fluorene	2,400,000	µg/kg	33 U	33 U	34 U	34 U	3.5 U	33 U	33 U
Anthracene	18,000,000	µg/kg	33 U	33 U	34 U	34 U	3.5 U	33 U	33 U
Fluoranthene	2,400,000	µg/kg	33 U	20 J	34 U	34 U	3.5 U	33 U	33 U
Pyrene	1,800,000	µg/kg	33 U	18 J	34 U	34 U	3.5 U	33 U	33 U
Benzo[a]anthracene	1,100	µg/kg	33 U	17 J	34 U	34 U	3.5 U	33 U	17
Chrysene	110,000	µg/kg	33 U	17 J	34 U	34 U	3.5 U	33 U	33 U
Benzo[b]fluoranthene	1,100	µg/kg	33 U	22 J	34 U J	34 U	3.5 U	33 U	15
Benzo[k]floranthene	11,000	µg/kg	33 U	33 U	34 U	34 U	3.5 U	33 U	33 U
Benzo[a]pyrene	110	µg/kg	33 U	13 J	34 U	34 U	3.5 U	33 U	33 U
Indeno[1,2,3-cd]pyrene	1,100	µg/kg	33 U	33 U	34 U	34 U	3.5 U	33 U	33 U
Dibenz[a,h]anthracene	110	µg/kg	33 U	33 U	34 U J	34 U	3.5 U	33 U	33 U
SVOC—PCB									
Aroclor 1016	4,100	mg/kg	0.016 U	0.016 U	0.016 U	0.016 U	0.017 U	0.016 U	0.016 U
Aroclor 1221	200	mg/kg	0.016 U	0.016 U	0.016 U	0.016 U	0.017 U	0.016 U	0.016 U
Aroclor 1232	170	mg/kg	0.016 U	0.016 U	0.016 U	0.016 U	0.017 U	0.016 U	0.016 U
Aroclor 1242	230	mg/kg	0.016 U	0.016 U	0.016 U	0.016 U	0.017 U	0.016 U	0.016 U
Aroclor 1248	230	mg/kg	0.016 U	0.016 U	0.016 U	0.016 U	0.017 U	0.016 U	0.016 U
Aroclor 1254	240	mg/kg	0.016 U	0.016 U	0.016 U	0.016 U	0.017 U	0.016 U	0.016 U
Aroclor 1260	240	mg/kg	0.016 U	0.010 U	0.010 U	0.023 J	0.017 U	0.016 U	0.012 J
SVOC-PCDD/PCDF									
2,3,7,8-TCDD	4.8	pg/g	0.15 J	1.4	4.5	**38**	0.42 U	0.88 J	0.78 J

Table 2. Contaminants of Potential Concern Results, 0.5 ft bgs

Analyte	Lab Sample ID:		160-24924-13	160-24925-12	160-24917-16	160-2491723	160-24848-10	160-24848-14	160-24924-7
	Sample Name:		SHAD041DP013SS01NS	SHAD041DP015SS01NS	SHAD041DP017SS01NS	SHAD041DP018SS01NS	SHAD041DP019SS01NS	SHAD041DP020SS01NS	SHAD041DP022SS01NS
	Screening Level[1]	Location: Units	VSP-13	VSP-15	VSP-17	VSP-18	VSP-19	VSP-20	VSP-22
VOCs									
1,1,1-Trichloroethane	1,700,000	µg/kg	0.86 U	0.97 U	0.82 U	0.85 U	0.92 U	0.93 U	0.91 U
1,1,2,2-Tetrachloroethane	600	µg/kg	0.86 U	0.97 U	0.82 U	0.85 U	0.92 U	0.93 U	0.91 U
1,1,2-Trichloroethane	1,100	µg/kg	0.86 U	0.97 U	0.82 U	0.85 U	0.92 U	0.93 U	0.91 U
1,1-Dichloroethane	3,600	µg/kg	0.86 U	0.97 U	0.82 U	0.85 U	0.92 U	0.93 U	0.91 U
1,1-Dichloroethene	230,000	µg/kg	4.3 U	4.8 U	4.1 U	4.3 U	4.6 U	4.6 U	4.5 U
1,2-Dichlorobenzene	1,800,000	µg/kg	0.86 U	0.97 U	0.82 U	0.85 U	0.92 U	0.93 U	0.91 U
1,2-Dichloroethane	460	µg/kg	0.86 U	0.97 U	0.82 U	0.85 U	0.92 U	0.93 U	0.91 U
cis-1,2-Dichloroethene	18,000	µg/kg	0.86 U	0.97 U	0.82 U	0.85 U	0.92 U	0.93 U	0.91 U
trans-1,2-Dichloroethene	130,000	µg/kg	0.86 U	0.97 U	0.82 U	0.85 U	0.92 U	0.93 U	0.91 U
1,2-Dichloropropane	2,500	µg/kg	0.86 U	0.97 U	0.82 U	0.85 U	0.92 U	0.93 U	0.91 U
cis-1,3-Dichloropropene	18,000	µg/kg	0.86 U	0.97 U	0.82 U	0.85 U	0.92 U	0.93 U	0.91 U
trans-1,3-Dichloropropene	580	µg/kg	0.86 U	0.97 U	0.82 U	0.85 U	0.92 U	0.93 U	0.91 U
1,4-Dichlorobenzene	2,600	µg/kg	0.86 U	0.97 U	0.82 U	0.85 U	0.92 U	0.93 U	0.91 U
Benzene	330	µg/kg	0.86 U	0.97 U	0.82 U	0.85 U	0.92 U	0.93 U	0.91 U
Bromodichloromethane	290	µg/kg	0.86 U	0.97 U	0.82 U	0.85 U	0.92 U	0.93 U	0.91 U
Bromoform	19,000	µg/kg	0.86 U	0.97 U	0.82 U	0.85 U	0.92 U	0.93 U	0.91 U
Carbon Tetrachloride	98	µg/kg	0.86 U	0.97 U	0.82 U	0.85 U	0.92 U	0.93 U	0.91 U
Chloroform	320	µg/kg	0.86 U	0.97 U	0.82 U	0.85 U	0.92 U	0.93 U	0.91 U
Chloromethane	110,000	µg/kg	4.3 U	0.97 U	4.1 U	4.3 U	4.6 U	4.6 U	0.91 U
Dibromochloromethane	940	µg/kg	0.86 U	0.97 U	0.82 U	0.85 U	0.92 U	0.93 U	0.91 U
Ethylbenzene	5,800	µg/kg	0.86 J	0.97 U	1.0 J	0.85 U	0.92 U	0.93 U	0.91 U
Methylene Chloride	1,800	µg/kg	0.86 U	4.8 U	4.1 U	4.5 J	4.6 U	4.6 U	4.5 U
Tetrachloroethene	590	µg/kg	0.86 U	0.97 U	0.82 U	0.85 U	0.92 U	0.93 U	0.91 U
Toluene	1,100,000	µg/kg	0.86 U	0.97 U	0.82 U	0.85 U	0.92 U	0.93 U	0.91 U
Trichloroethene	940	µg/kg	0.86 U	0.97 U	0.82 U	0.85 U	0.92 U	0.93 U	0.91 U
Vinyl Chloride	8.7	µg/kg	0.86 U	0.97 U	0.82 U	0.85 U	0.92 U	0.93 U	0.91 U
m-p-Xylene	580,000	µg/kg	4.9 J	4.8 U	7.6 J	4.3 U	4.6 U	4.6 U	0.91 U
o-Xylene			4.9 J	4.8 U	7.6 J	4.3 U	4.6 U	4.6 U	4.5 U

Table 2. Contaminants of Potential Concern Results, 0.5 ft bgs

Analyte		Lab Sample ID:	160-24848-6	160-24848-2	160-24848-1	160-24922-1	160-24922-8	160-24922-16	160-24922-23
		Sample Name:	SHAD041DP024SS01NS	SHAD041DP025SS01NS	SHAD041DP026SS01NS	SHAD041DP027SS01NS	SHAD041DP028SS01NS	SHAD041DP029SS01NS	SHAD041DP030SS01NS
	Screening Level[1]	Location:	VSP-24	VSP-25	VSP-26	VSP-27	VSP-28	VSP-29	VSP-30
		Units							
Inorganic Metals									
Chromium, Hexavalent	0.3	mg/kg	**0.34 J**	**41**	**0.4**	0.2	**1.8**	**0.41 (0.72)**	0.26 J
Chromium	36,000	mg/kg	41	29	28	24	36	21 (23)	12
Lead	80	mg/kg	5.1	**490**	**220**	**520**	**1700**	48 (310)	18
SVOC—PAH									
Naphthalene	3,800	µg/kg	3.6 U	34 U	33 U	33 U	17 U	35 U	1.6 J
2-Methylnaphthalene	240,000	µg/kg	3.6 U	34 U	33 U	33 U	17 U	35 U	0.64 J
1-Methylnaphthalene	18,000	µg/kg	3.6 U	34 U	33 U	33 U	17 U	35 U	3.3 U
Acenaphthene	3,600,000	µg/kg	3.6 U	34 U	33 U	33 U	17 U	35 U	3.3 U
Fluorene	2,400,000	µg/kg	3.6 U	34 U	33 U	33 U	17 U	35 U	3.3 U
Anthracene	18,000,000	µg/kg	3.6 U	34 U	33 U	33 U	11 J	35 U	3.3 U
Fluoranthene	2,400,000	µg/kg	3.6 U	34 U	33 U	33 U	25 J	35 U	3.3 U
Pyrene	1,800,000	µg/kg	3.6 U	34 U	33 U	33 U	23 J	35 U	3.3 U
Benzo[a]anthracene	1,100	µg/kg	3.6 U	34 U	33 U	33 U	18 J	35 U	3.3 U
Chrysene	110,000	µg/kg	3.6 U	34 U	33 U	33 U	28 J	35 U	3.3 U
Benzo[b]fluoranthene	1,100	µg/kg	3.6 U	34 U	33 U	33 U	59	35 U	3.3 U
Benzo[k]floranthene	11,000	µg/kg	3.6 U	34 U	33 U	33 U	17 U	35 U	3.3 U
Benzo[a]pyrene	110	µg/kg	3.6 U	34 U	33 U	33 U	20 J	35 U	3.3 U
Indeno[1,2,3-cd]pyrene	1,100	µg/kg	3.6 U	34 U	33 U	33 U	18 J	35 U	3.3 U
Dibenz[a,h]anthracene	110	µg/kg	3.6 U	34 U	33 U	33 U	17 U	35 U	3.3 U
SVOC—PCB									
Aroclor 1016	4,100	mg/kg	0.017 U	0.017 U	0.016 U	0.016 U	0.016 U	0.017 U	0.016 U
Aroclor 1221	200	mg/kg	0.017 U	0.017 U	0.016 U	0.016 U	0.016 U	0.017 U	0.016 U
Aroclor 1232	170	mg/kg	0.017 U	0.017 U	0.016 U	0.016 U	0.016 U	0.017 U	0.016 U
Aroclor 1242	230	mg/kg	0.017 U	0.017 U	0.016 U	0.016 U	0.016 U	0.017 U	0.016 U
Aroclor 1248	230	mg/kg	0.017 U	0.017 U	0.016 U	0.016 U	0.016 U	0.017 U	0.016 U
Aroclor 1254	240	mg/kg	0.017 U	0.017 U	0.016 U	0.016 U	0.016 U	0.017 U	0.016 U
Aroclor 1260	240	mg/kg	0.017 U	0.017 U	0.016 U	0.021 J	0.072 U	0.011 U (19 J)	0.010 U
SVOC-PCDD/PCDF									
2,3,7,8-TCDD	4.8	pg/g	0.43	1.6	0.56	0.85 J	**5.4**	0.61 J	0.25 J

Table 2. Contaminants of Potential Concern Results, 0.5 ft bgs

		Lab Sample ID:	160-24848-6	160-24848-2	160-24848-1	160-24922-1	160-24922-8	160-24922-16	160-24922-23
		Sample Name:	SHAD041DP024SS01NS	SHAD041DP025SS01NS	SHAD041DP026SS01NS	SHAD041DP027SS01NS	SHAD041DP028SS01NS	SHAD041DP029SS01NS	SHAD041DP030SS01NS
		Location:	VSP-24	VSP-25	VSP-26	VSP-27	VSP-28	VSP-29	VSP-30
Analyte	Screening Level^{1}	Units							
VOCs									
1,1,1-Trichloroethane	1,700,000	µg/kg	0.99 U	0.98 UJ	3.1 U	0.87 U	0.92 U	0.88 U	1.1 U
1,1,2,2-Tetrachloroethane	600	µg/kg	0.99 U	0.98 UJ	3.1 U	0.87 U	0.92 U	0.88 U	1.1 U
1,1,2-Trichloroethane	1,100	µg/kg	0.99 U	0.98 UJ	3.1 U	0.87 U	0.92 U	0.88 U	1.1 U
1,1-Dichloroethane	3,600	µg/kg	0.99 U	0.98 U	0.91 U	0.87 U	0.92 U	0.88 U	1.1 U
1,1-Dichloroethene	230,000	µg/kg	4.9 U	4.9 U	4.5 U	4.4	4.6 U	4.4 U	5.3 U
1,2-Dichlorobenzene	1,800,000	µg/kg	0.99 U	0.98 U	0.91 U	0.87 U	0.92 U	0.88 U	1.1 U
1,2-Dichloroethane	460	µg/kg	0.99 U	0.98 U	0.91 U	0.87 U	0.92 U	0.88 U	1.1 U
cis-1,2-Dichloroethene	18,000	µg/kg	0.99 U	0.98 U	0.91 U	0.87 U	0.92 U	0.88 U	1.1 U
trans-1,2-Dichloroethene	130,000	µg/kg	0.99 U	0.98 U	0.91 U	0.87 U	0.92 U	0.88 U	1.1 U
1,2-Dichloropropane	2,500	µg/kg	0.99 U	0.98 U	0.91 U	0.87 U	0.92 U	0.88 U	1.1 U
cis-1,3-Dichloropropene	18,000	µg/kg	0.99 U	0.98 U	0.91 U	0.87 U	0.92 U	0.88 U	1.1 U
trans-1,3-Dichloropropene	580	µg/kg	0.99 U	0.98 U	0.91 U	0.87 U	0.92 U	0.88 U	1.1 U
1,4-Dichlorobenzene	2,600	µg/kg	0.99 U	0.98 U	0.91 U	0.87 U	0.92 U	0.88 U	1.1 U
Benzene	330	µg/kg	0.99 U	0.98 U	0.91 U	0.87 U	0.92 U	0.88 U	1.1 U
Bromodichloromethane	290	µg/kg	0.99 U	0.98 U	0.91 U	0.87 U	0.92 U	0.88 U	1.1 U
Bromoform	19,000	µg/kg	0.99 U	0.98 U	0.91 U	0.87 U	0.92 U	0.88 U	1.1 U
Carbon Tetrachloride	98	µg/kg	0.99 U	0.98 U	0.91 U	0.87 U	0.92 U	0.88 U	1.1 U
Chloroform	320	µg/kg	0.99 U	0.98 U	0.91 U	0.87 U	0.92 U	0.88 U	1.1 U
Chloromethane	110,000	µg/kg	4.9 U	4.9 U	4.5 U	4.4	4.6 U	4.4 U	5.3 U
Dibromochloromethane	940	µg/kg	0.99 U	0.98 U	0.91 U	0.87 U	0.92 U	0.88 U	1.1 U
Ethylbenzene	5,800	µg/kg	0.99 U	0.98 U	0.91 U	6.8	3.1 J	0.7 J (2.2 J)	12
Methylene Chloride	1,800	µg/kg	4.9 U	4.9 U	4.5 U	4.4	4.6 U	4.4 U	5.3 U
Tetrachloroethene	590	µg/kg	0.99 U	0.98 U	0.91 U	0.87 U	0.92 U	0.88 U	1.1 U
Toluene	1,100,000	µg/kg	0.99 U	0.98 U	0.91 U	0.87 U	0.92 U	0.88 U	1.1 U
Trichloroethene	940	µg/kg	0.99 U	0.98 U	0.91 U	0.87 U	0.92 U	0.88 U	1.1 U
Vinyl Chloride	8.7	µg/kg	0.99 U	0.98 U	0.91 U	0.87 U	0.92 U	0.88 U	1.1 U
m-p-Xylene	580,000	µg/kg	4.9 U	4.9 U	4.5 U	49 J+	21 J+	5.8 J (16)	76
o-Xylene			4.9 U	4.9 U	4.5 U	49 J+	21 J+	5.8 J (16)	76

Table 2. Contaminants of Potential Concern Results, 0.5 ft bgs

Notes:

[1] The lower of the residential soil values from the November 2018 USEPA Regional Screening Level (where TR=1E-06; THQ=1.0) and HERO HHRA Note 3 DTSC-modified Screening Levels (June 2018).

Bolded value indicates exceedance of residential risk-based screening level (HERO, 2018; USEPA, 2018).

Bolded and Underlined value indicates exceedance of commercial/industrial risk-based screening level (HERO, 2018; USEPA, 2018).

( ) = Duplicate sample result
µg/kg = microgram per kilogram
J = Estimated
mg/kg = milligram per kilogram
PAH = Polynucluear Aromatic Hydrocarbons
PCB = Polychlorinated Biphenyls
PCDD/PCDF = Polychlorinated Dibenzodioxin/ Polychlorinated Dibenzofurans
pg/g = picogram per gram (parts per trillion)
SVOC = Semivolatile Organic Compounds
U = Non-detect
VOC = Volatile Organic Compounds

Table 3. Contaminants of Potential Concern Results, 2.5 ft bgs

Analyte	Screening Level[1]	Lab Sample ID:	160-24848-20	160-24917-7	160-24848-26	160-24917-15	160-24925-6	160-24851-2	160-24917-30
		Sample Name:	SHAD041DP0 02SS02NS	SHAD041DP0 04SS02NS	SHAD041DP0 06SS02NS	SHAD041DP0 08SS02NS	SHAD041DP0 10SS02NS	SHAD041DP0 11SS02NS	SHAD041DP0 12SS02NS
		Location: Units	VSP-2	VSP-4	VSP-6	VSP-8	VSP-10	VSP-11	VSP-12
Inorganic Metals									
Chromium, Hexavalent	0.3	mg/kg	**0.58**	0.20 J (0.20 J)	**0.39 J**	**0.56**	0.22 J (0.27 J)	0.29 J	**0.36 J (0.21 J)**
Chromium	36,000	mg/kg	25	8.8 (8.8)	10	8.3	11 (11)	9.2	17 (44)
Lead	80	mg/kg	34	2.7 (2.7)	18	1.8 J	4.5 J (2.2 J)	30	1,500 (650)
SVOC—PAH									
Naphthalene	3,800	µg/kg	3.5 U	3.4 U	34 U	3.5 U	3.5 U	3.5 U	3.6 U
2-Methylnaphthalene	240,000	µg/kg	3.5 U	3.4 U	34 U	3.5 U	3.5 U	3.5 U	3.6 U
1-Methylnaphthalene	18,000	µg/kg	3.5 U	3.4 U	34 U	3.5 U	3.5 U	3.5 U	3.6 U
Acenaphthene	3,600,000	µg/kg	3.5 U	3.4 U	34 U	3.5 U	3.5 U	3.5 U	3.6 U
Fluorene	2,400,000	µg/kg	3.5 U	3.4 U	34 U	3.5 U	3.5 U	3.5 U	3.6 U
Anthracene	18,000,000	µg/kg	3.5 U	3.4 U	34 U	3.5 U	3.5 U	3.5 U	3.6 U
Fluoranthene	2,400,000	µg/kg	3.5 U	3.4 U	34 U	3.5 U	3.5 U	3.5 U	3.6 U
Pyrene	1,800,000	µg/kg	3.5 U	3.4 U	34 U	3.5 U	3.5 U	3.5 U	3.6 U
Benzo[a]anthracene	1,100	µg/kg	3.5 U	3.4 U	16 J	3.5 U	3.5 U	3.5 U	3.6 U
Chrysene	110,000	µg/kg	2.1 J	3.4 U	34 U	3.5 U	3.5 U	3.5 U	3.6 U
Benzo[b]fluoranthene	1,100	µg/kg	2.3 J	3.4 U	34 U	3.5 U	3.5 U	3.5 U	3.6 U
Benzo[k]floranthene	11,000	µg/kg	3.5 U	3.4 U	34 U	3.5 U	3.5 U	3.5 U	3.6 U
Benzo[a]pyrene	110	µg/kg	0.95 J	3.4 U	34 U	3.5 U	3.5 U	3.5 U	3.6 U
Indeno[1,2,3-cd]pyrene	1,100	µg/kg	3.5 U	3.4 U	34 U	3.5 U	3.5 U	3.5 U	3.6 U
Dibenz[a,h]anthracene	110	µg/kg	3.5 U	3.4 U	34 U	3.5 U	3.5 U	3.5 U	3.6 U
SVOC—PCB									
Aroclor 1016	4,100	mg/kg	0.017 U	0.016 U	0.017U	0.017 U	0.017 U	0.017 U	0.017 U
Aroclor 1221	200	mg/kg	0.017 U	0.016 U	0.017U	0.017 U	0.017 U	0.016 U	0.017 U
Aroclor 1232	170	mg/kg	0.017 U	0.016 U	0.017U	0.017 U	0.017 U	0.016 U	0.017 U
Aroclor 1242	230	mg/kg	0.017 U	0.016 U	0.017U	0.017 U	0.017 U	0.016 U	0.017 U
Aroclor 1248	230	mg/kg	0.017 U	0.016 U	0.017U	0.017 U	0.017 U	0.016 U	0.017 U
Aroclor 1254	240	mg/kg	0.017 U	0.016 U	0.017U	0.017 U	0.017 U	0.016 U	0.017 U
Aroclor 1260	240	mg/kg	0.011 U	0.010 U	0.010U	0.011 U	0.011 U	0.010 U	0.011 U
SVOC-PCDD/PCDF									
2,3,7,8-TCDD	4.8	pg/g	0.42 U	0.42 U	0.37 J	0.43 U	0.40 U	2	31 J (8.5)

Table 3. Contaminants of Potential Concern Results, 2.5 ft bgs

Analyte	Screening Level[1]	Lab Sample ID:	160-24848-20	160-24917-7	160-24848-26	160-24917-15	160-24925-6	160-24851-2	160-24917-30
		Sample Name:	SHAD041DP002SS02NS	SHAD041DP004SS02NS	SHAD041DP006SS02NS	SHAD041DP008SS02NS	SHAD041DP010SS02NS	SHAD041DP011SS02NS	SHAD041DP012SS02NS
		Location:	VSP-2	VSP-4	VSP-6	VSP-8	VSP-10	VSP-11	VSP-12
		Units							
VOCs									
1,1,1-Trichloroethane	1,700,000	µg/kg	0.99 U	0.90 U	1.0 U	0.96 U	0.97 U	1.0 U	0.94 U
1,1,2,2-Tetrachloroethane	600	µg/kg	0.99 U	0.90 U	1.0 U	0.96 U	0.97 U	1.0 U	0.94 U
1,1,2-Trichloroethane	1,100	µg/kg	0.99 U	0.90 U	1.0 U	0.96 U	0.97 U	1.0 U	0.94 U
1,1-Dichloroethane	3,600	µg/kg	0.99 U	0.90 U	1.0 U	0.96 U	0.97 U	1.0 U	0.94 U
1,1-Dichloroethene	230,000	µg/kg	4.9 U	4.5 U	5.0 U	4.8 U	4.8 U	5.2 U	4.7 U
1,2-Dichlorobenzene	1,800,000	µg/kg	0.99 U	0.90 U	1.0 U	0.96 U	0.97 U	1.0 U	0.94 U
1,2-Dichloroethane	460	µg/kg	0.99 U	0.90 U	1.0 U	0.96 U	0.97 U	1.0 U	0.94 U
cis-1,2-Dichloroethene	18,000	µg/kg	0.99 U	0.90 U	1.0 U	0.96 U	0.97 U	1.0 U	0.94 U
trans-1,2-Dichloroethene	130,000	µg/kg	0.99 U	0.90 U	1.0 U	0.96 U	0.97 U	1.0 U	0.94 U
1,2-Dichloropropane	2,500	µg/kg	0.99 U	0.90 U	1.0 U	0.96 U	0.97 U	1.0 U	0.94 U
cis-1,3-Dichloropropene	18,000	µg/kg	0.99 U	0.90 U	1.0 U	0.96 U	0.97 U	1.0 U	0.94 U
trans-1,3-Dichloropropene	580	µg/kg	0.99 U	0.90 U	1.0 U	0.96 U	0.97 U	1.0 U	0.94 U
1,4-Dichlorobenzene	2,600	µg/kg	0.99 U	0.90 U	1.0 U	0.96 U	0.97 U	1.0 U	0.94 U
Benzene	330	µg/kg	0.99 U	0.90 U	1.0 U	0.96 U	0.97 U	1.0 U	0.94 U
Bromodichloromethane	290	µg/kg	0.99 U	0.90 U	1.0 U	0.96 U	0.97 U	1.0 U	0.94 U
Bromoform	19,000	µg/kg	0.99 U	0.90 U	1.0 U	0.96 U	0.97 U	1.0 U	0.94 U
Carbon Tetrachloride	98	µg/kg	0.99 U	0.90 U	1.0 U	0.96 U	0.97 U	1.0 U	0.94 U
Chloroform	320	µg/kg	0.99 U	0.90 U	1.0 U	0.96 U	0.97 U	1.0 U	0.94 U
Chloromethane	110,000	µg/kg	4.9 U	4.5 U	5.0 U	4.8 U	4.8 U	5.2 U	4.7 U
Dibromochloromethane	940	µg/kg	0.99 U	0.90 U	1.0 U	0.96 U	0.97 U	1.0 U	0.94 U
Ethylbenzene	5,800	µg/kg	0.99 U	4.5 U	1.0 U	0.47 J	0.97 U	1.0 U	0.94 U
Methylene Chloride	1,800	µg/kg	4.9 U	0.90 U	5.0 U	4.8 U	4.8 U	5.2 U	4.7 U
Tetrachloroethene	590	µg/kg	0.99 U	0.90 U	1.0 U	0.96 U	0.97 U	1.0 U	0.94 U
Toluene	1,100,000	µg/kg	0.99 U	0.90 U	1.0 U	0.96 U	0.97 U	1.0 U	0.94 U
Trichloroethene	940	µg/kg	0.99 U	0.90 U	1.0 U	0.96 U	0.97 U	1.0 U	0.94 U
Vinyl Chloride	8.7	µg/kg	0.99 U	0.90 U	1.0 U	0.96 U	0.97 U	1.0 U	0.94 U
m-p-Xylene	580,000	µg/kg	4.9 U	4.5 U	0.99 J	4.8 U	4.8 U	5.2 U	4.7 U
o-Xylene			4.9 U	4.5 U	0.99 J	4.8 U	4.8 U	5.2 U	4.7 U

Table 3. Contaminants of Potential Concern Results, 2.5 ft bgs

Analyte	Screening Level[1]	Lab Sample ID:	160-24924-14	160-24925-13	160-24917-17	160-24917-24	160-24848-11	160-24848-15	160-24924-8
		Sample Name:	SHAD041DP0 13SS02NS	SHAD041DP0 15SS02NS	SHAD041DP0 17SS02NS	SHAD041DP0 18SS02NS	SHAD041DP0 19SS02NS	SHAD041DP0 20SS02NS	SHAD041DP0 22SS02NS
		Location:	VSP-13	VSP-15	VSP-17	VSP-18	VSP-19	VSP-20	VSP-22
		Units							
Inorganic Metals									
Chromium, Hexavalent	0.3	mg/kg	**0.32 J**	**0.34 J**	**1.6**	**1.2**	0.19 J	**0.31 J**	1.1
Chromium	36,000	mg/kg	9.4	10	35	15	11	16	20
Lead	80	mg/kg	1.7 J	8.6	**2,000**	**780**	0.19 J	47	320
SVOC—PAH									
Naphthalene	3,800	µg/kg	3.5 U	3.4 U	2.6 J	3.4 J	3.8 U	3.8 U	17 U
2-Methylnaphthalene	240,000	µg/kg	3.5 U	3.4 U	0.73 J	1.6 J	3.8 U	3.8 U	17 U
1-Methylnaphthalene	18,000	µg/kg	3.5 U	3.4 U	3.5 U	3.5 U	3.8 U	3.8 U	17 U
Acenaphthene	3,600,000	µg/kg	3.5 U	3.4 U	3.5 U	4.3 J	3.8 U	3.8 U	17 U
Fluorene	2,400,000	µg/kg	3.5 U	3.4 U	3.5 U	1.3 J	3.8 U	3.8 U	17 U
Anthracene	18,000,000	µg/kg	3.5 U	3.4 U	1.0 J	4.2 J	3.8 U	3.8 U	17 U
Fluoranthene	2,400,000	µg/kg	3.5 U	3.4 U	1.9 J	4.2 J	3.8 U	3.8 U	17 U
Pyrene	1,800,000	µg/kg	3.5 U	3.4 U	2.5 J	3.6 J	3.8 U	3.8 U	17 U
Benzo[a]anthracene	1,100	µg/kg	3.5 U	3.4 U	1.5 J	2.3 J	3.8 U	3.8 U	17 U
Chrysene	110,000	µg/kg	3.5 U	3.4 U	4.0 J	4.8 J	3.8 U	3.8 U	17 U
Benzo[b]fluoranthene	1,100	µg/kg	1.9 J	3.4 U	4.1 J	5.3 J	3.8 U	3.8 U	13 J
Benzo[k]floranthene	11,000	µg/kg	3.5 U	3.4 U	2.1 J	2.1 J	3.8 U	3.8 U	17 U
Benzo[a]pyrene	110	µg/kg	3.5 U	3.4 U	6.2 J	6.2 J	3.8 U	3.8 U	17 U
Indeno[1,2,3-cd]pyrene	1,100	µg/kg	3.5 U	3.4 U	3.1 J	3.1 J	3.8 U	3.8 U	17 U
Dibenz[a,h]anthracene	110	µg/kg	3.5 U	3.4 U	3.5 U	3.5 U	3.8 U	3.8 U	17 U
SVOC—PCB									
Aroclor 1016	4,100	mg/kg	0.017 U	0.016 U	0.017 U	0.016 U	0.018 U	0.018 U	0.016 U
Aroclor 1221	200	mg/kg	0.017 U	0.016 U	0.017 U	0.016 U	0.018 U	0.018 U	0.016 U
Aroclor 1232	170	mg/kg	0.017 U	0.016 U	0.017 U	0.016 U	0.018 U	0.018 U	0.016 U
Aroclor 1242	230	mg/kg	0.017 U	0.016 U	0.017 U	0.016 U	0.018 U	0.018 U	0.016 U
Aroclor 1248	230	mg/kg	0.017 U	0.016 U	0.017 U	0.016 U	0.018 U	0.018 U	0.016 U
Aroclor 1254	240	mg/kg	0.017 U	0.016 U	0.017 U	0.016 U	0.018 U	0.018 U	0.016 U
Aroclor 1260	240	mg/kg	0.011 U	0.010 U	0.010 U	0.010 U	0.011 U	0.011 U	0.010 U
SVOC-PCDD/PCDF									
2,3,7,8-TCDD	4.8	pg/g	0.42 U	0.40 U	**24**	**39**	0.47 U	0.46 U	1.2

Table 3. Contaminants of Potential Concern Results, 2.5 ft bgs

		Lab Sample ID:	160-24924-14	160-24925-13	160-24917-17	160-24917-24	160-24848-11	160-24848-15	160-24924-8
		Sample Name:	SHAD041DP013SS02NS	SHAD041DP015SS02NS	SHAD041DP017SS02NS	SHAD041DP018SS02NS	SHAD041DP019SS02NS	SHAD041DP020SS02NS	SHAD041DP022SS02NS
Analyte	Screening Level[1]	Location: Units	VSP-13	VSP-15	VSP-17	VSP-18	VSP-19	VSP-20	VSP-22
VOCs									
1,1,1-Trichloroethane	1,700,000	µg/kg	0.92 U	0.90 U	1.0 U	0.91 U	0.93 U	1.1 U	0.94 U
1,1,2,2-Tetrachloroethane	600	µg/kg	0.92 U	0.90 U	1.0 U	0.91 U	0.93 U	1.1 U	0.94 U
1,1,2-Trichloroethane	1,100	µg/kg	0.92 U	0.90 U	1.0 U	0.91 U	0.93 U	1.1 U	0.94 U
1,1-Dichloroethane	3,600	µg/kg	0.92 U	0.90 U	1.0 U	0.91 U	0.93 U	1.1 U	0.94 U
1,1-Dichloroethene	230,000	µg/kg	4.6 U	4.5 U	5.0 U	4.6 U	4.6 U	5.3 U	4.7 U
1,2-Dichlorobenzene	1,800,000	µg/kg	0.92 U	0.90 U	1.0 U	0.91 U	0.93 U	1.1 U	0.94 U
1,2-Dichloroethane	460	µg/kg	0.92 U	0.90 U	1.0 U	0.91 U	0.93 U	1.1 U	0.94 U
cis-1,2-Dichloroethene	18,000	µg/kg	0.92 U	0.90 U	1.0 U	0.91 U	0.93 U	1.1 U	0.94 U
trans-1,2-Dichloroethene	130,000	µg/kg	0.92 U	0.90 U	1.0 U	0.91 U	0.93 U	1.1 U	0.94 U
1,2-Dichloropropane	2,500	µg/kg	0.92 U	0.90 U	1.0 U	0.91 U	0.93 U	1.1 U	0.94 U
cis-1,3-Dichloropropene	18,000	µg/kg	0.92 U	0.90 U	1.0 U	0.91 U	0.93 U	1.1 U	0.94 U
trans-1,3-Dichloropropene	580	µg/kg	0.92 U	0.90 U	1.0 U	0.91 U	0.93 U	1.1 U	0.94 U
1,4-Dichlorobenzene	2,600	µg/kg	0.92 U	0.90 U	1.0 U	0.91 U	0.93 U	1.1 U	0.94 U
Benzene	330	µg/kg	0.92 U	0.90 U	1.0 U	0.91 U	0.93 U	1.1 U	0.94 U
Bromodichloromethane	290	µg/kg	0.92 U	0.90 U	1.0 U	0.91 U	0.93 U	1.1 U	0.94 U
Bromoform	19,000	µg/kg	0.92 U	0.90 U	1.0 U	0.91 U	0.93 U	1.1 U	0.94 U
Carbon Tetrachloride	98	µg/kg	0.92 U	0.90 U	1.0 U	0.91 U	0.93 U	1.1 U	0.94 U
Chloroform	320	µg/kg	0.92 U	0.90 U	1.0 U	0.91 U	0.93 U	1.1 U	0.94 U
Chloromethane	110,000	µg/kg	4.6 U	4.5 U	5.0 U	4.6 U	4.6 U	5.3 U	4.7 U
Dibromochloromethane	940	µg/kg	0.92 U	0.90 U	1.0 U	0.91 U	0.92 U	1.1 U	0.94 U
Ethylbenzene	5,800	µg/kg	0.92 U	0.90 U	1.0 J	0.91 U	0.92 U	1.1 U	0.94 U
Methylene Chloride	1,800	µg/kg	4.6 U	4.5 U	5.0 U	4.6 U	4.6 U	5.3 U	4.7 U
Tetrachloroethene	590	µg/kg	0.92 U	0.90 U	1.0 U	0.91 U	0.93 U	1.1 U	0.94 U
Toluene	1,100,000	µg/kg	0.92 U	0.90 U	1.0 U	0.75 J	0.93 U	1.1 U	0.94 U
Trichloroethene	940	µg/kg	0.92 U	0.90 U	1.0 U	0.91 U	0.93 U	1.1 U	0.94 U
Vinyl Chloride	8.7	µg/kg	0.92 U	0.90 U	1.0 U	0.91 U	0.93 U	1.1 U	0.94 U
m-p-Xylene	580,000	µg/kg	4.6 U	4.5 U	5.0 U	4.6 U	0.91 J	5.3 U	4.7 U
o-Xylene			4.6 U	4.5 U	5.0 U	4.6 U	0.91 J	5.3 U	4.7 U

Table 3. Contaminants of Potential Concern Results, 2.5 ft bgs

		Lab Sample ID:	160-24848-7	160-24848-3	160-24924-1	160-24922-2	160-24922-9	160-24922-18	160-24922-24
		Sample Name:	SHAD041DP024SS02NS	SHAD041DP025SS02NS	SHAD041DP026SS02NS	SHAD041DP027SS02NS	SHAD041DP028SS02NS	SHAD041DP029SS02NS	SHAD041DP030SS02NS
	Screening	Location:	VSP-24	VSP-25	VSP-26	VSP-27	VSP-28	VSP-29	VSP-30
Analyte	**Level[1]**	**Units**							
Inorganic Metals									
Chromium, Hexavalent	0.3	mg/kg	0.20 J	0.15 J	**4.1**	**0.45 J**	**4.7**	0.25 U	**0.32 J**
Chromium	36,000	mg/kg	19	10	19	12	27	14	9.1
Lead	80	mg/kg	15	2.4 J	**380**	2.1 J	**230**	5.3 J	3.4 J
SVOC—PAH									
Naphthalene	3,800	µg/kg	3.9 U	3.9 U	17 U	4.0 U	17 U	4.2 U	3.4 U
2-Methylnaphthalene	240,000	µg/kg	3.9 U	3.9 U	17 U	4.0 U	17 U	4.2 U	3.4 U
1-Methylnaphthalene	18,000	µg/kg	3.9 U	3.9 U	17 U	4.0 U	17 U	4.2 U	3.4 U
Acenaphthene	3,600,000	µg/kg	3.9 U	3.9 U	17 U	4.0 U	17 U	4.2 U	3.4 U
Fluorene	2,400,000	µg/kg	3.9 U	3.9 U	17 U	4.0 U	17 U	4.2 U	3.4 U
Anthracene	18,000,000	µg/kg	3.9 U	5.1 J	5.1 J	4.0 U	5.4 J	4.2 U	3.4 U
Fluoranthene	2,400,000	µg/kg	3.9 U	19 J	19 J	4.0 U	17 U	4.2 U	3.4 U
Pyrene	1,800,000	µg/kg	3.9 U	3.9 U	17 U	4.0 U	17 U	4.2 U	3.4 U
Benzo[a]anthracene	1,100	µg/kg	3.9 U	13 J	13 J	4.0 U	7.0 J	4.2 U	3.4 U
Chrysene	110,000	µg/kg	3.9 U	14 J	14 J	4.0 U	19 J	4.2 U	3.4 U
Benzo[b]fluoranthene	1,100	µg/kg	3.9 U	19 J	19 J	4.0 U	30	4.2 U	3.4 U
Benzo[k]floranthene	11,000	µg/kg	3.9 U	3.9 U	17 U	4.0 U	17 U	4.2 U	3.4 U
Benzo[a]pyrene	110	µg/kg	3.9 U	11 J	11 J	4.0 U	17 U	4.2 U	3.4 U
Indeno[1,2,3-cd]pyrene	1,100	µg/kg	3.9 U	3.9 U	17 U	4.0 U	17 U	4.2 U	3.4 U
Dibenz[a,h]anthracene	110	µg/kg	3.9 U	3.9 U	17 U	4.0 U	17 U	4.2 U	3.4 U
SVOC—PCB									
Aroclor 1016	4,100	mg/kg	0.019 U	0.019 U	0.016 U	0.019 U	0.016 U	0.020 U	0.016 U
Aroclor 1221	200	mg/kg	0.019 U	0.019 U	0.016 U	0.019 U	0.016 U	0.020 U	0.016 U
Aroclor 1232	170	mg/kg	0.019 U	0.019 U	0.016 U	0.019 U	0.016 U	0.020 U	0.016 U
Aroclor 1242	230	mg/kg	0.019 U	0.019 U	0.016 U	0.019 U	0.016 U	0.020 U	0.016 U
Aroclor 1248	230	mg/kg	0.019 U	0.019 U	0.016 U	0.019 U	0.016 U	0.020 U	0.016 U
Aroclor 1254	240	mg/kg	0.019 U	0.019 U	0.016 U	0.019 U	0.016 U	0.020 U	0.016 U
Aroclor 1260	240	mg/kg	0.012 U	0.012 U	0.010 U	0.012 U	0.010 U	0.012 U	0.010 U
SVOC-PCDD/PCDF									
2,3,7,8-TCDD	4.8	pg/g	0.47 J	0.47 U	**7.9**	0.48 U	0.71 J	0.51 U	0.42 U

Table 3. Contaminants of Potential Concern Results, 2.5 ft bgs

Analyte	Screening Level[1]	Lab Sample ID:	160-24848-7	160-24848-3	160-24924-1	160-24922-2	160-24922-9	160-24922-18	160-24922-24
		Sample Name:	SHAD041DP024SS02NS	SHAD041DP025SS02NS	SHAD041DP026SS02NS	SHAD041DP027SS02NS	SHAD041DP028SS02NS	SHAD041DP029SS02NS	SHAD041DP030SS02NS
		Location:	VSP-24	VSP-25	VSP-26	VSP-27	VSP-28	VSP-29	VSP-30
		Units							
VOCs									
1,1,1-Trichloroethane	1,700,000	µg/kg	1.2 U	0.92 U	0.89 U	0.96 U	0.93 U	1.3 U	0.94 U
1,1,2,2-Tetrachloroethane	600	µg/kg	1.2 U	0.92 U	0.89 U	0.96 U	0.93 U	1.3 U	0.94 U
1,1,2-Trichloroethane	1,100	µg/kg	1.2 U	0.92 U	0.89 U	0.96 U	0.93 U	1.3 U	0.94 U
1,1-Dichloroethane	3,600	µg/kg	1.2 U	0.92 U	0.89 U	0.96 U	0.93 U	1.3 U	0.94 U
1,1-Dichloroethene	230,000	µg/kg	6.2 U	4.6 U	4.4 U	4.8	4.7 U	6.6	4.7 U
1,2-Dichlorobenzene	1,800,000	µg/kg	1.2 U	0.92 U	0.89 U	0.96 U	0.93 U	1.3 U	0.94 U
1,2-Dichloroethane	460	µg/kg	1.2 U	0.92 U	0.89 U	0.96 U	0.93 U	1.3 U	0.94 U
cis-1,2-Dichloroethene	18,000	µg/kg	1.2 U	0.92 U	0.89 U	0.96 U	0.93 U	1.3 U	0.94 U
trans-1,2-Dichloroethene	130,000	µg/kg	1.2 U	0.92 U	0.89 U	0.96 U	0.93 U	1.3 U	0.94 U
1,2-Dichloropropane	2,500	µg/kg	1.2 U	0.92 U	0.89 U	0.96 U	0.93 U	1.3 U	0.94 U
cis-1,3-Dichloropropene	18,000	µg/kg	1.2 U	0.92 U	0.89 U	0.96 U	0.93 U	1.3 U	0.94 U
trans-1,3-Dichloropropene	580	µg/kg	1.2 U	0.92 U	0.89 U	0.96 U	0.93 U	1.3 U	0.94 U
1,4-Dichlorobenzene	2,600	µg/kg	1.2 U	0.92 U	0.89 U	0.96 U	0.93 U	1.3 U	0.94 U
Benzene	330	µg/kg	1.2 U	0.92 U	0.89 U	0.96 U	0.93 U	1.3 U	0.94 U
Bromodichloromethane	290	µg/kg	1.2 U	0.92 U	0.89 U	0.96 U	0.93 U	1.3 U	0.94 U
Bromoform	19,000	µg/kg	1.2 U	0.92 U	0.89 U	0.96 U	0.93 U	1.3 U	0.94 U
Carbon Tetrachloride	98	µg/kg	1.2 U	0.92 U	0.89 U	0.96 U	0.93 U	1.3 U	0.94 U
Chloroform	320	µg/kg	1.2 U	0.92 U	0.89 U	0.96 U	0.93 U	1.3 U	0.94 U
Chloromethane	110,000	µg/kg	6.2 U	4.6 U	4.4 U	4.8	4.7 U	6.6	4.7 U
Dibromochloromethane	940	µg/kg	1.2 U	0.92 U	0.89 U	0.96 U	0.93 U	1.3 U	0.94 U
Ethylbenzene	5,800	µg/kg	1.2 U	0.92 U	0.89 U	4.8	0.93 U	1.3 U	0.94 U
Methylene Chloride	1,800	µg/kg	6.2 U	4.6 U	4.4 U	4.8	4.7 U	6.6	4.7 U
Tetrachloroethene	590	µg/kg	1.2 U	0.92 U	0.89 U	0.96 U	0.93 U	1.3 U	0.94 U
Toluene	1,100,000	µg/kg	1.2 U	0.92 U	0.89 U	0.96 U	0.93 U	1.3 U	0.94 U
Trichloroethene	940	µg/kg	1.2 U	0.92 U	0.89 U	0.96 U	0.93 U	1.3 U	0.94 U
Vinyl Chloride	8.7	µg/kg	1.2 U	0.92 U	0.89 U	0.96 U	0.93 U	1.3 U	0.94 U
m-p-Xylene	580,000	µg/kg	6.2 U	4.6 U	4.4 U	4.9 U	4.7 U	6.6	4.7 U
o-Xylene			6.2 U	4.6 U	4.4 U	4.8 U	4.7 U	6.6	4.7 U

Table 3. Contaminants of Potential Concern Results, 2.5 ft bgs

Notes:

[1] The lower of the residential soil values from the November 2018 USEPA Regional Screening Level (where TR=1E-06; THQ=1.0) and HERO HHRA Note 3 DTSC-modified Screening Levels (June 2018).

Bolded value indicates exceedance of residential risk-based screening level (HERO, 2018; USEPA, 2018).

<u>Bolded and Underlined</u> value indicates exceedance of commercial/industrial risk-based screening level (HERO, 2018; USEPA, 2018).

( ) = Duplicate sample result
µg/kg = microgram per kilogram
J = Estimated
mg/kg = milligram per kilogram
PAH = Polynucluear Aromatic Hydrocarbons
PCB = Polychlorinated Biphenyls
PCDD/PCDF = Polychlorinated Dibenzodioxin/ Polychlorinated Dibenzofurans
pg/g = picogram per gram (parts per trillion)
SVOC = Semivolatile Organic Compounds
U = Non-detect
VOC = Volatile Organic Compounds

Table 4. Contaminants of Potential Concern Results, 5.0 ft bgs

		Lab Sample ID:	160-24848-21	160-24917-9	160-24848-27	160-24925-1	160-24925-8	160-24851-3	160-24917-2
		Sample Name:	SHAD041DP002SS03NS	SHAD041DP004SS03NS	SHAD041DP006SS03NS	SHAD041DP008SS03NS	SHAD041DP010SS03NS	SHAD041DP011SS03NS	SHAD041DP012SS03NS
Analyte	Screening Level[1]	Location: Units	VSP-2	VSP-4	VSP-6	VSP-8	VSP-10	VSP-11	VSP-12
Inorganic Metals									
Chromium, Hexavalent	0.3	mg/kg	**0.35 J**	0.23 J	0.26 J	0.31 J	**0.34 J**	**0.44 J**	**0.39 J**
Chromium	36,000	mg/kg	25	14	11	12	17	15 J	14
Lead	80	mg/kg	15	3.1 J	3.5 J	2.3 J	18	50 J	21 J
SVOC—PAH									
Naphthalene	3,800	µg/kg	3.7 U	3.9 U	3.7 U	3.6 U	3.8 U	4.0 U	4.2 U
2-Methylnaphthalene	240,000	µg/kg	3.7 U	3.9 U	3.7 U	3.6 U	3.8 U	4.0 U	4.2 U
1-Methylnaphthalene	18,000	µg/kg	3.7 U	3.9 U	3.7 U	3.6 U	3.8 U	4.0 U	4.2 U
Acenaphthene	3,600,000	µg/kg	3.7 U	3.9 U	3.7 U	3.6 U	3.8 U	4.0 U	4.2 U
Fluorene	2,400,000	µg/kg	3.7 U	3.9 U	3.7 U	3.6 U	3.8 U	4.0 U	4.2 U
Anthracene	18,000,000	µg/kg	3.7 U	3.9 U	3.7 U	3.6 U	3.8 U	4.0 U	4.2 U
Fluoranthene	2,400,000	µg/kg	1.8 J	3.9 U	3.7 U	3.6 U	3.8 U	4.0 U	4.2 U
Pyrene	1,800,000	µg/kg	1.6 J	3.9 U	3.7 U	3.6 U	3.8 U	4.0 U	4.2 U
Benzo[a]anthracene	1,100	µg/kg	3.7 U	3.9 U	3.7 U	3.6 U	3.8 U	4.0 U	4.2 U
Chrysene	110,000	µg/kg	3.7 U	3.9 U	3.7 U	3.6 U	3.8 U	4.0 U	4.2 U
Benzo[b]fluoranthene	1,100	µg/kg	1.9 J	3.9 U	3.7 U	3.6 U	3.8 U	4.0 U	4.2 U
Benzo[k]floranthene	11,000	µg/kg	3.7 U	3.9 U	3.7 U	3.6 U	3.8 U	4.0 U	4.2 U
Benzo[a]pyrene	110	µg/kg	3.7 U	3.9 U	3.7 U	3.6 U	3.8 U	4.0 U	4.2 U
Indeno[1,2,3-cd]pyrene	1,100	µg/kg	3.7 U	3.9 U	3.7 U	3.6 U	3.8 U	4.0 U	4.2 U
Dibenz[a,h]anthracene	110	µg/kg	3.7 U	3.9 U	3.7 U	3.6 U	3.8 U	4.0 U	4.2 U
SVOC—PCB									
Aroclor 1016	4,100	mg/kg	0.018 U	0.019 U	0.017U	0.017 U	0.018 U	0.019 U	0.020 U
Aroclor 1221	200	mg/kg	0.018 U	0.019 U	0.017U	0.017 U	0.018 U	0.019 U	0.020 U
Aroclor 1232	170	mg/kg	0.018 U	0.019 U	0.017U	0.017 U	0.018 U	0.019 U	0.020 U
Aroclor 1242	230	mg/kg	0.018 U	0.019 U	0.017U	0.017 U	0.018 U	0.019 U	0.020 U
Aroclor 1248	230	mg/kg	0.018 U	0.019 U	0.017U	0.017 U	0.018 U	0.019 U	0.020 U
Aroclor 1254	240	mg/kg	0.018 U	0.019 U	0.017U	0.017 U	0.018 U	0.019 U	0.020 U
Aroclor 1260	240	mg/kg	0.011 U	0.012 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U
SVOC-PCDD/PCDF									
2,3,7,8-TCDD	4.8	pg/g	0.45 U	0.47 U	0.44	0.22 J	0.23	11	0.31 J

Table 4. Contaminants of Potential Concern Results, 5.0 ft bgs

Analyte	Screening Level[1]	Lab Sample ID: / Sample Name: / Location: / Units	160-24848-21	160-24917-9	160-24848-27	160-24925-1	160-24925-8	160-24851-3	160-24917-2
		Sample Name:	SHAD041DP0 02SS03NS	SHAD041DP0 04SS03NS	SHAD041DP0 06SS03NS	SHAD041DP0 08SS03NS	SHAD041DP0 10SS03NS	SHAD041DP0 11SS03NS	SHAD041DP0 12SS03NS
		Location:	VSP-2	VSP-4	VSP-6	VSP-8	VSP-10	VSP-11	VSP-12
VOCs									
1,1,1-Trichloroethane	1,700,000	µg/kg	0.82 U	1.0 U	1.0 U	1.0 U	1.1 U	1.1 U	1.0 U
1,1,2,2-Tetrachloroethane	600	µg/kg	0.82 U	1.0 U	1.0 U	1.0 U	1.1 U	1.1 U	1.0 U
1,1,2-Trichloroethane	1,100	µg/kg	0.82 U	1.0 U	1.0 U	1.0 U	1.1 U	1.1 U	1.0 U
1,1-Dichloroethane	3,600	µg/kg	0.82 U	1.0 U	1.0 U	1.0 U	1.1 U	1.1 U	1.0 U
1,1-Dichloroethene	230,000	µg/kg	4.1 U	5.2 U	5.1	5.1 U	5.4 U	5.3 U	5.2 U
1,2-Dichlorobenzene	1,800,000	µg/kg	0.82 U	1.0 U	1.0 U	1.0 U	1.1 U	1.1 U	1.0 U
1,2-Dichloroethane	460	µg/kg	0.82 U	1.0 U	1.0 U	1.0 U	1.1 U	1.1 U	1.0 U
cis-1,2-Dichloroethene	18,000	µg/kg	0.82 U	1.0 U	1.0 U	1.0 U	1.1 U	1.1 U	1.0 U
trans-1,2-Dichloroethene	130,000	µg/kg	0.82 U	1.0 U	1.0 U	1.0 U	1.1 U	1.1 U	1.0 U
1,2-Dichloropropane	2,500	µg/kg	0.82 U	1.0 U	1.0 U	1.0 U	1.1 U	1.1 U	1.0 U
cis-1,3-Dichloropropene	18,000	µg/kg	0.82 U	1.0 U	1.0 U	1.0 U	1.1 U	1.1 U	1.0 U
trans-1,3-Dichloropropene	580	µg/kg	0.82 U	1.0 U	1.0 U	1.0 U	1.1 U	1.1 U	1.0 U
1,4-Dichlorobenzene	2,600	µg/kg	0.82 U	1.0 U	1.0 U	1.0 U	1.1 U	1.1 U	1.0 U
Benzene	330	µg/kg	0.82 U	1.0 U	1.0 U	1.0 U	1.1 U	1.1 U	1.0 U
Bromodichloromethane	290	µg/kg	0.82 U	1.0 U	1.0 U	1.0 U	1.1 U	1.1 U	1.0 U
Bromoform	19,000	µg/kg	0.82 U	1.0 U	1.0 U	1.0 U	1.1 U	1.1 U	1.0 U
Carbon Tetrachloride	98	µg/kg	0.82 U	1.0 U	1.0 U	1.0 U	1.1 U	1.1 U	1.0 U
Chloroform	320	µg/kg	0.82 U	1.0 U	1.0 U	1.0 U	1.1 U	1.1 U	1.0 U
Chloromethane	110,000	µg/kg	4.1 U	5.2 U	5.1	5.1 U	5.4 U	5.3 U	5.2 U
Dibromochloromethane	940	µg/kg	0.82 U	1.0 U	1.0 U	1.0 U	1.1 U	1.1 U	1.0 U
Ethylbenzene	5,800	µg/kg	0.82 U	1.0 U	1.0 U	1.0 U	1.1 U	1.1 U	1.0 U
Methylene Chloride	1,800	µg/kg	4.1 U	5.2 U	5.1	5.1 U	5.4 U	5.3 U	5.2 U
Tetrachloroethene	590	µg/kg	0.82 U	1.0 U	1.0 U	1.0 U	1.1 U	1.1 U	1.0 U
Toluene	1,100,000	µg/kg	0.82 U	1.0 U	1.0 U	1.0 U	1.1 U	1.1 U	1.0 U
Trichloroethene	940	µg/kg	0.82 U	1.0 U	1.0 U	1.0 U	1.1 U	1.1 U	1.0 U
Vinyl Chloride	8.7	µg/kg	0.82 U	1.0 U	1.0 U	1.0 U	1.1 U	1.1 U	1.0 U
m-p-Xylene	580,000	µg/kg	4.1 U	5.2 U	5.1	5.1 U	5.4 U	5.3 U	5.2 U
o-Xylene			4.1 U	5.2 U	5.1	5.1 U	5.4 U	5.3 U	5.2 U

Table 4. Contaminants of Potential Concern Results, 5.0 ft bgs

		Lab Sample ID:	160-24924-15	160-24925-14	160-24917-18	160-24917-25	160-24848-12	160-24848-16	160-24924-9
		Sample Name:	SHAD041DP013SS03NS	SHAD041DP015SS03NS	SHAD041DP017SS03NS	SHAD041DP018SS03NS	SHAD041DP019SS03NS	SHAD041DP020SS03NS	SHAD041DP022SS03NS
Analyte	**Screening Level[1]**	**Location:** **Units**	**VSP-13**	**VSP-15**	**VSP-17**	**VSP-18**	**VSP-19**	**VSP-20**	**VSP-22**
Inorganic Metals									
Chromium, Hexavalent	0.3	mg/kg	0.28 J	0.26 J	**0.33 J**	0.14 J	0.22 J	0.27 J	**0.45**
Chromium	36,000	mg/kg	15	17	26	12	19	13	12 J
Lead	80	mg/kg	3.4 J	15	2.6 J	58	4.7 J	4.0 J	39
SVOC—PAH									
Naphthalene	3,800	µg/kg	3.8 U	3.7 U	4.1 U	3.9 U	4.2 U	4.1 U	3.4 U
2-Methylnaphthalene	240,000	µg/kg	3.8 U	3.7 U	4.1 U	3.9 U	4.2 U	4.1 U	3.4 U
1-Methylnaphthalene	18,000	µg/kg	3.8 U	3.7 U	4.1 U	3.9 U	4.2 U	4.1 U	3.4 U
Acenaphthene	3,600,000	µg/kg	3.8 U	3.7 U	4.1 U	3.9 U	4.2 U	4.1 U	3.4 U
Fluorene	2,400,000	µg/kg	3.8 U	3.7 U	4.1 U	3.9 U	4.2 U	4.1 U	3.4 U
Anthracene	18,000,000	µg/kg	3.8 U	3.7 U	4.1 U	3.9 U	4.2 U	4.1 U	3.4 U
Fluoranthene	2,400,000	µg/kg	3.8 U	3.7 U	4.1 U	3.9 U	4.2 U	4.1 U	3.4 U
Pyrene	1,800,000	µg/kg	3.8 U	3.7 U	4.1 U	3.9 U	4.2 U	4.1 U	3.4 U
Benzo[a]anthracene	1,100	µg/kg	3.8 U	3.7 U	4.1 U	3.9 U	4.2 U	4.1 U	3.4 U
Chrysene	110,000	µg/kg	3.8 U	3.7 U	4.1 U	3.9 U	4.2 U	4.1 U	3.4 U
Benzo[b]fluoranthene	1,100	µg/kg	3.8 U	3.7 U	4.1 U	3.9 U	4.2 U	4.1 U	1.5 J
Benzo[k]floranthene	11,000	µg/kg	3.8 U	3.7 U	4.1 U	3.9 U	4.2 U	4.1 U	3.4 U
Benzo[a]pyrene	110	µg/kg	3.8 U	3.7 U	4.1 U	3.9 U	4.2 U	4.1 U	3.4 U
Indeno[1,2,3-cd]pyrene	1,100	µg/kg	3.8 U	3.7 U	4.1 U	3.9 U	4.2 U	4.1 U	3.4 U
Dibenz[a,h]anthracene	110	µg/kg	3.8 U	3.7 U	4.1 U	3.9 U	4.2 U	4.1 U	3.4 U
SVOC—PCB									
Aroclor 1016	4,100	mg/kg	0.018 U	0.018 U	0.020 U	0.019 U	0.020U	0.020 U	0.016 U
Aroclor 1221	200	mg/kg	0.018 U	0.018 U	0.020 U	0.019 U	0.020U	0.020 U	0.016 U
Aroclor 1232	170	mg/kg	0.018 U	0.018 U	0.020 U	0.019 U	0.020U	0.020 U	0.016 U
Aroclor 1242	230	mg/kg	0.018 U	0.018 U	0.020 U	0.019 U	0.020U	0.020 U	0.016 U
Aroclor 1248	230	mg/kg	0.018 U	0.018 U	0.020 U	0.019 U	0.020U	0.020 U	0.016 U
Aroclor 1254	240	mg/kg	0.018 U	0.018 U	0.020 U	0.019 U	0.020U	0.020 U	0.016 U
Aroclor 1260	240	mg/kg	0.012 U	0.011 U	0.012 U	0.012 U	0.013 U	0.012 U	0.010 U
SVOC-PCDD/PCDF									
2,3,7,8-TCDD	4.8	pg/g	0.46 U	1.4	0.5 U	0.75 J	0.50 U	0.50 U	0.41 U

Table 4. Contaminants of Potential Concern Results, 5.0 ft bgs

Analyte	Screening Level[1]	Lab Sample ID:	160-24924-15	160-24925-14	160-24917-18	160-24917-25	160-24848-12	160-24848-16	160-24924-9
		Sample Name:	SHAD041DP0 13SS03NS	SHAD041DP0 15SS03NS	SHAD041DP0 17SS03NS	SHAD041DP0 18SS03NS	SHAD041DP0 19SS03NS	SHAD041DP0 20SS03NS	SHAD041DP0 22SS03NS
		Location: Units	VSP-13	VSP-15	VSP-17	VSP-18	VSP-19	VSP-20	VSP-22
VOCs									
1,1,1-Trichloroethane	1,700,000	µg/kg	1.0 U	1.1 U	1.2 U	1.1 U	1.0 U	1.2 U	0.92 U
1,1,2,2-Tetrachloroethane	600	µg/kg	1.0 U	1.1 U	1.2 U	1.1 U	1.0 U	1.2 U	0.92 U
1,1,2-Trichloroethane	1,100	µg/kg	1.0 U	1.1 U	1.2 U	1.1 U	1.0 U	1.2 U	0.92 U
1,1-Dichloroethane	3,600	µg/kg	1.0 U	1.1 U	1.2 U	1.1 U	1.0 U	1.2 U	0.92 U
1,1-Dichloroethene	230,000	µg/kg	5.0 U	5.6 U	6.1 U	5.3 U	5.2 U	6.0 U	4.6 U
1,2-Dichlorobenzene	1,800,000	µg/kg	1.0 U	1.1 U	1.2 U	1.1 U	1.0 U	1.2 U	0.92 U
1,2-Dichloroethane	460	µg/kg	1.0 U	1.1 U	1.2 U	1.1 U	1.0 U	1.2 U	0.92 U
cis-1,2-Dichloroethene	18,000	µg/kg	1.0 U	1.1 U	1.2 U	1.1 U	1.0 U	1.2 U	0.92 U
trans-1,2-Dichloroethene	130,000	µg/kg	1.0 U	1.1 U	1.2 U	1.1 U	1.0 U	1.2 U	0.92 U
1,2-Dichloropropane	2,500	µg/kg	1.0 U	1.1 U	1.2 U	1.1 U	1.0 U	1.2 U	0.92 U
cis-1,3-Dichloropropene	18,000	µg/kg	1.0 U	1.1 U	1.2 U	1.1 U	1.0 U	1.2 U	0.92 U
trans-1,3-Dichloropropene	580	µg/kg	1.0 U	1.1 U	1.2 U	1.1 U	1.0 U	1.2 U	0.92 U
1,4-Dichlorobenzene	2,600	µg/kg	1.0 U	1.1 U	1.2 U	1.1 U	1.0 U	1.2 U	0.92 U
Benzene	330	µg/kg	1.0 U	1.1 U	1.2 U	1.1 U	1.0 U	1.2 U	0.92 U
Bromodichloromethane	290	µg/kg	1.0 U	1.1 U	1.2 U	1.1 U	1.0 U	1.2 U	0.92 U
Bromoform	19,000	µg/kg	1.0 U	1.1 U	1.2 U	1.1 U	1.0 U	1.2 U	0.92 U
Carbon Tetrachloride	98	µg/kg	1.0 U	1.1 U	1.2 U	1.1 U	1.0 U	1.2 U	0.92 U
Chloroform	320	µg/kg	1.0 U	1.1 U	1.2 U	1.1 U	1.0 U	1.2 U	0.92 U
Chloromethane	110,000	µg/kg	5.0 U	5.6 U	6.1 U	1.1 U	5.2 U	6.0 U	4.6 U
Dibromochloromethane	940	µg/kg	1.0 U	1.1 U	1.2 U	5.3 U	1.0 U	1.2 U	0.92 U
Ethylbenzene	5,800	µg/kg	1.0 U	1.1 U	1.2 U	1.1 U	1.0 U	1.2 U	0.92 U
Methylene Chloride	1,800	µg/kg	5.0 U	5.6 U	6.1 U	2.0 J	5.2 U	5.0 J	4.6 U
Tetrachloroethene	590	µg/kg	1.0 U	1.1 U	1.2 U	1.1 U	1.0 U	1.2 U	0.92 U
Toluene	1,100,000	µg/kg	1.0 U	1.1 U	1.2 U	1.1 U	1.0 U	1.2 U	0.92 U
Trichloroethene	940	µg/kg	1.0 U	1.1 U	1.2 U	1.1 U	1.0 U	1.2 U	0.92 U
Vinyl Chloride	8.7	µg/kg	1.0 U	1.1 U	1.2 U	1.1 U	1.0 U	1.2 U	0.92 U
m-p-Xylene	580,000	µg/kg	5.0 U	5.6 U	6.1 U	5.3 U	5.2 U	6.0 U	4.6 U
o-Xylene			5.0 U	5.6 U	6.1 U	5.3 U	5.2 U	6.0 U	4.6 U

Table 4. Contaminants of Potential Concern Results, 5.0 ft bgs

		Lab Sample ID:	160-24848-8	160-24848-4	160-24924-2	160-24922-3	160-24922-10	160-24922-19	160-24922-25
		Sample Name:	SHAD041DP024SS03NS	SHAD041DP025SS03NS	SHAD041DP026SS03NS	SHAD041DP027SS03NS	SHAD041DP028SS03NS	SHAD041DP029SS03NS	SHAD041DP030SS03NS
		Location:	VSP-24	VSP-25	VSP-26	VSP-27	VSP-28	VSP-29	VSP-30
Analyte	Screening Level[1]	Units							
Inorganic Metals									
Chromium, Hexavalent	0.3	mg/kg	0.27 J	**0.71**	**0.40 J**	**0.34 J**	**0.54**	0.20 J	0.28 J
Chromium	36,000	mg/kg	13	14	14	16	12	16	13
Lead	80	mg/kg	5.0 J	11	34	2.7 J	6.9	4.2 J	2.1 J
SVOC—PAH									
Naphthalene	3,800	µg/kg	4.1 U	3.9 U	3.8 U	4.1 U	3.7 U	4.1 U	3.7 U
2-Methylnaphthalene	240,000	µg/kg	4.1 U	3.9 U	0.71 J	4.1 U	3.7 U	4.1 U	3.7 U
1-Methylnaphthalene	18,000	µg/kg	4.1 U	3.9 U	3.8 U	4.1 U	3.7 U	4.1 U	3.7 U
Acenaphthene	3,600,000	µg/kg	4.1 U	3.9 U	3.8 U	4.1 U	3.7 U	4.1 U	3.7 U
Fluorene	2,400,000	µg/kg	4.1 U	3.9 U	3.8 U	4.1 U	3.7 U	4.1 U	3.7 U
Anthracene	18,000,000	µg/kg	4.1 U	3.9 U	3.8 U	4.1 U	3.7 U	4.1 U	3.7 U
Fluoranthene	2,400,000	µg/kg	4.1 U	3.9 U	3.8 U	4.1 U	3.7 U	4.1 U	3.7 U
Pyrene	1,800,000	µg/kg	4.1 U	3.9 U	3.8 U	4.1 U	3.7 U	4.1 U	3.7 U
Benzo[a]anthracene	1,100	µg/kg	4.1 U	3.9 U	3.8 U	4.1 U	3.7 U	4.1 U	3.7 U
Chrysene	110,000	µg/kg	4.1 U	3.9 U	3.8 U	4.1 U	2.5 J	4.1 U	3.7 U
Benzo[b]fluoranthene	1,100	µg/kg	4.1 U	3.9 U	3.8 U	4.1 U	3.7 J	4.1 U	3.7 U
Benzo[k]floranthene	11,000	µg/kg	4.1 U	3.9 U	3.8 U	4.1 U	3.7 U	4.1 U	3.7 U
Benzo[a]pyrene	110	µg/kg	4.1 U	3.9 U	3.8 U	4.1 U	1.0 J	4.1 U	3.7 U
Indeno[1,2,3-cd]pyrene	1,100	µg/kg	4.1 U	3.9 U	3.8 U	4.1 U	3.7 U	4.1 U	3.7 U
Dibenz[a,h]anthracene	110	µg/kg	4.1 U	3.9 U	3.8 U	4.1 U	3.7 U	4.1 U	3.7 U
SVOC—PCB									
Aroclor 1016	4,100	mg/kg	0.020 U	0.019 U	0.018 U	0.020 U	0.018 U	0.020 U	0.018 U
Aroclor 1221	200	mg/kg	0.020 U	0.019 U	0.018 U	0.020 U	0.018 U	0.020 U	0.018 U
Aroclor 1232	170	mg/kg	0.020 U	0.019 U	0.018 U	0.020 U	0.018 U	0.020 U	0.018 U
Aroclor 1242	230	mg/kg	0.020 U	0.019 U	0.018 U	0.020 U	0.018 U	0.020 U	0.018 U
Aroclor 1248	230	mg/kg	0.020 U	0.019 U	0.018 U	0.020 U	0.018 U	0.020 U	0.018 U
Aroclor 1254	240	mg/kg	0.020 U	0.019 U	0.018 U	0.020 U	0.018 U	0.020 U	0.018 U
Aroclor 1260	240	mg/kg	0.012 U	0.012 U	0.011 U	0.012 U	0.011 U	0.012 U	0.011 U
SVOC-PCDD/PCDF									
2,3,7,8-TCDD	4.8	pg/g	0.50 U	0.47 U	0.69 J	0.50 U	0.45 U	0.5 U	0.44 U

Table 4. Contaminants of Potential Concern Results, 5.0 ft bgs

Analyte	Screening Level[1]	Lab Sample ID:	160-24848-8	160-24848-4	160-24924-2	160-24922-3	160-24922-10	160-24922-19	160-24922-25
		Sample Name:	SHAD041DP024SS03NS	SHAD041DP025SS03NS	SHAD041DP026SS03NS	SHAD041DP027SS03NS	SHAD041DP028SS03NS	SHAD041DP029SS03NS	SHAD041DP030SS03NS
		Location:	VSP-24	VSP-25	VSP-26	VSP-27	VSP-28	VSP-29	VSP-30
		Units							
VOCs									
1,1,1-Trichloroethane	1,700,000	µg/kg	0.92 U	1.0 U	1.3 U	0.93 U	1.1 U	1.1 U	1.0 U
1,1,2,2-Tetrachloroethane	600	µg/kg	0.92 U	1.0 U	1.3 U	0.93 U	1.1 U	1.1 U	1.0 U
1,1,2-Trichloroethane	1,100	µg/kg	0.92 U	1.0 U	1.3 U	0.93 U	1.1 U	1.1 U	1.0 U
1,1-Dichloroethane	3,600	µg/kg	0.92 U	1.0 U	1.3 U	0.93 U	1.1 U	1.1 U	1.0 U
1,1-Dichloroethene	230,000	µg/kg	4.6 U	5.1 U	6.4 U	4.7 U	5.3 U	5.5 U	5.1 U
1,2-Dichlorobenzene	1,800,000	µg/kg	0.92 U	1.0 U	1.3 U	0.93 U	1.1 U	1.1 U	1.0 U
1,2-Dichloroethane	460	µg/kg	0.92 U	1.0 U	1.3 U	0.93 U	1.1 U	1.1 U	1.0 U
cis-1,2-Dichloroethene	18,000	µg/kg	0.92 U	1.0 U	1.3 U	0.93 U	1.1 U	1.1 U	1.0 U
trans-1,2-Dichloroethene	130,000	µg/kg	0.92 U	1.0 U	1.3 U	0.93 U	1.1 U	1.1 U	1.0 U
1,2-Dichloropropane	2,500	µg/kg	0.92 U	1.0 U	1.3 U	0.93 U	1.1 U	1.1 U	1.0 U
cis-1,3-Dichloropropene	18,000	µg/kg	0.92 U	1.0 U	1.3 U	0.93 U	1.1 U	1.1 U	1.0 U
trans-1,3-Dichloropropene	580	µg/kg	0.92 U	1.0 U	1.3 U	0.93 U	1.1 U	1.1 U	1.0 U
1,4-Dichlorobenzene	2,600	µg/kg	0.92 U	1.0 U	1.3 U	0.93 U	1.1 U	1.1 U	1.0 U
Benzene	330	µg/kg	0.92 U	1.0 U	1.3 U	0.93 U	1.1 U	1.1 U	1.0 U
Bromodichloromethane	290	µg/kg	0.92 U	1.0 U	1.3 U	0.93 U	1.1 U	1.1 U	1.0 U
Bromoform	19,000	µg/kg	0.92 U	1.0 U	1.3 U	0.93 U	1.1 U	1.1 U	1.0 U
Carbon Tetrachloride	98	µg/kg	0.92 U	1.0 U	1.3 U	0.93 U	1.1 U	1.1 U	1.0 U
Chloroform	320	µg/kg	0.92 U	1.0 U	1.3 U	0.93 U	1.1 U	1.1 U	1.0 U
Chloromethane	110,000	µg/kg	4.6 U	5.1 U	6.4 U	4.7 U	5.3 U	5.5 U	5.1 U
Dibromochloromethane	940	µg/kg	0.92 U	1.0 U	1.3 U	0.93 U	1.1 U	1.1 U	1.0 U
Ethylbenzene	5,800	µg/kg	0.92 U	1.0 U	1.3 U	0.93 U	1.1 U	1.1 U	1.0 U
Methylene Chloride	1,800	µg/kg	4.6 U	5.1 U	6.4 U	4.7 U	5.3 U	5.5 U	5.1 U
Tetrachloroethene	590	µg/kg	0.92 U	1.0 U	1.3 U	0.93 U	1.1 U	1.1 U	1.0 U
Toluene	1,100,000	µg/kg	0.92 U	1.0 U	1.3 U	0.93 U	1.1 U	1.1 U	1.0 U
Trichloroethene	940	µg/kg	0.92 U	1.0 U	1.3 U	0.93 U	1.1 U	1.1 U	1.0 U
Vinyl Chloride	8.7	µg/kg	0.92 U	1.0 U	1.3 U	0.93 U	1.1 U	1.1 U	1.0 U
m-p-Xylene	580,000	µg/kg	4.6 U	5.1 U	6.4 U	4.7 U	5.3 U	5.5 U	5.1 U
o-Xylene			4.6 U	5.1 U	6.4 U	4.7 U	5.3 U	5.5 U	5.1 U

Table 4. Contaminants of Potential Concern Results, 5.0 ft bgs

Notes:

[1] The lower of the residential soil values from the November 2018 USEPA Regional Screening Level (where TR=1E-06; THQ=1.0) and HERO HHRA Note 3 DTSC-modified Screening Levels (June 2018).

Bolded value indicates exceedance of residential risk-based screening level (HERO, 2018; USEPA, 2018).
<u>Bolded and Underlined</u> value indicates exceedance of commercial/industrial risk-based screening level (HERO, 2018; USEPA, 2018).
( ) = Duplicate sample result
µg/kg = microgram per kilogram
J = Estimated
mg/kg = milligram per kilogram
PAH = Polynucluear Aromatic Hydrocarbons
PCB = Polychlorinated Biphenyls
PCDD/PCDF = Polychlorinated Dibenzodioxin/ Polychlorinated Dibenzofurans
pg/g = picogram per gram (parts per trillion)
SVOC = Semivolatile Organic Compounds
U = Non-detect
VOC = Volatile Organic Compounds

Table 5. Contaminants of Potential Concern Results, 10.0 ft bgs

Analyte	Screening Level[1]	Lab Sample ID:	160-24848-22	160-24917-10	160-24848-28	160-24925-2	160-24925-0	160-24851-4	160-24917-3
		Sample Name:	SHAD041DP0 02SS04NS	SHAD041DP0 04SS04NS	SHAD041DP0 06SS04NS	SHAD041DP0 08SS04NS	SHAD041DP0 10SS04NS	SHAD041DP0 11SS04NS	SHAD041DP0 12SS04NS
		Location:	VSP-2	VSP-4	VSP-6	VSP-8	VSP-10	VSP-11	VSP-12
		Units							
Inorganic Metals									
Chromium, Hexavalent	0.3	mg/kg	**6.4**	0.26 J (0.38 J)	0.12 J	**0.49**	**0.33 J**	0.25 J	0.28 J
Chromium	36,000	mg/kg	25	11 (13)	13	13	18	11	26
Lead	80	mg/kg	17	2.9 J (2.3 J)	3.6 J	2.9 J	2.0 J	3.2 J	3.2 J
SVOC—PAH									
Naphthalene	3,800	µg/kg	3.8 U	3.8 U	4.0 UJ	4.1 U	4.0 U	3.9 U	4.0 U
2-Methylnaphthalene	240,000	µg/kg	3.8 U	3.8 U	4.0 U	4.1 U	4.0 U	3.9 U	4.0 U
1-Methylnaphthalene	18,000	µg/kg	3.8 U	3.8 U	4.0 U	4.1 U	4.0 U	3.9 U	4.0 U
Acenaphthene	3,600,000	µg/kg	3.8 U	3.8 U	4.0 U	4.1 U	4.0 U	3.9 U	4.0 U
Fluorene	2,400,000	µg/kg	3.8 U	3.8 U	4.0 U	4.1 U	4.0 U	3.9 U	4.0 U
Anthracene	18,000,000	µg/kg	3.8 U	3.8 U	4.0 U	4.1 U	4.0 U	3.9 U	4.0 U
Fluoranthene	2,400,000	µg/kg	3.8 U	3.8 U	4.0 U	4.1 U	4.0 U	3.9 U	4.0 U
Pyrene	1,800,000	µg/kg	3.8 U	3.8 U	4.0 U	4.1 U	4.0 U	3.9 U	4.0 U
Benzo[a]anthracene	1,100	µg/kg	1.0 J	3.8 U	4.0 U	4.1 U	4.0 U	3.9 U	4.0 U
Chrysene	110,000	µg/kg	3.0 J	3.8 U	4.0 U	4.1 U	4.0 U	3.9 U	4.0 U
Benzo[b]fluoranthene	1,100	µg/kg	3.8 U	3.8 U	4.0 U	4.1 U	4.0 U	3.9 U	4.0 U
Benzo[k]floranthene	11,000	µg/kg	3.8 U	3.8 U	4.0 U	4.1 U	4.0 U	3.9 U	4.0 U
Benzo[a]pyrene	110	µg/kg	3.8 U	3.8 U	4.0 U	4.1 U	4.0 U	3.9 U	4.0 U
Indeno[1,2,3-cd]pyrene	1,100	µg/kg	3.8 U	3.8 U	4.0 U	4.1 U	4.0 U	3.9 U	4.0 U
Dibenz[a,h]anthracene	110	µg/kg	3.8 U	3.8 U	4.0 U	4.1 U	4.0 U	3.9 U	4.0 U
SVOC—PCB									
Aroclor 1016	4,100	mg/kg	0.018 U	0.018 U	0.019U	0.019 U	0.019 U	0.019 U	0.019 U
Aroclor 1221	200	mg/kg	0.018 U	0.018 U	0.019U	0.019 U	0.019 U	0.019 U	0.019 U
Aroclor 1232	170	mg/kg	0.018 U	0.018 U	0.019U	0.019 U	0.019 U	0.019 U	0.019 U
Aroclor 1242	230	mg/kg	0.018 U	0.018 U	0.019U	0.019 U	0.019 U	0.019 U	0.019 U
Aroclor 1248	230	mg/kg	0.018 U	0.018 U	0.019U	0.019 U	0.019 U	0.019 U	0.019 U
Aroclor 1254	240	mg/kg	0.018 U	0.018 U	0.019U	0.019 U	0.019 U	0.019 U	0.019 U
Aroclor 1260	240	mg/kg	0.011 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U	0.012 U
SVOC-PCDD/PCDF									
2,3,7,8-TCDD	4.8	pg/g	0.46 U	0.45 U	0.48 U	0.48 U	0.48 U	0.47 U	0.48 U

Table 5. Contaminants of Potential Concern Results, 10.0 ft bgs

Analyte		Lab Sample ID:	160-24848-22	160-24917-10	160-24848-28	160-24925-2	160-24925-0	160-24851-4	160-24917-3
		Sample Name:	SHAD041DP0 02SS04NS	SHAD041DP0 04SS04NS	SHAD041DP0 06SS04NS	SHAD041DP0 08SS04NS	SHAD041DP0 10SS04NS	SHAD041DP0 11SS04NS	SHAD041DP0 12SS04NS
	Screening Level[1]	Location: Units	VSP-2	VSP-4	VSP-6	VSP-8	VSP-10	VSP-11	VSP-12
VOCs									
1,1,1-Trichloroethane	1,700,000	µg/kg	0.97 U	1.2 U	1.2 U	1.1 U	0.96 U	1.1 U	0.92 U
1,1,2,2-Tetrachloroethane	600	µg/kg	0.97 U	1.2 U	1.2 U	1.1 U	0.96 U	1.1 U	0.92 U
1,1,2-Trichloroethane	1,100	µg/kg	0.97 U	1.2 U	1.2 U	1.1 U	0.96 U	1.1 U	0.92 U
1,1-Dichloroethane	3,600	µg/kg	0.97 U	1.2 U	1.2 U	1.1 U	0.96 U	1.1 U	0.92 U
1,1-Dichloroethene	230,000	µg/kg	4.9 U	5.8 U	5.8 U	5.3 U	4.8 U	5.3 U	4.6 U
1,2-Dichlorobenzene	1,800,000	µg/kg	0.97 U	1.2 U	1.2 U	1.1 U	0.96 U	1.1 U	0.92 U
1,2-Dichloroethane	460	µg/kg	0.97 U	1.2 U	1.2 U	1.1 U	0.96 U	1.1 U	0.92 U
cis-1,2-Dichloroethene	18,000	µg/kg	0.97 U	1.2 U	1.2 U	1.1 U	0.96 U	1.1 U	0.92 U
trans-1,2-Dichloroethene	130,000	µg/kg	0.97 U	1.2 U	1.2 U	1.1 U	0.96 U	1.1 U	0.92 U
1,2-Dichloropropane	2,500	µg/kg	0.97 U	1.2 U	1.2 U	1.1 U	0.96 U	1.1 U	0.92 U
cis-1,3-Dichloropropene	18,000	µg/kg	0.97 U	1.2 U	1.2 U	1.1 U	0.96 U	1.1 U	0.92 U
trans-1,3-Dichloropropene	580	µg/kg	0.97 U	1.2 U	1.2 U	1.1 U	0.96 U	1.1 U	0.92 U
1,4-Dichlorobenzene	2,600	µg/kg	0.97 U	1.2 U	1.2 U	1.1 U	0.96 U	1.1 U	0.92 U
Benzene	330	µg/kg	0.97 U	1.2 U	1.2 U	1.1 U	0.96 U	1.1 U	0.92 U
Bromodichloromethane	290	µg/kg	0.97 U	1.2 U	1.2 U	1.1 U	0.96 U	1.1 U	0.92 U
Bromoform	19,000	µg/kg	0.97 U	1.2 U	1.2 U	1.1 U	0.96 U	1.1 U	0.92 U
Carbon Tetrachloride	98	µg/kg	0.97 U	1.2 U	1.2 U	1.1 U	0.96 U	1.1 U	0.92 U
Chloroform	320	µg/kg	0.97 U	1.2 U	1.2 U	1.1 U	0.96 U	1.1 U	0.92 U
Chloromethane	110,000	µg/kg	4.9 U	5.8 U	5.8 U	5.3 U	4.8 U	5.3 U	4.6 U
Dibromochloromethane	940	µg/kg	0.97 U	1.2 U	1.2 U	1.1 U	0.96 U	1.1 U	0.92 U
Ethylbenzene	5,800	µg/kg	0.97 U	1.2 U	1.2 U	1.1 U	0.96 U	1.1 U	0.92 U
Methylene Chloride	1,800	µg/kg	4.9 U	5.8 U	5.8 U	5.3 U	4.8 U	5.3 U	4.6 U
Tetrachloroethene	590	µg/kg	0.97 U	1.2 U	1.2 U	1.1 U	0.96 U	1.1 U	0.92 U
Toluene	1,100,000	µg/kg	0.97 U	1.2 U	1.2 U	1.1 U	0.96 U	1.1 U	0.92 U
Trichloroethene	940	µg/kg	0.97 U	1.2 U	1.2 U	1.1 U	0.96 U	1.1 U	0.92 U
Vinyl Chloride	8.7	µg/kg	0.97 U	1.2 U	1.2 U	1.1 U	0.96 U	1.1 U	0.92 U
m-p-Xylene	580,000	µg/kg	4.9 U	5.8 U	5.8 U	5.3 U	4.8 U	5.3 U	4.6 U
o-Xylene			4.9 U	5.8 U	5.8 U	5.3 U	4.8 U	5.3 U	4.6 U

Table 5. Contaminants of Potential Concern Results, 10.0 ft bgs

		Lab Sample ID:	160-24924-16	160-24925-15	160-24917-19	160-24917-26	160-24848-13	160-24848-17	160-24924-10
		Sample Name:	SHAD041DP0 13SS04NS	SHAD041DP0 15SS04NS	SHAD041DP0 17SS04NS	SHAD041DP0 18SS04NS	SHAD041DP0 19SS04NS	SHAD041DP0 20SS04NS	SHAD041DP0 22SS04NS
Analyte	Screening Level[1]	Location: Units	VSP-13	VSP-15	VSP-17	VSP-18	VSP-19	VSP-20	VSP-22
Inorganic Metals									
Chromium, Hexavalent	0.3	mg/kg	**0.52**	**0.34 J**	**0.54**	0.30 J	0.27 J	0.18 J (0.14 J)	**0.46**
Chromium	36,000	mg/kg	9.8	13	18	18	11	7 (7.6)	11
Lead	80	mg/kg	1.6 J	4.2 J	3.6 J	3.5 J	3.8 J	2 J (2.4 J)	1.4 J
SVOC—PAH									
Naphthalene	3,800	µg/kg	3.9 U	3.5 U	4.0 U	4.1 U	4.0 U	3.7 U	3.8 U
2-Methylnaphthalene	240,000	µg/kg	3.9 U	3.5 U	4.0 U	4.1 U	4.0 U	3.7 U	3.8 U
1-Methylnaphthalene	18,000	µg/kg	3.9 U	3.5 U	4.0 U	4.1 U	4.0 U	3.7 U	3.8 U
Acenaphthene	3,600,000	µg/kg	3.9 U	3.5 U	4.0 U	4.1 U	4.0 U	3.7 U	3.8 U
Fluorene	2,400,000	µg/kg	3.9 U	3.5 U	4.0 U	4.1 U	4.0 U	3.7 U	3.8 U
Anthracene	18,000,000	µg/kg	3.9 U	3.5 U	4.0 U	4.1 U	4.0 U	3.7 U	3.8 U
Fluoranthene	2,400,000	µg/kg	3.9 U	3.5 U	4.0 U	4.1 U	4.0 U	3.7 U	3.8 U
Pyrene	1,800,000	µg/kg	3.9 U	3.5 U	4.0 U	4.1 U	4.0 U	3.7 U	3.8 U
Benzo[a]anthracene	1,100	µg/kg	3.9 U	3.5 U	4.0 U	4.1 U	4.0 U	3.7 U	3.8 U
Chrysene	110,000	µg/kg	3.9 U	3.5 U	4.0 U	4.1 U	4.0 U	3.7 U	3.8 U
Benzo[b]fluoranthene	1,100	µg/kg	3.9 U	3.5 U	4.0 U	4.1 U	4.0 U	3.7 U	3.8 U
Benzo[k]floranthene	11,000	µg/kg	3.9 U	3.5 U	4.0 U	4.1 U	4.0 U	3.7 U	3.8 U
Benzo[a]pyrene	110	µg/kg	3.9 U	3.5 U	4.0 U	4.1 U	4.0 U	3.7 U	3.8 U
Indeno[1,2,3-cd]pyrene	1,100	µg/kg	3.9 U	3.5 U	4.0 U	4.1 U	4.0 U	3.7 U	3.8 U
Dibenz[a,h]anthracene	110	µg/kg	3.9 U	3.5 U	4.0 U	4.1 U	4.0 U	3.7 U	3.8 U
SVOC—PCB									
Aroclor 1016	4,100	mg/kg	0.019 U	0.017 U	0.019 U	0.020 U	0.019 U	0.018 U	0.018 U
Aroclor 1221	200	mg/kg	0.019 U	0.017 U	0.019 U	0.020 U	0.019 U	0.018 U	0.018 U
Aroclor 1232	170	mg/kg	0.019 U	0.017 U	0.019 U	0.020 U	0.019 U	0.018 U	0.018 U
Aroclor 1242	230	mg/kg	0.019 U	0.017 U	0.019 U	0.020 U	0.019 U	0.018 U	0.018 U
Aroclor 1248	230	mg/kg	0.019 U	0.017 U	0.019 U	0.020 U	0.019 U	0.018 U	0.018 U
Aroclor 1254	240	mg/kg	0.019 U	0.017 U	0.019 U	0.020 U	0.019 U	0.018 U	0.018 U
Aroclor 1260	240	mg/kg	0.012 U	0.010 U	0.012 U	0.012 U	0.012 U	0.011 U	0.012 U
SVOC-PCDD/PCDF									
2,3,7,8-TCDD	4.8	pg/g	0.47 U	0.42 U	0.49 U	0.49 U	0.49 U	0.45 U	0.46 U

Table 5. Contaminants of Potential Concern Results, 10.0 ft bgs

Analyte	Screening Level^1	Lab Sample ID: / Sample Name: / Location: / Units	160-24924-16	160-24925-15	160-24917-19	160-24917-26	160-24848-13	160-24848-17	160-24924-10
		Sample Name:	SHAD041DP0 13SS04NS	SHAD041DP0 15SS04NS	SHAD041DP0 17SS04NS	SHAD041DP0 18SS04NS	SHAD041DP0 19SS04NS	SHAD041DP0 20SS04NS	SHAD041DP0 22SS04NS
		Location:	VSP-13	VSP-15	VSP-17	VSP-18	VSP-19	VSP-20	VSP-22
VOCs									
1,1,1-Trichloroethane	1,700,000	µg/kg	0.87 U	1.1 U	0.92 U	0.88 U	0.93 U	1.0 U	1.1 U
1,1,2,2-Tetrachloroethane	600	µg/kg	0.87 U	1.1 U	0.92 U	0.88 U	0.93 U	1.0 U	1.1 U
1,1,2-Trichloroethane	1,100	µg/kg	0.87 U	1.1 U	0.92 U	0.88 U	0.93 U	1.0 U	1.1 U
1,1-Dichloroethane	3,600	µg/kg	0.87 U	1.1 U	0.92 U	0.88 U	0.93 U	1.0 U	1.1 U
1,1-Dichloroethene	230,000	µg/kg	4.4 U	5.6 U	4.6 U	4.4 U	4.6 U	5.2 U	5.5 U
1,2-Dichlorobenzene	1,800,000	µg/kg	0.87 U	1.1 U	0.92 U	0.88 U	0.93 U	1.0 U	1.1 U
1,2-Dichloroethane	460	µg/kg	0.87 U	1.1 U	0.92 U	0.88 U	0.93 U	1.0 U	1.1 U
cis-1,2-Dichloroethene	18,000	µg/kg	0.87 U	1.1 U	0.92 U	0.88 U	0.93 U	1.0 U	1.1 U
trans-1,2-Dichloroethene	130,000	µg/kg	0.87 U	1.1 U	0.92 U	0.88 U	0.93 U	1.0 U	1.1 U
1,2-Dichloropropane	2,500	µg/kg	0.87 U	1.1 U	0.92 U	0.88 U	0.93 U	1.0 U	1.1 U
cis-1,3-Dichloropropene	18,000	µg/kg	0.87 U	1.1 U	0.92 U	0.88 U	0.93 U	1.0 U	1.1 U
trans-1,3-Dichloropropene	580	µg/kg	0.87 U	1.1 U	0.92 U	0.88 U	0.93 U	1.0 U	1.1 U
1,4-Dichlorobenzene	2,600	µg/kg	0.87 U	1.1 U	0.92 U	0.88 U	0.93 U	1.0 U	1.1 U
Benzene	330	µg/kg	0.87 U	1.1 U	0.92 U	0.88 U	0.93 U	1.0 U	1.1 U
Bromodichloromethane	290	µg/kg	0.87 U	1.1 U	0.92 U	0.88 U	0.93 U	1.0 U	1.1 U
Bromoform	19,000	µg/kg	0.87 U	1.1 U	0.92 U	0.88 U	0.93 U	1.0 U	1.1 U
Carbon Tetrachloride	98	µg/kg	0.87 U	1.1 U	0.92 U	0.88 U	0.93 U	1.0 U	1.1 U
Chloroform	320	µg/kg	0.87 U	1.1 U	0.92 U	0.88 U	0.93 U	1.0 U	1.1 U
Chloromethane	110,000	µg/kg	4.4 U	5.6 U	4.6 U	4.4 U	4.6 U	5.2 U	5.5 U
Dibromochloromethane	940	µg/kg	0.87 U	1.1 U	0.92 U	0.88 U	0.93 U	1.0 U	1.1 U
Ethylbenzene	5,800	µg/kg	0.87 U	1.1 U	0.92 U	0.88 U	0.93 U	1.0 U	1.1 U
Methylene Chloride	1,800	µg/kg	4.4 U	5.6 U	4.6 U	4.4 U	4.6 U	5.2 U	5.5 U
Tetrachloroethene	590	µg/kg	0.87 U	1.1 U	0.92 U	0.88 U	0.93 U	1.0 U	1.1 U
Toluene	1,100,000	µg/kg	0.87 U	1.1 U	0.92 U	0.88 U	0.93 U	1.0 U	1.1 U
Trichloroethene	940	µg/kg	0.87 U	1.1 U	0.92 U	0.88 U	0.93 U	1.0 U	1.1 U
Vinyl Chloride	8.7	µg/kg	0.87 U	1.1 U	0.92 U	0.88 U	0.93 U	1.0 U	1.1 U
m-p-Xylene	580,000	µg/kg	4.4 U	5.6 U	4.6 U	4.4 U	4.6 U	5.2 U	5.5 U
o-Xylene			4.4 U	5.6 U	4.6 U	4.4 U	4.6 U	5.2 U	5.5 U

Table 5. Contaminants of Potential Concern Results, 10.0 ft bgs

Analyte	Screening Level[1]	Lab Sample ID:	160-24848-9	160-24848-5	160-24924-3	160-24922-5	160-24922-11	160-24922-20	160-24922-26
		Sample Name:	SHAD041DP024SS04NS	SHAD041DP025SS04NS	SHAD041DP026SS04NS	SHAD041DP027SS04NS	SHAD041DP028SS04NS	SHAD041DP029SS04NS	SHAD041DP030SS04NS
		Location:	VSP-24	VSP-25	VSP-26	VSP-27	VSP-28	VSP-29	VSP-30
		Units							
Inorganic Metals									
Chromium, Hexavalent	0.3	mg/kg	0.28 J	**0.31 J**	**0.34 J**	**0.37 J (0.38 J)**	**0.52**	0.30 J	0.30 J (0.30 J)
Chromium	36,000	mg/kg	9.5	9.4	9.7	13 (13)	15	12	13 (14)
Lead	80	mg/kg	2.8 J	2.9 J	2.4 J	2.0 J (2.3 J)	3.7 J	2.4 J	2.8 J (2.3 J)
SVOC—PAH									
Naphthalene	3,800	µg/kg	4.0 U	3.8 U	3.7 U	3.8 U	3.9 U	3.9 U	4.1 U
2-Methylnaphthalene	240,000	µg/kg	4.0 U	3.8 U	3.7 U	3.8 U	3.9 U	3.9 U	4.1 U
1-Methylnaphthalene	18,000	µg/kg	4.0 U	3.8 U	3.7 U	3.8 U	3.9 U	3.9 U	4.1 U
Acenaphthene	3,600,000	µg/kg	4.0 U	3.8 U	3.7 U	3.8 U	3.9 U	3.9 U	4.1 U
Fluorene	2,400,000	µg/kg	4.0 U	3.8 U	3.7 U	3.8 U	3.9 U	3.9 U	4.1 U
Anthracene	18,000,000	µg/kg	4.0 U	3.8 U	3.7 U	3.8 U	3.9 U	3.9 U	4.1 U
Fluoranthene	2,400,000	µg/kg	4.0 U	3.8 U	3.7 U	3.8 U	3.9 U	3.9 U	4.1 U
Pyrene	1,800,000	µg/kg	4.0 U	3.8 U	3.7 U	3.8 U	3.9 U	3.9 U	4.1 U
Benzo[a]anthracene	1,100	µg/kg	4.0 U	3.8 U	3.7 U	3.8 U	3.9 U	3.9 U	4.1 U
Chrysene	110,000	µg/kg	4.0 U	3.8 U	3.7 U	3.8 U	3.9 U	3.9 U	4.1 U
Benzo[b]fluoranthene	1,100	µg/kg	4.0 U	3.8 U	3.7 U	3.8 U	3.9 U	3.9 U	4.1 U
Benzo[k]floranthene	11,000	µg/kg	4.0 U	3.8 U	3.7 U	3.8 U	3.9 U	3.9 U	4.1 U
Benzo[a]pyrene	110	µg/kg	4.0 U	3.8 U	3.7 U	3.8 U	3.9 U	3.9 U	4.1 U
Indeno[1,2,3-cd]pyrene	1,100	µg/kg	4.0 U	3.8 U	3.7 U	3.8 U	3.9 U	3.9 U	4.1 U
Dibenz[a,h]anthracene	110	µg/kg	4.0 U	3.8 U	3.7 U	3.8 U	3.9 U	3.9 U	4.1 U
SVOC—PCB									
Aroclor 1016	4,100	mg/kg	0.019 U	0.018 U	0.018 U	0.019 U	0.019 U	0.019 U	0.020 U
Aroclor 1221	200	mg/kg	0.019 U	0.018 U	0.018 U	0.019 U	0.019 U	0.019 U	0.020 U
Aroclor 1232	170	mg/kg	0.019 U	0.018 U	0.018 U	0.019 U	0.019 U	0.019 U	0.020 U
Aroclor 1242	230	mg/kg	0.019 U	0.018 U	0.018 U	0.019 U	0.019 U	0.019 U	0.020 U
Aroclor 1248	230	mg/kg	0.019 U	0.018 U	0.018 U	0.019 U	0.019 U	0.019 U	0.020 U
Aroclor 1254	240	mg/kg	0.019 U	0.018 U	0.018 U	0.019 U	0.019 U	0.019 U	0.020 U
Aroclor 1260	240	mg/kg	0.012 U	0.012 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U
SVOC-PCDD/PCDF									
2,3,7,8-TCDD	4.8	pg/g	0.48 U	0.46 U	0.44 U	0.47 U	0.48 U	0.48 U	0.50 U

Table 5. Contaminants of Potential Concern Results, 10.0 ft bgs

		Lab Sample ID:	160-24848-9	160-24848-5	160-24924-3	160-24922-5	160-24922-11	160-24922-20	160-24922-26
		Sample Name:	SHAD041DP024SS04NS	SHAD041DP025SS04NS	SHAD041DP026SS04NS	SHAD041DP027SS04NS	SHAD041DP028SS04NS	SHAD041DP029SS04NS	SHAD041DP030SS04NS
	Screening Level[1]	Location:	VSP-24	VSP-25	VSP-26	VSP-27	VSP-28	VSP-29	VSP-30
Analyte		Units							
VOCs									
1,1,1-Trichloroethane	1,700,000	µg/kg	1.0 U	0.97 U	0.82 U	0.84 U	1.0 U	0.98 U	0.96 U
1,1,2,2-Tetrachloroethane	600	µg/kg	1.0 U	0.97 U	0.82 U	0.84 U	1.0 U	0.98 U	0.96 U
1,1,2-Trichloroethane	1,100	µg/kg	1.0 U	0.97 U	0.82 U	0.84 U	1.0 U	0.98 U	0.96 U
1,1-Dichloroethane	3,600	µg/kg	1.0 U	0.97 U	0.82 U	0.84 U	1.0 U	0.98 U	0.96 U
1,1-Dichloroethene	230,000	µg/kg	5.2 U	4.9 U	4.1 U	4.2 U	5.0 U	4.9 U	4.8 U
1,2-Dichlorobenzene	1,800,000	µg/kg	1.0 U	0.97 U	0.82 U	0.84 U	1.0 U	0.98 U	0.96 U
1,2-Dichloroethane	460	µg/kg	1.0 U	0.97 U	0.82 U	0.84 U	1.0 U	0.98 U	0.96 U
cis-1,2-Dichloroethene	18,000	µg/kg	1.0 U	0.97 U	0.82 U	0.84 U	1.0 U	0.98 U	0.96 U
trans-1,2-Dichloroethene	130,000	µg/kg	1.0 U	0.97 U	0.82 U	0.84 U	1.0 U	0.98 U	0.96 U
1,2-Dichloropropane	2,500	µg/kg	1.0 U	0.97 U	0.82 U	0.84 U	1.0 U	0.98 U	0.96 U
cis-1,3-Dichloropropene	18,000	µg/kg	1.0 U	0.97 U	0.82 U	0.84 U	1.0 U	0.98 U	0.96 U
trans-1,3-Dichloropropene	580	µg/kg	1.0 U	0.97 U	0.82 U	0.84 U	1.0 U	0.98 U	0.96 U
1,4-Dichlorobenzene	2,600	µg/kg	1.0 U	0.97 U	0.82 U	0.84 U	1.0 U	0.98 U	0.96 U
Benzene	330	µg/kg	1.0 U	0.97 U	0.82 U	0.84 U	1.0 U	0.98 U	0.96 U
Bromodichloromethane	290	µg/kg	1.0 U	0.97 U	0.82 U	0.84 U	1.0 U	0.98 U	0.96 U
Bromoform	19,000	µg/kg	1.0 U	0.97 U	0.82 U	0.84 U	1.0 U	0.98 U	0.96 U
Carbon Tetrachloride	98	µg/kg	1.0 U	0.97 U	0.82 U	0.84 U	1.0 U	0.98 U	0.96 U
Chloroform	320	µg/kg	1.0 U	0.97 U	0.82 U	0.84 U	1.0 U	0.98 U	0.96 U
Chloromethane	110,000	µg/kg	5.2 U	4.9 U	4.1 U	4.2 U	5.0 U	4.9 U	4.8 U
Dibromochloromethane	940	µg/kg	1.0 U	0.97 U	0.82 U	0.84 U	1.0 U	0.98 U	0.96 U
Ethylbenzene	5,800	µg/kg	1.0 U	0.97 U	0.82 U	0.84 U	1.0 U	0.98 U	0.96 U
Methylene Chloride	1,800	µg/kg	5.2 U	4.9 U	4.1 U	4.2 U	5.0 U	4.9 U	4.8 U
Tetrachloroethene	590	µg/kg	1.0 U	0.97 U	0.82 U	0.84 U	1.0 U	0.98 U	0.96 U
Toluene	1,100,000	µg/kg	1.0 U	0.97 U	0.82 U	0.84 U	1.0 U	0.98 U	0.96 U
Trichloroethene	940	µg/kg	1.0 U	0.97 U	0.82 U	0.84 U	1.0 U	0.98 U	0.96 U
Vinyl Chloride	8.7	µg/kg	1.0 U	0.97 U	0.82 U	0.84 U	1.0 U	0.98 U	0.96 U
m-p-Xylene	580,000	µg/kg	5.2 U	4.9 U	4.1 U	4.2 U	5.0 U	4.9 U	4.8 U
o-Xylene			5.2 U	4.9 U	4.1 U	4.2 U	5.0 U	4.9 U	4.8 U

Table 5. Contaminants of Potential Concern Results, 10.0 ft bgs

Notes:

[1] The lower of the residential soil values from the November 2018 USEPA Regional Screening Level (where TR=1E-06; THQ=1.0) and HERO HHRA Note 3 DTSC-modified Screening Levels (June 2018).

Bolded value indicates exceedance of residential risk-based screening level (HERO, 2018; USEPA, 2018).

<u>Bolded and Underlined</u> value indicates exceedance of commercial/industrial risk-based screening level (HERO, 2018; USEPA, 2018).

( ) = Duplicate sample result
µg/kg = microgram per kilogram
J = Estimated
mg/kg = milligram per kilogram
PAH = Polynuclear Aromatic Hydrocarbons
PCB = Polychlorinated Biphenyls
PCDD/PCDF = Polychlorinated Dibenzodioxin/ Polychlorinated Dibenzofurans
pg/g = picogram per gram (parts per trillion)
SVOC = Semivolatile Organic Compounds
U = Non-detect
VOC = Volatile Organic Compounds

Table 6. Contaminants of Potential Concern Results, 12.5 ft bgs

		Lab Sample ID:	160-24848-23	160-24917-11	16024848-29	160-24925-3	160-24925-10	160-24851-5	160-24917-4
		Sample Name:	SHAD041DP0 02SS05NS	SHAD041DP0 04SS05NS	SHAD041DP0 06SS05NS	SHAD041DP0 08SS05NS	SHAD041DP0 10SS05NS	SHAD041DP0 11SS05NS	SHAD041DP0 12SS05NS
		Location:	VSP-2	VSP-4	VSP-6	VSP-8	VSP-10	VSP-11	VSP-12
Analyte	Screening Level[1]	Units							
Inorganic Metals									
Chromium, Hexavalent	0.3	mg/kg	**0.99**	**0.46 J**	**1.4**	**0.49**	0.15 J	**0.51**	**0.41 J**
Chromium	36,000	mg/kg	14	12	16	16	9.3	15	15
Lead	80	mg/kg	6.5	3.8 J	8.4	3.4 J	6.0 J	7.8	5.0 J
SVOC—PAH									
Naphthalene	3,800	µg/kg	4.4 U	4.2 U	4.4 U	4.2 U	3.5 U	4.3 U	4.1 U
2-Methylnaphthalene	240,000	µg/kg	4.4 U	4.2 U	4.4 U	4.2 U	3.5 U	4.3 U	4.1 U
1-Methylnaphthalene	18,000	µg/kg	4.4 U	4.2 U	4.4 U	4.2 U	3.5 U	4.3 U	4.1 U
Acenaphthene	3,600,000	µg/kg	4.4 U	4.2 U	4.4 U	4.2 U	3.5 U	4.3 U	4.1 U
Fluorene	2,400,000	µg/kg	4.4 U	4.2 U	4.4 U	4.2 U	3.5 U	4.3 U	4.1 U
Anthracene	18,000,000	µg/kg	4.4 U	4.2 U	4.4 U	4.2 U	3.5 U	4.3 U	4.1 U
Fluoranthene	2,400,000	µg/kg	4.4 U	4.2 U	4.4 U	4.2 U	3.5 U	4.3 U	4.1 U
Pyrene	1,800,000	µg/kg	4.4 U	4.2 U	4.4 U	4.2 U	3.5 U	4.3 U	4.1 U
Benzo[a]anthracene	1,100	µg/kg	4.4 U	4.2 U	4.4 U	4.2 U	3.5 U	4.3 U	4.1 U
Chrysene	110,000	µg/kg	4.4 U	4.2 U	4.4 U	4.2 U	3.5 U	4.3 U	4.1 U
Benzo[b]fluoranthene	1,100	µg/kg	4.4 U	4.2 U	4.4 U	4.2 U	3.5 U	4.3 U	4.1 U
Benzo[k]floranthene	11,000	µg/kg	4.4 U	4.2 U	4.4 U	4.2 U	3.5 U	4.3 U	4.1 U
Benzo[a]pyrene	110	µg/kg	4.4 U	4.2 U	4.4 U	4.2 U	3.5 U	4.3 U	4.1 U
Indeno[1,2,3-cd]pyrene	1,100	µg/kg	4.4 U	4.2 U	4.4 U	4.2 U	3.5 U	4.3 U	4.1 U
Dibenz[a,h]anthracene	110	µg/kg	4.4 U	4.2 U	4.4 U	4.2 U	3.5 U	4.3 U	4.1 U
SVOC—PCB									
Aroclor 1016	4,100	mg/kg	0.021 U	0.020 U	0.021 U	0.020 U	0.017 U	0.021 U	0.020 U
Aroclor 1221	200	mg/kg	0.021 U	0.020 U	0.021 U	0.020 U	0.017 U	0.021 U	0.020 U
Aroclor 1232	170	mg/kg	0.021 U	0.020 U	0.021 U	0.020 U	0.017 U	0.021 U	0.020 U
Aroclor 1242	230	mg/kg	0.021 U	0.020 U	0.021 U	0.020 U	0.017 U	0.021 U	0.020 U
Aroclor 1248	230	mg/kg	0.021 U	0.020 U	0.021 U	0.020 U	0.017 U	0.021 U	0.020 U
Aroclor 1254	240	mg/kg	0.021 U	0.020 U	0.021 U	0.020 U	0.017 U	0.021 U	0.020 U
Aroclor 1260	240	mg/kg	0.013 U	0.013 U	0.013 U	0.012 U	0.011 U	0.013 U	0.012 U
SVOC-PCDD/PCDF									
2,3,7,8-TCDD	4.8	pg/g	0.53 U	0.51 U	0.53 U	0.51 U	0.42 U	0.53 U	0.49 U

Table 6. Contaminants of Potential Concern Results, 12.5 ft bgs

		Lab Sample ID:	160-24848-23	160-24917-11	16024848-29	160-24925-3	160-24925-10	160-24851-5	160-24917-4
		Sample Name:	SHAD041DP0 02SS05NS	SHAD041DP0 04SS05NS	SHAD041DP0 06SS05NS	SHAD041DP0 08SS05NS	SHAD041DP0 10SS05NS	SHAD041DP0 11SS05NS	SHAD041DP0 12SS05NS
Analyte	Screening Level[1]	Location: Units	VSP-2	VSP-4	VSP-6	VSP-8	VSP-10	VSP-11	VSP-12
VOCs									
1,1,1-Trichloroethane	1,700,000	µg/kg	1.1 U	0.97 U	1.2 U	0.93 U	0.89 U	1.1 U	0.96 U
1,1,2,2-Tetrachloroethane	600	µg/kg	1.1 U	0.97 U	1.2 U	0.93 U	0.89 U	1.1 U	0.96 U
1,1,2-Trichloroethane	1,100	µg/kg	1.1 U	0.97 U	1.2 U	0.93 U	0.89 U	1.1 U	0.96 U
1,1-Dichloroethane	3,600	µg/kg	1.1 U	0.97 U	1.2 U	0.93 U	0.89 U	1.1 U	0.96 U
1,1-Dichloroethene	230,000	µg/kg	5.6 U	4.9 U	5.9 U	4.7 U	4.4 U	5.5 U	4.8 U
1,2-Dichlorobenzene	1,800,000	µg/kg	1.1 U	0.97 U	1.2 U	0.93 U	0.89 U	1.1 U	0.96 U
1,2-Dichloroethane	460	µg/kg	1.1 U	0.97 U	1.2 U	0.93 U	0.89 U	1.1 U	0.96 U
cis-1,2-Dichloroethene	18,000	µg/kg	1.1 U	0.97 U	1.2 U	0.93 U	0.89 U	1.1 U	0.96 U
trans-1,2-Dichloroethene	130,000	µg/kg	1.1 U	0.97 U	1.2 U	0.93 U	0.89 U	1.1 U	0.96 U
1,2-Dichloropropane	2,500	µg/kg	1.1 U	0.97 U	1.2 U	0.93 U	0.89 U	1.1 U	0.96 U
cis-1,3-Dichloropropene	18,000	µg/kg	1.1 U	0.97 U	1.2 U	0.93 U	0.89 U	1.1 U	0.96 U
trans-1,3-Dichloropropene	580	µg/kg	1.1 U	0.97 U	1.2 U	0.93 U	0.89 U	1.1 U	0.96 U
1,4-Dichlorobenzene	2,600	µg/kg	1.1 U	0.97 U	1.2 U	0.93 U	0.89 U	1.1 U	0.96 U
Benzene	330	µg/kg	1.1 U	0.97 U	1.2 U	0.93 U	0.89 U	1.1 U	0.96 U
Bromodichloromethane	290	µg/kg	1.1 U	0.97 U	1.2 U	0.93 U	0.89 U	1.1 U	0.96 U
Bromoform	19,000	µg/kg	1.1 U	0.97 U	1.2 U	0.93 U	0.89 U	1.1 U	0.96 U
Carbon Tetrachloride	98	µg/kg	1.1 U	0.97 U	1.2 U	0.93 U	0.89 U	1.1 U	0.96 U
Chloroform	320	µg/kg	1.1 U	0.97 U	1.2 U	0.93 U	0.89 U	1.1 U	0.96 U
Chloromethane	110,000	µg/kg	5.6 U	4.9 U	5.9 U	4.7 U	4.4 U	5.5 U	4.8 U
Dibromochloromethane	940	µg/kg	1.1 U	0.97 U	1.2 U	0.93 U	0.89 U	1.1 U	0.96 U
Ethylbenzene	5,800	µg/kg	1.1 U	0.97 U	1.2 U	0.93 U	0.89 U	1.1 U	0.96 U
Methylene Chloride	1,800	µg/kg	5.6 U	2.3 J	5.9 U	4.7 U	4.4 U	5.5 U	4.8 U
Tetrachloroethene	590	µg/kg	1.1 U	0.97 U	1.2 U	0.93 U	0.89 U	1.1 U	0.96 U
Toluene	1,100,000	µg/kg	1.1 U	0.97 U	1.2 U	0.93 U	0.89 U	1.1 U	0.96 U
Trichloroethene	940	µg/kg	1.1 U	0.97 U	1.2 U	0.41 J	0.89 U	1.1 U	0.96 U
Vinyl Chloride	8.7	µg/kg	1.1 U	0.97 U	1.2 U	0.93 U	0.89 U	1.1 U	0.96 U
m-p-Xylene	580,000	µg/kg	5.6 U	4.9 U	5.9 U	4.7 U	4.4 U	5.5 U	4.8 U
o-Xylene			5.6 U	4.9 U	5.9 U	4.7 U	4.4 U	5.5 U	4.8 U

Table 6. Contaminants of Potential Concern Results, 12.5 ft bgs

		Lab Sample ID:	160-24924-17	160-24925-16	160-24917-20	160-24917-27	NA	NA	160-24924-11
		Sample Name:	SHAD041DP0 13SS05NS	SHAD041DP0 15SS05NS	SHAD041DP0 17SS05NS	SHAD041DP0 18SS05NS	SHAD041DP0 19SS05NS	SHAD041DP0 20SS05NS	SHAD041DP0 22SS05NS
	Screening	Location:	VSP-13	VSP-15	VSP-17	VSP-18	VSP-19	VSP-20	VSP-22
Analyte	Level[1]	Units							
Inorganic Metals									
Chromium, Hexavalent	0.3	mg/kg	**0.57 (0.86)**	0.26 J	**2**	0.24 J	NS	NS	**1**
Chromium	36,000	mg/kg	17 (17)	17	17	14	NS	NS	9.4
Lead	80	mg/kg	6.3 (7.2)	4.2 J	8	4.3 J	NS	NS	2.6 J
SVOC—PAH									
Naphthalene	3,800	µg/kg	4.4 U	3.8 U	4.2 U	4.1 U	NS	NS	3.8 U
2-Methylnaphthalene	240,000	µg/kg	4.4 U	3.8 U	4.2 U	4.1 U	NS	NS	3.8 U
1-Methylnaphthalene	18,000	µg/kg	4.4 U	3.8 U	4.2 U	4.1 U	NS	NS	3.8 U
Acenaphthene	3,600,000	µg/kg	4.4 U	3.8 U	4.2 U	4.1 U	NS	NS	3.8 U
Fluorene	2,400,000	µg/kg	4.4 U	3.8 U	4.2 U	4.1 U	NS	NS	3.8 U
Anthracene	18,000,000	µg/kg	4.4 U	3.8 U	4.2 U	4.1 U	NS	NS	3.8 U
Fluoranthene	2,400,000	µg/kg	4.4 U	3.8 U	4.2 U	4.1 U	NS	NS	3.8 U
Pyrene	1,800,000	µg/kg	4.4 U	3.8 U	4.2 U	4.1 U	NS	NS	3.8 U
Benzo[a]anthracene	1,100	µg/kg	4.4 U	3.8 U	4.2 U	4.1 U	NS	NS	3.8 U
Chrysene	110,000	µg/kg	4.4 U	3.8 U	4.2 U	4.1 U	NS	NS	3.8 U
Benzo[b]fluoranthene	1,100	µg/kg	4.4 U	3.8 U	4.2 U	4.1 U	NS	NS	3.8 U
Benzo[k]floranthene	11,000	µg/kg	4.4 U	3.8 U	4.2 U	4.1 U	NS	NS	3.8 U
Benzo[a]pyrene	110	µg/kg	4.4 U	3.8 U	4.2 U	4.1 U	NS	NS	3.8 U
Indeno[1,2,3-cd]pyrene	1,100	µg/kg	4.4 U	3.8 U	4.2 U	4.1 U	NS	NS	3.8 U
Dibenz[a,h]anthracene	110	µg/kg	4.4 U	3.8 U	4.2 U	4.1 U	NS	NS	3.8 U
SVOC—PCB									
Aroclor 1016	4,100	mg/kg	0.021 U	0.019 U	0.020 U	0.020 U	NS	NS	0.018 U
Aroclor 1221	200	mg/kg	0.021 U	0.019 U	0.020 U	0.020 U	NS	NS	0.018 U
Aroclor 1232	170	mg/kg	0.021 U	0.019 U	0.020 U	0.020 U	NS	NS	0.018 U
Aroclor 1242	230	mg/kg	0.021 U	0.019 U	0.020 U	0.020 U	NS	NS	0.018 U
Aroclor 1248	230	mg/kg	0.021 U	0.019 U	0.020 U	0.020 U	NS	NS	0.018 U
Aroclor 1254	240	mg/kg	0.021 U	0.019 U	0.020 U	0.020 U	NS	NS	0.018 U
Aroclor 1260	240	mg/kg	0.013 U	0.012 U	0.013 U	0.012 U	NS	NS	0.011 U
SVOC-PCDD/PCDF									
2,3,7,8-TCDD	4.8	pg/g	0.53 U	0.47 U	0.51 U	0.50 U	NS	NS	0.46 U

Table 6. Contaminants of Potential Concern Results, 12.5 ft bgs

		Lab Sample ID:	**160-24924-17**	**160-24925-16**	**160-24917-20**	**160-24917-27**	**NA**	**NA**	**160-24924-11**
		Sample Name:	**SHAD041DP013SS05NS**	**SHAD041DP015SS05NS**	**SHAD041DP017SS05NS**	**SHAD041DP018SS05NS**	**SHAD041DP019SS05NS**	**SHAD041DP020SS05NS**	**SHAD041DP022SS05NS**
	Screening	**Location:**	**VSP-13**	**VSP-15**	**VSP-17**	**VSP-18**	**VSP-19**	**VSP-20**	**VSP-22**
Analyte	**Level^1**	**Units**							
VOCs									
1,1,1-Trichloroethane	1,700,000	µg/kg	1.2 U	0.86 U	1.1 U	1.0 U	NS	NS	1.1 U
1,1,2,2-Tetrachloroethane	600	µg/kg	1.2 U	0.86 U	1.1 U	1.0 U	NS	NS	1.1 U
1,1,2-Trichloroethane	1,100	µg/kg	1.2 U	0.86 U	1.1 U	1.0 U	NS	NS	1.1 U
1,1-Dichloroethane	3,600	µg/kg	1.2 U	0.86 U	1.1 U	1.0 U	NS	NS	1.1 U
1,1-Dichloroethene	230,000	µg/kg	5.9 U	4.3 U	5.3 U	5.2 U	NS	NS	5.4 U
1,2-Dichlorobenzene	1,800,000	µg/kg	1.2 U	0.86 U	1.1 U	1.0 U	NS	NS	1.1 U
1,2-Dichloroethane	460	µg/kg	1.2 U	0.86 U	1.1 U	1.0 U	NS	NS	1.1 U
cis-1,2-Dichloroethene	18,000	µg/kg	1.2 U	0.86 U	1.1 U	1.0 U	NS	NS	1.1 U
trans-1,2-Dichloroethene	130,000	µg/kg	1.2 U	0.86 U	1.1 U	1.0 U	NS	NS	1.1 U
1,2-Dichloropropane	2,500	µg/kg	1.2 U	0.86 U	1.1 U	1.0 U	NS	NS	1.1 U
cis-1,3-Dichloropropene	18,000	µg/kg	1.2 U	0.86 U	1.1 U	1.0 U	NS	NS	1.1 U
trans-1,3-Dichloropropene	580	µg/kg	1.2 U	0.86 U	1.1 U	1.0 U	NS	NS	1.1 U
1,4-Dichlorobenzene	2,600	µg/kg	1.2 U	0.86 U	1.1 U	1.0 U	NS	NS	1.1 U
Benzene	330	µg/kg	1.2 U	0.86 U	1.1 U	1.0 U	NS	NS	1.1 U
Bromodichloromethane	290	µg/kg	1.2 U	0.86 U	1.1 U	1.0 U	NS	NS	1.1 U
Bromoform	19,000	µg/kg	1.2 U	0.86 U	1.1 U	1.0 U	NS	NS	1.1 U
Carbon Tetrachloride	98	µg/kg	1.2 U	0.86 U	1.1 U	1.0 U	NS	NS	1.1 U
Chloroform	320	µg/kg	1.2 U	0.86 U	1.1 U	1.0 U	NS	NS	1.1 U
Chloromethane	110,000	µg/kg	5.9 U	4.3 U	5.3 U	5.2 U	NS	NS	5.4 U
Dibromochloromethane	940	µg/kg	1.2 U	0.86 U	1.1 U	1.0 U	NS	NS	1.1 U
Ethylbenzene	5,800	µg/kg	1.2 U	0.86 U	1.1 U	1.0 U	NS	NS	1.1 U
Methylene Chloride	1,800	µg/kg	5.9 U	4.3 U	5.3 U	5.2 U	NS	NS	5.4 U
Tetrachloroethene	590	µg/kg	1.2 U	0.86 U	1.1 U	1.0 U	NS	NS	1.1 U
Toluene	1,100,000	µg/kg	1.2 U	0.86 U	1.1 U	1.0 U	NS	NS	1.1 U
Trichloroethene	940	µg/kg	1.2 U	0.86 U	1.1 U	1.0 U	NS	NS	1.1 U
Vinyl Chloride	8.7	µg/kg	1.2 U	0.86 U	1.1 U	1.0 U	NS	NS	1.1 U
m-p-Xylene	580,000	µg/kg	5.9 U	4.3 U	5.3 U	5.2 U	NS	NS	5.4 U
o-Xylene			5.9 U	4.3 U	5.3 U	5.2 U	NS	NS	5.4 U

Table 6. Contaminants of Potential Concern Results, 12.5 ft bgs

		Lab Sample ID:	NA	NA	160-24924-4	160-24922-6	160-24922-12	160-24922-21	160-24922-28
		Sample Name:	SHAD041DP024SS05NS	SHAD041DP025SS05NS	SHAD041DP026SS05NS	SHAD041DP027SS05NS	SHAD041DP028SS05NS	SHAD041DP029SS05NS	SHAD041DP030SS05NS
	Screening	Location:	VSP-24	VSP-25	VSP-26	VSP-27	VSP-28	VSP-29	VSP-30
Analyte	Level[1]	Units							
Inorganic Metals									
Chromium, Hexavalent	0.3	mg/kg	NS	NS	**1.2 (1.1)**	**0.97**	**1.7**	0.18 J	**1.4**
Chromium	36,000	mg/kg	NS	NS	14 (15)	3.4	21	18	13
Lead	80	mg/kg	NS	NS	7.2 (8.9)	1.6	8.3	4.9 J	5.8
SVOC—PAH									
Naphthalene	3,800	µg/kg	NS	NS	4.1 U	4.4 U	4.7 U	3.7 U	3.8 U
2-Methylnaphthalene	240,000	µg/kg	NS	NS	4.1 U	4.4 U	4.7 U	3.7 U	3.8 U
1-Methylnaphthalene	18,000	µg/kg	NS	NS	4.1 U	4.4 U	4.7 U	3.7 U	3.8 U
Acenaphthene	3,600,000	µg/kg	NS	NS	4.1 U	4.4 U	4.7 U	3.7 U	3.8 U
Fluorene	2,400,000	µg/kg	NS	NS	4.1 U	4.4 U	4.7 U	3.7 U	3.8 U
Anthracene	18,000,000	µg/kg	NS	NS	4.1 U	4.4 U	4.7 U	3.7 U	3.8 U
Fluoranthene	2,400,000	µg/kg	NS	NS	4.1 U	4.4 U	4.7 U	3.7 U	3.8 U
Pyrene	1,800,000	µg/kg	NS	NS	4.1 U	4.4 U	4.7 U	3.7 U	3.8 U
Benzo[a]anthracene	1,100	µg/kg	NS	NS	4.1 U	4.4 U	4.7 U	3.7 U	3.8 U
Chrysene	110,000	µg/kg	NS	NS	4.1 U	4.4 U	4.7 U	3.7 U	3.8 U
Benzo[b]fluoranthene	1,100	µg/kg	NS	NS	4.1 U	4.4 U	4.7 U	3.7 U	3.8 U
Benzo[k]floranthene	11,000	µg/kg	NS	NS	4.1 U	4.4 U	4.7 U	3.7 U	3.8 U
Benzo[a]pyrene	110	µg/kg	NS	NS	4.1 U	4.4 U	4.7 U	3.7 U	3.8 U
Indeno[1,2,3-cd]pyrene	1,100	µg/kg	NS	NS	4.1 U	4.4 U	4.7 U	3.7 U	3.8 U
Dibenz[a,h]anthracene	110	µg/kg	NS	NS	4.1 U	4.4 U	4.7 U	3.7 U	3.8 U
SVOC—PCB									
Aroclor 1016	4,100	mg/kg	NS	NS	0.020 U	0.021 U	0.022 U	0.019 U	0.019 U
Aroclor 1221	200	mg/kg	NS	NS	0.020 U	0.021 U	0.022 U	0.019 U	0.019 U
Aroclor 1232	170	mg/kg	NS	NS	0.020 U	0.021 U	0.022 U	0.019 U	0.019 U
Aroclor 1242	230	mg/kg	NS	NS	0.020 U	0.021 U	0.022 U	0.019 U	0.019 U
Aroclor 1248	230	mg/kg	NS	NS	0.020 U	0.021 U	0.022 U	0.019 U	0.019 U
Aroclor 1254	240	mg/kg	NS	NS	0.020 U	0.021 U	0.022 U	0.019 U	0.019 U
Aroclor 1260	240	mg/kg	NS	NS	0.012 U	0.013 U	0.014 U	0.012 U	0.012 U
SVOC-PCDD/PCDF									
2,3,7,8-TCDD	4.8	pg/g	NS	NS	0.49 U	0.53 U	0.57 U	0.46 U	0.47 U

Table 6. Contaminants of Potential Concern Results, 12.5 ft bgs

		Lab Sample ID:	NA	NA	160-24924-4	160-24922-6	160-24922-12	160-24922-21	160-24922-28
		Sample Name:	SHAD041DP024SS05NS	SHAD041DP025SS05NS	SHAD041DP026SS05NS	SHAD041DP027SS05NS	SHAD041DP028SS05NS	SHAD041DP029SS05NS	SHAD041DP030SS05NS
Analyte	Screening Level[1]	Location: Units	VSP-24	VSP-25	VSP-26	VSP-27	VSP-28	VSP-29	VSP-30
VOCs									
1,1,1-Trichloroethane	1,700,000	µg/kg	NS	NS	1.1 U	1.0 U	1.2 U	0.97 U	1.0 U
1,1,2,2-Tetrachloroethane	600	µg/kg	NS	NS	1.1 U	1.0 U	1.2 U	0.97 U	1.0 U
1,1,2-Trichloroethane	1,100	µg/kg	NS	NS	1.1 U	1.0 U	1.2 U	0.97 U	1.0 U
1,1-Dichloroethane	3,600	µg/kg	NS	NS	1.1 U	1.0 U	1.2 U	0.97 U	1.0 U
1,1-Dichloroethene	230,000	µg/kg	NS	NS	5.7 U	5.1 U	6.1 U	4.9 U	5.1 U
1,2-Dichlorobenzene	1,800,000	µg/kg	NS	NS	1.1 U	1.0 U	1.2 U	0.97 U	1.0 U
1,2-Dichloroethane	460	µg/kg	NS	NS	1.1 U	1.0 U	1.2 U	0.97 U	1.0 U
cis-1,2-Dichloroethene	18,000	µg/kg	NS	NS	1.1 U	1.0 U	1.2 U	0.97 U	1.0 U
trans-1,2-Dichloroethene	130,000	µg/kg	NS	NS	1.1 U	1.0 U	1.2 U	0.97 U	1.0 U
1,2-Dichloropropane	2,500	µg/kg	NS	NS	1.1 U	1.0 U	1.2 U	0.97 U	1.0 U
cis-1,3-Dichloropropene	18,000	µg/kg	NS	NS	1.1 U	1.0 U	1.2 U	0.97 U	1.0 U
trans-1,3-Dichloropropene	580	µg/kg	NS	NS	1.1 U	1.0 U	1.2 U	0.97 U	1.0 U
1,4-Dichlorobenzene	2,600	µg/kg	NS	NS	1.1 U	1.0 U	1.2 U	0.97 U	1.0 U
Benzene	330	µg/kg	NS	NS	1.1 U	1.0 U	1.2 U	0.97 U	1.0 U
Bromodichloromethane	290	µg/kg	NS	NS	1.1 U	1.0 U	1.2 U	0.97 U	1.0 U
Bromoform	19,000	µg/kg	NS	NS	1.1 U	1.0 U	1.2 U	0.97 U	1.0 U
Carbon Tetrachloride	98	µg/kg	NS	NS	1.1 U	1.0 U	1.2 U	0.97 U	1.0 U
Chloroform	320	µg/kg	NS	NS	1.1 U	1.0 U	1.2 U	0.97 U	1.0 U
Chloromethane	110,000	µg/kg	NS	NS	5.7 U	5.1 U	6.1 U	4.9 U	5.1 U
Dibromochloromethane	940	µg/kg	NS	NS	1.1 U	1.0 U	1.2 U	0.97 U	1.0 U
Ethylbenzene	5,800	µg/kg	NS	NS	1.1 U	1.0 U	1.2 U	0.97 U	1.0 U
Methylene Chloride	1,800	µg/kg	NS	NS	5.7 U	5.1 U	6.1 U	4.9 U	5.1 U
Tetrachloroethene	590	µg/kg	NS	NS	1.1 U	1.0 U	1.2 U	0.97 U	1.0 U
Toluene	1,100,000	µg/kg	NS	NS	1.1 U	1.0 U	1.2 U	0.97 U	1.0 U
Trichloroethene	940	µg/kg	NS	NS	1.1 U	1.0 U	1.2 U	0.97 U	1.0 U
Vinyl Chloride	8.7	µg/kg	NS	NS	1.1 U	1.0 U	1.2 U	0.97 U	1.0 U
m-p-Xylene	580,000	µg/kg	NS	NS	5.7 U	5.1 U	6.1 U	4.9 U	5.1 U
o-Xylene			NS	NS	5.7 U	5.1 U	6.1 U	4.9 U	5.1 U

Table 6. Contaminants of Potential Concern Results, 12.5 ft bgs

Notes:

[1] The lower of the residential soil values from the November 2018 USEPA Regional Screening Level (where TR=1E-06; THQ=1.0) and HERO HHRA Note 3 DTSC-modified Screening Levels (June 2018).

Bolded value indicates exceedance of residential risk-based screening level (HERO, 2018; USEPA, 2018).

( ) = Duplicate sample result
µg/kg = microgram per kilogram
J = Estimated
mg/kg = milligram per kilogram
NA = not applicable
NS = not sampled
PAH = Polynuclear Aromatic Hydrocarbons
PCB = Polychlorinated Biphenyls
PCDD/PCDF = Polychlorinated Dibenzodioxin/ Polychlorinated Dibenzofurans
pg/g = picogram per gram (parts per trillion)
SVOC = Semivolatile Organic Compounds
U = Non-detect
VOC = Volatile Organic Compounds

Table 7. Contaminants of Potential Concern Results, 15.0 ft bgs

Analyte		Lab Sample ID:	160-24848-24	160-24917-12	160-24848-30	160-24925-4	160-24925-11	160-24851-6	160-24917-5
		Sample Name:	SHAD041DP0 02SS06NS	SHAD041DP0 04SS06NS	SHAD041DP0 06SS06NS	SHAD041DP0 08SS06NS	SHAD041DP0 10SS06NS	SHAD041DP0 11SS06NS	SHAD041DP0 12SS06NS
	Screening Level[1]	Location: Units	VSP-2	VSP-4	VSP-6	VSP-8	VSP-10	VSP-11	VSP-12
Inorganic Metals									
Chromium, Hexavalent	0.3	mg/kg	0.23 J	0.25 J	0.24 J	0.28 J	0.24 J	0.27 J	0.12 J
Chromium	36,000	mg/kg	13	20	15	13	23	15	13
Lead	80	mg/kg	4.2 J	4.8 J	5.5	2.3 J	6	5.3 J	4.3 J
SVOC—PAH									
Naphthalene	3,800	µg/kg	4.0 U	3.9 U	4.1 U	3.9 U	4.3 U	4.2 U	3.9 U
2-Methylnaphthalene	240,000	µg/kg	4.0 U	3.9 U	4.1 U	3.9 U	4.3 U	4.2 U	3.9 U
1-Methylnaphthalene	18,000	µg/kg	4.0 U	3.9 U	4.1 U	3.9 U	4.3 U	4.2 U	3.9 U
Acenaphthene	3,600,000	µg/kg	4.0 U	3.9 U	4.1 U	3.9 U	4.3 U	4.2 U	3.9 U
Fluorene	2,400,000	µg/kg	4.0 U	3.9 U	4.1 U	3.9 U	4.3 U	4.2 U	3.9 U
Anthracene	18,000,000	µg/kg	4.0 U	3.9 U	4.1 U	3.9 U	4.3 U	4.2 U	3.9 U
Fluoranthene	2,400,000	µg/kg	4.0 U	3.9 U	4.1 U	3.9 U	4.3 U	4.2 U	3.9 U
Pyrene	1,800,000	µg/kg	4.0 U	3.9 U	4.1 U	3.9 U	4.3 U	4.2 U	3.9 U
Benzo[a]anthracene	1,100	µg/kg	4.0 U	3.9 U	4.1 U	3.9 U	4.3 U	4.2 U	3.9 U
Chrysene	110,000	µg/kg	4.0 U	3.9 U	4.1 U	3.9 U	4.3 U	4.2 U	3.9 U
Benzo[b]fluoranthene	1,100	µg/kg	4.0 U	3.9 U	4.1 U	3.9 U	4.3 U	4.2 U	3.9 U
Benzo[k]floranthene	11,000	µg/kg	4.0 U	3.9 U	4.1 U	3.9 U	4.3 U	4.2 U	3.9 U
Benzo[a]pyrene	110	µg/kg	4.0 U	3.9 U	4.1 U	3.9 U	4.3 U	4.2 U	3.9 U
Indeno[1,2,3-cd]pyrene	1,100	µg/kg	4.0 U	3.9 U	4.1 U	3.9 U	4.3 U	4.2 U	3.9 U
Dibenz[a,h]anthracene	110	µg/kg	4.0 U	3.9 U	4.1 U	3.9 U	4.3 U	4.2 U	3.9 U
SVOC—PCB									
Aroclor 1016	4,100	mg/kg	0.019 U	0.018 U	0.019U	0.019 U	0.021 U	0.020 U	0.019 U
Aroclor 1221	200	mg/kg	0.019 U	0.018 U	0.019U	0.019 U	0.021 U	0.020 U	0.019 U
Aroclor 1232	170	mg/kg	0.019 U	0.018 U	0.019U	0.019 U	0.021 U	0.020 U	0.019 U
Aroclor 1242	230	mg/kg	0.019 U	0.018 U	0.019U	0.019 U	0.021 U	0.020 U	0.019 U
Aroclor 1248	230	mg/kg	0.019 U	0.018 U	0.019U	0.019 U	0.021 U	0.020 U	0.019 U
Aroclor 1254	240	mg/kg	0.019 U	0.018 U	0.019U	0.019 U	0.021 U	0.020 U	0.019 U
Aroclor 1260	240	mg/kg	0.012 U	0.011 U	0.012 U	0.012 U	0.013 U	0.013 U	0.012 U
SVOC-PCDD/PCDF									
2,3,7,8-TCDD	4.8	pg/g	0.48 U	0.46 U	0.49 U	0.48 U	0.52 U	0.51 U	0.46

Table 7. Contaminants of Potential Concern Results, 15.0 ft bgs

Analyte	Screening Level[1]	Lab Sample ID:	160-24848-24	160-24917-12	160-24848-30	160-24925-4	160-24925-11	160-24851-6	160-24917-5
		Sample Name:	SHAD041DP002SS06NS	SHAD041DP004SS06NS	SHAD041DP006SS06NS	SHAD041DP008SS06NS	SHAD041DP010SS06NS	SHAD041DP011SS06NS	SHAD041DP012SS06NS
		Location: Units	VSP-2	VSP-4	VSP-6	VSP-8	VSP-10	VSP-11	VSP-12
VOCs									
1,1,1-Trichloroethane	1,700,000	µg/kg	0.90 U	0.79 U	1.1 U	0.78 U	1.1 U	1.0 U	0.87 U
1,1,2,2-Tetrachloroethane	600	µg/kg	0.90 U	0.79 U	1.1 U	0.78 U	1.1 U	1.0 U	0.87 U
1,1,2-Trichloroethane	1,100	µg/kg	0.90 U	0.79 U	1.1 U	0.78 U	1.1 U	1.0 U	0.87 U
1,1-Dichloroethane	3,600	µg/kg	0.90 U	0.79 U	1.1 U	0.78 U	1.1 U	1.0 U	0.87 U
1,1-Dichloroethene	230,000	µg/kg	4.5 U	4.0 U	5.4 U	3.9 U	5.4 U	5.0 U	4.3 U
1,2-Dichlorobenzene	1,800,000	µg/kg	0.90 U	0.79 U	1.1 U	0.78 U	1.1 U	1.0 U	0.87 U
1,2-Dichloroethane	460	µg/kg	0.90 U	0.79 U	1.1 U	0.78 U	1.1 U	1.0 U	0.87 U
cis-1,2-Dichloroethene	18,000	µg/kg	0.90 U	0.79 U	1.1 U	0.78 U	1.1 U	1.0 U	0.87 U
trans-1,2-Dichloroethene	130,000	µg/kg	0.90 U	0.79 U	1.1 U	0.78 U	1.1 U	1.0 U	0.87 U
1,2-Dichloropropane	2,500	µg/kg	0.90 U	0.79 U	1.1 U	0.78 U	1.1 U	1.0 U	0.87 U
cis-1,3-Dichloropropene	18,000	µg/kg	0.90 U	0.79 U	1.1 U	0.78 U	1.1 U	1.0 U	0.87 U
trans-1,3-Dichloropropene	580	µg/kg	0.90 U	0.79 U	1.1 U	0.78 U	1.1 U	1.0 U	0.87 U
1,4-Dichlorobenzene	2,600	µg/kg	0.90 U	0.79 U	1.1 U	0.78 U	1.1 U	1.0 U	0.87 U
Benzene	330	µg/kg	0.90 U	0.79 U	1.1 U	0.78 U	1.1 U	1.0 U	0.87 U
Bromodichloromethane	290	µg/kg	0.90 U	0.79 U	1.1 U	0.78 U	1.1 U	1.0 U	0.87 U
Bromoform	19,000	µg/kg	0.90 U	0.79 U	1.1 U	0.78 U	1.1 U	1.0 U	0.87 U
Carbon Tetrachloride	98	µg/kg	0.90 U	0.79 U	1.1 U	0.78 U	1.1 U	1.0 U	0.87 U
Chloroform	320	µg/kg	0.90 U	0.79 U	1.1 U	0.78 U	1.1 U	1.0 U	0.87 U
Chloromethane	110,000	µg/kg	4.5 U	4.0 U	5.4 U	3.9 U	5.4 U	5.0 U	4.3 U
Dibromochloromethane	940	µg/kg	0.90 U	0.79 U	1.1 U	0.78 U	1.1 U	1.0 U	0.87 U
Ethylbenzene	5,800	µg/kg	0.90 U	0.79 U	1.1 U	0.78 U	1.1 U	1.0 U	0.87 U
Methylene Chloride	1,800	µg/kg	4.5 U	2.2 J	5.4 U	3.9 U	5.4 U	5.0 U	4.3 U
Tetrachloroethene	590	µg/kg	0.90 U	0.79 U	1.1 U	0.78 U	1.1 U	1.0 U	0.87 U
Toluene	1,100,000	µg/kg	0.90 U	0.79 U	1.1 U	0.78 U	1.1 U	1.0 U	0.87 U
Trichloroethene	940	µg/kg	0.90 U	0.79 U	1.1 U	0.78 U	1.1 U	1.0 U	0.87 U
Vinyl Chloride	8.7	µg/kg	0.90 U	0.79 U	1.1 U	0.78 U	1.1 U	1.0 U	0.87 U
m-p-Xylene	580,000	µg/kg	4.5 U	4.0 U	5.4 U	3.9 U	5.4 U	5.0 U	4.3 U
o-Xylene			4.5 U	4.0 U	5.4 U	3.9 U	5.4 U	5.0 U	4.3 U

Table 7. Contaminants of Potential Concern Results, 15.0 ft bgs

Analyte		Lab Sample ID:	160-24924-19	160-24925-17	160-24917-21	160-24917-28	NA	NA	160-24924-12
		Sample Name:	SHAD041DP0 13SS06NS	SHAD041DP0 15SS06NS	SHAD041DP0 17SS06NS	SHAD041DP0 18SS06NS	SHAD041DP0 19SS06NS	SHAD041DP0 20SS06NS	SHAD041DP0 22SS06NS
	Screening Level[1]	Location:	VSP-13	VSP-15	VSP-17	VSP-18	VSP-19	VSP-20	VSP-22
		Units							
Inorganic Metals									
Chromium, Hexavalent	0.3	mg/kg	0.24 J	0.23 J	**0.36 J (0.30 J)**	0.27 J	NS	NS	0.23 J
Chromium	36,000	mg/kg	15	21	16 (16)	15	NS	NS	19
Lead	80	mg/kg	7.2	5.0 J	5.3 (5.4)	4.9	NS	NS	4.8 J
SVOC—PAH									
Naphthalene	3,800	µg/kg	3.9 U	4.1 U	3.8 U	3.7 U	NS	NS	3.7 U
2-Methylnaphthalene	240,000	µg/kg	3.9 U	4.1 U	3.8 U	3.7 U	NS	NS	3.7 U
1-Methylnaphthalene	18,000	µg/kg	3.9 U	4.1 U	3.8 U	3.7 U	NS	NS	3.7 U
Acenaphthene	3,600,000	µg/kg	3.9 U	4.1 U	3.8 U	3.7 U	NS	NS	3.7 U
Fluorene	2,400,000	µg/kg	3.9 U	4.1 U	3.8 U	3.7 U	NS	NS	3.7 U
Anthracene	18,000,000	µg/kg	3.9 U	4.1 U	3.8 U	3.7 U	NS	NS	3.7 U
Fluoranthene	2,400,000	µg/kg	3.9 U	4.1 U	3.8 U	3.7 U	NS	NS	3.7 U
Pyrene	1,800,000	µg/kg	3.9 U	4.1 U	3.8 U	3.7 U	NS	NS	3.7 U
Benzo[a]anthracene	1,100	µg/kg	3.9 U	4.1 U	3.8 U	3.7 U	NS	NS	3.7 U
Chrysene	110,000	µg/kg	3.9 U	4.1 U	3.8 U	3.7 U	NS	NS	3.7 U
Benzo[b]fluoranthene	1,100	µg/kg	3.9 U	4.1 U	3.8 U	3.7 U	NS	NS	3.7 U
Benzo[k]floranthene	11,000	µg/kg	3.9 U	4.1 U	3.8 U	3.7 U	NS	NS	3.7 U
Benzo[a]pyrene	110	µg/kg	3.9 U	4.1 U	3.8 U	3.7 U	NS	NS	3.7 U
Indeno[1,2,3-cd]pyrene	1,100	µg/kg	3.9 U	4.1 U	3.8 U	3.7 U	NS	NS	3.7 U
Dibenz[a,h]anthracene	110	µg/kg	3.9 U	4.1 U	3.8 U	3.7 U	NS	NS	3.7 U
SVOC—PCB									
Aroclor 1016	4,100	mg/kg	0.019 U	0.020 U	0.018 U	0.018 U	NS	NS	0.018 U
Aroclor 1221	200	mg/kg	0.019 U	0.020 U	0.018 U	0.018 U	NS	NS	0.018 U
Aroclor 1232	170	mg/kg	0.019 U	0.020 U	0.018 U	0.018 U	NS	NS	0.018 U
Aroclor 1242	230	mg/kg	0.019 U	0.020 U	0.018 U	0.018 U	NS	NS	0.018 U
Aroclor 1248	230	mg/kg	0.019 U	0.020 U	0.018 U	0.018 U	NS	NS	0.018 U
Aroclor 1254	240	mg/kg	0.019 U	0.020 U	0.018 U	0.018 U	NS	NS	0.018 U
Aroclor 1260	240	mg/kg	0.012 U	0.012 U	0.012 U	0.011 U	NS	NS	0.011 U
SVOC-PCDD/PCDF									
2,3,7,8-TCDD	4.8	pg/g	0.47 U	0.49 U	0.46 U	0.50 U	NS	NS	0.44 U

Table 7. Contaminants of Potential Concern Results, 15.0 ft bgs

	Lab Sample ID:		160-24924-19	160-24925-17	160-24917-21	160-24917-28	NA	NA	160-24924-12
	Sample Name:		SHAD041DP0 13SS06NS	SHAD041DP0 15SS06NS	SHAD041DP0 17SS06NS	SHAD041DP0 18SS06NS	SHAD041DP0 19SS06NS	SHAD041DP0 20SS06NS	SHAD041DP0 22SS06NS
Analyte	Screening Level[1]	Location: Units	VSP-13	VSP-15	VSP-17	VSP-18	VSP-19	VSP-20	VSP-22
VOCs									
1,1,1-Trichloroethane	1,700,000	µg/kg	1.1 U	1.1 U	0.95 U	0.81 U	NS	NS	1.1 U
1,1,2,2-Tetrachloroethane	600	µg/kg	1.1 U	1.1 U	0.95 U	0.81 U	NS	NS	1.1 U
1,1,2-Trichloroethane	1,100	µg/kg	1.1 U	1.1 U	0.95 U	0.81 U	NS	NS	1.1 U
1,1-Dichloroethane	3,600	µg/kg	1.1 U	1.1 U	0.95 U	0.81 U	NS	NS	1.1 U
1,1-Dichloroethene	230,000	µg/kg	5.5 U	5.7 U	4.8 U	4.1 U	NS	NS	5.7 U
1,2-Dichlorobenzene	1,800,000	µg/kg	1.1 U	1.1 U	0.95 U	0.81 U	NS	NS	1.1 U
1,2-Dichloroethane	460	µg/kg	1.1 U	1.1 U	0.95 U	0.81 U	NS	NS	1.1 U
cis-1,2-Dichloroethene	18,000	µg/kg	1.1 U	1.1 U	0.95 U	0.81 U	NS	NS	1.1 U
trans-1,2-Dichloroethene	130,000	µg/kg	1.1 U	1.1 U	0.95 U	0.81 U	NS	NS	1.1 U
1,2-Dichloropropane	2,500	µg/kg	1.1 U	1.1 U	0.95 U	0.81 U	NS	NS	1.1 U
cis-1,3-Dichloropropene	18,000	µg/kg	1.1 U	1.1 U	0.95 U	0.81 U	NS	NS	1.1 U
trans-1,3-Dichloropropene	580	µg/kg	1.1 U	1.1 U	0.95 U	0.81 U	NS	NS	1.1 U
1,4-Dichlorobenzene	2,600	µg/kg	1.1 U	1.1 U	0.95 U	0.81 U	NS	NS	1.1 U
Benzene	330	µg/kg	1.1 U	1.1 U	0.95 U	0.81 U	NS	NS	1.1 U
Bromodichloromethane	290	µg/kg	1.1 U	1.1 U	0.95 U	0.81 U	NS	NS	1.1 U
Bromoform	19,000	µg/kg	1.1 U	1.1 U	0.95 U	0.81 U	NS	NS	1.1 U
Carbon Tetrachloride	98	µg/kg	1.1 U	1.1 U	0.95 U	0.81 U	NS	NS	1.1 U
Chloroform	320	µg/kg	1.1 U	1.1 U	0.95 U	0.81 U	NS	NS	1.1 U
Chloromethane	110,000	µg/kg	5.5 U	5.7 U	4.8 U	4.1 U	NS	NS	5.7 U
Dibromochloromethane	940	µg/kg	1.1 U	1.1 U	0.95 U	0.81 U	NS	NS	1.1 U
Ethylbenzene	5,800	µg/kg	1.1 U	1.1 U	0.95 U	0.81 U	NS	NS	1.1 U
Methylene Chloride	1,800	µg/kg	5.5 U	5.7 U	3.9 J (3.6 J)	4.1 U	NS	NS	5.7 U
Tetrachloroethene	590	µg/kg	1.1 U	1.1 U	0.95 U	0.81 U	NS	NS	1.1 U
Toluene	1,100,000	µg/kg	1.1 U	1.1 U	0.95 U	0.81 U	NS	NS	1.1 U
Trichloroethene	940	µg/kg	1.1 U	1.1 U	0.95 U	0.81 U	NS	NS	1.1 U
Vinyl Chloride	8.7	µg/kg	1.1 U	1.1 U	0.95 U	0.81 U	NS	NS	1.1 U
m-p-Xylene	580,000	µg/kg	5.5 U	5.7 U	4.8 U	4.1 U	NS	NS	5.7 U
o-Xylene			5.5 U	5.7 U	4.8 U	4.1 U	NS	NS	5.7 U

Table 7. Contaminants of Potential Concern Results, 15.0 ft bgs

Analyte	Screening Level[1]	Lab Sample ID:	NA	NA	160-24924-6	160-24922-7	160-24922-13	160-24922-22	160-24922-29
		Sample Name:	SHAD041DP0 24SS06NS	SHAD041DP0 25SS06NS	SHAD041DP0 26SS06NS	SHAD041DP0 27SS06NS	SHAD041DP0 28SS06NS	SHAD041DP0 29SS06NS	SHAD041DP0 30SS06NS
		Location:	VSP-24	VSP-25	VSP-26	VSP-27	VSP-28	VSP-29	VSP-30
		Units							
Inorganic Metals									
Chromium, Hexavalent	0.3	mg/kg	NS	NS	**0.39 J**	**0.41 J**	**0.43 J (0.42)**	0.18 J	0.29 J
Chromium	36,000	mg/kg	NS	NS	18	16	13 (16)	17	12
Lead	80	mg/kg	NS	NS	5.5 J	4.2 J	5.0 J (4.5 J)	5.0 J	3.4 J
SVOC—PAH									
Naphthalene	3,800	µg/kg	NS	NS	3.8 U	4.0 U	4.0 U	3.8 U	3.8 U
2-Methylnaphthalene	240,000	µg/kg	NS	NS	3.8 U	4.0 U	4.0 U	3.8 U	0.60 J
1-Methylnaphthalene	18,000	µg/kg	NS	NS	3.8 U	4.0 U	4.0 U	3.8 U	3.8 U
Acenaphthene	3,600,000	µg/kg	NS	NS	3.8 U	4.0 U	4.0 U	3.8 U	3.8 U
Fluorene	2,400,000	µg/kg	NS	NS	3.8 U	4.0 U	4.0 U	3.8 U	3.8 U
Anthracene	18,000,000	µg/kg	NS	NS	3.8 U	4.0 U	4.0 U	3.8 U	3.8 U
Fluoranthene	2,400,000	µg/kg	NS	NS	3.8 U	4.0 U	4.0 U	3.8 U	3.8 U
Pyrene	1,800,000	µg/kg	NS	NS	3.8 U	4.0 U	4.0 U	3.8 U	3.8 U
Benzo[a]anthracene	1,100	µg/kg	NS	NS	3.8 U	4.0 U	4.0 U	3.8 U	3.8 U
Chrysene	110,000	µg/kg	NS	NS	3.8 U	4.0 U	4.0 U	3.8 U	3.8 U
Benzo[b]fluoranthene	1,100	µg/kg	NS	NS	3.8 U	4.0 U	4.0 U	3.8 U	3.8 U
Benzo[k]floranthene	11,000	µg/kg	NS	NS	3.8 U	4.0 U	4.0 U	3.8 U	3.8 U
Benzo[a]pyrene	110	µg/kg	NS	NS	3.8 U	4.0 U	4.0 U	3.8 U	3.8 U
Indeno[1,2,3-cd]pyrene	1,100	µg/kg	NS	NS	3.8 U	4.0 U	4.0 U	3.8 U	3.8 U
Dibenz[a,h]anthracene	110	µg/kg	NS	NS	3.8 U	4.0 U	4.0 U	3.8 U	3.8 U
SVOC—PCB									
Aroclor 1016	4,100	mg/kg	NS	NS	0.019 U	0.019 U	0.019 U	0.019 U	0.018 U
Aroclor 1221	200	mg/kg	NS	NS	0.019 U	0.019 U	0.019 U	0.019 U	0.018 U
Aroclor 1232	170	mg/kg	NS	NS	0.019 U	0.019 U	0.019 U	0.019 U	0.018 U
Aroclor 1242	230	mg/kg	NS	NS	0.019 U	0.019 U	0.019 U	0.019 U	0.018 U
Aroclor 1248	230	mg/kg	NS	NS	0.019 U	0.019 U	0.019 U	0.019 U	0.018 U
Aroclor 1254	240	mg/kg	NS	NS	0.019 U	0.019 U	0.019 U	0.019 U	0.018 U
Aroclor 1260	240	mg/kg	NS	NS	0.012 U	0.012 U	0.012 U	0.012 U	0.011 U
SVOC-PCDD/PCDF									
2,3,7,8-TCDD	4.8	pg/g	NS	NS	0.47 U	0.48 U	0.52 U	0.47 U	0.46 U

Table 7. Contaminants of Potential Concern Results, 15.0 ft bgs

Analyte	Screening Level[1]	Lab Sample ID:	NA	NA	160-24924-6	160-24922-7	160-24922-13	160-24922-22	160-24922-29
		Sample Name:	SHAD041DP0 24SS06NS	SHAD041DP0 25SS06NS	SHAD041DP0 26SS06NS	SHAD041DP0 27SS06NS	SHAD041DP0 28SS06NS	SHAD041DP0 29SS06NS	SHAD041DP0 30SS06NS
		Location:	VSP-24	VSP-25	VSP-26	VSP-27	VSP-28	VSP-29	VSP-30
		Units							
VOCs									
1,1,1-Trichloroethane	1,700,000	µg/kg	NS	NS	1.1 U	0.85 U	0.93 U	0.82 U	0.79 U
1,1,2,2-Tetrachloroethane	600	µg/kg	NS	NS	1.1 U	0.85 U	0.93 U	0.82 U	0.79 U
1,1,2-Trichloroethane	1,100	µg/kg	NS	NS	1.1 U	0.85 U	0.93 U	0.82 U	0.79 U
1,1-Dichloroethane	3,600	µg/kg	NS	NS	1.1 U	0.85 U	0.93 U	0.82 U	0.79 U
1,1-Dichloroethene	230,000	µg/kg	NS	NS	5.4 U	4.2 U	4.6 U	4.1 U	4.0 U
1,2-Dichlorobenzene	1,800,000	µg/kg	NS	NS	1.1 U	0.85 U	0.93 U	0.82 U	0.79 U
1,2-Dichloroethane	460	µg/kg	NS	NS	1.1 U	0.85 U	0.93 U	0.82 U	0.79 U
cis-1,2-Dichloroethene	18,000	µg/kg	NS	NS	1.1 U	0.85 U	0.93 U	0.82 U	0.79 U
trans-1,2-Dichloroethene	130,000	µg/kg	NS	NS	1.1 U	0.85 U	0.93 U	0.82 U	0.79 U
1,2-Dichloropropane	2,500	µg/kg	NS	NS	1.1 U	0.85 U	0.93 U	0.82 U	0.79 U
cis-1,3-Dichloropropene	18,000	µg/kg	NS	NS	1.1 U	0.85 U	0.93 U	0.82 U	0.79 U
trans-1,3-Dichloropropene	580	µg/kg	NS	NS	1.1 U	0.85 U	0.93 U	0.82 U	0.79 U
1,4-Dichlorobenzene	2,600	µg/kg	NS	NS	1.1 U	0.85 U	0.93 U	0.82 U	0.79 U
Benzene	330	µg/kg	NS	NS	1.1 U	0.85 U	0.93 U	0.82 U	0.79 U
Bromodichloromethane	290	µg/kg	NS	NS	1.1 U	0.85 U	0.93 U	0.82 U	0.79 U
Bromoform	19,000	µg/kg	NS	NS	1.1 U	0.85 U	0.93 U	0.82 U	0.79 U
Carbon Tetrachloride	98	µg/kg	NS	NS	1.1 U	0.85 U	0.93 U	0.82 U	0.79 U
Chloroform	320	µg/kg	NS	NS	1.1 U	0.85 U	0.93 U	0.82 U	0.79 U
Chloromethane	110,000	µg/kg	NS	NS	5.4 U	4.2 U	4.6 U	4.1 U	4.0 U
Dibromochloromethane	940	µg/kg	NS	NS	1.1 U	0.85 U	0.93 U	0.82 U	0.79 U
Ethylbenzene	5,800	µg/kg	NS	NS	1.1 U	0.85 U	0.93 U	0.82 U	0.79 U
Methylene Chloride	1,800	µg/kg	NS	NS	5.4 U	4.2 U	4.6 U	4.1 U	4.0 U
Tetrachloroethene	590	µg/kg	NS	NS	1.1 U	0.85 U	0.93 U	0.82 U	0.79 U
Toluene	1,100,000	µg/kg	NS	NS	1.1 U	0.85 U	0.93 U	0.82 U	0.79 U
Trichloroethene	940	µg/kg	NS	NS	1.1 U	0.85 U	0.93 U	0.82 U	0.79 U
Vinyl Chloride	8.7	µg/kg	NS	NS	1.1 U	0.85 U	0.93 U	0.82 U	0.79 U
m-p-Xylene	580,000	µg/kg	NS	NS	5.4 U	4.2 U	4.6 U	4.1 U	4.0 U
o-Xylene			NS	NS	5.4 U	4.2 U	4.6 U	4.1 U	4.0 U

Table 7. Contaminants of Potential Concern Results, 15.0 ft bgs

Notes:

[1] The lower of the residential soil values from the November 2018 USEPA Regional Screening Level (where TR=1E-06; THQ=1.0) and HERO HHRA Note 3 DTSC-modified Screening Levels (June 2018).

Bolded value indicates exceedance of residential risk-based screening level (HERO, 2018; USEPA, 2018).

( ) = Duplicate sample result
µg/kg = microgram per kilogram
J = Estimated
mg/kg = milligram per kilogram
NA = not applicable
NS = not sampled
PAH = Polynucluear Aromatic Hydrocarbons
PCB = Polychlorinated Biphenyls
PCDD/PCDF = Polychlorinated Dibenzodioxin/ Polychlorinated Dibenzofurans
pg/g = picogram per gram (parts per trillion)
SVOC = Semivolatile Organic Compounds
U = Non-detect
VOC = Volatile Organic Compounds

Table 8. Ra-226 Results, Surface

Location	Sample ID	Depth (ft bgs)	Units	^{226}Ra (pCi/g)
VSP-2	02-01-0	0.0	pCi/g	0.93
VSP-2	02-01-0	0.0	pCi/g	0.76
VSP-2	02-01-0	0.0	pCi/g	0.72
VSP-4	4-01-0	0.0	pCi/g	0.90
VSP-6	06-01-0	0.0	pCi/g	1.84
VSP-8	8-01-0	0.0	pCi/g	1.13
VSP-10	10-01-0	0.0	pCi/g	1.22
VSP-11	11-01-0	0.0	pCi/g	1.42
VSP-12	12-01-0	0.0	pCi/g	**10.40**
VSP-13	13-01-0	0.0	pCi/g	1.03
VSP-15	15-01-0	0.0	pCi/g	**2.48**
VSP-17	17-01-0	0.0	pCi/g	**3.31**
VSP-18	18-01-0	0.0	pCi/g	**19.30**
VSP-20	20-01-0	0.0	pCi/g	**3.26**
VSP-26	26-01-0	0.0	pCi/g	**79.60**
VSP-27	27-01-0	0.0	pCi/g	0.91
VSP-28	28-01-0	0.0	pCi/g	**7.08**
VSP-29	29-01-0	0.0	pCi/g	1.40 (0.934)
VSP-30	30-01-0	0.0	pCi/g	0.90
VSP-30	30-01-0	0.0	pCi/g	1.05

Notes:

Bold = Exceeds ^{226}Ra screening level of 2.0 pCi/g
^{226}Ra = Radium-226
( ) = Duplicate sample result
ft bgs = feet below ground surface
pCi/g = picocuries per gram

Table 9. Ra-226 Results, 1 to 5 ft bgs

Location	Sample ID	Depth (ft bgs)	Units	^{226}Ra (pCi/g)
VSP-2	02-06-2	2.0	pCi/g	0.79
VSP-4	4-02-2	2.0	pCi/g	1.03
VSP-6	06-02-2	2.0	pCi/g	1.20
	06-03-4	4.0	pCi/g	1.17
VSP-8	8-02-2	2.0	pCi/g	1.12
	8-03-4	4.0	pCi/g	1.19
VSP-10	10-02-2	2.0	pCi/g	0.9 (0.8)
	10-03-4	4.0	pCi/g	0.95
VSP-11	11-02-2	2.0	pCi/g	**2.86**
VSP-12	12-02-1	1.0	pCi/g	1.70 (1.45)
	12-03-4	4.0	pCi/g	1.39
VSP-13	13-02-2	2.0	pCi/g	0.91 (0.98)
VSP-15	15-02-1	1.0	pCi/g	1.08
	15-02-1	1.0	pCi/g	1.13
	15-03-4	4.0	pCi/g	1.38
VSP-17	17-02-3	3.0	pCi/g	1.28
VSP-18	18-02-1	1.0	pCi/g	**8.64 (4.66)**
	18-03-4	4.0	pCi/g	1.41
VSP-19	19-01-2	2.0	pCi/g	0.92
VSP-20	20-02-4	4.0	pCi/g	0.86
VSP-22	22-02-1	1.0	pCi/g	1.07
	22-02-1	1.0	pCi/g	1.06
	22-03-2	2.0	pCi/g	1.10
	22-03-2	2.0	pCi/g	1.13
VSP-24	24-01-3	3.0	pCi/g	0.87
	24-02-4	4.0	pCi/g	1.16
VSP-25	25-02-2	2.0	pCi/g	0.91
VSP-26	26-02-1	1.0	pCi/g	**11.50**
	26-03-4	4.0	pCi/g	**2.04**
VSP-27	27-02-4	4.0	pCi/g	1.56
VSP-28	28-02-1	1.0	pCi/g	**2.65**
	28-03-3	3.0	pCi/g	1.33
VSP-29	29-02-3	3.0	pCi/g	1.36
	29-03-4	4.0	pCi/g	1.21
VSP-30	30-02-01	1.0	pCi/g	1.02
	30-03-4	4.0	pCi/g	1.24

Notes:

Bold = Exceeds ^{226}Ra screening level of 2.0 pCi/g

^{226}Ra = Radium-226

( ) = Duplicate sample result

ft bgs = feet below ground surface

pCi/g = picocuries per gram

Table 10. Ra-226 Results, 5 to 10 ft bgs

Location	Sample ID	Depth (ft bgs)	Units	^{226}Ra (pCi/g)
VSP-2	02-05-6	6.0	pCi/g	0.89
VSP-4	4-3-5	5.0	pCi/g	1.11
	4-4-9	9.0	pCi/g	1.06
VSP-6	06-04-8	8.0	pCi/g	1.47
	06-04-8	8.0	pCi/g	1.58
VSP-8	8-04-7	7.0	pCi/g	1.35
VSP-10	10-04-8	8.0	pCi/g	1.54
VSP-11	11-03-5	5.0	pCi/g	**3.06**
	11-03-5	5.0	pCi/g	**3.09**
	11-04-9	9.0	pCi/g	**2.02**
VSP-12	12-4-9	9.0	pCi/g	1.50
	12-4-9	9.0	pCi/g	1.37
VSP-13	13-03-5	5.0	pCi/g	1.36
	13-04-9	9.0	pCi/g	1.96
VSP-15	15-04-8	8.0	pCi/g	1.21
VSP-17	17-03-7	7.0	pCi/g	1.12
	17-03-7	7.0	pCi/g	1.12
VSP-18	18-04-7	7.0	pCi/g	1.75
VSP-19	19-02-6	6.0	pCi/g	1.15
	19-03-8	8.0	pCi/g	1.62
	19-04-9	9.0	pCi/g	1.76
VSP-20	20-03-8	8.0	pCi/g	1.40 (1.30)
	20-04-9	9.0	pCi/g	1.20
VSP-22	22-04-5	5.0	pCi/g	1.31
VSP-24	24-03-6	6.0	pCi/g	1.50
	24-04-9	9.0	pCi/g	1.23
VSP-25	25-01-5	5.0	pCi/g	1.19
	25-01-5	5.0	pCi/g	1.32
	25-03-7	7.0	pCi/g	1.31
	25-04-9	9.0	pCi/g	1.60
VSP-26	26-04-9	9.0	pCi/g	1.78
VSP-27	27-03-7	7.0	pCi/g	1.52
	27-04-9	9.0	pCi/g	1.16 (1.27)
VSP-28	28-04-5	5.0	pCi/g	1.51
VSP-29	29-04-8	8.0	pCi/g	1.68
VSP-30	30-04-9	9.0	pCi/g	1.68 (1.53)

Notes:

Bold = Exceeds ^{226}Ra screening level of 2.0 pCi/g

^{226}Ra = Radium-226

( ) = Dduplicate sample result

ft bgs = feet below ground surface

pCi/g = picocuries per gram

Table 11. Ra-226 Results, 10 to 15 ft bgs

Location	Sample ID	Depth (ft bgs)	Units	^{226}Ra (pCi/g)
VSP-2	02-04-12	12.0	pCi/g	1.94
	02-03-14	14.0	pCi/g	1.18
VSP-4	4-05-12	12.0	pCi/g	1.24
	4-06-14	14.0	pCi/g	1.10
VSP-6	06-05-12	12.0	pCi/g	1.90
	06-06-14	14.0	pCi/g	1.26
VSP-8	8-05-11	11.0	pCi/g	**2.14**
	8-06-14	14.0	pCi/g	1.26
VSP-10	10-05-10	10.0	pCi/g	1.75
	10-06-14	14.0	pCi/g	1.50
VSP-11	11-06-12	12.0	pCi/g	**2.60**
	11-05-14	14.0	pCi/g	1.35
VSP-12	12-5-11	11.0	pCi/g	1.83
	12-6-14	14.0	pCi/g	1.20
VSP-13	13-05-12	12.0	pCi/g	**2.35 (2.22)**
	13-06-14	14.0	pCi/g	1.57
VSP-15	15-05-13	13.0	pCi/g	1.24
	15-06-14	14.0	pCi/g	1.46
VSP-17	17-05-12	12.0	pCi/g	1.86
	17-06-14	14.0	pCi/g	1.52 (1.09)
VSP-18	18-05-11	11.0	pCi/g	1.44
	18-06-14	14.0	pCi/g	**75.40**
VSP-22	22-05-10	10.0	pCi/g	1.44
	22-06-14	14.0	pCi/g	1.16
VSP-26	26-05-11	11.0	pCi/g	**2.21 (2.24)**
	26-06-14	14.0	pCi/g	1.13
VSP-27	27-05-12	12.0	pCi/g	1.54
	27-06-14	14.0	pCi/g	1.47
VSP-28	28-05-12	12.0	pCi/g	**2.04**
	28-06-14	14.0	pCi/g	1.23
	28-06-14	14.0	pCi/g	1.13 (1.57)
VSP-29	29-05-13	13.0	pCi/g	1.17
	29-06-14	14.0	pCi/g	1.00
VSP-30	30-05-13	13.0	pCi/g	1.82
	30-06-14	14.0	pCi/g	1.15

Notes:

Bold = Exceeds ^{226}Ra screening level of 2.0 pCi/g

^{226}Ra = Radium-226

( ) = Duplicate sample result

ft bgs = feet below ground surface

pCi/g = picocuries per gram

Table 12. Initial Ra-226 Action Level Input Parameters for USEPA Preliminary Remediation Goals

Parameter	Value	Reference
TR (target cancer risk) unitless	1.00E-06	EPA, 2014
tres (time - resident) yr	26	EPA, 2014
EDres (exposure duration - resident) yr	26	EPA, 2014
ETres (exposure time - resident) hr/day	24	EPA, 2014
ETres-a (exposure time-resident adult) hr/day	24	EPA, 2014
ETres-i (exposure time - indoor resident) hr/day	16.416	EPA, 2014
ETres-o (exposure time - outdoor resident) hr/day	1.752	EPA, 2014
EDres-a (exposure duration - resident adult) yr	20	HERO Note 1, 2014
EFres (exposure frequency - resident) day/yr	350	HERO Note 1, 2014
EFres-a (exposure frequency - resident adult) day/yr	350	HERO Note 1, 2014
IRSres-a (soil intake rate - resident adult) mg/day	100	HERO Note 1, 2014
IRAres-a (inhalation rate - resident adult) m3/day	20	HERO Note 1, 2014
IFSres-adj (age-adjusted soil ingestion factor - res) mg	1120000	EPA, 2014
IFAres-adj (age-adjusted soil inhalation factor - res) m3	161000	EPA, 2014
GSFi (gamma shielding factor - indoor) unitless	0.4	EPA, 2014
Site area for ACF (area correction factor) m2	5000	Site Specific
Cover thickness for GSFo (gamma shielding factor) cm	0	Site Specific
Cover thickness for GSFb (gamma shielding factor) cm	0	Site Specific
TR (target cancer risk) unitless	1.00E-06	EPA, 2014
EDres-a (exposure duration - resident adult) yr	20	HERO Note 1, 2014
EFres-a (exposure frequency - resident adult) day/yr	350	HERO Note 1, 2014
City (Climate Zone)	26	Site Specific
As (acres)	1.2	Site Specific
Q/Cwp (g/m2-s per kg/m3)	88.42690368	EPA, 2014
PEF (particulate emission factor) m3/kg	1.30E+09	EPA, 2014

References:

EPA, 2014. OSWER Directive 9200.1-120, Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors 2014. Office of Solid Waste and Emergency Response.

HERO Human Health Risk Assessment (HHRA) Note Number 1; September 30, 2014.

Table 13. Preliminary Screening of General Response Actions, Technology Types, and Process Options

General Response Action	Remedial Technology Type	Process Option	Effectiveness	Implementability	Cost	Screening Status
No Action	No Action	No Action	Not Applicable	Not Applicable	Low	Retained[a]
Containment	Capping	**In-Place Covers –** A cover of clean soil is placed over the contaminated soil to eliminate the direct exposure pathway.	Highly effective when the integrity of the cover is maintained. Limits exposure to COCs and CORCs. Requires long-term maintenance and monitoring to maintain effectiveness; COCs and CORCs would remain on site. Therefore, would require LUCs.	Moderate Implementability. Cover may be eroded by extreme weather conditions unless vegetative cover is maintained.	High (Large area)	Eliminated (Effectiveness, Cost)
		Asphalt or Concrete Covers – Contaminated soil is left in place and an asphalt or concrete cover is placed over the contaminated soil to eliminate the direct exposure pathway.	Highly effective when the integrity of the cover is maintained. Limits exposure to COCs and CORCs. Requires long-term maintenance and monitoring to maintain effectiveness; COCs and CORCs would remain on site. Therefore, would require LUCs.	Moderate Implementability. Ground cover and plant life would be destroyed; would require asphalt over large area.	High (Large area)	Eliminated (Effectiveness, Cost)
Excavation / Disposal	Excavation and Capping	**On-Site Containment Cell –** Contaminated soil is excavated and contained on-site in an engineered containment cell or CAMU.	Highly effective when the integrity of the cell is maintained. Limits exposure to COCs and CORCs. Requires long-term maintenance and monitoring to maintain effectiveness; COCs and CORCs would remain on-site but consolidated in designated area. LUCs would be required for containment area.	Moderate implementability. Would require construction and long-term maintenance of a large containment cell or CAMU.	High (Due to volume of contaminated soil and size of containment cell)	Retained

Table 13. Preliminary Screening of General Response Actions, Technology Types, and Process Options

General Response Action	Remedial Technology Type	Process Option	Effectiveness	Implementability	Cost	Screening Status
Access Restrictions	LUCs	**Access Restrictions –** Fencing, barriers, and posted signs to restrict land use where there is exposure to potentially contaminated soil (USEPA, 2000).	Moderately Effective. Restricts human activity based on land use; prevents direct contact with contaminants; may be used in combination with other process options.	High Implementability	Low	Retained
		Land-Use Restrictions – Prohibits activities not specified for the designated land use (USEPA, 2000).	Moderately Effective. Restricts human activity based on land use; prevents direct contact with contaminants; may be used in combination with other process options.	High Implementability	Low	Retained
		Covenants to Restrict Use of Property – Restricts the use of the parcel to those reuses that are identified at the time the ROD is signed; includes criteria during and after future development to assure that mitigated exposure conditions are maintained such as covers, barriers, or other engineering controls (USEPA, 2000).	Moderately Effective. The property would not be used in a manner which compromises the restrictions.	High Implementability	Low	Retained
Excavation / Treatment / Disposal	Excavation	**Excavation and Disposal at an Off-Site Treatment/Disposal Facility –** Excavation of contaminated soil, transport and disposal of soil at permitted treatment and disposal facility.	Highly Effective. Removes COCs and CORCs from on-site soil; permanent remedy.	High Implementability	High (Due to the volume and concentration of contamination)	Retained[b]

Table 13. Preliminary Screening of General Response Actions, Technology Types, and Process Options

General Response Action	Remedial Technology Type	Process Option	Effectiveness	Implementability	Cost	Screening Status
Treatment	In-Situ Biological Treatment	**Phytoremediation –** Plants are used to remove, transfer, stabilize, or destroy contaminants in soil.	Low Effectiveness. Remains in demonstration phase; plants may accumulate high levels of COCs and CORCs and may require additional treatment prior to disposal; may introduce COCs and CORCs into the food chain if plants are consumed by other organisms.	Low Implementability. Likely to require large number of plants or grasses to cover treatment area; dependent on climate and plant growth; may require irrigation to establish growth over a long time frame.	Moderate (Requires long-term maintenance)	Eliminated (Low Effectiveness, Low Implement-ability)
	In-Situ Physical/ Chemical Treatment	**In-Situ Solidification/Stabilization –** Physically binds or encloses contaminants within a stabilized mass and chemically reduces the hazard potential of a waste by converting the contaminants to less soluble, mobile, or toxic forms (USEPA, 2002).	Low effectiveness. Will not reduce toxicity from the direct exposure to soils; soil may have to be solidified or covered to prevent direct exposure COCs and CORCs; may increase volume of contaminated soil 10 to 50 percent.	High Implementability. Easily implemented for surface soil; short to medium time frame; may be used in combination with other process options.	Moderate (Costs may increase if covers are necessary)	EliminatedLow Effectiveness Low Implement-ability

Table 13. Preliminary Screening of General Response Actions, Technology Types, and Process Options

General Response Action	Remedial Technology Type	Process Option	Effectiveness	Implementability	Cost	Screening Status
Treatment (cont.)	In-Situ Physical/ Chemical Treatment (cont.)	**In-Situ Soil Flushing –** Extracts organic and inorganic contaminants from soil by using water, a solution of chemicals in water, or an organic extractant, without excavating the contaminated material itself. The solution is injected into or sprayed onto the area of contamination, mobilizing contaminants by dissolution or emulsification. After passing through the contamination zone, the contaminant-bearing flushing solution is collected and pumped to the surface for treatment, discharge, or reinjection (USEPA, 2002).	Low effectiveness. Limited number of applications of the technology for metals and no application for 226Ra; flushing of COCs and CORCs from surface soil may contaminate subsurface soil and groundwater; soil flushing may cause COCs and CORCs to precipitate and obstruct the soil pore structure and inhibit flow through the soil (USEPA, 2002); spent flushing solutions may require treatment prior to reuse or disposal.	Low Implementability. May be difficult to implement for surface and subsurface soil and large area; may require large amount of fluid to flush metals from surface and subsurface soil to groundwater.	No cost data are currently available on the cost of soil flushing systems used to treat 226Ra.	Eliminated (Low Effectiveness, Low Implementability)

Table 13. Preliminary Screening of General Response Actions, Technology Types, and Process Options

General Response Action	Remedial Technology Type	Process Option	Effectiveness	Implementability	Cost	Screening Status
Treatment (cont.)	In-Situ Physical/ Chemical Treatment (cont.)	**Electrokinetic Treatment –** Based on the theory that a low-density current applied to soil will mobilize contaminants in the form of charged species. A current passes between electrodes inserted into the subsurface is intended to cause water, ions, and particulates to move through the soil. Contaminants arriving at the electrodes can be removed by means of electroplating or electrodeposition, precipitation or coprecipitaiton, adsorption, complexing with ion exchange resins, or by pumping of water (or other fluid) near the electrode (USEPA, 2002).	Low effectiveness. Emerging technology with no applications for 226Ra treatment; most effective for soil with small particle sizes, such as clay; requires adequate soil moisture, most effective for saturated soil; adding fluid to allow treatment of soils without sufficient moisture may flush contaminants out of the treatment area and contaminate subsurface soil and groundwater; if extraction fluid is used it may require further treatment before disposal.	Low Implementability. May be difficult to implement for surface and subsurface soil and large area; few previous applications of technology for metals (lead) treatment and no applications for 226Ra treatment.	Moderate to high	Eliminated (Low Effectiveness, Low Implement-ability, High Cost)
		Vitrification – High temperature treatment that reduces the mobility of metals by incorporating them into a chemically durable, leach resistant, vitreous mass. The process may also cause contaminants to volatilize, thereby reducing their concentration in the soil or waste (USEPA, 2002).	Moderately effective at mitigating COC mobility; may cause COCs and CORCs to volatilize, off-gas treatment/c ontainment, such as a baghouse, may be necessary to remove contaminants.	Low implementability. May be difficult to implement over large areas at shallow and deeper depths.	High (Typically uses large amounts of energy)	Eliminated (Low Effectiveness, Low Implement-ability, High Cost)

Table 13. Preliminary Screening of General Response Actions, Technology Types, and Process Options

General Response Action	Remedial Technology Type	Process Option	Effectiveness	Implementability	Cost	Screening Status
Treatment (cont.)	Ex-Situ Physical/ Chemical Treatment	**Soil Washing/Acid Extraction –** Contaminants preferentially adsorb onto the fines fraction of soil; the soil is suspended in a wash solution and the fines are separated from the suspension, thereby reducing the contaminant concentration in the remaining soil (USEPA, 2002).	Low effectiveness. Technology targets contaminants that are preferentially adsorbed onto the fines fraction; the separated fines must be treated to remove or immobilize COCs and CORCs.	Moderate implementability. Involves excavation of surface soil, ex situ treatment and replacement of treated soil on site.	High (Includes treatment of fines and wash water after separation)	Eliminated (Low Effectiveness, High Cost)
		Pyrometallurgical – Heat is used to convert a contaminated waste feed into a product with a high concentration of the contaminant that can be reused or sold (USEPA, 2002).	Low effectiveness. Used primarily to recycle metals from soil containing high concentrations of metals. Concentrations are too low to remove enough metals to make this technology effective; may produce treatment residuals such as slag, flue dust, and baghouse dust; may require off-gas treatment depending on method of metals recovery; limited number of full-scale applications of the technology for recovery of metals and no applications for recovery of 226Ra.	Moderate Implementability. Includes excavation of surface soil and ex situ treatment; may require treatment of off gas and other residuals.	High (To make recovery of metals economically feasible, concentration of metals should be over 10,000 mg/kg [USEPA, 2002])	Eliminated (Low Effectiveness, High Cost)

Table 13. Preliminary Screening of General Response Actions, Technology Types, and Process Options

General Response Action	Remedial Technology Type	Process Option	Effectiveness	Implementability	Cost	Screening Status
Treatment (cont.)	Ex-Situ Physical/ Chemical Treatment	**Ex-Situ Solidification/Stabilization-** Reduces mobility of contaminants in soil through physical or chemical reaction with stabilizing agents (USEPA, 1998); same process as in-situ solidification/stabilization except goal would be to reduce leaching potential so soil could be disposed of as non- hazardous waste.	Highly effective at reducing the potential for leaching. May be effective for use in combination with other removal technology for meeting regulatory requirements for off-site disposal at a nonhazardous landfill; may increase volume of contaminated soil 10 to 50 percent.	Moderate Implementability. Includes excavation of surface soil; may be used in combination with other process options, such as off-site disposal at a permitted landfill.	High (Includes treatment plus disposal cost and clean backfill)	Eliminated (High Cost)

Notes:

[a] Evaluation of "No Action" is required under the NCP as a baseline for comparison with other remedial alternatives.

[b] Per DOD policy, a remedial alternative to achieve unrestricted use must be evaluated in the Feasibility Study when LUCs are retained as a remedial alternative (DOD, 2003a).

226Ra = Radium-226
CAMU = Corrective action management unit
COC = contaminant of concern
CORC = contaminant of radiological concern
DOD = Department of Defense
LUC = land use control
mg/kg = milligram per kilogram
NCP = National Oil and Hazardous Substances Pollution Contingency Plan
ROD = Record of Decision
USEPA = U.S. Environmental Protection Agency

<u>Sources:</u>

DOD, 2003a. "Policy on Land Use Controls Associated with Environmental Restoration Activities." January.

USEPA, 1998. "Evaluation of Subsurface Engineered Barriers at Waste Sites." EPA 542-R-98_005. August.

USEPA, 2000. The Office of Solid Waste and Emergency Response (OSWER) publication on Land Use Controls. Available Online at: http://www.epa.gov/oerrpage/superfund/action/ic/guide/

USEPA, 2002 index.htm>. "Metals" Treatment Technologies for Soil, Waste, and Water" Solid Waste and Emergency Response. EPA-542-R-02-004. September.

Table 14. Summary of Estimated Costs

Alternative	Capital Cost	30-Year O&M Cost	Total Cost (Capital Cost plus 30-year O&M Cost)	Present Value Cost
Alternative 1: No Action	$0	$0	$0	**$0**
Alternative 2: Land Use Controls	$174,000	$589,000	$763,000	**$536,000**
Alternative 3: On-Site Treatment and Land Use Controls	$6,896,000	$1,512,000	$8,408,000	**$7,584,000**
Alternative 4A: Excavation and Off-Site Disposal, Industrial Use	$5,195,000	$1,512,000	$6,707,000	**$6,148,000**
Alternative 4B: Excavation and Off-Site Disposal, Unrestricted Exposure/Unlimited Use	$11,455,000	$0	$11,455,000	**$11,123,166**
Alternative 5: Excavation, On-Site Containment and Land Use Controls	$7,899,000	$1,512,000	$9,411,000	**$8,018,000**

Notes:

O&M = Operation and maintenance

Table 15. Remedial Alternative Ranking for Protection of Human Health and Ecological Receptors

Criterion Description	Alternative 1: No Action	Alternative 2: LUCs	Alternative 3: On-Site Treatment and LUCs	Alternative 4A: Excavation and Off-Site Disposal, Industrial Use	Alternative 4B: Excavation and Off-Site Disposal, UU/UE	Alternative 5: Excavation, On-Site Containment and LUCs
Overall Protection of Human Health (1 = least protective, 5 = most protective)	**1**	**5**	**4**	**4**	**5**	**4**
Compliance with ARARs (1 = least compliant, 5 = most compliant)	**1**	**5**	**4**	**5**	**5**	**4**
Long-Term Effectiveness and Permanence (1 = least effective, 5 = most effective)						
Expected long-term residual risk posed by the site after response action is taken	1	4	4	5	5	4
Adequacy and reliability to manage residual contamination	1	3	4	5	5	3
Average Long-Term Effectiveness:	**1**	**3.5**	**4**	**5**	5	**3.5**
Reduction of Toxicity, Mobility, or Volume through Treatment (1 = least reduction, 5 = most reduction)						
Destruction of toxic chemicals	1	1	2	1	1	1
Reduction in chemical mobility	1	1	2	1	1	1
Reduction of chemical volume	1	1	2	1	1	1
Average Reduction Through Treatment:	**1**	**1**	**2**	**1**	**1**	**1**
Short-Term Effectiveness (1 = least effective, 5 = most effective)						
Community protection during response action	1	5	3	3	3	4
Protection of workers during construction	1	5	4	4	4	4
Potential negative environmental effects of response action	1	5	3	3	4	3
Time required to achieve the remedial action objective	1	5	4	4	4	3
Average Short Term Effectiveness:	**1**	**5**	**3.5**	**3.5**	**3.5**	**3.5**

Table 15. Remedial Alternative Ranking for Protection of Human Health and Ecological Receptors

Criterion Description	Alternative 1: No Action	Alternative 2: LUCs	Alternative 3: On-Site Treatment and LUCs	Alternative 4A: Excavation and Off-Site Disposal, Industrial Use	Alternative 4B: Excavation and Off-Site Disposal, UU/UE	Alternative 5: Excavation, On-Site Containment and LUCs
Implementability (1 = least implementable, 5 = most implementable)						
Ability to construct and operate	1	5	3	5	5	4
Ease of doing more action if needed	1	5	3	5	5	4
Availability of services and capacities	1	5	4	5	5	4
Ability to obtain approvals and permits from other agencies	1	5	4	5	5	4
Average Implementability:	**1**	**5**	**3.5**	**5**	**5**	**4**
Costs (1 = most expensive, 5 = least expensive)	**5**	**5**	**3**	**4**	**1**	**2**
State Acceptance (1 = least acceptable, 5 = most acceptable)	*	*	*	*	*	*
Community Acceptance (1 = least acceptable, 5 = most acceptable)	*	*	*	*	*	*
Overall Score:	**11**	**29.5**	**24**	**27.5**	**25.5**	**22**

Notes:

*Ranking for this criterion will be evaluated based on state and community input during the Proposed Plan phase.

LUCs = land use controls

UU/UE = unlimited use/unrestricted exposure