FINAL
Engineering Evaluation/Cost Analysis: RVAAP-34 Sand Creek Disposal Road Landfill at Camp James A. Garfield Joint Military Training Center Portage and Trumbull Counties, Ohio

Project No. 118064-RVAAP-34

January 14, 2019

Prepared by:

U.S. Army Corps of Engineers, Louisville District
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Prepared for:

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14. ABSTRACT

This Draft Engineering Evaluation/Cost Analysis (EE/CA) was completed to identify and assess Alternatives to support the selection of appropriate remedial actions for the chemicals of concern (COCs), and to evaluate potential risks to human health and the environment at the RVAAP-34 Sand Creek Disposal Road Landfill, Camp Ravenna Joint Military Training Center, Portage and Trumbull Counties, Ohio. A Risk Management Evaluation (RME) was completed to reassess the specific locations and concentrations of chemicals identified in the 2016 Remedial Investigation (RI) Report. Three chemicals (arsenic, benzo(a)pyrene, and benzo(b)fluoranthene were identified as COCs in the RI. The RME used a process called hill topping where individual locations with the greatest concentrations are removed from the dataset and the average concentration is recalculated. Additionally, the Facility-wide Cleanup Goals (FWCUGs) for polycyclic aromatic hydrocarbons (PAHs) are outdated (toxicity values have been increased) since the RI was completed. The RME showed that two surface soil Incremental Sampling Method (ISM) sample locations and two subsurface discrete soil locations needed to be removed to Unrestricted (Residential) Land Use. Alternative 2, Excavation with Off-site Disposal For Soil with Arsenic (and Ex-situ Thermal Treatment for Soil with PAHs to attain Unrestricted (Residential) Land Use was selected in the EE/CA. Once the removal action is complete, the site will be No Further Action under CERCLA.

15. SUBJECT TERMS

EE/CA, PAHs, Arsenic, No Further Action, Sand Creek Disposal Road Landfill, Sand Creek AOC, RVAAP-34, Unrestricted (Residential) Land Use, Ex-situ Thermal Treatment, Excavation and Off-site Disposal, COCs, Risk Management Evaluation

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February 12, 2019

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Re: US Army Ammunition Plt RVAAP
Remediation Response
Project Records
Remedial Response
Portage County
267000859137

Subject: Ravenna Army Ammunition Plant, Portage/Trumbull Counties. Approval of the "Final Engineering Evaluation/Cost Analysis for RVAAP-34 Sand Creek Disposal Road Landfill" at the Former Ravenna Army Ammunition Plant, Ravenna, Ohio, Dated January 14, 2019 Ohio EPA ID # 267000859137

Dear Mr. Connolly:

The Ohio Environmental Protection Agency (Ohio EPA) has received the "Final Engineering Evaluation/Cost Analysis for RVAAP-34 Sand Creek Disposal Road Landfill" at the Former Ravenna Army Ammunition Plant, Ravenna, Ohio. This document was received at Ohio EPA's Northeast District Office (NEDO), Division of Environmental Response and Revitalization (DERR) on January 15, 2019. The report was prepared for the Army National Guard Directorate by the U.S. Army Corps of Engineers, Louisville District.

The final document was reviewed by personnel from Ohio EPA, DERR. Pursuant to the 2004 Director's Findings and Orders, paragraph 39 (b), Ohio EPA considers the document final and approved.

If you have any questions, please call me at (330) 963-1292.

Sincerely,

Kevin M. Palombo
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DISCLAIMER STATEMENT

STATEMENT OF INDEPENDENT TECHNICAL REVIEW

The United States Army Corps of Engineers has completed the Engineering Evaluation/Cost Analysis for the RVAAP-34 Sand Creek Disposal Road Landfill Site at the Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio. Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in this project. During the independent technical review, compliance with established policy principals and procedures, utilizing justified and valid assumptions, was verified. This included review of data quality objectives; technical assumptions, methods, procedures, and materials used; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with the law and existing United States Army Corps of Engineers policy.

Reviewed/Approved by: [signature] Date: Jan. 8, 2019

Richard Kennard
Independent Technical Reviewer

Reviewed/Approved by: [signature] Date: Jan 8, 2019

Nathaniel Peters, II
Independent Technical Reviewer

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DOCUMENT DISTRIBUTION

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Camp James A. Garfield Joint Military Training Center
Portage and Trumbull Counties, Ohio

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ARNG—Army National Guard
DERR—Division of Environmental Response and Revitalization
NEDO—Northeast District Office
IED—Installations and Environment, Cleanup Division
OHARNG—Ohio Army National Guard
RVAAP—Former Ravenna Army Ammunition Plant

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ACRONYMS AND ABBREVIATIONS

µg/L	micrograms per liter
°F	degrees Fahrenheit
ACM	asbestos-containing material
ADD	average daily dose
AMEC	AMEC Earth and Environmental, Inc.
amsl	above mean sea level
AOC	Area of Concern
atm-m^3/mol	cubic meters of atmosphere per mole fraction
AUF	area use factor
BAF	bioaccumulation factor
BCF	bioconcentration factor
bgs	below ground surface
BSV	background screening value
CAS	Chemical Abstracts Service
CERCLA	Comprehensive Environmental, Response, Compensation, and Liability Act
C&DD	construction and demolition debris
CMCOPC	contaminant migration chemical of potential concern
COC	chemical of concern
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
CSM	conceptual site model
d_a	aquifer thickness
DAF	dilution attenuation factor
DGM	digital geophysical mapping
DOD	U.S. Department of Defense
DQO	data quality objective
DPT	direct-push technology
EcoSSL	ecological soil screening level
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ERA	ecological risk assessment
ESA	Endangered Species Act
ESL	ecological screening level
ESV	ecological screening value
ET	evapotranspiration
EU	exposure unit
f_{oc}	organic carbon fraction of soil
FS	feasibility study
FWSAP	Facility-Wide Sampling and Analysis Plan
ft/yr	feet per year
FWBWQS	Facility-Wide Biological and Water Quality Study

Acronyms and Abbreviations (continued)

FWCUG	facility-wide cleanup goal
gpd/ft	gallons per day per foot
GPS	global positioning system
GSSL	generic soil screening level
HELP	Hydrologic Evaluation of Landfill Performance
HI	hazard index
HHRA	human health risk assessment
HHRAM	Human Health Risk Assessment Manual
HLC	Henry's Law Constant
HQ	hazard quotient
i	hydraulic gradient
IAEA	International Atomic Energy Agency
ID	identification
IRP	Installation Restoration Program
ISM	incremental sampling method
K_d	soil-water partition coefficient for inorganic chemicals
K_{oc}	soil-water partition coefficient for organic compounds
K_{ow}	log octanol-water partition coefficient
kg	kilogram
LANL	Los Alamos National Laboratory
LCG	Louisville Chemistry Guideline
LCS	laboratory control sample
LOAEL	lowest observed adverse effect level
m	meters
m/yr	meters per year
MCL	maximum contaminant level
MD	munitions debris
MDC	maximum detected concentration
MEC	munitions and explosives of concern
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MKM	MKM Engineers, Inc.
mm	millimeter
MS	matrix spike
MSD	matrix spike duplicate
NGB	National Guard Bureau
NGT	National Guard Trainee
NOAEL	no observed adverse effect level
OAC	Ohio Administrative Code
ODNR	Ohio Department of Natural Resources
OHARNG	Ohio Army National Guard
Ohio EPA	Ohio Environmental Protection Agency
ORNL	Oak Ridge National Laboratory

Acronyms and Abbreviations (continued)

OWQS	Ohio Water Quality Standards
PA	preliminary assessment
PAH	polycyclic aromatic hydrocarbon
PBT	persistent, bioaccumulative, and toxic
PCB	polychlorinated biphenyl
PID	photoionization detector
PRG	preliminary remediation goal
QA	quality assurance
QC	quality control
QSM	Quality Systems Manual
R_f	Retardation Factor
RA	removal action
RD	remedial design
RI	remedial investigation
ROD	record of decision
RME	reasonable maximum exposure
RSL	regional screening level
RRSE	relative risk site evaluation
RVAAP	Former Ravenna Army Ammunition Plant
SAIC	Science Applications International Corporation
SAP	sampling and analysis plan
Shaw	Shaw Environmental & Infrastructure, Inc.
SLERA	screening level ecological risk assessment
SMDP	scientific management decision point
SOP	standard operating procedure
SRC	site-related chemical
SSSL	site-specific soil screening level
SUXOS	Senior Unexploded Ordnance Supervisor
SVOC	semivolatile organic compound
TAL	Target Analyte List
TCL	Target Compound List
TEC	threshold effect concentration
TRV	toxicity reference value
TUF	temporal use factor
UCL	upper confidence limit
USP&FO	United States Property and Fiscal Officer
USACE	U.S. Army Corps of Engineers
USACHPPM	U.S. Army Center for Health Promotion & Preventative Medicine
USAEC	U.S. Army Environmental Command
VOC	volatile organic compound
WQC	Water Quality Criteria

SECTION 1: INTRODUCTION

This Engineering Evaluation/Cost Analysis (EE/CA) was prepared by the United States Army Corps of Engineers (USACE), Louisville District to identify and assess Alternatives to support the selection of appropriate remedial actions for the RVAAP-34 Sand Creek Disposal Road Landfill area of concern (AOC) at the Camp Ravenna Joint Military Training Center (Camp Ravenna) (formerly the Ravenna Army Ammunition Plant - RVAAP) in Portage and Trumbull counties, Ohio (**Figures 1 and 2**). The RVAAP-34 Sand Creek Disposal Road Landfill AOC (herein, referred to as the Sand Creek AOC) is located at the former Ravenna Army Ammunition Plant (former RVAAP) in Ravenna, Ohio (**Figure 1-3**).

The 2017 Remedial Investigation (RI) prepared by USACE, recommended that the path forward is to proceed to the FS phase of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process. The FS was deemed necessary to evaluate remedial alternatives to address the Chemicals of Concern (COCs) identified in surface and subsurface soil. Instead of completing an FS and going through the detailed Alternatives analysis and remedy selection, the Army has determined the most efficient and cost-effective way to complete the removal action is through the EE/CA process. As included in an FS, this EE/CA also includes a Risk Management Evaluation to fully assess each COC to identify the areas where COCs need to be removed and which COCs need to be addressed in the removal action to meet the Land Use requirements for human health. No Chemicals of Potential Ecological Concern (COPECs) in soil were identified in the RI; therefore, additional remedial actions are not warranted at the AOC from an ecological perspective. No COCs or COPECs were identified in sediment or surface water; therefore, removal actions are not warranted for sediment or surface water at the Sand Creek Site.

The RI also recommended that further analysis of the groundwater should be conducted for this AOC. Contaminant Migration Chemicals of Potential Concern (CMCPOCs) were identified in the RI. The presence of these CMCPOCs may be indicative that leaching from soil to groundwater may occur. Evaluation of groundwater at the AOC will be conducted as part of the Facility Wide Groundwater Investigation (RVAAP-66).

This EE/CA streamlines the CERCLA process for the Sand Creek AOC, given the limited number of COCs distributed at only a few locations. The EE/CA allows the CERCLA process at the Sand Creek AOC to proceed in a defensible and cost-effective manner. Although the EE/CA is streamlined compared to the FS, the EE/CA process will ensure appropriate measures are taken to protect human health, the community, and the environment as done in an FS. This report was prepared in accordance with CERLCA (42 U. S. Code 9601 et seq.) requirements to develop and evaluate removal action alternatives. Following CERLCA guidance, this EE/CA identifies removal action objectives (RmAOs), identifies potential removal action alternatives, and evaluates alternatives against criteria identified in U. S. Environmental Protection Agency (USEPA) Guidance for Conducting Non-Time Critical Removal Actions under CERLCA (USEPA 1993).

This EE/CA was conducted under the United States (U.S.) Department of Defense (DOD) Installation Restoration Program (IRP). In addition, planning and performance of all elements of this work will be in accordance with the requirements of the Ohio Environmental Protection Agency (Ohio EPA) Director's Final Findings and Orders (DFFOs) dated June 10, 2004 (Ohio EPA, 2004).

This EE/CA was completed in compliance with the CERCLA of 1980 and prepared in accordance with the U.S. Environmental Protection Agency's (USEPA) guidance documents *Use of Non-Time Critical Removal Authority in Superfund Response Actions* (USEPA, 2000) and *Guidance on Conducting Non-Time Critical Removal Actions under CERCLA* (USEPA, 1993). As stated in the guidelines, the USEPA has urged Superfund decision makers to broadly use the CERCLA removal authority to achieve quick, protective results at Superfund sites, consistent with legal requirements, including public participation. Most importantly, this EE/CA provides an efficient pathway to assess and evaluate potential Alternatives at the Sand Creek AOC.

1.1 SCOPE AND PURPOSE

The primary purpose of this EE/CA is to evaluate limited Alternatives for the Sand Creek AOC for the specific areas where elevated concentrations of COCs occur. Following CERCLA guidance, this EE/CA identifies removal action objectives (RAOs), identifies potential removal action Alternatives, and evaluates Alternatives against criteria identified in USEPA's 1993 Guidance on Conducting Non-Time Critical Removal Actions under CERCLA. The final outcome of this EE/CA is to identify the most suitable Alternative that ensures the Sand Creek AOC meets the requirements for Unrestricted (Residential) Land Use.

1.2 REPORT ORGANIZATION

This report is organized as follows:

- Section 1 presents the introduction, scope and purpose, and report organization.
- Section 2 summarizes the facility description, site background and description, and previous investigations and results.
- Section 3 includes the Risk Management Evaluation.
- Section 4 summarizes the removal action objectives, cleanup goals, and volumes of soil requiring removal.
- Section 5 summarizes Applicable or Relevant and Appropriate Requirements.
- Section 6 includes the identification of Alternatives.
- Section 7 presents an evaluation of each Alternative.

- Section 8 presents a comparative analysis of the two Alternatives.

- Section 9 summarizes agency coordination and public involvement activities.

- Section 10 presents the Recommended Alternative.

- Section 11 provides references.

- Appendix A presents the Risk Management Evaluation of COCs.

- Appendix B identifies relevant Applicable or Relevant and Appropriate Requirements (ARARs).

- Appendix C presents information regarding the estimated costs.

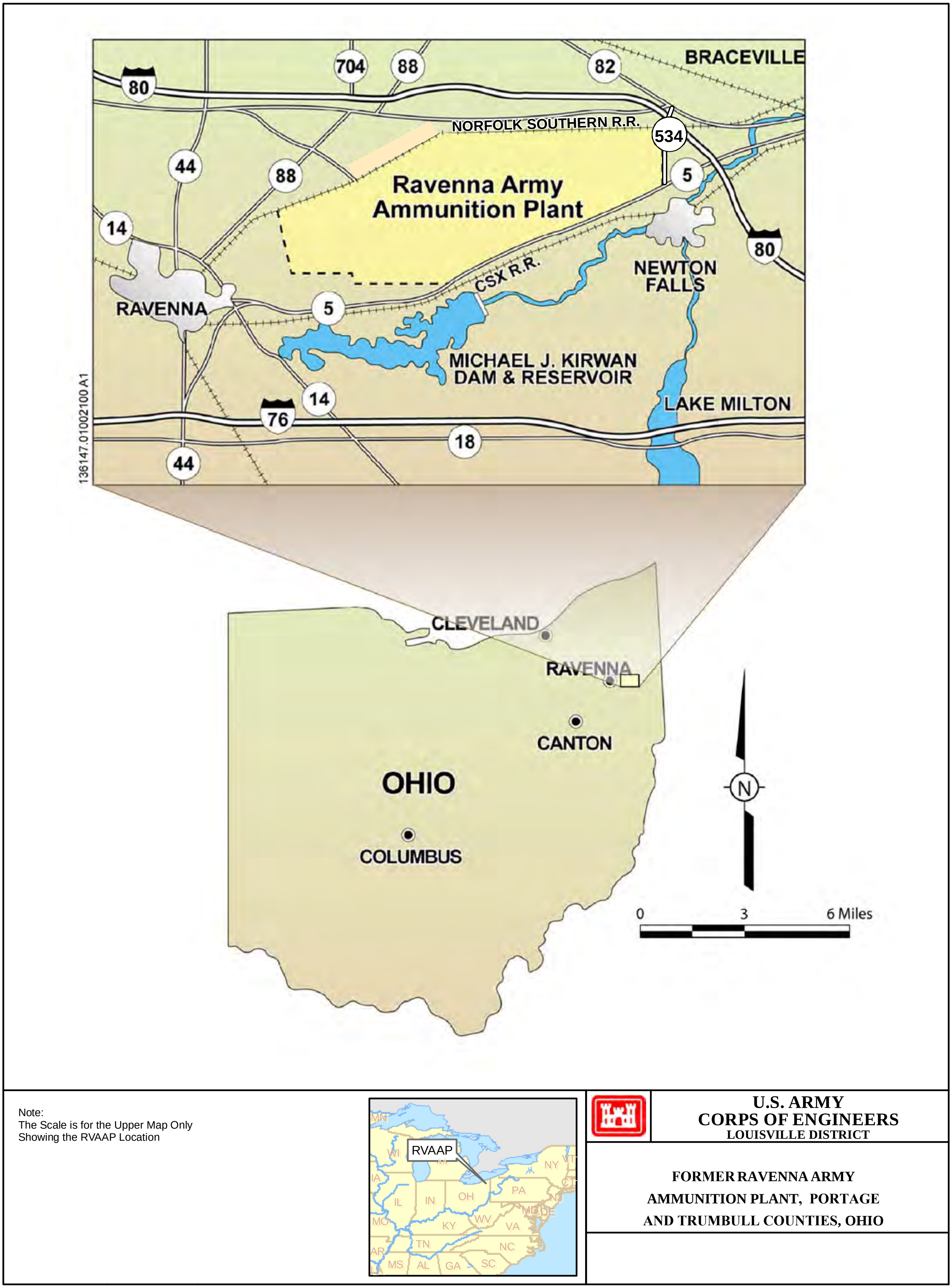
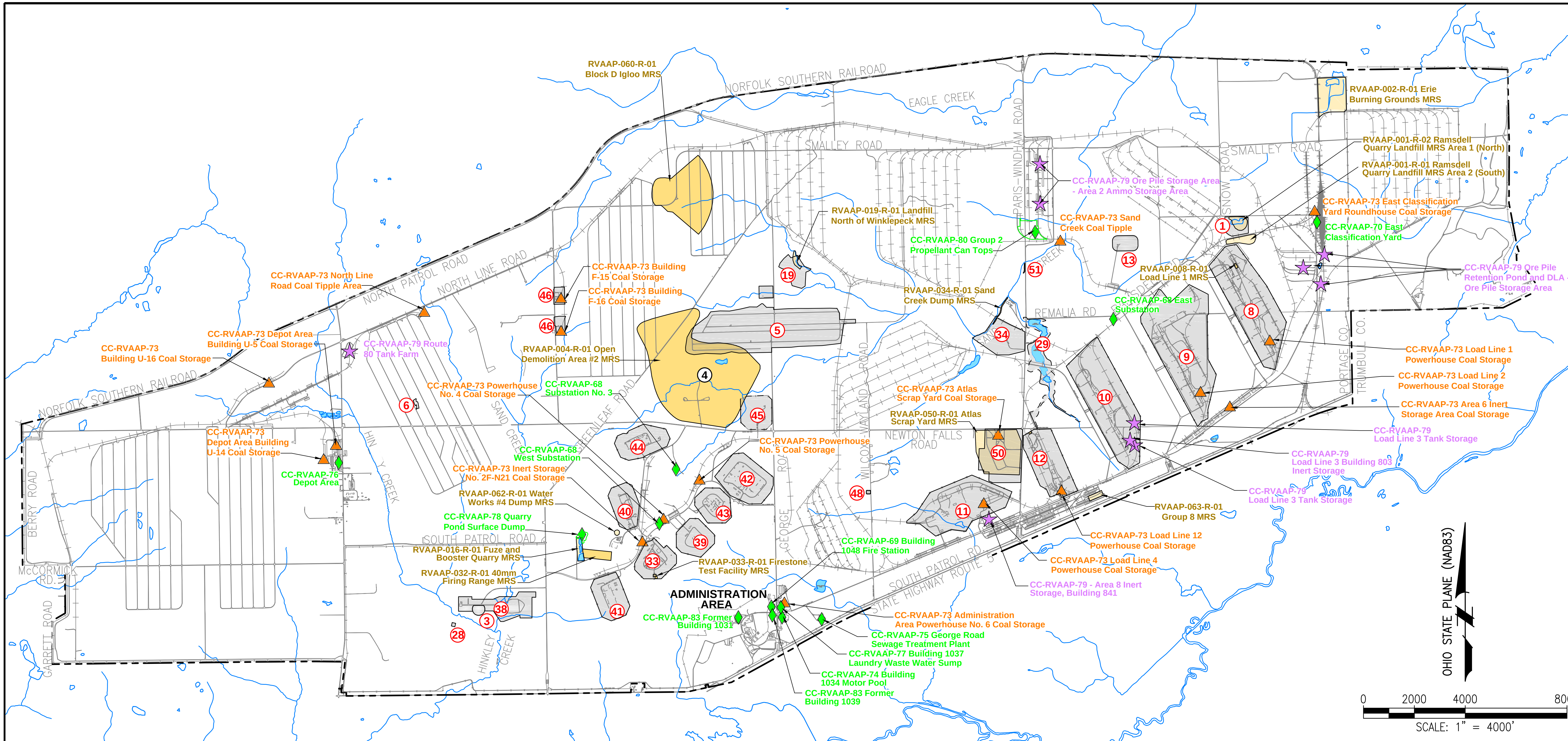


Figure 1-1. Location Map



IRP SITES - CERCLA

- (1) RVAAP-01 .... RAMSDELL QUARRY LANDFILL
- (3) RVAAP-03 .... OPEN DEMOLITION AREA #1
- (5) RVAAP-05 .... WINKLEPECK BURNING GROUNDS
- (6) RVAAP-06 .... C BLOCK QUARRY
- (8) RVAAP-08 .... LOAD LINE 1
- (9) RVAAP-09 .... LOAD LINE 2
- (10) RVAAP-10 .... LOAD LINE 3
- (11) RVAAP-11 .... LOAD LINE 4
- (12) RVAAP-12 .... LOAD LINE 12
- (13) RVAAP-13 ..... BLDG 1200 & DILUTION\SETTLING POND
- (19) RVAAP-19 .... LANDFILL NORTH OF WINKLEPECK BURNING GROUNDS
- (28) RVAAP-28 .... MUSTARD AGENT BURIAL SITE
- (29) RVAAP-29 ...... UPPER AND LOWER COBBS PONDS
- (33) RVAAP-33 .... LOAD LINE 6
- (34) RVAAP-34 .. SAND CREEK DISPOSAL ROAD LANDFILL
- (38) RVAAP-38 .... NACA TEST AREA
- (39) RVAAP-39 .... LOAD LINE 5
- (40) RVAAP-40 .... LOAD LINE 7
- (41) RVAAP-41 .... LOAD LINE 8
- (42) RVAAP-42 .... LOAD LINE 9
- (43) RVAAP-43 .... LOAD LINE 10
- (44) RVAAP-44 .... LOAD LINE 11
- (45) RVAAP-45 .... WET STORAGE AREA
- (46) RVAAP-46 .... BUILDINGS F-15 AND F-16
- (48) RVAAP-48 .... ANCHOR TEST AREA
- (50) RVAAP-50 .... ATLAS SCRAP YARD
- (51) RVAAP-51 .... DUMP ALONG PARIS-WINDHAM ROAD
- RVAAP-66 .... FACILITY-WIDE GROUNDWATER
- RVAAP-67 .... FACILITY-WIDE SEWERS

COMPLIANCE RESTORATION SITES (13 SITES)

- RVAAP-68 .... ELECTRIC SUBSTATIONS (E,W,NO.3)
- RVAAP-69 .... BUILDING 1048 – FIRE STATION
- RVAAP-70 .... EAST CLASSIFICATION YARD
- RVAAP-72 .... FACILITY-WIDE USTs
- RVAAP-73 .... FACILITY-WIDE COAL STORAGE
- RVAAP-74 BUILDING 1034 MOTOR POOL HYDRAULIC LIFT
- RVAAP-75 .GEORGE ROAD SEWAGE TREATMENT PLANT
- RVAAP-76 .... DEPOT AREA
- RVAAP-77 BUILDING 1037 LAUNDRY WASTE WATER SUMP
- RVAAP-78 .... QUARRY POND SURFACE DUMP
- RVAAP-79 .... DLA ORE STORAGE SITES
- RVAAP-80 .... GROUP 2 PROPELLANT CAN TOPS
- RVAAP-83 ...... FORMER BUILDINGS 1031 AND 1039

MMRP SITES (14 SITES)

- RVAAP-001-R-02 .... RAMSDELL QUARRY LANDFILL AREA 1 (NORTH)
- RVAAP-001-R-01 .... RAMSDELL QUARRY LANDFILL AREA 2 (SOUTH)
- RVAAP-002-R-01 .... ERIE BURNING GROUNDS MRS
- RVAAP-004-R-01 .... OPEN DEMOLITION AREA #2 MRS
- RVAAP-008-R-01 .... LOAD LINE 1 MRS
- RVAAP-016-R-01 .... FUZE AND BOOSTER QUARRY MRS
- RVAAP-019-R-01 ... LANDFILL NORTH OF WINKLEPECK MRS
- RVAAP-032-R-01 .... 40MM FIRING RANGE MRS
- RVAAP-033-R-01 .... FIRESTONE TEST FACILITY MRS
- RVAAP-034-R-01 .... SAND CREEK DUMP MRS
- RVAAP-050-R-01 .... ATLAS SCRAP YARD MRS
- RVAAP-060-R-01 .... BLOCK D IGLOO MRS
- RVAAP-061-R-01 .... BLOCK D IGLOO – TD MRS
- RVAAP-062-R-01 .... WATER WORKS #4 DUMP MRS
- RVAAP-063-R-01 .... GROUP 8 MRS

OTHER REGULATORY - RCRA

- (4) RVAAP-04 ..... OPEN DEMOLITION AREA #2

LEGEND:

- ◆ .... COMPLIANCE RESTORATION SITES – APPROVED
- ★ .... DLA ORE STORAGE AREAS (7 SITES)
- ▲ .... COAL STORAGE AREAS (17 SITES)
- .... AOC SITES
- .... MMRP SITES
- .... RAILROAD TRACKS
- .... FENCELINE
- .... STREAM OR CREEK

US Army Corps of Engineers Louisville District

leidos

FORMER RVAAP/CAMP RAVENNA
PORTAGE & TRUMBULL COUNTIES, OHIO

DRAWN BY:	REV. NO./DATE:	CAD FILE:
P. HOLM	REV.2/02-05-16	08042/DWGS/Q94-RVAAP-AOCs

Figure 1-2. Location of AOCs at RVAAP/Camp Ravenna.

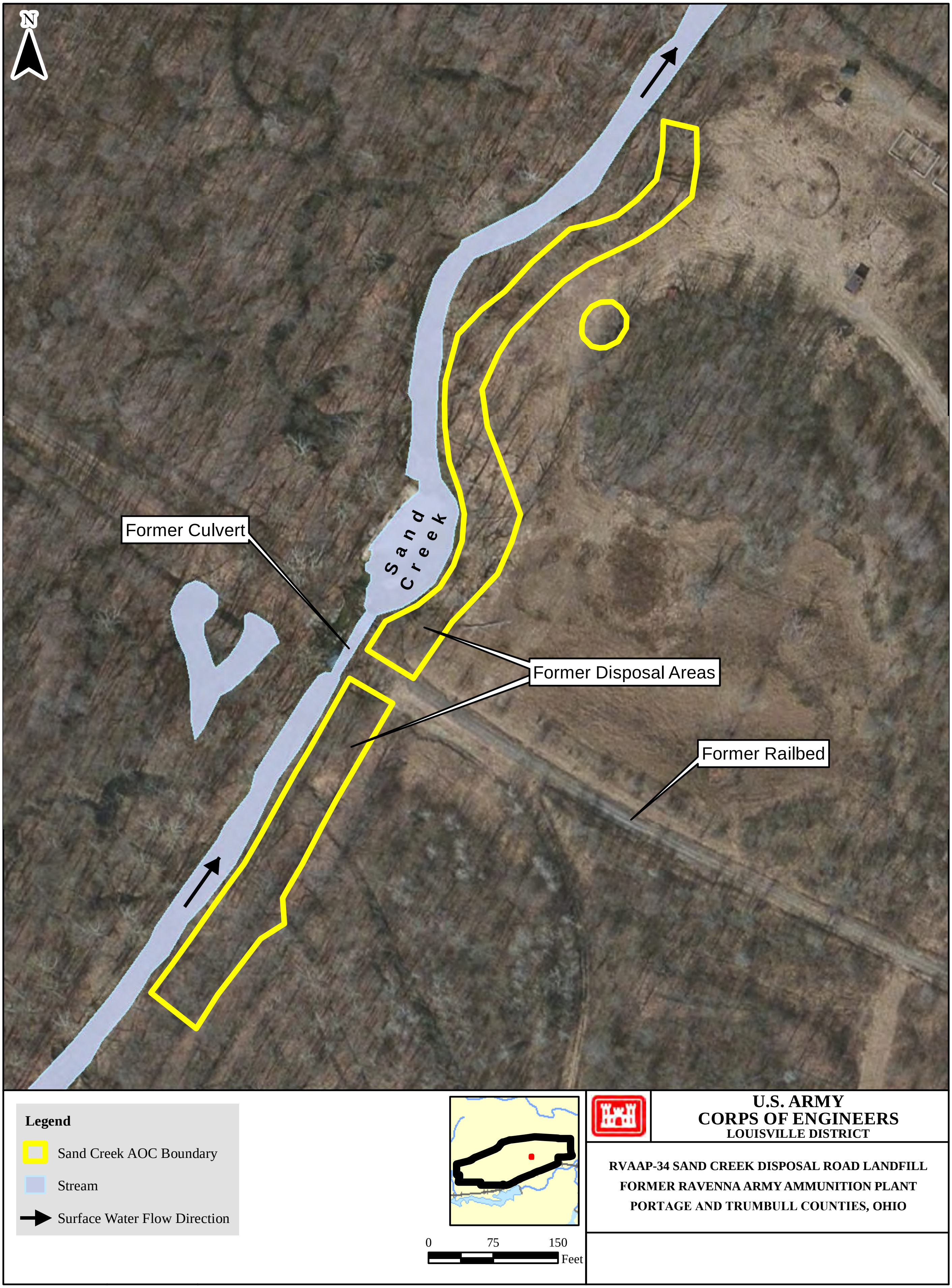


Figure 1-3. Site Map

SECTION 2: SITE DESCRIPTION AND HISTORY

2.1 GENERAL FACILITY

Camp Ravenna, former RVAAP, is located in northeastern Ohio within Portage and Trumbull counties, approximately 1.6 kilometers (km) (1 mile) northwest of the city of Newton Falls and 4.8 km (3 miles) east-northeast of the city of Ravenna (**Figure 1-1**). The installation is surrounded by several communities: Windham to the north; Garrettsville 1 mile to the northwest; Newton Falls 1 mile to the east; Charlestown to the southwest; and Wayland 3 miles southeast. The facility is a parcel of property approximately 17.7 km (11 miles) long and 5.6 km (3.5 miles) wide bounded by State Route 5, the Michael J. Kirwan Reservoir, and the CSX System Railroad on the south; Garret, McCormick, and Berry Roads on the west; the Norfolk Southern Railroad on the north; and State Route 534 on the east (**Figure 1-2**).

As of September 2013, administrative accountability of the entire 21,683-acre installation has been transferred to the United States Property and Fiscal Officer (USP&FO) for Ohio. The installation has been licensed to the OHARNG for use as a military training site known as Camp Ravenna. The RVAAP IRP involves cleanup of former production/operational areas throughout the facility related to operations that were conducted at the former RVAAP facility.

2.2 OPERATIONAL HISTORY AND MISSION OF THE FORMER RVAAP

Constructed in 1940, production at the former RVAAP began in December 1941, with the primary missions of depot storage and ammunition loading. The installation was divided into two separate units: the Portage Ordnance Depot and the Ravenna Ordnance Plant. The depot's primary mission was storage of munitions and components, while the mission of the ordnance plant was loading and packing major caliber artillery ammunition and the assembly of munitions-initiating components that included fuzes, boosters, and percussion elements. In August 1943, the installation was re-designated as the Ravenna Ordnance Center, and in November 1945, it was re-designated as the Ravenna Arsenal.

The plant was placed in standby status in 1950 and reactivated during the Korean Conflict to load and pack major caliber shells and components. All production ended in August 1957, and in October 1957 the installation again was placed in a standby condition. In October 1960 the ammonium nitrate line was renovated for demilitarization operations, which involved melting explosives out of bomb casings for subsequent recycling. These operations began in January 1961. In July 1961, the plant was deactivated again. In November 1961, the installation was divided into the Ravenna Ordnance Plant and an industrial section, with the entire Installation designated as the RVAAP.

In May 1968, loading, assembling, and packing munitions began on three load lines and two component lines to support the Southeast Asia conflict. These facilities were deactivated in August 1972. The destruction of M71A1 90-millimeter (mm) projectiles extended from June 1973 until March 1974. Destruction of various munitions was conducted from October 1982 through 1992.

Until 1993, the former RVAAP maintained the capability to load, assemble, and pack military ammunition. As part of the former RVAAP mission, the U.S. Army maintained inactive facilities in a standby status by keeping equipment in a condition to allow resuming production within prescribed limitations. In September 1993, the U.S. Army placed the former RVAAP in inactive caretaker status, which subsequently changed to modified caretaker status. The load lines and associated real estate were determined to be excess by the U.S. Army.

2.3 CURRENT STATUS

Administrative accountability for the entire 21,683-acre facility has been transferred to the USP&FO for Ohio and the property subsequently licensed to the OHARNG for use as a military training site, Camp Ravenna. The RVAAP restoration program involves cleanup of former production/operational areas throughout the facility related to former activities conducted under the RVAAP.

The former RVAAP IRP encompasses investigation and cleanup of past activities over the 21,683-acre former RVAAP. Therefore, references to the former RVAAP in this document are considered to be inclusive of the historical extent of the former RVAAP, which is inclusive of the combined acreages of the current Camp Ravenna and the former RVAAP, unless otherwise specifically stated. The Ohio EPA is the lead regulatory agency for the investigation and remediation conducted by the U.S. Army under the U.S. Department of Defense (DOD) IRP.

2.4 SAND CREEK DISPOSAL ROAD LANDFILL SITE DESCRIPTION

This section presents a summary of the Sand Creek AOC history, previous RAs and investigations, and site-related chemicals (SRCs) in environmental media at the AOC.

2.4.1 OPERATIONAL HISTORY

The Sand Creek Disposal Road Landfill is located in the central eastern portion of the former RVAAP and was used as an open dump area (**Figure 1-2**). The operational history of disposal activities at the site is incomplete. Construction and demolition debris (C&DD) type material were delivered to the site and dumped over an embankment located immediately adjacent to Sand Creek. The dump site extended along the embankment for approximately 1,200 feet and varied in width from 20 to 40 feet from the top of the bank to the bottom (**Figure 1-3**). The size of the defined AOC is approximately 1 acre. The bank slopes from east to west towards Sand Creek at 40 to 60 degrees from the horizontal. There are no records indicating the quantities or materials dumped at the site and the dates of operation for the landfill are unknown. Several buildings associated with the former Sand Creek Sewage Treatment Plant are located northeast of the site. Surface water runoff follows the topography of the site and flows in a westerly direction where it enters Sand Creek. A very narrow floodplain occupies the land between the bottom of the embankment and Sand Creek. A former railroad bed bisects the AOC (MKM, 2004).

During the preliminary site assessment work on the Sand Creek AOC, the site was very overgrown with mature trees and ground level vegetation. The entire site was littered with C&DD materials with large piles of debris concentrated mostly in the southern portion of the AOC. Some of the types of C&DD materials identified during the preliminary site assessment included the following:

- Asbestos-containing material (ACM) (i.e., large piles of corrugated transite roofing and flat transite siding)
- Rubble (i.e., concrete, brick, and masonry fragments)
- Drywall and plaster
- Glass bottles, fluorescent light tubes, and broken glass
- Scrap metal items including wire fencing
- Wooden debris.

2.4.2 PREVIOUS INVESTIGATIONS AND REMOVAL ACTIONS

Several RI activities, previous investigations and other activities have been conducted at the Sand Creek Site included a preliminary assessment (PA), RA, confirmatory sampling, a Facility wide Baseline Water Quality Study, a Digital Geophysical Mapping (DGM) survey, and a Phase I (Site Inspection), and a Phase II RI. A discussion of these activities and the results/recommendations is presented further in this section.

2.4.2.1 Preliminary Assessment (1996)

In 1996, SAIC was contracted by the USACE to conduct a PA at various AOCs at the former RVAAP. The purpose of the PA was to collect information concerning conditions at the former RVAAP. The information was to be sufficient to assess the potential threat posed to human health and the environment and to determine the need for additional characterization at areas identified as containing potentially hazardous materials from former munitions assembly and demilitarization operations at the installation. The scope of the PA included review of available information, interviews with former employees, and field visits to review and identify potential sites. The PA reported that the site contained concrete, wood, several tons of asbestos and spent fluorescent light bulbs. The waste was characterized as containing asbestos and heavy metals (mercury), although no characterization data were available (SAIC, 1996).

2.4.2.2 Relative Risk Site Evaluation (1996)

The U.S. Army Center for Health Promotion and Preventative Medicine (USACHPPM) conducted a relative risk site evaluation (RRSE) for previously uninvestigated sites at the former RVAAP in 1996. From the 19 sites that were evaluated, 4 were classified as “high” priority AOCs and the others were classified as “low” or ”medium.” The four high-priority AOCs included the Sand Creek Disposal Road Landfill.

The 1996 USACHPPM Report identified surface soil and sediments to be potential media for contaminant migration at the Sand Creek Site due to the lack of any physical barriers/fence around the site and its proximity to Sand Creek. Three shallow soil samples and one sediment sample were collected from the site during the RRSE. The study identified arsenic as exceeding RRSE screening values for sediments and identified the potential for arsenic to migrate into Sand Creek. The RRSE for this AOC was scored "high" since it is the habitat for state-endangered species (Mountain Brook Lamprey and the River Otter). Under the CERCLA process, a site which registers a RRSE rating of "high" requires further investigation and/or removal (USACHPPM, 1998).

2.4.2.3 Additional Investigations

Site evaluations following the USACHPPM sampling event showed that the area used for dumping at the Sand Creek Site was larger than originally defined. In addition, observations identified multiple potential sources of chemical contamination, such as solvent drums, gas cylinders, open canisters, broken lab bottles, and construction debris.

Additional surface soil samples were taken to further characterize the dump site. Samples were collected and analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs or polycyclic aromatic hydrocarbons (PAHs)), metals, cyanide, pesticides, polychlorinated biphenyls (PCBs), explosives, and nitroguanidine. Results indicated metals and SVOCs were present and should be evaluated further.

Additionally, results indicated that contaminants had migrated to the sediments of Sand Creek. Additional contamination in soils beneath sediment along the Sand Creek was a concern. However, unexploded ordnance concerns prevented additional sampling before debris removal. As such, a Removal Action (RA) was the selected alternative for the Sand Creek Disposal Road Landfill as detailed in the *Final Remedial Design and Removal Action Plan for RVAAP-34 Sand Creek Disposal Road Landfill at Ravenna Army Ammunition Plant* (MKM, 2004).

2.4.2.4 Facility-Wide Biological and Water Quality Study (2003)

In 2003, the USACE performed surface water and sediment sampling and biological monitoring at 26 stream sites at the former RVAAP that included sample location (S-7) at the intersection of the Sand Creek and the former railroad that transects the site (**Figure 2-1**). Biological monitoring included fish and macroinvertebrate community assessments. Two surface water samples from each location at different collection dates during the summer of 2003 (June and September) were analyzed for target analyte list (TAL) metals, pesticides, PCBs, explosive compounds, SVOCs, and several nutrient parameters. One sediment sample was collected using the ISM at the collocated biological sampling sites. Sediments were analyzed for TAL metals, SVOCs, pesticides, PCBs, explosive compounds, percent solids, and cyanide as well as several nutrient parameters. The collection of the aforementioned data provided (1) aquatic life use attainment status of streams regarding the Warm Water Habitat or other applicable aquatic life use designation codified in the Ohio Water Quality Standards (OWQS), (2) an assessment if chemical contamination within the streams was adversely affecting the biological communities, and (3) an ecological assessment report summarizing the sediment, surface water, and aquatic biological results. The results of the surface water and sediment results collected at sample location S-7 is presented in the 2003 FWBWQS (USACE, 2005a). A summary of the results are as follows:

- Sediment—Cadmium and antimony were the only inorganics in the sediment sample that exceeded the former RVAAP background screening value (BSV) since the BSV is 0. A low SVOC concentration of di-n-butyl phthalate was also detected. No PCBs, pesticides, cyanide, or explosives compounds were detected in the sediment sample.

- Surface Water—The only detected metal that exceeded an RVAAP-calculated BSV samples from the September 2003 sampling event was arsenic. Concentrations of chromium, cobalt, silver, and vanadium were detected between the two sampling events and exceeded the BSV of 0. All other detected metals were either essential nutrients (calcium, iron, magnesium, potassium, and sodium), or the maximum detected concentration (MDC) was less than the former RVAAP surface water BSV (aluminum, barium, copper, manganese, and zinc). A low concentration of bis(2-ethylhexyl) phthalate was detected in surface water during the first round of sampling, and di-n-butyl phthalate was detected in the second round of sampling. No PCBs, pesticides, or explosive concentrations were detected in the surface water samples.

A comparison of the results at sample location S-7 indicates that historical activities at the Sand Creek Site have not impacted surface water or sediment quality within the portion of the Sand Creek that is adjacent to the AOC. Furthermore, evaluation of the surface water and sediment data at the nearest downstream sample location (S-9 located approximately 1000 feet downstream of the site) provides support that historical activities at the Sand Creek Site have not impacted downstream conditions. In general, the FWBWQS 2003 Report (USACE, 2005a) concluded that surface water quality throughout the installation was generally good to excellent with very few exceedances of Ohio aquatic life water quality criteria (WQC). Sediment samples generally reflected non-contaminated conditions and stream habitat was good at most sites.

2.4.2.5 Removal Action (2003) (RA)

An RA at the Sand Creek Site was conducted by MKM between August and September 2003. The removal effort at the site consisted of removing all existing unconsolidated surface debris, the limited removal of subsurface debris, transportation and disposal of debris and restoration activities. Due to the presence of transite, all debris was disposed of as ACM special waste. Approximately 1,118 tons (~799 cubic yards) of ACM material, including the subsurface transite, glass, and miscellaneous debris were removed from the AOC (MKM, 2004). The areas that had the debris are presented on **Figure 2-2**.

The 2003 RA event included the collection of discrete surface soil (0 to 1 foot), sediment samples (0 to 6 inches) and surface water samples. The results and conclusions of the confirmatory sampling were evaluated and presented in the RD/RA Report (MKM, 2004). At the time the report was issued, the confirmatory results were compared to the former RVAAP

BSVs for inorganics and the U.S. Environmental Protection Agency (EPA) Preliminary Remediation Goals (PRGs), which are based on risk-based screening concentrations adjusted to account for additive effects between chemicals and routes of exposure.

The analysis of the confirmatory soil samples showed elevated concentrations (i.e., greater than the former RVAAP BSVs and/or the PRGs) of heavy metals in the northern third of the site with lower concentrations of heavy metals, SVOCs, explosives, and propellants dispersed over the remainder of the site. The confirmation sediment samples collected from the neighboring floodplain and Sand Creek reported arsenic levels greater than the EPA PRG level.

2.4.2.6 After Action Sample Collection (2003)

Confirmatory soil, surface water, and sediment samples were collected in and around the site by MKM following the removal efforts to evaluate the success of the RA and characterize potential impact to Sand Creek and the neighboring floodplain (**Figure 2-2**). Prior to sampling, the dump area was divided into 30 sampling grids to facilitate collection of the soil discrete samples. One shallow soil sample (0 to 1 foot), not including duplicates and quality control (QC) samples, was collected from each grid (30 total) measuring approximately 40 feet by 40 feet. Surface water was collected at 3 locations, and sediment samples were collected at 12 locations within the Sand Creek and neighboring floodplains, respectively, to characterize potential impact associated with surface water runoff from the site.

A summary of results for the samples collected during the RA is as follows:

- **Surface Soil—**Multiple inorganics were detected in the 2003 RA confirmatory surface soil samples in excess of the facility-wide BSVs. Although sporadic, numerous SVOCs consisting of PAHs, three explosives (2,4-trintrotoluene, 2,4-dinitrotoluene, and 2,6-dinitrotoluene), one propellant (nitrocellulose), and one VOC concentration (chloroethane) were detected at two surface soil sample locations.

- **Sediment—**Multiple inorganics were detected in the RA confirmatory sediment samples in excess of the facility-wide BSVs), and one VOC (acetone) was detected at two sample locations. No SVOCs were detected.

- **Surface Water—**No VOCs, SVOCs, explosives, or propellants were detected in surface water during the 2003 RA. All detected metals were either essential nutrients (calcium, iron, magnesium, potassium, and sodium), or the maximum detected concentration (MDC) was less than the RVAAP surface water BSVs (arsenic, aluminum, barium, copper, manganese, and zinc).

Results indicated that there could be some impact to environmental media at the AOC as a result of historical activities, in particular surface soil. During confirmation sampling following the RA, two 75-mm projectile shells (i.e. munitions debris [MD]) were discovered at the northern portion of the site.

2.4.2.7 DGM Survey

Between April and May 2010, Shaw conducted a Digital Geophysical Mapping (DGM) survey at and in the immediate vicinity of the Sand Creek Site where historical dumping activities occurred. The primary purpose of the survey was determining the horizontal extent of potential munitions and explosives of concern (MEC) contamination and other suspected buried anomalies without performing intrusive activities at the site. The secondary objective was to evaluate the data to characterize the anomaly density at the site. Geophysical data were collected south and north of the access road adjacent to the stream, along the steep slopes of the embankment in the central portion of the Sand Creek Site and east of the steep embankment in the open area. During this effort, data were acquired in accessible areas void of thick vegetation and fallen trees and where the embankments and other localized slopes were navigable by the field crew (Shaw, 2011). The areas at and adjacent to the Sand Creek Site that the DGM survey covered are presented in **Figure 2-3**.

The DGM data collected at the Sand Creek Site were able to determine the broader limits of metallic waste materials as well as to define more localized regions within and outside the AOC footprint that contain relatively higher metal content. The survey data indicated that the largest portion of the metal debris at the site is present northeast of the former railroad bed. Several areas characterized by relatively higher density of anomalies are located between the stream and the edge of the eastern plateau. The large oval-shaped area that trends southwest-northeast in the northeastern portion of the survey area (contiguous pink colors on **Figure 2-3**) is approximately 0.8 acres in size. Areas characterized by relatively lower density of anomalies are present throughout the southern portion of the survey area. During the survey of the area, the field crew noticed several relatively large areas where concrete rubble was present along and at the bottom of the embankment at the northern portion of the site.

2.4.2.8 Remedial Investigation (2017)

An RI Report was completed to document the results of the field activities performed for RVAAP-34 Sand Creek Site. As part of the RI, a human health risk assessment (HHRA) was performed to evaluate whether site conditions may pose a risk to current or future human receptors and to identify which, if any site conditions need to be addressed in the FS. The data sets used for the risk assessment process were primarily from the RI and included the ISM surface soil and sediment samples and subsurface samples (**Figures 2-4 and 2-5)**. **Figure 2-6** presents the cross-section soil types and fill/debris. The surface water samples from the 2003 RA and the 2003 FWBWQS were also used.

The AOC is not currently used for military training activities but may receive periodic foot traffic during maintenance, restoration, and security activities. The most likely future land use for the AOC is the Military Training. The Representative Receptor for this Land Use is the National Guard Trainee (NGT) per the *USACE's Facility-Wide Human Health Risk Assessment Manual* (HHRAM - USACE, 2005b) and the 2014 Risk Assessment Tech Memo. This anticipated future Land Use, in conjunction with the evaluation of Unrestricted (Residential) Land Use, form the basis for identifying chemicals of concern (COCs) in this RI. Unrestricted (Residential) Land Use is included to evaluate COCs for Unrestricted

(Residential) Land Use at the AOC, as required by the CERCLA process and as outlined in the HHRAM (USACE, 2005b).

A third Land Use was also included in the RI. The third Land Use, Commercial Industrial Land Use was identified in the Risk Assessment Tech Memo as a means to evaluate the site to determine if it is suitable for full-time, permanent employees. According to the Risk Assessment Tech Memo (NGB, 2014), if the criteria for the Commercial Industrial Land Use is met, then no additional remedial actions are required except for the development of Land Use Controls through the CERCLA process (FS, PP, ROD, etc.). The Military Training Land Use is the primary Land Use and is protective of all activities that the OHARNG may conduct on the site except for full-time, permanent-occupational use.

The Sand Creek AOC was considered as a single Exposure Unit (EU) based on the future land use. Although the site was evaluated as a single EU, soil data collected within and adjacent to the AOC were aggregated by depth intervals since different future use receptors with different depths of potential exposure were evaluated. The RI included analyses to assess potential risks at various depths to assess whether the most likely receptor to deep surface soil and subsurface soil, the NGT, could be allowed to dig. The soil intervals for Unrestricted (Residential) Land Use and Commercial Industrial Land Use were also assessed. Sediment samples collected for the RI and previously collected surface water samples were evaluated in the same manner for the identified receptors. The purpose of evaluating the receptors in this manner was to provide information for further evaluation in the FS and to determine the best remedial action to meet the evaluation criteria. The COPC identification was completed for the following data sets:

- Resident Receptor (Adult and Child)—Surface soil (0–1 foot bgs)
- Industrial Receptor—Surface soil (0–1 foot bgs)
- National Guard Trainee —Deep Surface soil (0–4 feet bgs)
- Resident Receptor (Adult/Child)—Subsurface soil (1–13 feet bgs)
- Industrial Receptor —Subsurface soil (1–13 feet bgs)
- National Guard Trainee—Subsurface soil (4–7 feet bgs))
- Resident Receptor (Adult and Child), Industrial Receptor, and National Guard Trainee—Sediment
- Resident Receptor (Adult and Child), Industrial Receptor, and National Guard Trainee—Surface water.

The exposure scenarios for RVAAP-specific receptors (Resident Receptor and NGT) are presented in the FWCUG Report (SAIC, 2010). The exposure parameters for the Industrial Receptor (Composite Indoor and Outdoor Worker) can be found on the USEPA's Regional Screening Levels (RSL) website and are those used to calculate Industrial RSLs. There is no depth or intrusive activity associated with the Industrial Receptor so for the HHRA, they are assumed to be exposed to depths similar to that of the Resident Receptor.

The HHRA was prepared using the streamlined approach to risk decision making as described in the *U.S. Army Corps of Engineers Ravenna Army Ammunition Plant Position Paper for the Application and Use of Facility-Wide Cleanup Goals* (USACE, 2012). The approach identifies chemicals of potential concern (COPCs) by comparing concentrations to background screening values, eliminating essential nutrients, and comparing site concentrations to the FWCUGs. The COCs were identified through additional screening of the COPCs by comparing site concentrations to specific FWCUGs and using a "sum of ratios" (SOR) approach to account for cumulative effects for carcinogens and non-carcinogens acting on the same critical effect.

COCs in Surface Soil and Deep Surface Soil

Surface soil for Unrestricted (Residential) Land Use and the Commercial Industrial Land Use is defined as the 0- to 1-foot interval. Deep surface soil for the Military Training Land Use receptors is defined as the 0- to 4-foot interval. The COC determination for each receptor was determined separately for non-cancer (by target organ/critical effect) and for cancer risks

COCs Unrestricted Residential/Commercial Industrial Land Uses in Surface Soil

Only arsenic was identified as a COC based on non-cancerous effects for the child Resident Receptor for the Unrestricted (Residential) Land Uses in surface soil (**Table 1**). Two COCs were identified based on cancer risks and using the SOR. These were arsenic and benzo(a)pyrene. These were determined using the maximum concentration of any of the ISM surface soil results for each COPC for the Unrestricted (Residential) Land Use.

No COCs based on noncancer effects were identified for the Commercial Industrial Land Use receptors in surface soil (**Table 1)**. Two COCs were identified based on cancer risks and using the SOR. These were arsenic and benzo(a)pyrene for the Commercial Industrial Land Use. These COCs were based on the maximum detected concentration for each COPC at any of the ISM locations and not by ISM location.

COCs Military Training Land Use in Deep Surface Soil

Deep surface soil for the Military Training Land Use receptors is defined as the 0- to 4-foot interval. Samples from this interval include the ISM surface soil samples from 0 to 1 foot and the subsurface samples from the 1- to 5-foot interval.

No COCs based on noncancer effects were identified for the Military Training Land use in the surface samples using ISM maximum sample concentrations in the 0- to 1 foot interval (**Table-1**). Three COCs were identified based on cancer risks and using the SOR. These were arsenic, cobalt, and benzo(a)pyrene for the Military Training Land Use.

In the discrete samples from the 1 to 5 foot interval, the 95% UCL was estimated and used in the calculations. No COCs based on noncancer effects were identified for the Military Training Land Use in the deep surface samples (1-to 5 foot interval) using the 95% UCL (**Table 1)**. Four COCs were identified based on cancer risks and using the SOR for this interval. These were arsenic, cobalt, benzo(a) pyrene, and benzo(b)fluoranthene for the Military Training Land Use.

COCs Unrestricted (Residential) Land Use in Subsurface Soil

Based on the results of this HHRA, there are several COCs identified in the subsurface soil for the Unrestricted (Residential) Land Use. These were identified using the 95% UCL or the MDC (if it was larger than the 95% UCL) for each COPCs regardless of location. No COCs based on non-cancer effects were identified for the Unrestricted (Residential) Land Use receptors in subsurface soil. The results from ISM DU from 1 to 5 feet, 5 to 9 feet, and 9 to 13 feet is presented in (**Table 1**). Two COCs were identified based on cancer risks and using the SOR. These were arsenic and benzo(a)pyrene. These were determined using the maximum concentration of any of the ISM surface soil results for each COPC.

COCs in Subsurface Soil for the Commercial Industrial Land Use

No COCs based on noncancer effects were identified for the Commercial Industrial Land Use receptors in subsurface soil. Four COCs were identified based on cancer risks and using the SOR. These were arsenic, benzo(a)anthracene, dibenzo(a,h)anthracene, and benzo(a)pyrene. These COCs were derived using the 95% UCL for each COC at any of the ISM locations and not for each individual ISM locations. This type of re-assessment should be completed in the FS, so that the minimum area to be evaluated can be focused where there is the most contamination. This would help focus the FS so that only the contaminated areas are evaluated.

COCs in Subsurface Soil for the Military Training Land Use

Subsurface soil for the National Guard Trainee is defined as the 4- to 7-foot interval. Samples from the 4- to 7-foot interval include the subsurface samples from 5 to 9 feet since the sample intervals overlap. No COCs were identified for the Military Training Land Use in the subsurface interval for the NGT (should have been only 4 to 7 feet but this also included data from 5 to 9 feet).

COCs in Sediment Summary for all Land Uses

No COCs were identified for Unrestricted (Residential) Land Use, Commercial Industrial Land Use, or Military Training Land Use in the sediment at the AOC. This media does not require further evaluation in an FS. A “No further Action” (NFA) determination is obtained for sediment at the Sand Creek Site.

Surface Water Summary

No COCs were identified for Unrestricted (Residential) Land Use, Commercial Industrial Land Use, or Military Training Land Use in the surface water. This media does not require further evaluation in an FS. An NFA determination is obtained for surface water at the Sand Creek Site.

Conclusions

Results of the HHRA indicated the presence of several COCs in surface soil and subsurface soil for Unrestricted (Residential) Land Use, Commercial Industrial Land Use, and Military Training Land Use. Arsenic and benzo(a)pyrene were the COCs. These COCs were recommended to be further evaluated in an FS to determine the appropriate remedial actions for soil at this AOC.

A screening level ecological risk assessment (SLERA) was conducted as part of the RI to evaluate the potential for adverse ecological effects to ecological receptors from SRCs at the Sand Creek Site and to determine if any ecological receptors need to be recommended for further evaluation in the FS. The SLERA included characterizing the ecological communities in the vicinity of the site, determining the particular contaminants present, identifying pathways for receptor exposure, and estimating the magnitude of the likelihood of potential adverse effects to identified receptors. Site-specific analyte concentration data for surface soil, sediment, and surface water from the Sand Creek Site were included in the SLERA. The ecological receptor species selected for evaluation in the SLERA were identified in the *RVAAP Facility-Wide Ecological Risk Assessment Work Plan* (USACE, 2003).

Mercury in surface soil was the only COPEC recommended to be evaluated under the Level III Baseline evaluation following the Level II Screen. The only species identified as having a hazard quotient (HQ) greater than 1 associated with mercury was the robin, which indicates that potential hazards could exist to omnivorous birds foraging exclusively at the site. It is important to state that the finding of HQs greater than 1 does not necessarily indicate that adverse impacts are occurring. Additionally, the size of the entire AOC would only support one breeding pair of the American robin. The AOC is not large enough to support very many birds, especially as foraging habitat. Therefore, no further evaluation from an ecological risk perspective is warranted.

The RI recommended that the CERCLA process at the AOC should proceed to the FS phase of the CERCLA process. The FS should include a Risk Management Evaluation to fully assess each COCs before proceeding to the alternative analysis for human health. Since no COPECs in soil were identified in the SLERA, no additional remedial actions are warranted at the AOC from an ecological perspective. No COCs or COPECs were identified in sediment or surface water; therefore, an FS was not warranted for sediment or surface water at the Sand Creek Site.

In addition to the FS to assess soils at the AOC, the RI recommended that further analysis of the groundwater should be conducted for this AOC. An analysis of remedial alternatives for surface and subsurface soil is recommended based on fate and transport results of the leaching potential to groundwater that is associated with the identified CMCPOCs for these media. Evaluation of groundwater at the AOC should be conducted as part of the Facility Wide Groundwater Investigation (RVAAP-66).

TABLE 1. Summary of COCs identified for Unrestricted (Residential) Land Use, Commercial Industrial Land Use, and Military Training Land Use for each Exposure Media from the 2017 RI.

Receptor per Land Use and Exposure Point	COPCs Identified[a]		COCs Identified[b]
SURFACE SOIL			
Surface Soil (0 to 1 foot bgs)			
Unrestricted (Residential) Land Use *-Based on MDC*	*Antimony*	*Benzo(a)anthracene*	Arsenic Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Dibenzo(a,h)anthracene *All carcinogenic. Arsenic was also identified for non-carcinogenic effects*
	Arsenic	*Benzo(a)pyrene*	
	Cadmium	*Benzo(b)fluoranthene*	
	Copper	*Dibenzo(a,h)anthracene*	
	Mercury	*Indeno(1,2,3-cd)pyrene*	
	Silver	*Thallium*	
Surface Soil (0 to 1 foot bgs)			
Commercial Industrial Land Use *-Based on MDC*	*Arsenic*	*Benzo(a)pyrene*	Arsenic Benzo(a)pyrene *All carcinogenic*
	Thallium		
Deep Surface Soil (0 to 1 feet bgs)			
Military Training Land Use *-Based on MDC ISM results for 0 to 1 feet*	*Arsenic*	*Benzo(a)pyrene*	Arsenic Cobalt Benzo(a)pyrene *All carcinogenic based*
	Barium	*Benzo(b)fluoranthene*	
	Cadmium	*Dibenzo(a,h)anthracene*	
	Cobalt		
Deep Surface Soil (1 to 5 feet bgs)			
Military Training Land Use *-Based on site-wide results for 1 to 5 feet and 95% UCL for Discrete samples*	*Arsenic*	*Benzo(a)pyrene*	Arsenic Cobalt Benzo(a)pyrene *All carcinogenic based*
	Barium	*Benzo(b)fluoranthene*	
	Cadmium	*Dibenzo(a,h)anthracene*	
	Cobalt		

TABLE 1. Summary of COCs identified for Unrestricted (Residential) Land Use, Commercial Industrial Land Use, and Military Training Land Use for each Exposure Media from the 2017 RI (continued).

Receptor per Land Use and Exposure Point	COPCs Identified[a]		COCs Identified[b]
	SUBSURFACE SOIL		
Subsurface Soil (1 to 13 foot bgs)			
Unrestricted (Residential) Land Use (1 to 13 feet bgs) *Based on site-wide results and 95% UCL for Discrete samples*	*Antimony*	*Benzo(a)anthracene*	Arsenic Benzo(a)pyrene *All carcinogenic based*
	Arsenic	*Benzo(a)pyrene*	
	Copper	*Benzo(b)fluoranthene*	
	Thallium	*Dibenzo(a,h)anthracene*	
	Vanadium		
Commercial Industrial Land Use (1 to 13 feet bgs) *-Based on site-wide results and 95% UCL for Discrete samples*	*Arsenic*	*Benzo(a)anthracene*	Arsenic Benzo(a)pyrene Dibenzo(a,h)anthracene *All carcinogenic based*
	Thallium	*Benzo(a)pyrene*	
		Dibenzo(a,h)anthracene	
Subsurface Soil (4 to 7 foot bgs)			
Military Training Land Use *-Based on site-wide results for 5 to 9 feet and 95% UCL for Discrete samples*	*Arsenic*		Arsenic *Carcinogenic based*
Sediment (0 to 0.5 foot bgs)			
Unrestricted (Residential) Land Use, Commercial Industrial Land Use, and Military Training Land Use	*Antimony*	*Thallium*	None
	Silver	*Benzo(a)pyrene*	
Surface Water			
Unrestricted (Residential) Land Use, Commercial Industrial Land Use, and Military Training Land Use	*Arsenic*		None

[a] denotes COPCs identified by screening.
[b] denotes COCs identified by screening.
COC denotes chemical of concern. COPC denotes chemical of potential concern.
bgs denotes below ground surface.
mg/kg denotes milligrams per kilogram.

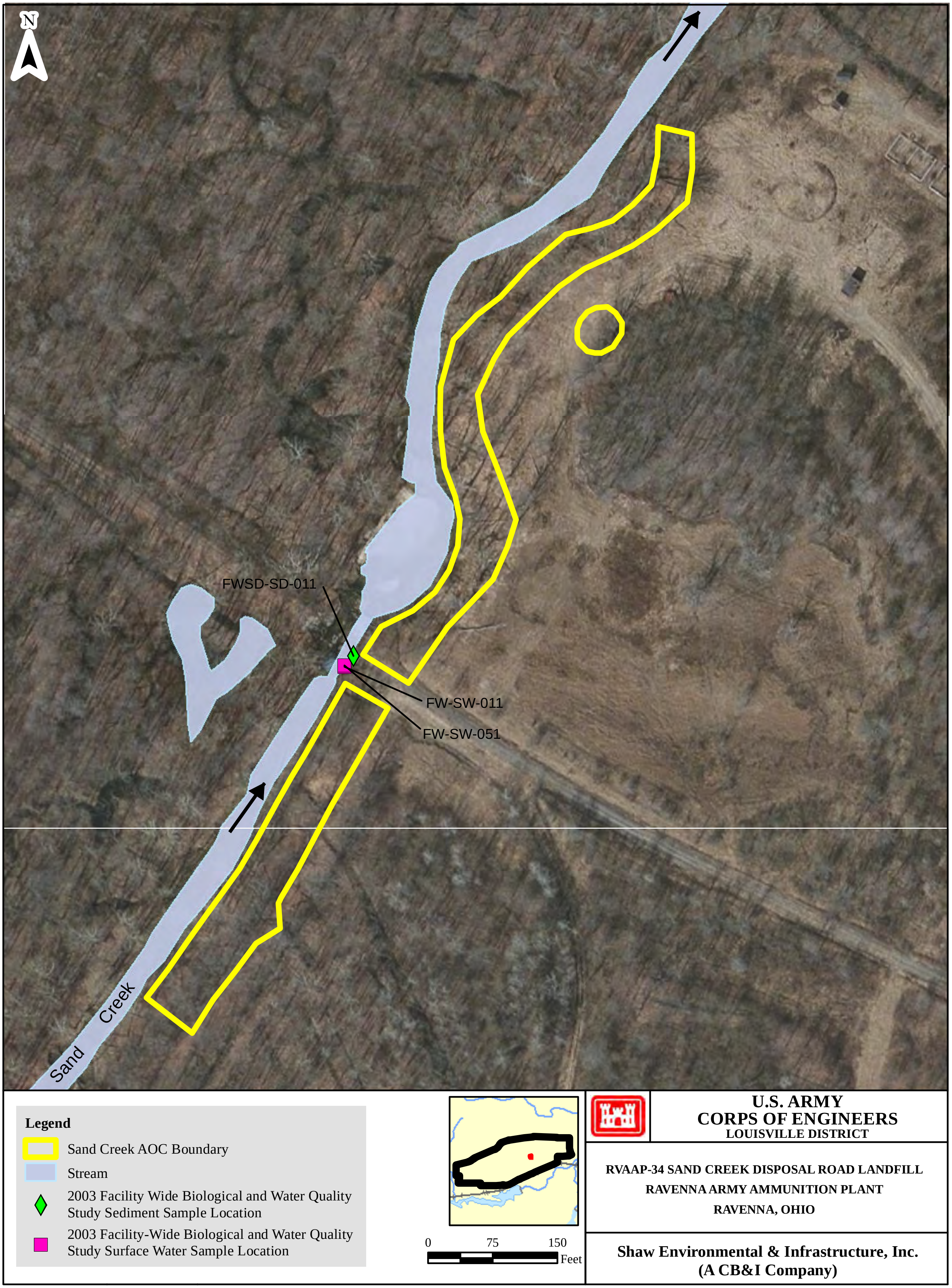


Figure 2-1. 2003 Facility-Wide Biological and Water Quality Study Sample Locations

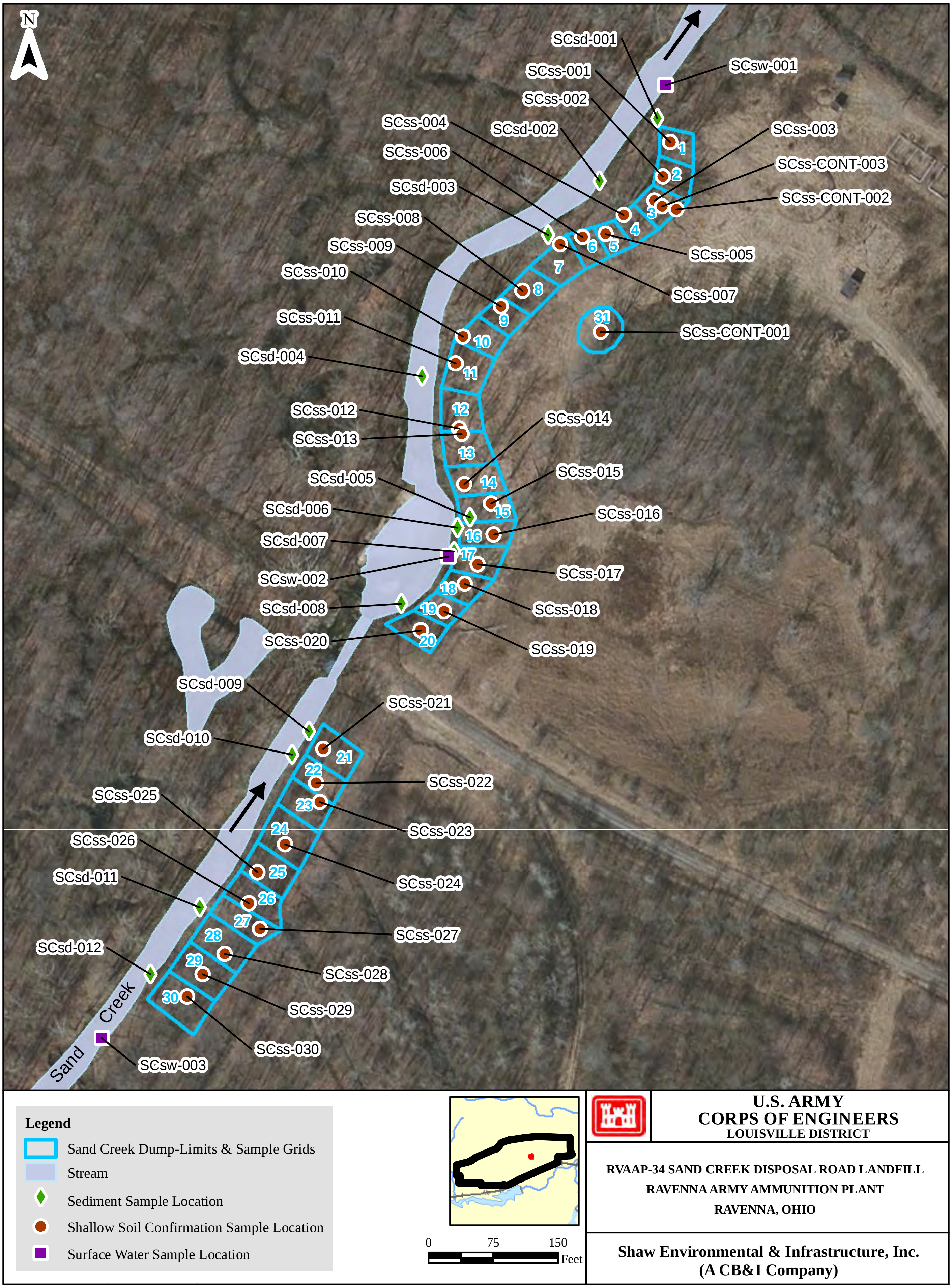
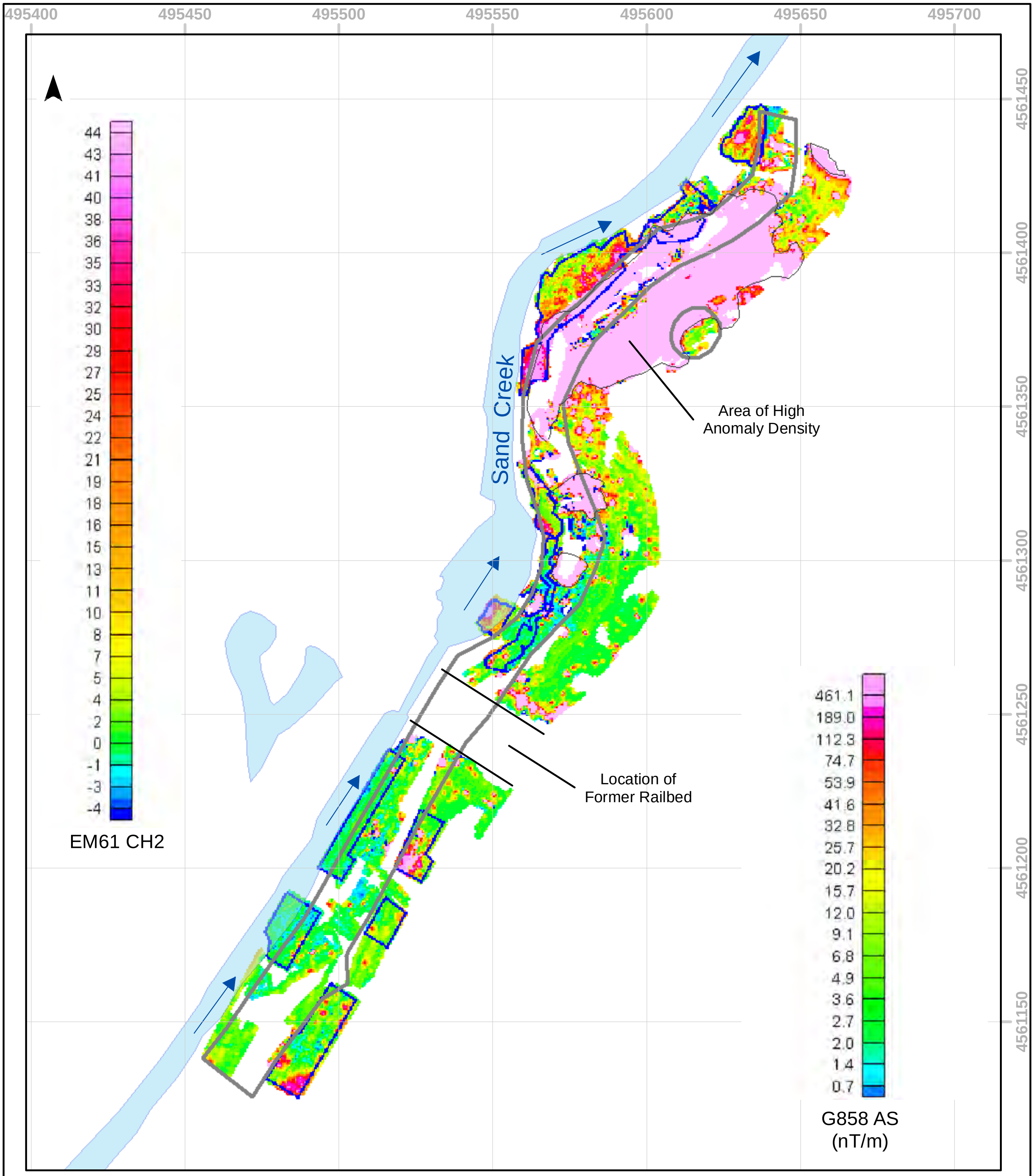


Figure 2-2. 2003 Removal Action Sample Locations



Legend

Sand Creek Disposal Road Landfill Area of Concern Boundary

Sand Creek

Direction of Flow

NOTES:

1) Outlined areas indicate larger contniguous area of increased anomaly density.
2) Dark blue outlined areas indicate areas that were investigated using the Geometrics G-858G cesium vapor magnetometer instrument.

0 75 150 Feet

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LOUISVILLE DISTRICT

RVAAP-34 SAND CREEK DISPOSAL ROAD LANDFILL
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

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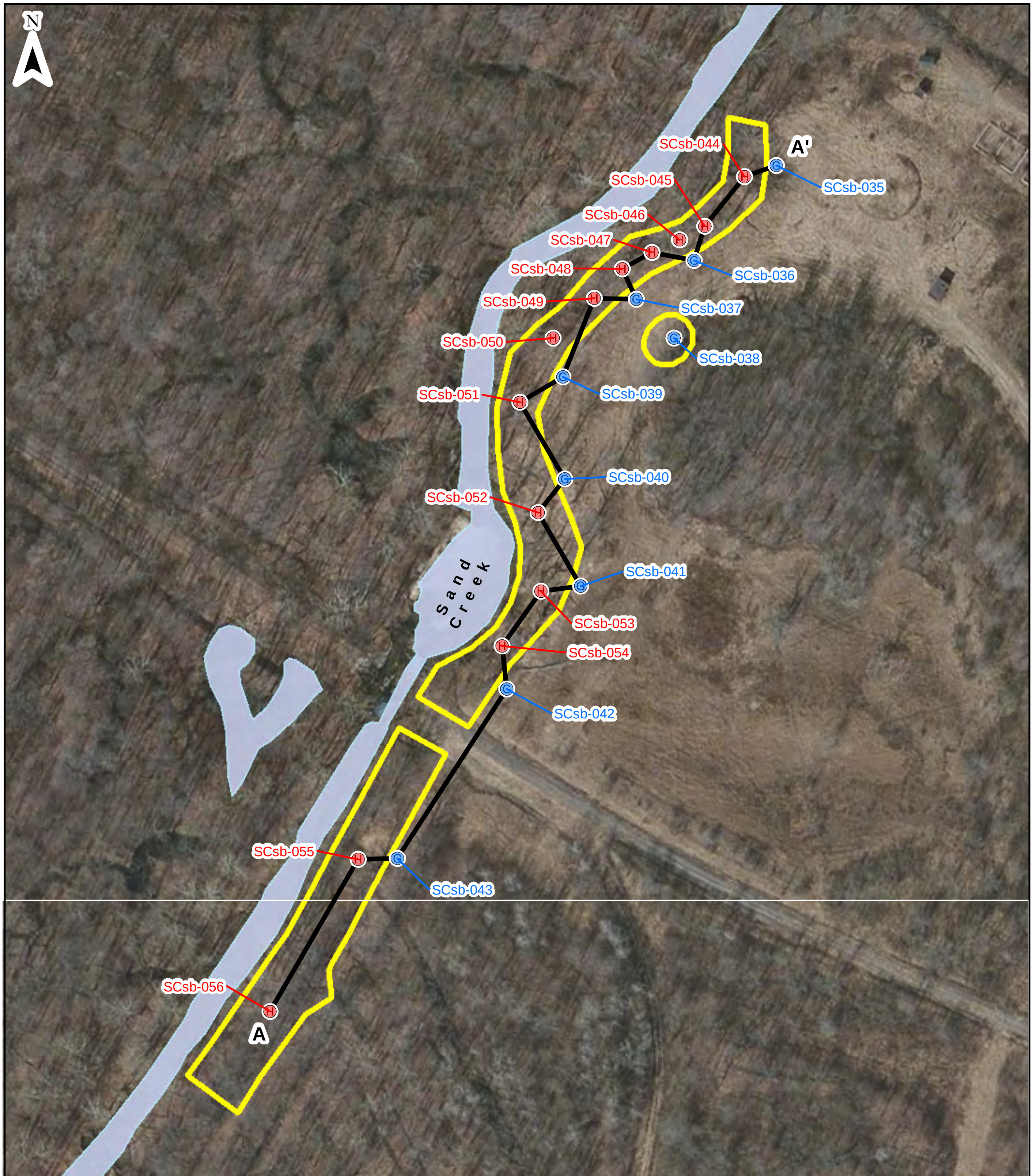
Figure 2-3. Geophysical Investigation Boundary



Legend

- Sand Creek AOC Boundary
- Stream
- A-A' Cross Section as Shown on Figure 2-6
- Geoprobe Sample Location (9)
- Hand-Auger Sample Location (13)

0 75 150 Feet

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RVAAP-34 SAND CREEK DISPOSAL ROAD LANDFILL
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

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Figure 2-4. Phase I Remedial Investigation Boring Locations

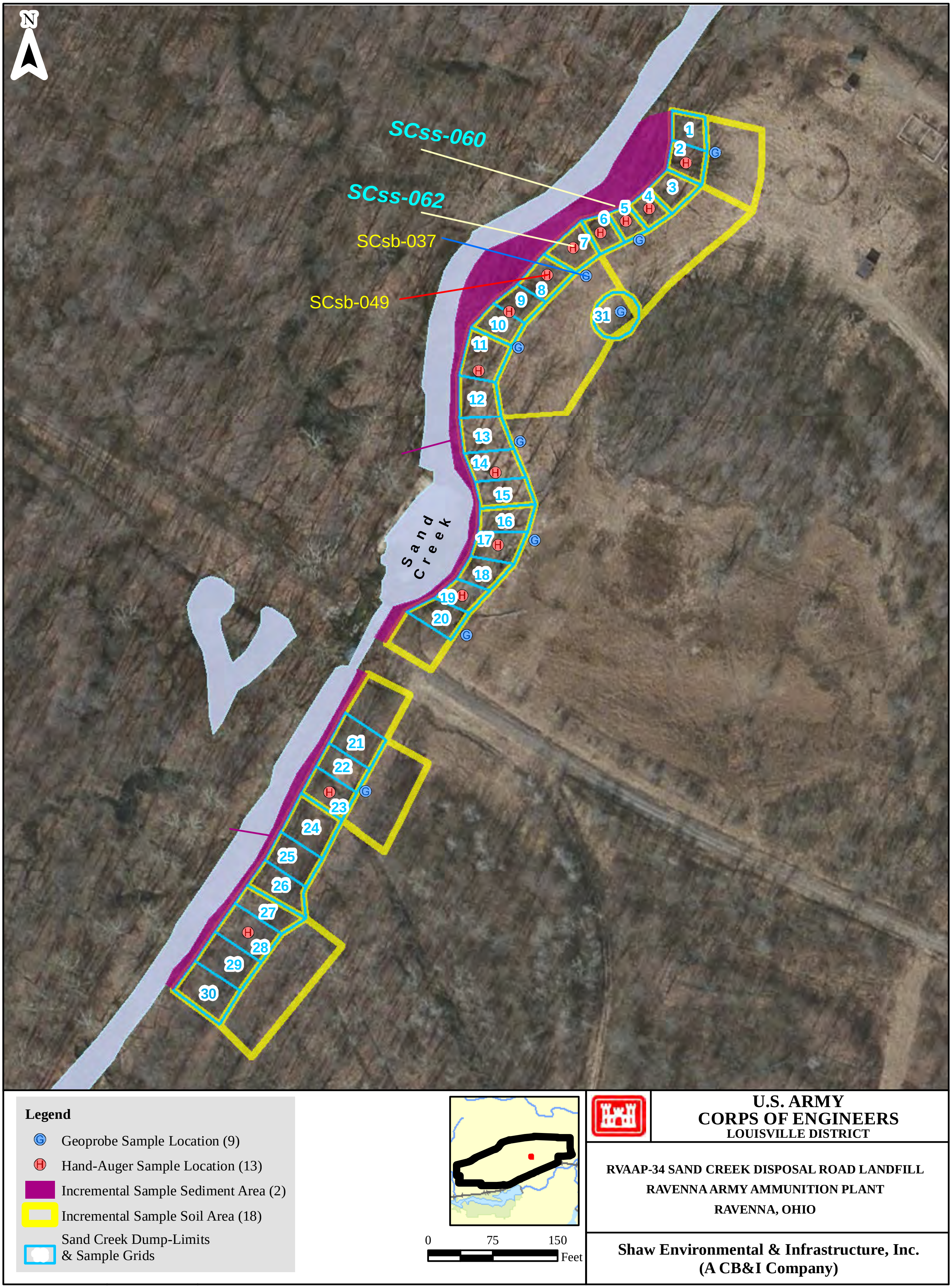

Figure 2-5. Sample Locations from the 2017 Remedial Investigation (2017 Phase II RI)

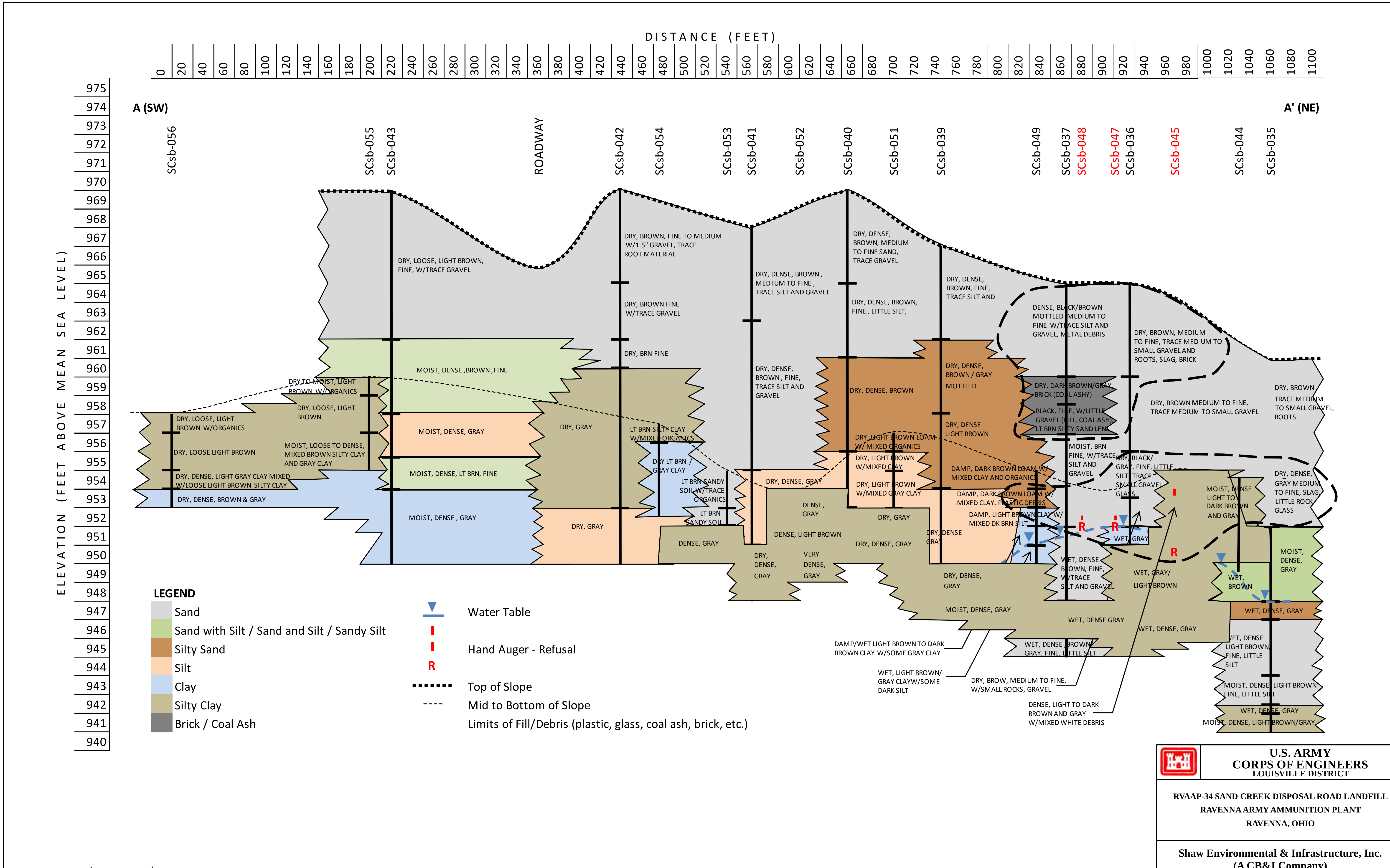

Figure 2-6. Cross Section of the AOC

SECTION 3: Risk Management Evaluation

Only a few COCs were identified in the RI for the Unrestricted (Residential) Land Use. The representative receptor for this Land Use is the Resident Receptor (adult and child). This section presents a re-evaluation of the COCs identified in the RI for the Unrestricted (Residential) Land Use in surface soil and subsurface soil to present information to aid in the determination of Remedial Alternatives and help assess the attainability of Unrestricted (Residential) Land Use.

3.1 ASSESSMENT PROCESS

The COCs were assessed differently in the RI for surface soil and subsurface soil because the type of sample collected to characterize each soil interval was different. In addition, COCs were evaluated for non-carcinogenic effects using the Hazard Quotient (HQ) and cancer risks using the Target Cancer Risk (TCR – excess cancer risk level) and both types of risks were further assessed using the Sum of Ratios (SOR) approach. The SOR approach is used to account for multiple chemicals and multiple exposures. Using this approach, the ratio of the chemical EPC or maximum detected concentration to the risk criteria such as the FWCUGs or the USEPA RSLs is determined. In general, ratios exceeding 1 may be indicative of a potential risk. In cases where an individual may be exposed to multiple non-carcinogenic chemicals, a sum the ratios is used for those chemicals that affect the same target organ or system. If there are multiple carcinogenic compounds, a carcinogenic SOR is also calculated regardless of the type of cancer that the chemical may cause.

Surface soil was characterized across the Sand Creek AOC by numerous ISM Decision Units (DUs) (**Figure 2-5**). Therefore, COCs in surface soil were identified using the maximum concentration detected in all of the ISM locations for each chemical.

Subsurface soil for Unrestricted (Residential) Land Use is defined as the 1- to 13-foot interval. Samples from this interval include discrete subsurface samples that were taken from 1 to 5 feet, 5 to 9 feet, and 9 to 13 feet bgs. Since there were numerous discrete samples from the subsurface, an exposure point concentration (EPC) was calculated. A 95% Upper Confidence Limit (UCL) was calculated as the EPC for each chemical using the USEPA's ProUCL statistical program. The EPC was then evaluated for the subsurface soil to determine the COCs.

The approach to determine which COCs should be removed, and at which locations, for surface soil and subsurface soil is based on an approach known as "hill-topping". Hill-topping is an incremental process in which elevated concentrations of a chemical are targeted for remediation and are incrementally removed from the dataset. In this Risk Management Evaluation, the initial evaluation was based on the three locations where the greatest concentrations of COCs were detected. Because surface soil samples were ISM samples, the individual maximum detected concentrations were sequentially removed from the dataset and then the remaining maximum detected concentration for each COC was reassessed to determine if it was still a COC. This process was repeated until no COCs were identified in the surface soil. The locations where the maximum concentration was detected that were removed from the dataset, were identified as needing to be remediated (removed). As with the surface soil, the elevated concentrations in the subsurface soil were sequentially removed and the EPC was recalculated until no COCs remained. All locations where the elevated concentrations of the COC were removed from the dataset were identified as requiring remediation. The Hill-topping approach provides a systematical approach to determine which locations in the surface soil and the subsurface soil need to be remediated to eliminate COCs and make the AOC meet Unrestricted (Residential) Land Use criteria.

3.2 EVALUATION OF COCS IDENTIFIED IN SURFACE SOIL IN THE 2017 RI

Surface Soil

To determine COCs, the COPCS were compared to Resident Receptor's FWCUGs that were developed in 2010. The FWCUGs are currently under revision. In order to ensure that the most current values are used, this Risk Management Evaluation rescreened the values for the COPCs using the most recent USEPA's RSLs. How the FWCUGs and the USEPA RSLs are to be used to determine COCs can be found in Position Paper (USACE, 2012); *USACE's Facility-Wide Human Health Risk Assessment Manual* (HHRAM - USACE, 2005b) and in the 2014 Risk Assessment Tech Memorandum (NGB, 2014).

The following chemicals were identified as COPCs in the 2017 RI: arsenic, benzo(a)pyrene, benzo(b)fluoranthene, cadmium, copper, indeno(1,2,3-cd)pyrene, mercury, silver, and thallium. Each of the COPCs was assessed using the FWCUGs for the Resident Receptor (adult and child) in the RI. The COPCs were assessed for the Resident Receptor and were evaluated separately for risks from noncancerous effects (by target organ/critical effect) and target cancer risks. Four COCs: arsenic, benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene were identified using the maximum detected concentration for each COPC at any of the ISM locations.

Arsenic was the only chemical identified as a COC based on non-carcinogenic effects for the Unrestricted (Residential) Land Use receptors in surface soil using the maximum detected concentration. This was due to potential impacts to the child Resident Receptor for arsenic since the FWCUG for the child is less than the maximum detected concentration. No impacts were identified for the adult. Arsenic was also identified as a carcinogenic COC along with the three PAHs. This Risk Management Evaluation only includes a re-evaluation of the COCs based on carcinogenic effects which would also address any potential non-carcinogenic effects from carcinogenic chemicals. Arsenic and three PAHs were identified as the primary COCs based for cancer risks and were identified using the Sum of Ratios (SOR) approach. The following three PAHs were identified as COCs in surface soil for the Unrestricted (Residential) Land Use: benzo(a)anthracene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene.

Table 2 presents each of the chemical and their subsequent SOR calculations for target cancer risks. These were determined using the maximum concentration detected in any of the ISM surface soil results for each COPC. Since the completion of the 2017 RI, the toxicity values that the FWCUGs were based upon changed for several PAHs. Therefore, the USEPA RSLs were used to re-evaluate the COCs.

Table 3 includes the chemicals that were identified as COCs using the SOR in the RI and the revised SOR using the RSL-based calculation for the ISM sample results. The SOR calculated using the FWCUGs was 16.9 but the SOR calculated using the USEPA RSLs was 4.5. Dibenzo(a,h)anthracene was eliminated from further evaluation in the Risk Management Evaluation since the percent contribution to the SOR was 5%.

This Risk Management Evaluation was initially completed using the hill-topping approach for each COC to determine which areas need to be removed to achieve Unrestricted (Residential) Land Use across the AOC. The three locations where the COC was evaluated to determine the three locations where the greatest concentrations of each occurred. These values and the locations where they were measured are included in **Table 4**.

The SOR was recalculated assuming that the maximum concentration was removed for arsenic, benzo(a)pyrene, and benzo(b)fluoranthene. The maximum concentration of arsenic (36.6 mg/kg) occurred at sample location SCss-062M-0001-SO (**Figure 2-5**). The maximum concentrations of benzo(a)pyrene (2.4 mg/kg), and benzo(b)fluoranthene (4.8 mg/kg) both occurred at SCss-060M-0001.

After removing the maximum detected concentration for each of the three COCs, the COCs were re-evaluated using the remaining greatest concentrations of each. The re-evaluation of the COCs after the maximum concentration was removed indicated that the remaining greatest concentration of arsenic was 21.8 mg/kg (**Table 4**). This concentration is very similar to the arsenic background levels that have been measured at Camp Ravenna. Therefore, if the ISM location SCss-062M-0001-SO is remediated, then arsenic would no longer be a COC in the surface soil. This conclusion was based on several considerations of arsenic that were assessed in the background study presented in the Winklepeck Burning Ground Phase II RI, April 2001 and the distribution of arsenic in the remaining ISM sample locations across the Site.

If the maximum detected concentration of arsenic is removed from the dataset for surface soil, the remaining value of 21.8 mg/kg (**Table 4**). The 2001 Background Study determined both a surface soil and subsurface soil background for arsenic. The surface soil background was determined to be 15.4 mg/kg with the 95% Parametric UTL determined to be 20.2 mg/kg. The subsurface background value was determined to be 19.8 mg/kg with the 95% Parametric UTL determined to be 21.4 mg/kg. Although the 21.8 mg/kg concentration is slightly greater than that of background, it is very similar to 95% UTL determined for both the surface and subsurface concentrations for arsenic.

The second and third greatest concentrations of arsenic are both similar to background (**Table 4**). All remaining values that were measured in the ISM surface soil samples are much less than the surface soil background concentration of arsenic (15.4 mg/kg). Considering that ISM samples were taken across the entire surface (18 large ISM locations with 32 smaller ISM locations mostly within the larger 18 ISM grids – **Figure 2-4**) of the AOC and all the remaining concentrations were much less than background or similar to background arsenic at 2 ISM locations, only ISM sample location SCss-062M-0001-SO needs to be removed to eliminate arsenic as a COC in surface soil.

Similarly, the USEPA RSL for benzo(a)pyrene is 1.1 mg/kg and the second greatest concentration of benzo(a)pyrene was 1.5 mg/kg. This ratio between the USEPA RSL and the second greatest concentration was of benzo(a)pyrene is 1.3, which only slightly exceeds 1. For comparison purposes, the soil Industrial USEPA RSL for benzo(a)pyrene is 21 mg/kg. It is believed that the 1.1 mg/kg USEPA RSL and the 1.5 mg/kg second greatest concentration are similar and would not be distinguishable in the soil. Additionally, the ISM sample locations for surface soil at Sand Creek are numerous and cover almost the entire Site. If the location SCss-060M-0001 is removed, then the remaining concentrations of benzo(a)pyrene across the AOC for each ISM sample location (16 ISM locations) are all less than the USEPA Residential RSL with the exception of SCss-059M-0001-SO where the concentration is 1.5. All the other results for the ISM sample locations were less than this value which indicates no widespread residual contamination across of the Site. Based on these results, SCss-062M-0001-SO (for arsenic) and SCss-060M-0001-SO (for benzo(a)pyrene, and benzo(b)fluoranthene) are recommended for removal actions in this EE/CA to eliminate these two COCs.

TABLE 2 (6-17 from the 2017 RI). Summary of only COCs Identified for Cancer Risk in Surface Soil (0 to 1 foot) for Unrestricted (Residential) Land Use using the maximum detected concentration at the Sand Creek Disposal Road Landfill.

Parameter	EPC[a] (mg/kg)	BSV (mg/kg)	RRA FWCUG (mg/kg)	Ratio of EPC to RRA FWCUG	% Contribution to the Total Sum	COC?	COC Justification
Arsenic	36.60	15.4/19.8	4.25	2.3 (used BG)	13.6%	Yes	Contribution to sum > 5%
Benzo(a)anthracene	2.6	---	2.2	1.18	6.9%	Yes	Ratio > 1
Benzo(a)pyrene	2.4	---	0.221	10.9	64.5%	Yes	Contribution to sum > 5%
Benzo(b)fluoranthene	4.8	---	2.21	2.17	12.8%	Yes	Contribution to sum > 5%
Cancer Risk Sum of Ratios:				**16.9**			

[a] denotes the EPC is the maximum concentration.

--- denotes no BSV is available for this analyte. BSV denotes background screening value. COC denotes chemical of concern. EPC denotes exposure point concentration.

FWCUG denotes Facility-Wide Cleanup Goal per the Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant, Ravenna, Ohio, Final (SAIC, 2010).

mg/kg denotes milligrams per kilogram. NA denotes not applicable, no FWCUG for cancer or other risk-screening criteria.

RRA denotes Residential Receptor Adult. The RRA was used to make decisions instead of the RRC since the effects are long term and chronic. SAIC denotes Science Applications International Corporation. RSL denotes USEPA Regional Screening Value (November, 2015).

TABLE 3. Comparison of COCs from the RI to current USEPA RSLs in Surface Soil (0 to 1 foot) ISM samples for Unrestricted (Residential) Land Use using the maximum detected concentration at the Sand Creek Disposal Road Landfill.

Arsenic	36.60	15.4/ 19.8	4.25	2.3 (used BG)	13.6 %	Yes	Contribution to sum > 5%
***Arsenic** (SCss-062M-0001-SO)	**36.60**		**6.8**	**1.7**	**37.7%**	**Yes**	**Ratio >1**
Benzo(a)anthracene	2.6	---	2.2	1.18	6.9 %	Yes	Ratio > 1
Benzo(a)anthracene	**2.6**	**---**	**11**	**0.23**	**5.0 %**	**No**	**Contribution to sum < 5%**
Benzo(a)pyrene	2.4	---	0.221	10.9	64.5 %	Yes	Contribution to sum > 5%
Benzo(a)pyrene	**2.4**	**---**	**1.1**	**2.18**	**48.0 %**	**Yes**	**Ratio > 1**
Benzo(b)fluoranthene	4.8	---	2.21	2.17	12.8 %	Yes	Contribution to sum > 5%
Benzo(b)fluoranthene	**4.8**	**---**	**11**	**0.43**	**9.5 %**	**Yes**	**Contribution to sum > 5%**
Cancer Risk Sum of Ratios based on FWCUGs:				16.9			
Cancer Risk Sum of Ratios based on USEPA RSLs: 4.5							

[a] denotes the EPC is the maximum concentration.

--- denotes no BSV is available for this analyte. BSV denotes background screening value. COC denotes chemical of concern. EPC denotes exposure point concentration.

FWCUG denotes Facility-Wide Cleanup Goal per the Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant, Ravenna, Ohio, Final (SAIC, 2010).

mg/kg denotes milligrams per kilogram. NA denotes not applicable, no FWCUG for cancer or other risk-screening criteria.

RRA denotes Residential Receptor Adult. The RRA was used to make decisions instead of the RRC since the effects are long term and chronic. SAIC denotes Science Applications International Corporation. RSL denotes USEPA Regional Screening Value (November, 2015).

TABLE 4. Location and concentration of the greatest three concentrations for each COC assessed in the RI in the surface soil.

Chemical of Concern	Sample ID	Concentration (mg/kg)
Arsenic	SCss-062M-0001-SO	36.6
Arsenic	SCss-073M-0001-SO	21.8
Arsenic	SCss-061M-0001-SO	21.2
Benzo(a)pyrene	SCss-060M-0001-SO	2.4
Benzo(a)pyrene	SCss-059M-0001-SO	1.5
Benzo(a)pyrene	SCss-061M-0001-SO	0.76
Benzo(b)fluoranthene	SCss-060M-0001-SO	4.8
Benzo(b)fluoranthene	SCss-059M-0001-SO	2.3
Benzo(b)fluoranthene	SCss-061M-0001-SO	1.7

TABLE 5. Re-evaluation of the SOR using the USEPA RSLs in Surface Soil (0 to 1 foot) for Unrestricted (Residential) Land Use with the maximum concentration detected removed from ISM dataset at the Sand Creek Disposal Road Landfill.

Parameter and location of EPC	Maximum concentration removed EPC[a] (mg/kg)	BSV (mg/kg)	(mg/kg)/ USEPA RSL (10^{-5})	Ratio of EPC to USEPA RSL	COC based on based on RSL after Greatest concentration removed?	Justification
*Arsenic greater BG value SCss-073M-0001-SO	21.8	15.4/ 19.8	6.8	-	No	Concentration is indistinguishable to background. See discussion in the text.
Benzo(a)pyrene SCss-060M-0001-SO	1.5	---	1.1	1.3	No close enough to 1.1 USEPA RSL to be dismissed	Concentration is similar to the USEPA Residential RSL
Benzo(b)fluoranthene SCss-060M-0001-SO	2.3	---	11	0.2	No	Ratio < 1%
Revised Cancer Risk Sum of Ratios based on USEPA RSLs after EPC was the second greatest concentration:				1.5		

[a] denotes the EPC is the maximum concentration.

--- denotes no BSV is available for this analyte. BSV denotes background screening value. COC denotes chemical of concern. EPC denotes exposure point concentration.

FWCUG denotes Facility-Wide Cleanup Goal per the Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant, Ravenna, Ohio, Final (SAIC, 2010).

mg/kg denotes milligrams per kilogram. NA denotes not applicable, no FWCUG for cancer or other risk-screening criteria.

RRA denotes Residential Receptor Adult. The RRA was used to make decisions instead of the RRC since the effects are long term and chronic. SAIC denotes Science Applications International Corporation. RSL denotes USEPA Regional Screening Value (November, 2015).

3.2 EVALUATION OF COCS IDENTIFIED IN SUBSURFACE SOIL

Samples from this interval include discrete subsurface samples that were taken from 1 to 5 feet, 5 to 9 feet, and 9 to 13 feet bgs intervals. Because there were numerous discrete samples from the subsurface, an EPC was calculated to represent the representative concentration of the COC in the subsurface soil. A 95% UCL was calculated using the USEPA's ProUCL statistical program.

No COCs were identified from non-cancer effects for the Unrestricted (Residential) Land Use receptors in subsurface soil in the RI. Two COCs were identified based on cancer risks and using the SOR method. These were arsenic and benzo(a)pyrene. Both COCs were further assessed to using the hill-topping method to determine which sample locations needed to be remediated to eliminate COCs from the subsurface soil. The greatest concentrations of each COC were removed from the dataset one at a time until the recalculated EPC (95% UCL) was less than that of the risk criteria (USEPA RSLs).

Table 6 presents the discrete sample locations and depths where the three greatest concentrations of arsenic and benzo(a)pyrene occur. The maximum detected concentration of arsenic were both at the same location but at two different intervals. The arsenic concentration of 182 mg/kg occurred at the 1 to 5 foot bgs sample at discrete sample location SCsb-037M-0001-SO. The arsenic concentration of 155 mg.kg occurred at the 5 to 9 foot bgs sample at discrete sample location SCsb-037M-0001-SO. The maximum concentration of benzo(a)pyrene (8.3 mg/kg) in the discrete surface soil samples occurs at location SCsb-049M-0001-SO. This value is in the 1 to 5 feet bgs interval in the subsurface (**Table 6**).

The EPC (using the 95% UCL) was recalculated for arsenic after removing the two largest discrete sample concentrations from the dataset (**Table 6**). The arsenic concentration of 182 mg/kg at the 1 to 5 foot bgs sample and the arsenic concentration of 155 mg/kg occurred at the 5 to 9 foot bgs sample at discrete sample location SCsb-037M-0001-SO. The EPC (using the 95% UCL) was reduced from 45 mg/kg to 15.7 mg/kg for arsenic (**Table 7**) after removing the two concentrations. Therefore, only the discrete location SCsb-037M-0001-SO from the 1 to 5 feet bgs interval and the 5 to 9 interval need to be remediated so that arsenic is eliminated as a COC in the subsurface soil.

The EPC (using the 95% UCL) was recalculated for benzo(a)pyrene after removing the benzo(a)pyrene (8.3 mg/kg) in the discrete surface soil at location SCsb-049M-0001-SO, from the dataset (**Table 6**). The EPC assessed in the 2017 RI where benzo(a)pyrene was identified as a COC was 1.3 mg/kg but without the maximum detected value, the EPC is reduced to 0.83 mg/kg. Therefore, only the discrete location SCsb-049M-0001-SO from the 1 to 5 feet bgs interval needs to be remediated so that benzo(a)pyrene is eliminated as a COC.

TABLE 6. Sample locations, concentrations, and depths of the Arsenic and benzo(a)pyrene where the three greatest concentrations of each were identified.

Chemical of Concern	Sample ID	Concentration (mg/kg)	Depth of Sample (bgs)
Arsenic	SCsb-037M-0001-SO	182	1 to 5 feet
Arsenic	SCsb-037M-0002-SO	155	5 to 9 feet
Arsenic	SCsb-040M-0003-SO	20.5	9 to 13 feet
Benzo(a)pyrene	SCsb-049M-0001-SO	8.3	1 to 5 feet
Benzo(a)pyrene	SCsb-036M-0003-SO	1.7	9 to 13 feet
Benzo(a)pyrene	SCsb-050M-0001-SO	1.3 J	1 to 5 feet

TABLE 7. Evaluation of COCs based on Cancer Risk in Subsurface Soil (1 to 13 feet) for Unrestricted (Residential) Land Use using the revised EPC 95% UCL without the greatest concentrations measured in the subsurface for arsenic and benzo(a) pyrene.

Parameter	EPC[a] (mg/kg)	BSV (mg/kg)	USEPA RSL (10^{-5}) (mg/kg)	Ratio of EPC to USEPA RSL	% Contribution to the Total Sum	COC based on based on RSL after Greatest concentration removed?
Arsenic (Evaluated in the RI)	45	15.4	4.25	10.59	56.1%	Yes
Arsenic (without 2 concentrations from SCsb-037M-0001-SO	15.7	19.8	4.25	NA	NA	No
Benzo(a)pyrene (Evaluated in the RI)	1.3	---	0.221	6.2	32.8%	Yes
Benzo(a)pyrene (without concentration from SCsb-049M-0001-SO	0.8	----	1.1	0.6	NA	No

*[a] denotes EPC is 95 percent of the UCL. See **Appendix A**. EPC for PCB-1254 is the maximum concentration due to low number of samples.*
denotes no BSV is available for this analyte. BSV denotes background screening value. COC denotes chemical of concern.
EPC denotes exposure point concentration. FWCUG denotes Facility-Wide Cleanup Goal per the Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant, Ravenna, Ohio, Final (SAIC, 2010). mg/kg denotes milligrams per kilogram. NA denotes not applicable, no FWCUG for cancer or other risk-screening criteria.
RRA denotes Residential Receptor Adult. SAIC denotes Science Applications International Corporation. UCL denotes Upper Confidence Limit.

SECTION 4: REMOVAL ACTION OBJECTIVES, CLEANUP GOALS, AND VOLUME CALCULATIONS

The scope, objectives, cleanup goals, and estimates of volume of soil requiring remediation are presented in this section.

4.1 SCOPE AND PURPOSE

The Sand Creek AOC was characterized in the RI (USACE, 2017). Surface and subsurface soil, surface water, and sediment samples were collected during the RI field activities to define the nature and extent of contamination and to support the preparation of an FS and a subsequent Record of Decision for the AOC. Therefore, the recommended path forward was to proceed to the FS phase of the CERCLA process. The purpose of this EE/CA is to evaluate remedial alternatives to address the COCs identified in surface and subsurface soil only. The determination of which ISM sampling locations in the surface soil and which discrete samplings locations in the subsurface need to be removed to meet RAOs was presented in Section 3 in the Risk Management Evaluation. Since no COPECs in soil were identified in the ERA, no additional remedial actions are warranted at the AOC from an ecological perspective. Because no COCs or COPECs were identified in sediment or surface water, analysis of remedial activities in a FS is not warranted for sediment or surface water at the Sand Creek AOC.

4.2 REMOVAL ACTION OBJECTIVES

The main objective for the EE/CA is to evaluate the removal action Alternatives for the Sand Creek AOC. Following CERCLA guidance, this EE/CA identifies removal action objectives, identifies potential removal action Alternatives, and evaluates Alternatives against criteria identified in U.S. Environmental Protection Agency (USEPA) Guidance for *Conducting Non-Time Critical Removal Actions under CERCLA* (USEPA, 1993).

The Removal Action Objectives (RAOs) are to remove the soil from locations identified in the Risk Management Evaluation (Section 3) so the Sand Creek AOC meets the Unrestricted (Residential) Land Use requirements. The removal action will prevent Resident Receptors from contacting unsafe concentrations of arsenic at SCss-062M-0001-SO in the surface soil; PAHs (benzo(a)pyrene and benzo(b)fluoranthene) at location SCss-060M-0001-SO in the surface soil; arsenic at location SCsb-037M-0001-SO from the 1 to 5 feet bgs interval and the 5 to 9 in subsurface soil; and benzo(a)pyrene at location SCsb-049M-0001-SO from the 1 to 5 feet bgs interval in subsurface soil.

The RAOs specify requirements the selected Alternative must fulfill to protect human health and the environment from contaminants and to meet the evaluation criteria

4.3 REMOVAL ACTION CLEANUP GOALS

The removal action cleanup goal represents the media (surface soil and subsurface soil) and chemical-specific criteria below which remedial action is not required. The goal of the removal action for the surface soil is to remove all ISM sample locations where the concentrations of COCs are greater than the selected criteria such as background for metals or the USEPA's RSLs.

As demonstrated in Section 3, three COCs were identified in the soil at the Sand Creek AOC: arsenic, PAHs (benzo(a)pyrene, and benzo(b)fluoranthene). The removal action cleanup goal for each is presented in the following:

- arsenic (background 15.5 to 18.8 mg/kg and compared to 20.1 95%UTL),
- benzo(a)pyrene (1.1 mg/kg - USEPA Residential RSL at 1 X 10^{-5} target risk level), and
- benzo(b)fluoranthene (11 mg/kg - USEPA Residential RSL at 1 X 10^{-5} target risk level).

4.4 VOLUMES OF SOIL REQUIRING REMOVAL

Table 8 presents the calculations and values used to estimate the amount of soil that needs to be excavated and either disposed off-site or undergo ex-situ thermal treatment. A total volume of 157 cubic yards (yds^3) needs to be excavated. Of this volume, 101 yds^3 will be excavated and disposed off-site and 56 yds^3 will undergo ex-situ thermal treatment and be redeposited on site. Figure 2-4 illustrates the sample locations for the ISM samples and the discrete sample locations. Based on the results in Section 3, ISM locations SCss-062M-0001-SO (for arsenic) and SCss-060M-0001-SO (PAHs - benzo(a)pyrene, and benzo(b)fluoranthene) are recommended for removal actions in this EE/CA to eliminate these two COCs in the surface soil.

The discrete location SCsb-037M-0001-SO from the 1 to 5 feet bgs interval and SCsb-037M-0002-SO from the 5 to 9 feet bgs interval need to be remediated so that arsenic is eliminated as a COC in the subsurface soil. The discrete location SCsb-049M-0001-SO from the 1 to 5 feet bgs interval needs to be remediated so that PAHs (benzo(a)pyrene) is eliminated as a COC.

TABLE 8. Estimated Volumes of Surface Soil and Subsurface Requiring Removal at Sand Creek AOC.

Sample Location	Average Length (ft)	Average Width (ft)	Depth (ft bgs)	Volume (ft^3)	Volume (yd^3)[a]
SCss-062M-0001-SO	45	42.5	1	1912	85
SCss-060M-0001-SO	37.5	27.5	1	1032	46
SCsb-037M-0001-SO SCsb-037M-0002-SO	6	6	10	360	16
SCsb-049M-0001-SO	6	6	6	216	10
			Total	**3,520**	**157**

Yellow highlighted locations are where the soil has PAH contamination. Non-highlighted locations have arsenic contamination.

[a]Includes 20% swell factor.
bgs = Below ground surface.
ft^3 = Cubic feet.
ft = Feet.
yd^3 = Cubic yard.

Note: *At the soil boring sample locations (SCsb-037M-0001-SO and SCsb-049M-0001-SO), it is assumed that the removal would be done by excavating a 6-ft by 6-ft area centered on the boring location in 1-ft to 2-ft depths. The soil in this area would be disposed of. This is a conservative approach to ensure that no contaminated soil associated with the target boring is missed. As the excavation is deepened, soil outside of the 6 ft-by 6-ft target area would have to be cut back to keep the excavation from collapsing. The soil outside of the 6 ft-by 6-ft target area would be stockpiled and used as backfill once the excavation is complete. It is assumed that each excavation would be advanced to a depth of one foot below the target depth identified for removal.*

SECTION 5: APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Applicable or relevant and appropriate requirements (ARARs) are described in this section.

5.1 INTRODUCTION

The identification and evaluation of ARARs is an integral part of complying with CERCLA and SARA. As defined in the National Contingency Plan (NCP), applicable requirements are "those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances at a CERCLA site" (40 Code of Federal Regulations [CFR] 300.5 [1995]). Relevant and appropriate requirements are "those cleanup standards, standards of control and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law 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 that their use is well suited to the particular site" (40 CFR 300.5 [1995]).

Requirements under Federal or state law may be either applicable or relevant and appropriate to CERCLA cleanup actions, but not both. In the latter case, requirements must be both relevant and appropriate to be ARARs. The Federal regulation must be selected when both a Federal and state ARARs are available or when two potential ARARs address the same issue (even if a state has authorization to administer the Federal program), unless the state has promulgated a more stringent requirement. "More stringent" also includes those state laws or programs that have no Federal counterpart because "they add to the Federal law requirements that are specific to the environmental conditions in the State" (USEPA, 1989).

All CERCLA onsite remedial response actions must comply only with the substantive requirements of a regulation and not the administrative requirements (CERCLA § 121[e]). This position has been reaffirmed in the NCP (55 Federal Register [FR] 8756, March 8, 1990). Substantive requirements pertain directly to the actions or conditions at a site, and administrative requirements facilitate their implementation. Certain administrative requirements should be observed if they are useful in determining cleanup standards at the site (55 FR 8757, March 8, 1990). Offsite actions, on the other hand, are subject to the full requirements of the applicable standards or regulations, including all administrative and procedural regulations.

Although remedial actions for AOCs at National Priorities List sites must comply only with the substantive requirements of federal or state environmental regulations, the Ohio Revised Code does not provide a similar permit waiver for actions conducted under the Ohio EPA Remedial Response Program Policy. The Ohio EPA's Division of Emergency and Remedial Response (DERR) Policy DERR-00-RR-034 states, "it has been DERR's policy to require responsible parties to acquire and comply with all necessary permits, including the substantive and administrative requirements." However, a DFFO was entered into on June 10, 2004, that provided certain exemptions from the Ohio Administrative Code (OAC) administrative requirements and required groundwater monitoring and remediation at RVAAP to be performed under the CERCLA process. The DFFO includes provisions for compliance resulting in the potential negation of all provided exemptions within the DFFO in the event non-compliant activities are identified.

The selection of ARARs is dependent on the hazardous substances at a site, the physical site characteristics and geographic location. The actions selected as remedy, and are addressed by chemical-, location-, and action-specific ARARs, respectively, as described below:

- Chemical-specific---Chemical-specific requirements define acceptable exposure levels for specific hazardous substances and, therefore, may be used as a basis for establishing preliminary remediation goals (PRGs) and cleanup levels for chemicals of concern (COCs) in the designated media. Chemical-specific ARARs and to-be-considered (TBC) criteria also are used to determine treatment and disposal requirements for removal actions. In the event a chemical has more than one requirement, the more stringent of the two requirements is used. There are no known promulgated Federal chemical-specific cleanup standards for soil. The TBC guidance pertaining to the cleanup objectives for soil include the USEPA Regional Screening Levels (RSLs) (USEPA, 2017).

- Location-specific---Location-specific ARARs set restrictions on the types of removal actions that can be performed based on the physical characteristics of the site or its immediate surroundings. In determining the use of the location-specific ARARs for selection of remedial actions at CERCLA sites, the jurisdictional prerequisites of each regulation must be investigated. Alternative removal actions may be restricted or precluded based on Federal and state laws for hazardous waste facilities or proximity to faults, floodplains, caves, salt-dome formations, salt-bed formations, underground mines, wetlands, wilderness areas, wildlife refuges, wildlife resources, and scenic rivers. None of the previous listed physical characteristics pertain to Sand Creek AOC or its immediate surroundings; therefore, no location-specific ARARs pertain to this site.

- Action-specific---Action-specific ARARs are technology-based requirements that set controls or restrictions on the design, implementation, and performance levels of removal activities related to the management of hazardous substances, pollutants, or contaminants. Potential action-specific ARARs are presented in **Appendix B.** If no remedial action was selected under the CERCLA process, compliance with action-specific ARARs would not be required.

In accordance with the NCP (40 Code of Federal Regulations [CFR] 300.415(j)) on-site removal actions conducted under CERCLA are required to meet ARARs "to the extent practicable, considering the exigencies of the situation." Shipments of contaminated soils and dry sediments will comply with Federal, State, and local rules, laws and regulations. In addition to the identified applicable and relevant or appropriate requirements (ARARs) for the selected action, the Army will comply with requirements applicable to off-site actions, such as Resource Conservation and Recovery Act (RCRA) hazardous waste transportation requirements under Ohio Administrative Code (OAC) 3745-52-20 to OAC 3745-52-33, and offsite treatment prior to land disposal as required by RCRA's land disposal restrictions under OAC 3745-270, including alternative land disposal restriction treatment standards for contaminated soil under OAC 3745-270-49.

In some cases, most ARARs will be chemical-specific. Action- or location-specific requirements will be ARARs to the extent that they establish standards addressing contaminants of concern that will remain at the AOC. In addition, CERCLA Section 121(d)(1) directs that remedial actions taken to achieve a degree of cleanup that is protective of human health and the environment are to be relevant and appropriate under the circumstances presented by the release. Accordingly, any chemical-, action-, or location-specific requirements will be ARARs to the extent that they ensure the degree of cleanup will be protective of human health and the environment under the circumstances presented by the release. An evaluation of the regulatory requirements has shown there are no chemical-specific ARARs for the chemicals identified in various media at the AOC.

In summary, chemical-, action-, or location-specific requirements will be ARARs to the extent that they establish standards protective of human health and the environment for chemicals that will remain on site after the remedial action and ensure protection of site works and the environment during remedy implementation. Requirements identified as chemical-specific ARARs must ensure a degree of cleanup that is protective of human health and the environment under the circumstances presented by the release.

5.2 POTENTIAL CHEMICAL-SPECIFIC ARARS

A review of the regulations indicated there are no potential chemical-specific ARARs for any of the alternatives being considered in this EE/CA for the media and COCs. No regulations were identified that included specific chemical concentrations or requirements that would be a potential ARAR to drive the remedial action process. No chemical-specific ARARs have been identified for the COCs (arsenic, PAHs - benzo(a)pyrene, and benzo(b)fluoranthene) identified in the surface soil or subsurface soil at the Sand Creek AOC.

5.3 POTENTIAL ACTION-SPECIFIC ARARS

Implementing an excavation and disposal alternative triggers potential ARARs associated with land disturbance and emission controls. The OAC 3745-15-07 requires that nuisance air pollution emissions be controlled. This includes controlling potential fugitive dust from excavation activities associated with the potential removal of the pipes/inlets/manholes. In addition, any construction (i.e., soil disturbance activities that would encompass over 1 acre) would trigger the storm water requirements found at 40 CFR Part 450. These requirements mandate that erosion and sedimentation control measures be designed and implemented to control erosion and sediment runoff.

Because excavation would include generating and managing contaminated media, RCRA requirements would be considered potential ARARs for this activity. The RCRA requirements mandate that a generator must determine whether a material is (or contains in the case of environmental media) hazardous waste under OAC 3745-52-11. If a material is determined to be or contain a listed hazardous waste, or exhibits a hazardous waste characteristic, additional management requirements under RCRA must be followed as an ARAR under CERCLA.

These requirements include how hazardous waste is stored, treated, transported, and disposed. The RCRA requirements are generally not considered to be chemical-specific ARARs because they do not relate directly to the degree of cleanup or to specific chemicals. In addition to the substantive requirements associated with managing and storing material that is also RCRA hazardous waste (or found to contain such waste), some RCRA requirements prescribe standards for disposing hazardous material, including LDRs prohibiting disposal of specific chemicals until they are treated to a specified level or by a specific treatment technology and minimum technical requirements for land disposal units.

Shipments of contaminated soils will comply with federal, state, and local rules, laws and regulations. In addition to the identified ARARs for the selected action, the Army will comply with requirements applicable to off-site actions, such as Resource Conservation and Recovery Act (RCRA) hazardous waste transportation requirements under OAC 3745-52-20 to OAC 3745-52-33, and off-site treatment prior to land disposal as required by RCRA's land disposal restrictions (LDRs) under OAC 3745-270, including alternative LDR treatment standards for contaminated soil under OAC 3745-270-49.

The USEPA cautions that LDRs should not be used to determine site-specific cleanup levels (USEPA 2002). All LDRs require appropriate treatment of RCRA hazardous waste that is to be disposed to minimize short- and long-term threats to human health or the environment, based on available technology. Performing treatment to meet LDR standards is different from the CERCLA approach to remediation, which analyzes risk and then develops cleanup standards based on the risk present; this may result in cleanup levels that are different from those of a risk-based approach. Nevertheless, if RCRA hazardous waste is generated from the CERCLA action and is disposed on site, the material must meet the established LDR.

In order for LDRs to be triggered as potential ARARs, RCRA hazardous waste must be present. This requires: (1) the waste material must contain contaminants that derive from RCRA-listed waste or exhibit a characteristic of RCRA hazardous waste, and (2) the waste material is managed in a way that "generates" hazardous waste. Several methods of waste material management that do not "generate" hazardous waste, and so do not trigger LDRs, are available for use. These methods include using the AOC approach, using a staging pile, using a storage or treatment corrective action management unit (CAMU), or using a temporary unit.

If waste material (soil) is managed in a manner that generates hazardous waste, such as removing it to an aboveground container and then re-depositing the material within the land unit for disposal, then LDRs become potential ARARs. Land Disposal Restrictions are assigned to the waste when it is removed from the unit under an AOC approach or when the waste material is excavated and lifted out of the unit. Potential LDR ARARs in Ohio are variances from treatment standards in OAC Section 3745-270-44, LDR standards for contaminated debris in OAC Section 3745-270-45, Universal Treatment Standards (UTS) in OAC Section 3745-270-48, and Alternative LDR Treatment Standards for Contaminated Soil in OAC Section 3745-270-49.

Ohio has adopted the alternative soil treatment standards promulgated by USEPA in its Phase IV LDR rule, effective August 1998. The rules provide that if RCRA hazardous waste is present, the material must meet one of two sets of LDRs before being disposed of in a land unit: (1) the

UTS, or (2) the contaminated soil (technology-based treatment) standards promulgated in Phase IV of the LDRs, whichever is greater. Or, if a generator so chooses, they may use the generic treatment standards in OAC Section 3745-270-40 which apply to all hazardous waste. Only the alternative soil treatment standards are explained in this document.

Under the alternative soil treatment standards, all soil subject to treatment must be treated as follows:

1. For non-metals, treatment must achieve a 90% reduction in total constituent concentration (i.e., the primary constituent for which the waste is characteristically hazardous as well as for any organic or inorganic chemical underlying hazardous constituent), subject to item three below.

2. For contaminants in soil (e.g., inorganic chemicals, carbon disulfide, cyclohexanone, and methanol), treatment must achieve a 90% reduction in constituent concentrations as measured in leachate from the treated media [tested according to the toxicity characteristic leaching procedure (TCLP)] or a 90% reduction in total constituent concentrations (when an inorganic chemical removal treatment technology is used), subject to item three below.

3. When treating any constituent subject to treatment to a 90% reduction standard would result in a concentration less than 10 times the UTS for that constituent, treatment to achieve constituent concentrations less than 10 times the UTS is not required. This is commonly referred to as "90% capped by 10 x UTS."

4. USEPA and Ohio EPA have established a site-specific variance from the soil treatment standards, which can be used when treatment to concentrations of hazardous constituents higher than those specified in the soil treatment standards minimizes short- and long-term threats to human health and the environment. In this way, on a case-by-case basis, risk-based LDR treatment standards approved through a variance process could supersede the soil treatment standards. Any variance granted cannot rely on capping, containment, or other physical or institutional controls.

If CAMUs are used as disposal units at the AOC, the design and treatment standards established in OAC Section 3745-57-72 will be potentially relevant and appropriate to the response action. Only CAMU-eligible waste can be disposed in a CAMU. CAMU-eligible waste includes hazardous and non-hazardous wastes that are managed for implementing cleanup, depending on the Ohio EPA Director's approval or prohibition of specific waste or waste streams. Using a CAMU for disposal does not trigger LDRs or MTRs as long as the standards specified in the rule are observed. The Director will incorporate design and treatment standards into a permit or order. Design standards include a composite liner and a leachate collection system designed and constructed to maintain less than 30 cm of leachate over the liner. A composite liner entails a system consisting of two components which each have detailed specifications and installation requirements. The Director may approve alternate requirements if he can make the findings adhere to the requirements specified in the rule. Treatment standards are similar to LDR standards for contaminated soil, although alternative and adjusted standards may be approved or required by the Director as long as the adjusted standard is protective of human health and the environment.

Treatment standards are similar to LDR standards for contaminated soil, although alternative and adjusted standards may be approved or required by the Ohio EPA Director, as long as the adjusted standard is protective of human health and the environment.

In the event solid waste material is found to be contaminated but not a RCRA hazardous waste, management and disposal of this material would be subject to the requirements associated with managing and disposing solid waste within the state of Ohio. The OAC Section 3745-27-05 requirements would be potential ARARs for disposing non-hazardous contaminated waste material generated during excavation and subsequent disposal at an off-site location.

A permit-by-rule (PBR) is a specific permit exemption in the OAC that applies to certain types of low-emitting air pollution sources. Soil vapor emissions from a thermal treatment system would require exemption under OAC 3745-31-03 (PBR). The PBR contains qualifying criteria, emission limitations, conditions for operation, and requirements for record keeping and reporting which must be followed. Potential action-specific ARARs for the Sand Creek AOC are provided in **Appendix B.**

5.4 POTENTIAL LOCATION-SPECIFIC ARARS

Location-specific requirements include those established for potential remedial activities conducted within wetlands, within a floodplain area, or with respect to threatened and endangered species. Generally, for wetlands and floodplains, rules require alternatives to remedial activity within the sensitive area be pursued; if that is not feasible, adverse effects from any actions taken within the sensitive area must be mitigated to the extent possible. These requirements do not relate to specific chemicals nor do they further change the degree of cleanup in the sense of protecting human health or the environment from the effects of harmful substances. Rather, their purpose is to protect the sensitive areas (i.e., ecological areas or areas that include cultural resources and/or sites of historical/archeological significance) to the extent possible. Under CERCLA Section 121(d), relevance and appropriateness are related to the circumstances presented by the release of hazardous substances, with the goal of attaining a degree of cleanup and control of further release that ensures protection of human health and the environment.

Potential location-specific ARARs for the Sand Creek AOC are provided in **Appendix B**.

In addition to the requirements identified as ARARs, any action taken by the federal government must be conducted in accordance with requirements established under the National Environmental Policy Act, Endangered Species Act, National Historic Preservation Act, and federal and state wetlands and floodplains construction and placement of material considerations, even though these laws and rules do not establish standards, requirements, limitations, or criteria relating to the degree of cleanup for chemicals remaining on site at the close of the response actions.

SECTION 6: IDENTIFICATION OF ALTERNATIVES

This section describes the removal action Alternatives developed for the Sand Creek AOC and the individual analysis of each.

6.1 INTRODUCTION

Remedial removal Action Alternatives should assure adequate protection of human health and the environmental, achieve RAOs, meet ARARs, and if applicable, permanently and significantly reduce the volume, toxicity, and/or mobility of contaminants.

The two Alternatives considered in this EE/CA are:

- Alternative 1 – No Action
- Alternative 2 – Excavation with Off-site Disposal For Soil with Arsenic (and Ex-situ Thermal Treatment for Soil with PAHs and to attain Unrestricted (Residential) Land Use.

6.2 ALTERNATIVE 1: NO ACTION

The no action alternative is required for evaluation under the NCP. This alternative is the baseline to which other alternatives are compared. This alternative assumes all current actions (e.g., access restrictions and environmental monitoring) are discontinued and assumes no future actions will take place to protect human receptors or the environment. Impacted media at the AOC would not be removed or treated.

6.3 ALTERNATIVE 2: EXCAVATION AND OFF-SITE DISPOSAL FOR SOIL CONTAINING ARSENIC AND EX-SITU THERMAL TREATMENT FOR SOIL WITH PAHS (BENZO(A)PYRENE AND BENZO(B)FLUORANTHENE)

Alternative 2 consists of involves two remedial technologies: Excavation and off-site disposal for the soil at SCss-062M-0001-SO (0 to 1 ft bgs) and discrete locations SCsb-037M-0001-SO from the 1 to 5 feet bgs interval and SCsb-037M-0002-SO from the 5 to 9 interval in the subsurface soil (for arsenic). Ex-situ thermal treatment, such as the Vapor Energy Generator (VEG©) treatment, for soil at sample locations SCss-060M-0001-SO (for benzo(a)pyrene, and benzo(b)fluoranthene) in the surface soil (0 to 1 feet bgs) and discrete location SCsb-049M-0001-SO from the 1 to 5 feet bgs (benzo(a)pyrene). Implementing these remedial technologies will meet the criteria for Unrestricted (Residential) Land Use. The evaluation of this Alternative assumes that a mobile thermal treatment system is already on site and readily available for use. An Alternative to mobilize a treatment system on site solely for treating the soil volume specified in this EE/CA may not be feasible.

This remedial alternative requires coordinating remediation activities with Ohio EPA, OHARNG, and the Army. Coordinating with stakeholders during implementation of the excavation will minimize health and safety risks to on-site personnel and potential disruptions of Camp Ravenna activities. The time period to complete this remedial action is relatively short and will not include an O&M period, as an Unrestricted (Residential) Land Use scenario will be achieved. Components of this remedial alternative include:

- Delineation/pre-excavation confirmation sampling,
- Waste characterization sampling,
- Remedial Design (RD),
- Soil excavation and off-site disposal (SCss-062M-0001-SO (0 to 1 ft bgs) and discrete locations SCsb-037M-0001-SO from the 1 to 5 feet bgs interval and SCsb-037M-0002-SO from the 5 to 9 interval in the subsurface soil (for arsenic).
- Soil treatment (SCss-060M-0001-SO (for PAHs - benzo(a)pyrene, and benzo(b)fluoranthene) in the surface soil (0 to 1 feet bgs) and discrete location SCsb-049M-0001-SO from the 1 to 5 feet bgs (PAHs - benzo(a)pyrene), and
- Restoration.

Excavating specific locations and then completing thermal treatment in the surface soil and subsurface soil where the concentrations of COCs were identified in the Risk Management Evaluation (Section 3) as requiring removal in order for the Sand Creek AOC to meet Unrestricted (Residential) Land Use. These locations assessed in the 2017 RI were from ISM sample locations for surface soil and discrete sample locations in the subsurface soil (**Figure 2-5**).

6.3.1 REMOVAL ACTION WORK PLAN

An RD or Removal Action Work Plan will be developed prior to initiating removal actions. The RD will include an outline of construction requirements; site preparation activities (e.g., staging and equipment storage areas, truck routes, and storm water controls); the extent of soil removal; the sequence of excavation activities; decontamination; and segregation, transportation, and disposal of the waste. Erosion controls and health and safety controls will be developed as part of the RD to ensure protection of remediation workers and the environment. Waste characterization sampling will be completed in accordance with disposal facility requirements. In addition to these planning activities, the estimated CO_2 emissions will be calculated, and a PBR will be acquired prior to full-scale implementation.

6.3.2 EXCAVATION, REMOVAL, AND DISPOSAL

Prior to any ground disturbance, erosion control material such as silt fences and straw bales will be installed to minimize sediment runoff from the excavation area. Dust generation will be minimized during excavation activities by keeping equipment movement areas and excavation areas misted with water. The health and safety of remediation workers, on-site Camp Ravenna employees, and the general public will be detailed in a site-specific health and safety plan.

To achieve a scenario in which the AOC is protective for Unrestricted (Residential) Land Use under CERCLA, soil will be removed from the proposed excavation locations stated above and shown on **Figure 6-1. Figure 2-5** shows all the sample locations both for offsite disposal and thermal treatment**.** Approximately 157 yds^3 will be removed from the excavation sites for either disposal or thermal treatment.

The excavated soil at (SCss-062M-0001-SO (0 to 1 ft bgs) and discrete locations SCsb-037M-0001-SO from the 1 to 5 feet bgs interval and SCsb-037M-0002-SO from the 5 to 9 interval in the subsurface soil (for arsenic) will be directly loaded onto trucks for off-site disposal at a licensed and permitted disposal facility. For cost estimation purposes, it is assumed the waste will be disposed as non-hazardous waste in this EE/CA.

Soil removal is accomplished using conventional construction equipment such as backhoes, bulldozers, front-end loaders, and scrapers. Oversize debris will be crushed or otherwise processed to meet disposal facility requirements.

Soil will be hauled by truck to a licensed and permitted disposal facility. All trucks will be inspected prior to exiting the Sand Creek AOC. Appropriate waste manifests will accompany each waste shipment. Only regulated and licensed transporters and vehicles will be used. All trucks will travel pre-designated routes within Camp Ravenna.

Residual solid waste will be managed under the solid waste management plan which is currently in development and any solid waste identified during excavation will be removed and properly disposed. Excavated soil will be disposed at an existing off-site facility licensed and permitted to accept the characterized waste stream. The selection of an appropriate facility considers the type of waste, location, transportation options, and cost. Waste streams with different constituents and/or characteristics may be generated. Disposal cost savings can be made possible by utilizing specific disposal facilities for different waste streams but all excavated soil that is does not undergo thermal treatment is contaminated with arsenic.

6.3.3 SOIL TREATMENT

Prior to any ground disturbance, the excavation area will be surveyed and demarcated by stakes. Erosion control material such as silt fences and straw bales will be installed to minimize sediment runoff. Dust generation will be minimized during excavation activities by keeping equipment movement areas and excavation areas misted with water. The health and safety of remediation workers, on-site Camp Ravenna employees, and the general public will be covered in a site-specific health and safety plan.

To achieve Unrestricted (Residential) Land Use at SCss-060M-0001-SO (for benzo(a)pyrene, and benzo(b)fluoranthene) in the surface soil (0 to 1 feet bgs) and discrete location SCsb-049M-0001-SO from the 1 to 5 feet bgs (benzo(a)pyrene) the contaminated soil will undergo ex-situ thermal treatment. The treatment system will be pre-heated to the optimal treatment temperature based on results of past bench- and pilot-scale tests previously conducted at the former RVAAP. While the system is being heated, soil will be excavated using conventional construction equipment such as backhoes, bulldozers, front-end loaders, and scrapers and will be stockpiled immediately adjacent to the treatment system into approximately 50 yd^3 piles.

Once the treatment system is at the optimal treatment temperature, contaminated soil will be fed directly into the fully enclosed, preheated chamber by being placed onto a conveyor. Steam at a temperature of 1300°F will be fed into the renewal/treatment chamber, where it serves as the heat source for thermally treating soils. As the soil moves through the system via a rotational auger, the soil contaminants will be desorbed at specified temperatures and residence times and passed as vapors into the box head space within the enclosed chamber.

The PAH vapors will then be subject to a patented filter/scrubber system to remove the acidic gases [i.e., nitrous oxides, sulfur oxides, and hydrogen chloride] and CO2 components, using an engineered mixture of sodium hydroxide, lime, zero valent iron, steam, and water within a slender packed column. Induced vapors from the contaminated soils will be routed through this filtration system, allowing for full treatment of acidic gases, SVOC vapors, and conversion of any remaining vapors into a synthetic gas. This synthetic gas will be used as a renewable source of fuel to replace the propane used initially to generate steam and to continue operating the VEG treatment system.

Relying on this fully-enclosed looping system, there will be no emissions to the atmosphere, and the limited CO2 generated through the process may be further reduced (by some 90% to levels below background) using the water-lime component of the patented filtration process. After treatment, the soil will be stockpiled into approximately 50 yd^3 stockpiles on tarp and covered with plastic sheeting.

Soil samples will be collected from the individual stockpiles, and soil will be analyzed for COCs using USEPA Method 8270. The laboratory results will be compared to Removal Action Cleanup Goals. Once the laboratory analysis determines COCs are less than the Cleanup Goals, the treated soil will be used for backfill and site restoration. Should confirmation samples indicate that any contaminants are not sufficiently treated, then those soils will be rerun through the VEG© system, likely at a higher temperature, until the target post-treatment levels are reached.

6.3.4 RESTORATION

Upon completing the excavation, confirmation samples will be taken to verify the removal action was successful and all contamination was removed. The disturbed areas will be backfilled with overburden from the excavation and clean fill (from an approved and tested source) will be used if needed to assist in grading to neighboring contours. After the area is backfilled and graded, workers will apply a seed mixture (as approved by OHARNG) and mulch. Restored areas will be inspected and monitored consistent with best management practices.

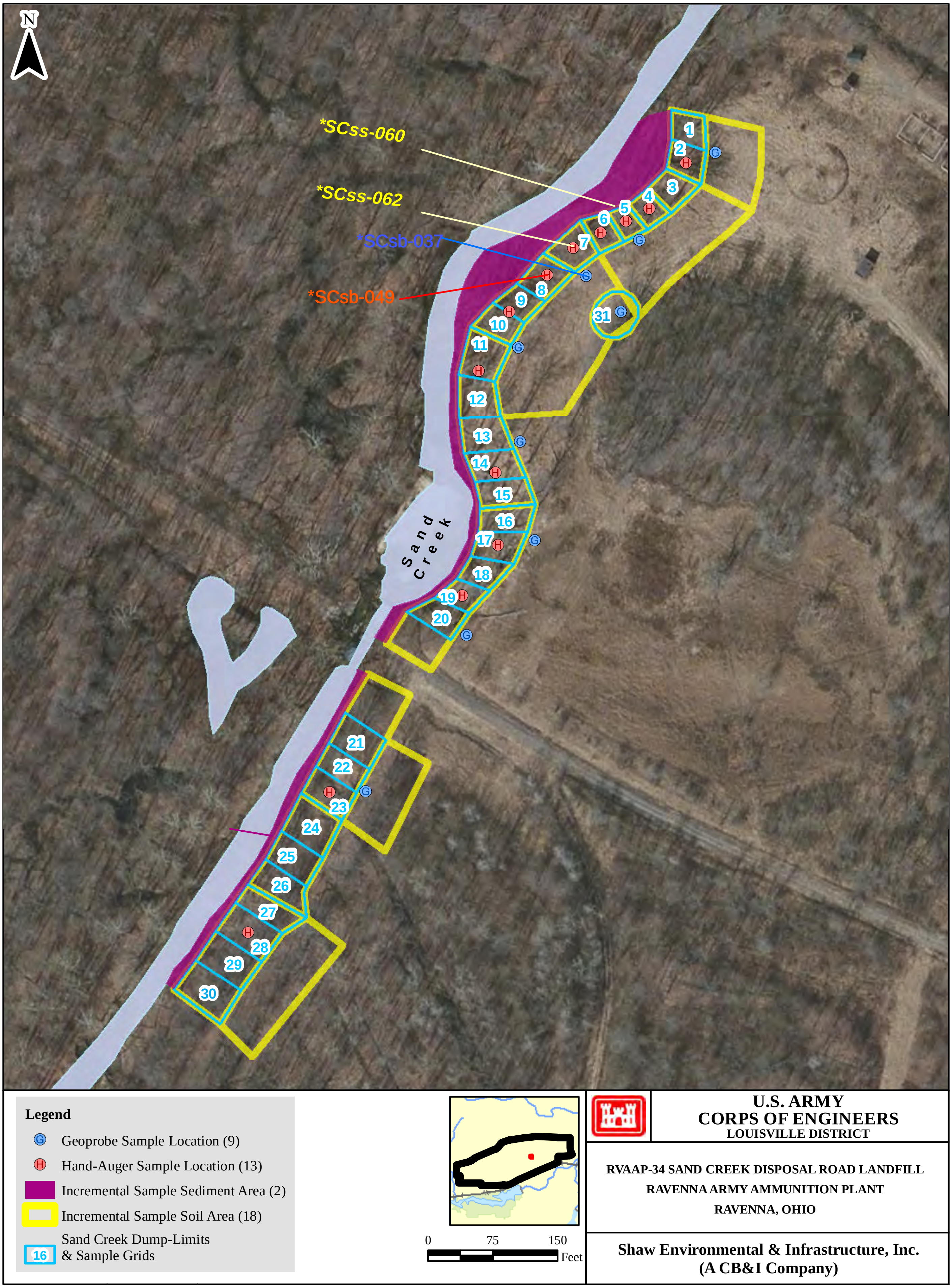

Figure 6-1. Four Locations Identified as Requiring a Removal Action

SECTION 7: ANALYSIS OF ALTERNATIVES

7.1 EVALUATION CRITERIA

Section 300.430(e) of the NCP lists nine criteria by which each remedial Alternative must be assessed. The acceptability and performance of each Alternative against the criteria are evaluated individually so that relative strengths and weaknesses can be identified. However, in an EE/CA a streamlined version of evaluation criteria is considered. Each Alternative is evaluated using the short- and long-term aspects of three broad criteria: effectiveness, implementability, and cost. Additionally, each of the three broad criteria have sub-criteria that are also considered under each criteria. Consistent with the Guidance for Conducting Non-Time Critical Removal Actions under CERCLA EPA/540-R-93-057 (USEPA, 1993), the two Alternatives were evaluated against the following three broad criteria and associated sub-criteria:

- Effectiveness:
  - Overall protection of human health and the environment:
  - Complies with ARARS,
  - Long-term effectiveness and permanence,
  - Reduction of toxicity, mobility, or volume through treatment, and
  - Short-term effectiveness.

- Implementability:
  - Technical Feasibility,
  - Administrative Feasibility,
  - Availability of services and materials,
  - State (support agency) acceptance, and
  - Community acceptance.

- Cost:
  - Capital costs (including present worth and post removal site control), and
  - No operation and maintenance costs and fees are needed.

7.1.1 EFFECTIVENESS CRITERIA

The USEPA defines effectiveness of an Alternative as the ability to meet the objectives within the scope of the removal action. The criteria that determines the level of effectiveness is the overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume; and short-term effectiveness.

7.1.1.1 Overall Protection of Human Health and the Environment

One measure of effectiveness is how well the overall protection of human health (community) and the environment are met by the Alternative. Each Alternative must be evaluated to determine how it achieves and maintains protection of human health and the environment.

7.1.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

Compliance with ARARs addresses whether or not a remedy will meet all of the applicable or relevant and appropriate requirements of other Federal and state environmental statutes and/or provide grounds for invoking a waiver. Compliance with ARARs is required to the extent possible based on the urgency of the situation and the scope of the action contemplated (40 CFR 1300.415(j)). Each Alternative must be evaluated against the ARARs presented in **Appendix B**. On-site response actions must comply with the substantive requirements that may be an ARAR, where practical.

7.1.1.3 Long-term Effectiveness and Permanence

Long-term effectiveness and permanence is an evaluation of the magnitude of residual risk (risk remaining after implementation of the Alternative) and the adequacy and reliability of controls used to manage the remaining waste (untreated waste and treatment residuals) over the long term once the cleanup goals have been met. Alternatives that provide the highest degree of long-term effectiveness and permanence leave little or no untreated waste at the site, make long-term maintenance and monitoring unnecessary, and minimize the need for land use controls.

7.1.1.4 Reduction of Toxicity, Mobility, or Volume

Reduction of toxicity, mobility, or volume through soil removal is an evaluation of the ability of the Alternative to reduce the toxicity, mobility, or volume of the waste. The evaluation involves an assessment of the amount of hazardous material removed, the degree of reduction in toxicity, mobility, or volume, and the type and quantities of residuals remaining after removal. Reduction of toxicity, mobility, or volume through treatment is the anticipated performance of the treatment technologies that may be employed in a remedy

7.1.1.5 Short-term Effectiveness

Short-term effectiveness addresses the protection of workers and the community during the removal action, the environmental effects of implementing the action, and the time required to achieve media-specific cleanup goals. This criterion accounts for potential threats to workers (e.g., fugitive dust and transportation of hazardous materials), the environment (e.g., potential spills and releases), and reliability of mitigation measures. Short-term Effectiveness refers to the speed with which the remedy achieves protection, as well as the remedy's potential top create adverse impacts on human health and the environment that may result during the construction and implementation period.

7.1.2 IMPLEMENTABILITY CRITERIA

Implementability addresses the technical and administrative feasibility of implementing an Alternative, the availability of various services and materials required during implementation, and the state and community acceptance. Implementability is a measure of whether a course of action Alternative can be physically and administratively implemented, such as the ability to construct, excavate, or demolish. It is also a measure of the availability of the services and materials needed to implement the Alternative. Other considerations regarding Implementability include state agency and community acceptance of a given Alternative.

7.1.2.1 Technical Feasibility

Technical feasibility assesses the reliability of the technology and operational difficulties and the environmental conditions of construction/removal implementation. It also addresses the ability to perform the removal in the allotted amount of time. Technical feasibility may also takes into consideration the potential need and ease of future removal actions.

7.1.2.2 Administrative Feasibility

The administrative feasibility criterion assesses the coordination of all aspects involved with the removal action, addressing concerns from regulatory agencies, and adherence to non-environmental laws.

7.1.2.3 Availability of Services and Materials

The availability of services and materials to implement the removal actions is evaluated. The evaluation includes an assessment of the availability of materials, availability of contractors and specialists, and the availability of off-site treatment, storage, and disposal of excavated material.

7.1.2.4 State and Community Acceptance

State acceptance considers that all comments received from agencies of the State of Ohio are addressed and the EE/CA is accepted. The primary state agency supporting this investigation is the Ohio EPA. Community acceptance considers comments made by the community, including stakeholders, on the Alternatives being considered during the public comment period. Comments will be accepted from the community on the EE/CA and the preferred remedy presented in an Action Memorandum.

7.1.3 COST CRITERIA

Cost analyses provide an estimate of the dollar cost of each Alternative. This analysis includes an estimate of the capital cost in dollars, annual operation and maintenance (O&M) cost (if applicable), and indicates the period of time to complete the proposed action. Details and assumptions used in developing cost estimates for each of the Alternatives presented in this EE/CA are provided in **Appendix C**. Cost figures (provided in **Appendix C**) were obtained from readily available sources (e.g., Means Site Work Costs Data, vendors, local suppliers, and experience at other sites) and were used to estimate costs for the Alternatives for comparison and estimating purposes. These cost estimates should not be considered the actual cost of designing and implementing a remedial action, but rather relative costs among the Alternatives using consistent assumptions and estimating methods.

7.2 EVALUATION OF ALTERNATIVES

The two removal action Alternatives evaluated for the Sand Creek Disposal Road Landfill are described in Section 6. These Alternatives are as follows: Alternative 1: No Action and Alternative 2 – Excavation with Off-site Disposal For Soil with Arsenic (and Ex-situ Thermal Treatment for Soil with PAHs (benzo(a)pyrene and benzo(b)fluoranthene) to attain Unrestricted (Residential) Land Use.

The following sections analyze each removal action alternative using the criteria described in Section 7.1. This analysis will provide the advantages and disadvantages of each alternative.

7.2.1 ALTERNATIVE 1 – NO ACTION

This Alternative would involve no further CERCLA response action at the Sand Creek AOC except to document the decision. There would be no overall protection for of human health and the environment. Removal goals would not be achieved and this Alternative provides for no long-term effectiveness and permanence. This alternative has no removal or treatment; therefore, there is no reduction in toxicity, mobility, or volume.

7.2.1.1 Effectiveness of Alternative 1

No additional removal actions would be taken at the Sand Creek AOC under this Alternative. This Alternative would not provide additional protection of human health and the environment; compliance with ARARs; long- or short-term effectiveness; or reduction of toxicity, mobility, or volume. Under this Alternative, contaminated soil would remain in place at the AOC. This Alternative would not provide for overall protection of human health and the environment. Removal goals would not be achieved and this Alternative provides for no long-term effectiveness and permanence. This Alternative has no removal or treatment so there is no reduction in toxicity, mobility, or volume. Under this Alternative, Five-Year Reviews would not be conducted as stated in CERCLA 121(c).

7.2.1.2 Implementability of Alternative 1

The No Action Alternative would be technically and administratively feasible, and would require no services or materials to be implemented. No actions are proposed under this Alternative. However, it is unlikely that the State of Ohio and the Community would accept no action to occur as contaminated soil would remain on the Site.

7.2.1.3 Cost of Alternative 1

The present value cost to complete Alternative 1 is zero. There is no capital cost associated with No Action Alternative.

7.2.1.4 Outcome

The No Action Alternative will not be further evaluated or considered because it fails the effectiveness and implementability criteria.

7.2.2 ALTERNATIVE 2 – EXCAVATION WITH OFF-SITE DISPOSAL FOR SOIL WITH ARSENIC (AND EX-SITU THERMAL TREATMENT FOR SOIL WITH PAHS TO ATTAIN UNRESTRICTED (RESIDENTIAL) LAND USE.

Alternative 2 consists of excavating specific locations in the surface soil and subsurface soil where the concentrations of COCs were identified in the Risk Management Evaluation (Section 3) as requiring removal in order for the Sand Creek AOC to meet Unrestricted (Residential) Land Use and then subjecting the excavated soils to ex-situ thermal treatment at locations where PAHs (benzo(a)pyrene and benzo(b)fluoranthene) COCs occur.

- Soil excavation and off-site disposal (SCss-062M-0001-SO (0 to 1 ft bgs) and discrete locations SCsb-037M-0001-SO from the 1 to 5 feet bgs interval and SCsb-037M-0002-SO from the 5 to 9 interval in the subsurface soil (for arsenic).
- Soil treatment (SCss-060M-0001-SO with (PAHs - benzo(a)pyrene and benzo(b) fluoranthene) in the surface soil (0 to 1 feet bgs) and discrete location SCsb-049M-0001-SO from the 1 to 5 feet bgs (benzo(a)pyrene).

7.2.2.1 Effectiveness of Alternative 2

Alternative 2 will remove and treat portions of contaminated soil from the AOC. Excavating and removing the arsenic contaminated soil and thermally treating the soil contaminated with benzo(a)pyrene and benzo(b)fluoranthene would result in a permanent reduction in risks at the Sand Creek AOC. The arsenic contaminated soil would be removed and placed in a permanent disposal facility. The thermally treated soil can be placed back in the same location. As a result, long-term management and CERCLA five-year reviews would not be required.

For the soils contaminated with PAHs (benzo(a)pyrene and benzo(b)fluoranthene) involved with this Alternative, COCs will be destroyed. Therefore, this Alternative will reduce the toxicity, mobility, and volume of COCs through treatment.

During implementation, risks will be mitigated through use of proper controls such requiring workers to follow a health and safety plan and wear appropriate personal protective equipment to minimize exposures during site activities. Implementing mitigation measures such as erosion and dust control during construction would be included in Alternative 2. Other controls such as inspecting vehicles transporting soils before and after use, and limiting the distance waste is transported in vehicles would be considered.

7.2.2.2 Implementability of Alternative 2

This alternative is implementable. Coordination would be required between removal action planners and OHARNG to minimize disruptions and/or impacts to OHARNG operations. Excavation and truck transport of soil are conventional construction activities. Resources such as standard excavation and construction equipment would be used and are readily available. Soil borrow sites and permitted waste disposal facilities are available within a reasonable distance.

The implementability of Alternative 2 for the soil to be treated using thermal is dependent on having an existing on-site thermal treatment system performing remediation at other sites on the installation. The treatment system can efficiently mobilize from within the former RVAAP; however, this alternative may not be practical if a treatment system needs to mobilize solely for this remediation.

Alternative 2 will be implementable after using historic bench-scale tests to establish optimal treatment temperature and residence times, developing an RD that is approved by stakeholders, and completing all appropriate coordination with local, state, and federal agencies. Excavating soil, constructing temporary roads, and waste handling are conventional, straightforward construction techniques and methods. Implementing this alternative is predicated on the availability of an on-site thermal treatment system, thus resulting in readily available equipment and minimal mobilization.

Soil treatment activities will be coordinated with Camp Ravenna and OHARNG to minimize alterations and/or impacts to OHARNG proceedings. The RD will identify access routes to the AOC for heavy equipment and steps to minimize potential hazards to on-site personnel. Developing the RD and coordinating with local, state, and federal agencies will increase the implementation difficulty of Alternative 2.

7.2.2.3 Cost of Alternative 2

The present value cost to complete Alternative 2 is approximately $142,400 (in base year 2018 dollars). Costs include implementing the removal, off-site disposal, thermal treatment, and site restoration. See **Appendix C** for a detailed description of Alternative 2 costs.

7.2.2.4 Outcome

Alternative 2 would be an effective method of removing and disposing contaminated soil at the Sand Creek AOC for arsenic contaminated soil. Excavation and off-site disposal are conventional technologies which can be readily implemented. This Alternative would also be effective for eliminating PAHs in soil. This Alternative would reduce risks and once implemented, the Sand Creek AOC would meet Unrestricted (Residential) Land Use. Under this Alternative, soils undergoing the thermal treatment will be effectively treated and will meet Unrestricted (Residential) Land Use after treatment.

SECTION 8: COMPARATIVE ANALYSIS OF ALTERNATIVES

The comparative analysis is used to assess the performance of each Alternative with respect to effectiveness, implementability, and costs. This analysis also identifies the advantages and disadvantages of the Alternatives relative to one another with respect to the evaluation criteria.

The comparative analysis for the two Alternatives in this EE/CA is presented in **Table 9**. Based on the analysis, there are major differences between Alternative 1 and Alternative 2 regarding effectiveness, implementability, and costs.

TABLE 9. Comparative Analysis of Alternative for the EE/CA at the RVAAP-34 Sand Creek AOC.

Alternative	Evaluation Criteria		
	Effectiveness	**Implementability**	**Costs**
Alternative 1: **No Action**	Fails to meet this criteria. The primary component of this criteria is the overall protection of human health and the environment which this Alternative does not meet.	Implementable	$0
Alternative 2: Excavation with Off-site Disposal For Soil with Arsenic (and Ex-situ Thermal Treatment for Soil with PAHs to attain Unrestricted (Residential) Land Use	Effective Overall	Readily Implementable	$142,400

As presented in **Table 9**, the No Action Alternative will not meet effectiveness evaluation criteria although there are no costs.

Alternative 2: Excavation and Off-site Disposal for soil with arsenic and Thermal treatment for Soil with PAHs meets all of the requirements under the effectiveness evaluation criteria. This Alternative meets all evaluation criteria and has an estimated cost of $142,400.

SECTION 9: AGENCY COORDINATION AND PUBLIC INVOLVEMENT

The Army is the lead agency under the Defense Environmental Restoration Program responsible for achieving remedy of soils at this AOC. This section reviews actions that have been conducted and that are planned to ensure Regulatory Agencies and the Public have been provided with appropriate opportunities to stay informed of the progress of the removal actions and to provide meaningful input on the planning effort as well as the final selection of a remedy.

9.1 STATE ACCEPTANCE

State acceptance considers comments received from agencies of the state of Ohio on the actions being considered. For the process of achieving remedy of soils at this AOC, Ohio EPA is the lead regulatory agency. This EE/CA has been prepared in consultation with Ohio EPA. Ohio EPA provided input during the ongoing investigation and report development process to ensure the action ultimately selected meets the needs of the State of Ohio and fulfills the requirements of the DFFO (Ohio EPA 2004).

The Final EE/CA will be submitted for review and comment as required under the DFFOs. After the Army has responded to Ohio EPA's comments and the Agency approves the decision and selected Alternative, the EE/CA will be finalized and published for public review and comment as described in the following.

9.2 COMMUNITY ACCEPTANCE

Community acceptance considers comments provided by the community on the actions being considered. Under CERCLA 42 U.S.C. 9617(a) early, constant, and responsive community relations is emphasized. The Army has prepared a Community Relations Plan for the Ravenna Army Ammunition Plant Restoration Program (Vista 2017) for Camp Ravenna to ensure the public has convenient access to information regarding project progress. The community relations program interacts with the public through news releases, public meetings, public workshops, and Restoration Advisory Board meetings with local officials, interest groups, and the general public.

Community involvement is a necessary part of the CERCLA process and the DFFOs. The NCP requires that a public notice describing the EE/CA and announcing a public comment period be published in a major local newspaper.

The Army will notify the local newspaper to announce the availability of the Final EE/CA for public review. A public comment period of 30 days will commence following release of the EE/CA report to provide the public appropriate opportunities for involvement in site-related decisions. The Army will respond to comments received during the public comment period. These comments will be considered in the final selection of an Alternative for the Sand Creek AOC.

The CERCLA 42 U.S.C. 9617(a) requires that an Administrative Record be established "at or near the facility at issue." Relevant documents regarding the RVAAP Restoration Program have been made available to the public for review and comment.

The Administrative Record for this project is available at the following location:

Camp Ravenna Joint Military Training Center (Camp Ravenna)
Environmental Office
1438 State Route 534 SW
Newton Falls Ohio 44444
(614) 336-6136

Note: Access is restricted to Camp Ravenna, but maybe obtained by contacting the environmental office at (614) 336-6136.

In addition, an Information Repository of current information and final documents is available to any interested reader at the following libraries:

Reed Memorial Library
167 East Main Street
Ravenna, Ohio 44266

Newton Falls Public Library
204 South Canal Street
Newton Falls, Ohio 44444-1694

The RVAAP Restoration Program has an online resource for restoration news and information. This website can be viewed at www.rvaap.org.

SECTION 10: RECOMMENDED REMOVAL ACTION ALTERNATIVE

This section presents the recommended Alternative for the Sand Creek AOC.

Alternative 2: Excavation with Off-site Disposal For Soil with Arsenic (and Ex-situ Thermal Treatment for Soil with PAHs to attain Unrestricted (Residential) Land Use is the recommended action for the Sand Creek AOC. The arsenic contaminated soil at the AOC will be removed from the former RVAAP facility, hauled to a licensed and permitted disposal facility, and appropriately disposed. The soil locations with PAH contamination, will be excavated and then undergo thermal treatment. The soil will be put back in place. The arsenic removal areas will be restored with clean fill material.

No long-term monitoring or five-year reviews would be required under CERCLA since Unrestricted (Residential) Land Use will be obtained. However, residual solid waste will be managed under the solid waste management plan which is currently in development and any solid waste identified during excavation will be removed and properly disposed. Approximately 101 yds^3 of contaminated soil will be removed from the AOC for off-site disposal and 56 yds^3 will be excavated, undergo thermal treatment, and then put back in place. This removal will be conducted as an NTCRA and will achieve quick, protective results at the AOC and was determined to be cost effective (estimated $142,400 for removal and thermal treatment). **Figure 6-1** provides the locations of the areas that required removal. **Appendix C** includes breakdown of the costs and other information used to make this estimate.

SECTION 11: REFERENCES

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APPENDIX A: Statistical Information for Risk Management Evaluation

Table D-1
Phase I RI Surface Soil Analytical Data Summary
Sand Creek Disposal Road Landfill

				Location Code:	SCSS-057		SCSS-057		SCSS-058		SCSS-058		SCSS-059		SCSS-060		SCSS-061		SCSS-062	
				Sample Number:	SCSS-057D-0001-SO		SCSS-057M-0001-SO		SCSS-058M-0001-SO		SCSS-085M-0001-SO		SCSS-059M-0001-SO		SCSS-060M-0001-SO		SCSS-061M-0001-SO		SCSS-062M-0001-SO	
				Sample Date:	9/24/2010		9/24/2010		9/23/2010		9/23/2010		9/23/2010		9/23/2010		9/23/2010		9/22/2010	
				Depth:	0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft	
				Sample Purpose:	REG		REG		REG		FD		REG		REG		REG		REG	
Parameter	Units	Screening Criteria FWCUG[a]	Screening Criteria ECOSV[b]	BSV	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
General Chemistry																				
Nitrocellulose	mg/kg	1.8E+07*	NA	*NA*	---		7	U	---		---		---		---		---		---	
Cyanide, Totalc	mg/kg	2.2[c]*	1.33	*0*	---		**0.3**	**J**	---		---		---		---		---		---	
Hexavalent Chromium	mg/kg	1.64	130	*0*	---		1.9	U	---		---		---		2	U	---		2	U
Total Solids	Percent	NA	NA	*NA*	70.5		98.4		98.1		97.8		93.9		93.4		93.8		97	
Explosives and Propellants																				
1,3,5-Trinitrobenzene	mg/kg	220*	0.376	*NA*	---		0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U
1,3-Dinitrobenzene	mg/kg	0.61*	0.655	*NA*	---		0.079	U	0.08	U	0.08	U	0.079	U	0.08	U	0.08	U	0.08	U
2,4,6-Trinitrotoluene	mg/kg	3.65	6.4	*NA*	---		0.089	U	0.26	J	**0.21**	**J**	0.089	U	0.09	U	0.09	U	0.09	U
2,4-Dinitrotoluene	mg/kg	1.1	1.28	*NA*	---		0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
2,6-Dinitrotoluene	mg/kg	6.1	0.0328	*NA*	---		0.069	U	0.07	U	0.07	U	0.07	U	0.07	U	0.07	U	0.07	U
2-Amino-4,6-Dinitrotoluene	mg/kg	1.54	2.1	*NA*	---		0.049	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
3,5-Dinitroaniline	mg/kg	TBC	NA	*NA*	---		0.089	U	0.09	U	0.09	U	0.089	U	0.09	U	0.09	U	0.09	U
4-Amino-2,6-Dinitrotoluene	mg/kg	1.54	0.73	*NA*	---		0.069	U	0.07	U	0.07	U	0.07	U	0.07	U	0.07	U	0.07	U
HMX	mg/kg	359	27	*NA*	---		0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U
m-Nitrotoluene	mg/kg	2.9*	2	*NA*	---		0.069	U	0.07	U	0.07	U	0.07	U	0.07	U	0.07	U	0.07	U
Nitrobenzene	mg/kg	4.8*	1.31	*NA*	---		0.04	U	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U
Nitroglycerin	mg/kg	0.61*	71	*NA*	---		0.49	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Nitroguanidine	mg/kg	610*	NA	*NA*	---		**0.64**		---		---		---		---		---		---	
o-Nitrotoluene	mg/kg	0.61*	2.4	*NA*	---		0.089	U	0.09	U	0.09	U	0.089	U	0.09	U	0.09	U	0.09	U
PETN	mg/kg	TBC	8,600	*NA*	---		0.49	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
p-Nitrotoluene	mg/kg	24*	4.4	*NA*	---		0.069	U	0.07	U	0.07	U	0.07	U	0.07	U	0.07	U	0.07	U
RDX	mg/kg	8.03	7.5	*NA*	---		0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U
Tetryl	mg/kg	24.4	0.99	*NA*	---		0.089	U	0.09	U	0.09	U	0.089	U	0.09	U	0.09	U	0.09	U
Metals																				
Aluminum	mg/kg	3,496	NA	*17,700*	---		12,800		10,400		9,250		12,200		9,170		9,550		10,600	
Antimony	mg/kg	2.82	0.27	*0.96*	---		1.6	UJ	**3.1**		**3.3**		0.43	U	**1.5**		**17.1**		**3.7**	
Arsenic	mg/kg	0.524	18	*15.4*	---		8.3	J	4.5		5.3		10.4		13.4		21.2		36.6	
Barium	mg/kg	351	330	*88.4*	---		67.6		**127**		83.3		66.8		**163**		**764**		**226**	
Beryllium	mg/kg	16*	21	*0.88*	---		0.71		0.66		0.51		0.41		0.58		0.66		**1.1**	
Cadmium	mg/kg	6.41	0.36	*0*	---		**0.41**	**J**	**1.9**		**1.7**		0.032	U	**3.6**		**12.9**		**2.3**	
Calcium	mg/kg	NA	NA	*15,800*	---		4,880		**21,500**		10,400		**32,500**		**17,900**		11,900		15,300	
Chromium (as Cr^{+3})	mg/kg	8,147	26	*17.4*	---		**174**		**143**		**152**		**30.9**		**33.5**		**77.6**		**106**	
Cobalt	mg/kg	19.9	13	*10.4*	---		**13.2**		6.7		6.9		**12.2**		7.4		10		6.7	
Copper	mg/kg	311	28	*17.7*	---		**25.3**		**33.7**		**32.3**		**17.8**		**42.8**		**188**		**63.7**	
Iron	mg/kg	2,313	NA	*23,100*	---		**30,000**		**27,100**		**26,400**		**28,200**		23,000		**34,800**		**25,200**	
Lead	mg/kg	400**	11	*26.1*	---		12.1	J	**139**		**120**		10.8		**134**		**405**		**141**	
Magnesium	mg/kg	NA	NA	*3,030*	---		**4,410**		**3,930**		2,870		**8,130**		**4,340**		**3,500**		2,650	
Manganese	mg/kg	35.1	220	*1,450*	---		421		729		516		453		705		876		765	
Mercury	mg/kg	2.27	0.00051	*0.036*	---		**15.1**		**11.1**		**11.1**		**24.6**		**8.8**		**2.7**		**0.5**	

Table D-1
Phase I RI Surface Soil Analytical Data Summary
Sand Creek Disposal Road Landfill

				Location Code:	SCSS-057		SCSS-057		SCSS-058		SCSS-058		SCSS-059		SCSS-060		SCSS-061		SCSS-062	
				Sample Number:	SCSS-057D-0001-SO		SCSS-057M-0001-SO		SCSS-058M-0001-SO		SCSS-085M-0001-SO		SCSS-059M-0001-SO		SCSS-060M-0001-SO		SCSS-061M-0001-SO		SCSS-062M-0001-SO	
				Sample Date:	9/24/2010		9/24/2010		9/23/2010		9/23/2010		9/23/2010		9/23/2010		9/23/2010		9/22/2010	
				Depth:	0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft	
				Sample Purpose:	REG		REG		REG		FD		REG		REG		REG		REG	
		Screening Criteria																		
Parameter	Units	FWCUG[a]	ECOSV[b]	BSV	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Nickel	mg/kg	155	38	*21.1*	---		**34.6**		**21.7**		**22.9**		**26.4**		21		**30.7**		**37.6**	
Potassium	mg/kg	NA	NA	*927*	---		**1,540**		**1,180**		**1,120**		**1,030**		**942**		**1,020**		**1,120**	
Selenium	mg/kg	39*	0.52	*1.4*	---		1.4	UJ	0.83	J	0.8	J	0.37	U	0.63	J	0.4	J	**3.1**	
Silver	mg/kg	38.6	4.2	*0*	---		**12.9**		**3.8**		**4.4**		0.091	U	**47.9**	**J**	**256**		**145**	
Sodium	mg/kg	NA	NA	*123*	---		51.8		99.6		64.7		61		55.4		108		107	
Thallium	mg/kg	0.612	1	*0*	---		**3.2**	**J**	**1.7**		**1.7**		**1.8**		**1.7**		**2.4**		**1.4**	
Vanadium	mg/kg	44.9	7.8	*31.1*	---		20.9		14.8		15.4		17.6		16.3		21.6		15.7	
Zinc	mg/kg	2,321	46	*61.8*	---		**94**		**269**		**252**		59.9		**234**		**373**		**111**	
Polychlorinated biphenyls																				
PCB-1016	mg/kg	0.203	0.371	*NA*	---		0.01	U	---		---		---		---		---		---	
PCB-1221	mg/kg	0.14*	0.371	*NA*	---		0.02	U	---		---		---		---		---		---	
PCB-1232	mg/kg	0.14*	0.371	*NA*	---		0.027	U	---		---		---		---		---		---	
PCB-1242	mg/kg	0.22*	0.371	*NA*	---		0.029	U	---		---		---		---		---		---	
PCB-1248	mg/kg	0.203	0.371	*NA*	---		0.029	U	---		---		---		---		---		---	
PCB-1254	mg/kg	0.12	0.371	*NA*	---		0.023	U	---		---		---		---		---		---	
PCB-1260	mg/kg	0.203	0.371	*NA*	---		0.012	U	---		---		---		---		---		---	
PCB-1262	mg/kg	0.203	0.371	*NA*	---		0.021	U	---		---		---		---		---		---	
PCB-1268	mg/kg	0.203	0.371	*NA*	---		0.028	U	---		---		---		---		---		---	
Pesticides																				
4,4'-DDD	mg/kg	0.2*	0.021	*NA*	---		**0.0014**	**J**	---		---		---		---		---		---	
4,4'-DDE	mg/kg	2.63	TBC	*NA*	---		0.00031	U	---		---		---		---		---		---	
4,4'-DDT	mg/kg	0.17*	0.21	*NA*	---		**0.0015**	**J**	---		---		---		---		---		---	
Aldrin	mg/kg	0.053	TBC	*NA*	---		0.00051	U	---		---		---		---		---		---	
alpha-BHC	mg/kg	0.077*	TBC	*NA*	---		0.00061	U	---		---		---		---		---		---	
alpha-Chlordane	mg/kg	1.6*	0.0024	*NA*	---		0.00031	U	---		---		---		---		---		---	
beta-BHC	mg/kg	0.77	TBC	*NA*	---		0.00061	U	---		---		---		---		---		---	
Chlordane	mg/kg	0.16*	TBC	*NA*	---		0.0041	U	---		---		---		---		---		---	
delta-BHC	mg/kg	0.27*	TBC	*NA*	---		0.00031	U	---		---		---		---		---		---	
Dieldrin	mg/kg	0.056	TBC	*NA*	---		0.00031	U	---		---		---		---		---		---	
Endosulfan I	mg/kg	37*	TBC	*NA*	---		0.00071	U	---		---		---		---		---		---	
Endosulfan II	mg/kg	37*	TBC	*NA*	---		0.00031	U	---		---		---		---		---		---	
Endosulfan Sulfate	mg/kg	TBC	TBC	*NA*	---		0.00092	UJ	---		---		---		---		---		---	
Endrin	mg/kg	1.12	TBC	*NA*	---		0.00041	U	---		---		---		---		---		---	
Endrin Aldehyde	mg/kg	TBC	TBC	*NA*	---		0.0011	U	---		---		---		---		---		---	
Endrin Ketone	mg/kg	TBC	TBC	*NA*	---		0.00081	U	---		---		---		---		---		---	
gamma-Chlordane	mg/kg	TBC	TBC	*NA*	---		0.00031	U	---		---		---		---		---		---	
Heptachlor	mg/kg	0.198	0.00598	*NA*	---		**0.0081**	**J**	---		---		---		---		---		---	
Heptachlor Epoxide	mg/kg	0.098	TBC	*NA*	---		0.00051	U	---		---		---		---		---		---	
Lindane	mg/kg	0.198	0.005	*NA*	---		0.00051	U	---		---		---		---		---		---	
Methoxychlor	mg/kg	31*	0.0199	*NA*	---		0.00071	U	---		---		---		---		---		---	

Table D-1
Phase I RI Surface Soil Analytical Data Summary
Sand Creek Disposal Road Landfill

				Location Code:	SCSS-057		SCSS-057		SCSS-058		SCSS-058		SCSS-059		SCSS-060		SCSS-061		SCSS-062	
				Sample Number:	SCSS-057D-0001-SO		SCSS-057M-0001-SO		SCSS-058M-0001-SO		SCSS-085M-0001-SO		SCSS-059M-0001-SO		SCSS-060M-0001-SO		SCSS-061M-0001-SO		SCSS-062M-0001-SO	
				Sample Date:	9/24/2010		9/24/2010		9/23/2010		9/23/2010		9/23/2010		9/23/2010		9/23/2010		9/22/2010	
				Depth:	0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft	
				Sample Purpose:	REG		REG		REG		FD		REG		REG		REG		REG	
		Screening Criteria																		
Parameter	Units	FWCUG[a]	ECOSV[b]	BSV	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Toxaphene	mg/kg	0.044*	TBC	*NA*	---		0.0051	U	---		---		---		---		---		---	
Semivolatile Organic Compounds																				
1,2,4-Trichlorobenzene	mg/kg	6.2*	20	*NA*	---		0.021	U	0.021	U	0.021	U	0.022	U	0.023	U	**0.027**	**J**	0.022	U
1,2-Dichlorobenzene	mg/kg	190*	2.96	*NA*	---		**0.028**	**J**	0.024	U	0.024	U	**0.028**	**J**	**0.078**	**J**	**0.11**	**J**	**0.041**	**J**
1,3-Dichlorobenzene	mg/kg	2.4[d]*	37.7	*NA*	---		0.02	U	0.02	U	0.02	U	0.021	U	0.021	U	**0.031**	**J**	0.021	U
1,4-Dichlorobenzene	mg/kg	2.4*	20	*NA*	---		0.019	U	**0.022**	**J**	**0.019**	**J**	**0.058**	**J**	**0.21**	**J**	**0.27**	**J**	**0.041**	**J**
2,4,5-Trichlorophenol	mg/kg	610*	9	*NA*	---		0.13	U	0.13	U	0.13	U	0.14	U	0.14	U	0.14	U	0.13	U
2,4,6-Trichlorophenol	mg/kg	6.1*	4	*NA*	---		0.13	U	0.13	U	0.13	U	0.14	U	0.14	U	0.14	U	0.13	U
2,4-Dichlorophenol	mg/kg	18*	87.5	*NA*	---		0.12	U	0.12	U	0.12	U	0.13	U	0.13	U	0.13	U	0.12	U
2,4-Dimethylphenol	mg/kg	120*	0.01	*NA*	---		0.1	U	0.1	U	0.1	U	0.1	U	0.11	U	0.11	U	0.1	U
2,4-Dinitrophenol	mg/kg	12*	20	*NA*	---		0.7	U	0.7	U	0.7	U	0.73	U	0.74	U	0.74	U	0.71	U
2,4-Dinitrotoluene	mg/kg	0.753	1.28	*NA*	---		0.024	U	0.024	U	0.024	U	0.025	U	0.026	U	0.026	U	0.025	U
2,6-Dinitrotoluene	mg/kg	0.769	0.0328	*NA*	---		0.024	U	0.024	U	0.024	U	0.025	U	0.026	U	0.026	U	0.025	U
2-Chloronaphthalene	mg/kg	630*	0.0122	*NA*	---		0.023	U	0.023	U	0.023	U	0.024	U	0.025	U	0.025	U	0.024	U
2-Chlorophenol	mg/kg	39*	0.243	*NA*	---		0.35	U	0.35	U	0.35	U	0.36	U	0.37	U	0.36	U	0.35	U
2-Methylnaphthalene	mg/kg	30.6	3.24	*NA*	---		0.025	U	**0.37**	**J**	**0.32**	**J**	**0.23**	**J**	**0.35**	**J**	**0.48**		**0.41**	
2-Nitroaniline	mg/kg	61*	74.1	*NA*	---		0.023	U	0.023	U	0.023	U	0.024	U	0.025	U	0.025	U	0.024	U
2-Nitrophenol	mg/kg	TBC	1.6	*NA*	---		0.29	U	0.28	U	0.29	U	0.3	U	0.3	U	0.3	U	0.29	U
3,3'-Dichlorobenzidine	mg/kg	1.1*	0.646	*NA*	---		0.15	UJ	0.15	U	0.15	U	0.16	U	0.16	U	0.16	U	0.16	U
3-Nitroaniline	mg/kg	TBC	3.16	*NA*	---		0.022	U	0.022	U	0.022	U	0.023	U	0.024	U	0.023	U	0.023	U
4,6-Dinitro-2-Methylphenol	mg/kg	0.49*	0.144	*NA*	---		0.28	UJ	0.27	U	0.28	U	0.29	U	0.29	U	0.29	U	0.28	U
4-Bromophenyl Phenyl Ether	mg/kg	TBC	NA	*NA*	---		0.025	U	0.025	U	0.025	U	0.026	U	0.027	U	0.027	U	0.026	U
4-Chloro-3-Methylphenol	mg/kg	610*	7.95	*NA*	---		0.39	U	0.39	U	0.39	U	0.4	U	0.41	U	0.41	U	0.39	U
4-Chloroaniline	mg/kg	2.4*	1.1	*NA*	---		0.04	UJ	0.04	U	0.04	U	0.041	U	0.042	U	0.042	U	0.04	U
4-Chlorophenyl Phenyl Ether	mg/kg	TBC	NA	*NA*	---		0.027	U	0.026	U	0.027	U	0.028	U	0.028	U	0.028	U	0.027	U
4-Nitrobenzenamine	mg/kg	TBC	TBC	*NA*	---		0.031	U	0.031	U	0.031	U	0.032	U	0.032	U	0.032	U	0.031	U
4-Nitrophenol	mg/kg	61.2	7	*NA*	---		0.41	U	0.41	U	0.41	U	0.42	U	0.43	U	0.43	U	0.41	U
Acenaphthene	mg/kg	340*	29	*NA*	---		0.024	U	**0.043**	**J**	**0.034**	**J**	**0.44**		**0.34**	**J**	**0.074**	**J**	0.025	U
Acenaphthylene	mg/kg	340[e]*	29	*NA*	---		0.024	U	**0.16**	**J**	**0.043**	**J**	**0.056**	**J**	**0.13**	**J**	**0.087**	**J**	0.025	U
Anthracene	mg/kg	1,700*	29	*NA*	---		0.024	U	**0.3**	**J**	**0.12**	**J**	**1.1**		**1.1**		**0.32**	**J**	**0.056**	**J**
Benzo(a)anthracene	mg/kg	0.221	1.1	*NA*	---		**0.046**	**J**	**0.74**		**0.38**	**J**	**1.8**		**2.6**		**0.89**		**0.18**	**J**
Benzo(a)pyrene	mg/kg	0.022	1.1	*NA*	---		**0.045**	**J**	**0.59**		**0.33**	**J**	**1.5**		**2.4**		**0.76**		**0.17**	**J**
Benzo(b)fluoranthene	mg/kg	0.221	1.1	*NA*	---		**0.072**	**J**	**1**		**0.58**		**2.3**		**4.8**		**1.7**		**0.33**	**J**
Benzo(ghi)perylene	mg/kg	170*	1.1	*NA*	---		0.022	U	**0.17**	**J**	**0.12**	**J**	**0.51**		**0.69**		**0.24**	**J**	**0.13**	**J**
Benzo(k)fluoranthene	mg/kg	2.21	1.1	*NA*	---		**0.042**	**J**	**0.33**	**J**	**0.18**	**J**	**0.68**		**1.4**		**0.76**		**0.13**	**J**
Benzoic Acid	mg/kg	24,000*	1	*NA*	---		0.3	U	0.3	U	0.3	U	**0.45**	**J**	**0.41**	**J**	**0.39**	**J**	0.3	U
Benzyl Alcohol	mg/kg	TBC	65.8	*NA*	---		0.085	UJ	0.084	U	0.085	U	0.088	U	0.089	U	0.088	U	0.086	U
Bis(2-Chloroethoxy)methane	mg/kg	23	0.302	*NA*	---		0.023	U	0.023	U	0.023	U	0.024	U	0.025	U	0.025	U	0.024	U
Bis(2-Chloroethyl)ether	mg/kg	0.21*	23.7	*NA*	---		0.025	U	0.025	U	0.025	U	0.026	U	0.027	U	0.027	U	0.026	U
Bis(2-Chloroisopropyl)ether	mg/kg	4.6*	19.9	*NA*	---		0.031	U	0.031	U	0.031	U	0.032	U	0.032	U	0.032	U	0.031	U

Table D-1
Phase I RI Surface Soil Analytical Data Summary
Sand Creek Disposal Road Landfill

				Location Code:	SCSS-057		SCSS-057		SCSS-058		SCSS-058		SCSS-059		SCSS-060		SCSS-061		SCSS-062	
				Sample Number:	SCSS-057D-0001-SO		SCSS-057M-0001-SO		SCSS-058M-0001-SO		SCSS-085M-0001-SO		SCSS-059M-0001-SO		SCSS-060M-0001-SO		SCSS-061M-0001-SO		SCSS-062M-0001-SO	
				Sample Date:	9/24/2010		9/24/2010		9/23/2010		9/23/2010		9/23/2010		9/23/2010		9/23/2010		9/22/2010	
				Depth:	0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft	
				Sample Purpose:	REG		REG		REG		FD		REG		REG		REG		REG	
		Screening Criteria																		
Parameter	Units	FWCUG[a]	ECOSV[b]	BSV	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Bis(2-Ethylhexyl)phthalate	mg/kg	35*	0.925	*NA*	---		0.089	U	0.089	U	0.089	U	**0.11**	**J**	0.093	U	0.093	U	0.09	U
Butyl Benzyl Phthalate	mg/kg	260*	0.239	*NA*	---		0.074	U	0.074	U	0.074	U	0.077	U	0.078	U	0.078	U	0.076	U
Carbazole	mg/kg	44.6	0.00008	*NA*	---		0.029	U	**0.078**	**J**	**0.069**	**J**	**0.61**		**0.59**		**0.12**	**J**	**0.045**	**J**
Chrysene	mg/kg	22.1	1.1	*NA*	---		**0.049**	**J**	**0.7**		**0.36**	**J**	**1.6**		**2.7**		**0.97**		**0.22**	**J**
Cresols (Total)	mg/kg	610*	TBC	*NA*	---		0.66	U	0.66	U	0.66	U	0.69	U	0.7	U	0.69	U	0.67	U
Dibenzo(a,h)anthracene	mg/kg	0.022	1.1	*NA*	---		0.022	U	**0.075**	**J**	**0.05**	**J**	**0.17**	**J**	**0.28**	**J**	**0.11**	**J**	0.023	U
Dibenzofuran	mg/kg	15.3	6.1	*NA*	---		0.024	U	**0.14**	**J**	**0.086**	**J**	**0.3**	**J**	**0.33**	**J**	**0.16**	**J**	**0.089**	**J**
Diethyl Phthalate	mg/kg	4,900*	100	*NA*	---		0.065	U	0.065	U	0.065	U	0.068	U	0.069	U	0.068	U	0.066	U
Dimethyl Phthalate	mg/kg	TBC	734	*NA*	---		0.064	U	0.064	U	0.064	U	0.067	U	0.068	U	0.067	U	0.065	U
Di-n-Butyl Phthalate	mg/kg	610*	200	*NA*	---		**0.17**	**J**	**0.12**	**J**	**0.13**	**J**	**0.18**	**J**	**0.47**		**0.3**	**J**	**0.14**	**J**
Di-n-Octyl Phthalate	mg/kg	TBC	709	*NA*	---		0.06	U	0.06	U	0.06	U	0.063	U	0.063	U	0.063	U	0.061	U
Fluoranthene	mg/kg	163	29	*NA*	---		**0.078**	**J**	**1.8**		**0.8**		**3.8**		**4.3**		**1.4**		**0.33**	**J**
Fluorene	mg/kg	243	29	*NA*	---		0.025	U	**0.19**	**J**	**0.046**	**J**	**0.46**		**0.47**		**0.079**	**J**	0.026	U
Hexachlorobenzene	mg/kg	0.3*	0.199	*NA*	---		0.029	U	0.028	U	0.029	U	0.03	U	0.03	U	0.03	U	0.029	U
Hexachlorobutadiene	mg/kg	6.1*	0.0398	*NA*	---		0.063	U	0.063	U	0.063	U	0.066	U	0.067	U	0.066	U	0.064	U
Hexachlorocyclopentadiene	mg/kg	37*	10	*NA*	---		0.053	UJ	0.053	U	0.053	U	0.055	U	0.056	U	0.055	U	0.054	U
Hexachloroethane	mg/kg	6.1*	0.596	*NA*	---		0.034	U	0.034	U	0.034	U	0.035	U	0.035	U	0.035	U	0.034	U
Indeno(1,2,3-cd)pyrene	mg/kg	0.221	1.1	*NA*	---		0.023	U	**0.18**	**J**	**0.1**	**J**	**0.54**		**0.81**		**0.27**	**J**	**0.11**	**J**
Isophorone	mg/kg	510*	139	*NA*	---		0.051	U	**0.11**	**J**	**0.079**	**J**	0.053	U	0.054	U	0.053	U	**0.13**	**J**
Naphthalene	mg/kg	122	29	*NA*	---		0.021	U	**0.24**	**J**	**0.2**	**J**	**0.22**	**J**	**0.32**	**J**	**0.31**	**J**	**0.25**	**J**
Nitrobenzene	mg/kg	0.48	1.31	*NA*	---		0.06	U	0.06	U	0.06	U	0.063	U	0.063	U	0.063	U	0.061	U
N-Nitroso-di-n-Propylamine	mg/kg	0.12	0.544	*NA*	---		0.071	U	0.071	U	0.071	U	0.074	U	0.075	U	0.075	U	0.073	U
N-Nitrosodiphenylamine	mg/kg	99*	0.545	*NA*	---		0.051	U	0.051	U	0.051	U	0.053	U	0.054	U	0.053	U	0.052	U
o-Cresol	mg/kg	390	TBC	*NA*	---		0.43	U	0.43	U	0.43	U	**0.45**		0.45	U	0.45	U	0.44	U
Pentachlorophenol	mg/kg	2.12	2.1	*NA*	---		0.24	UJ	0.24	U	0.24	U	0.25	U	**0.52**	**J**	**0.4**	**J**	0.25	U
Phenanthrene	mg/kg	NA	29	*NA*	---		**0.033**	**J**	1.2		**0.52**		**3.4**		**3.1**		**0.69**		**0.29**	**J**
Phenol	mg/kg	1,800*	30	*NA*	---		0.16	U	0.16	U	0.16	U	0.17	U	0.17	U	0.17	U	0.17	U
Pyrene	mg/kg	122	1.1	*NA*	---		**0.063**	**J**	**1.3**		**0.68**		**3**		**4**		**1.5**		**0.28**	**J**
Volatile Organic Compounds																				
1,1,1-Trichloroethane	mg/kg	870*	TBC	*NA*	0.013	U	---		---		---		---		---		---		---	
1,1,2,2-Tetrachloroethane	mg/kg	0.056*	TBC	*NA*	0.0079	U	---		---		---		---		---		---		---	
1,1,2-Trichloroethane	mg/kg	0.11*	TBC	*NA*	0.011	U	---		---		---		---		---		---		---	
1,1-Dichloroethane	mg/kg	0.33*	TBC	*NA*	0.015	U	---		---		---		---		---		---		---	
1,1-Dichloroethylene	mg/kg	24*	TBC	*NA*	0.021	U	---		---		---		---		---		---		---	
1,2-Dibromoethane	mg/kg	0.0034*	TBC	*NA*	0.013	U	---		---		---		---		---		---		---	
1,2-Dichloroethane	mg/kg	0.043*	TBC	*NA*	0.016	U	---		---		---		---		---		---		---	
1,2-Dichloropropane	mg/kg	0.094*	TBC	*NA*	0.0093	U	---		---		---		---		---		---		---	
1,2-Dimethylbenzene	mg/kg	NA	TBC	*NA*	0.011	U	---		---		---		---		---		---		---	
2-Hexanone	mg/kg	21*	TBC	*NA*	0.09	U	---		---		---		---		---		---		---	
Acetone	mg/kg	6,100*	TBC	*NA*	0.083	U	---		---		---		---		---		---		---	

Table D-1
Phase I RI Surface Soil Analytical Data Summary
Sand Creek Disposal Road Landfill

				Location Code:	SCSS-057		SCSS-057		SCSS-058		SCSS-058		SCSS-059		SCSS-060		SCSS-061		SCSS-062	
				Sample Number:	SCSS-057D-0001-SO		SCSS-057M-0001-SO		SCSS-058M-0001-SO		SCSS-085M-0001-SO		SCSS-059M-0001-SO		SCSS-060M-0001-SO		SCSS-061M-0001-SO		SCSS-062M-0001-SO	
				Sample Date:	9/24/2010		9/24/2010		9/23/2010		9/23/2010		9/23/2010		9/23/2010		9/23/2010		9/22/2010	
				Depth:	0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft	
				Sample Purpose:	REG		REG		REG		FD		REG		REG		REG		REG	
		Screening Criteria																		
Parameter	Units	FWCUG[a]	ECOSV[b]	BSV	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Benzene	mg/kg	0.11*	TBC	*NA*	0.0066	U	---		---		---		---		---		---		---	
Bromochloromethane	mg/kg	16*	TBC	*NA*	0.011	U	---		---		---		---		---		---		---	
Bromodichloromethane	mg/kg	0.027*	TBC	*NA*	0.012	U	---		---		---		---		---		---		---	
Bromoform	mg/kg	6.2*	TBC	*NA*	0.0079	U	---		---		---		---		---		---		---	
Bromomethane	mg/kg	0.73*	TBC	*NA*	0.04	U	---		---		---		---		---		---		---	
Carbon Disulfide	mg/kg	82*	TBC	*NA*	0.02	U	---		---		---		---		---		---		---	
Carbon Tetrachloride	mg/kg	0.061*	TBC	*NA*	0.015	U	---		---		---		---		---		---		---	
Chlorobenzene	mg/kg	29*	TBC	*NA*	0.011	U	---		---		---		---		---		---		---	
Chloroethane	mg/kg	TBC	TBC	*NA*	0.025	U	---		---		---		---		---		---		---	
Chloroform	mg/kg	0.029*	TBC	*NA*	0.012	U	---		---		---		---		---		---		---	
Chloromethane	mg/kg	12*	TBC	*NA*	0.033	U	---		---		---		---		---		---		---	
cis-1,2-Dichloroethene	mg/kg	16*	TBC	*NA*	0.013	U	---		---		---		---		---		---		---	
cis-1,3-Dichloropropene	mg/kg	0.17*	TBC	*NA*	0.013	U	---		---		---		---		---		---		---	
Dibromochloromethane	mg/kg	0.068*	TBC	*NA*	0.011	U	---		---		---		---		---		---		---	
Ethylbenzene	mg/kg	5*	TBC	*NA*	0.011	U	---		---		---		---		---		---		---	
Methyl Ethyl Ketone	mg/kg	2,800*	TBC	*NA*	0.13	U	---		---		---		---		---		---		---	
Methyl Isobutyl Ketone	mg/kg	530*	TBC	*NA*	0.11	U	---		---		---		---		---		---		---	
Methylene Chloride	mg/kg	5.6*	TBC	*NA*	0.053	U	---		---		---		---		---		---		---	
Styrene	mg/kg	630*	TBC	*NA*	0.0079	U	---		---		---		---		---		---		---	
Tetrachloroethylene	mg/kg	2.2*	TBC	*NA*	0.011	U	---		---		---		---		---		---		---	
Toluene	mg/kg	500*	TBC	*NA*	0.0093	U	---		---		---		---		---		---		---	
trans-1,2-Dichloroethene	mg/kg	15*	TBC	*NA*	0.015	U	---		---		---		---		---		---		---	
trans-1,3-Dichloropropene	mg/kg	0.17*	TBC	*NA*	0.0093	U	---		---		---		---		---		---		---	
Trichloroethylene	mg/kg	0.091*	TBC	*NA*	0.013	U	---		---		---		---		---		---		---	
Vinyl Chloride	mg/kg	0.006*	TBC	*NA*	0.019	U	---		---		---		---		---		---		---	
Xylene, (Total)	mg/kg	63*	TBC	*NA*	0.024	U	---		---		---		---		---		---		---	

Table D-1
Phase I RI Surface Soil Analytical Data Summary
Sand Creek Disposal Road Landfill

				Location Code:	SCSS-063		SCSS-064		SCSS-065		SCSS-066		SCSS-067		SCSS-068		SCSS-068		SCSS-068	
				Sample Number:	SCSS-063M-0001-SO		SCSS-064M-0001-SO		SCSS-065M-0001-SO		SCSS-066M-0001-SO		SCSS-067M-0001-SO		SCSS-068D-0001-SO		SCSS-068M-0001-SO		SCSS-086D-0001-SO	
				Sample Date:	9/22/2010		9/22/2010		9/22/2010		9/22/2010		9/21/2010		9/21/2010		9/21/2010		9/21/2010	
				Depth:	0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft	
				Sample Purpose:	REG		REG		REG		REG		REG		REG		REG		FD	
		Screening Criteria																		
Parameter	Units	FWCUG[a]	ECOSV[b]	BSV	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
General Chemistry																				
Nitrocellulose	mg/kg	1.8E+07*	NA	*NA*	---		---		---		---		---		---		---		---	
Cyanide, Totalc	mg/kg	2.2[c]*	1.33	*0*	---		---		---		---		---		---		---		---	
Hexavalent Chromium	mg/kg	1.64	130	*0*	---		2	U	---		1.9	U	---		---		---		---	
Total Solids	Percent	NA	NA	*NA*	97.8		96.4		95.9		97.8		98		86		98.1		85.6	
Explosives and Propellants																				
1,3,5-Trinitrobenzene	mg/kg	220*	0.376	*NA*	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	---		0.13	U	---	
1,3-Dinitrobenzene	mg/kg	0.61*	0.655	*NA*	0.08	U	0.08	U	0.08	U	0.079	U	0.08	U	---		0.08	U	---	
2,4,6-Trinitrotoluene	mg/kg	3.65	6.4	*NA*	0.09	U	0.09	U	0.09	U	0.089	U	0.09	U	---		0.09	U	---	
2,4-Dinitrotoluene	mg/kg	1.1	1.28	*NA*	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	---		0.2	U	---	
2,6-Dinitrotoluene	mg/kg	6.1	0.0328	*NA*	0.07	U	0.07	U	0.07	U	0.069	U	0.07	U	---		0.07	U	---	
2-Amino-4,6-Dinitrotoluene	mg/kg	1.54	2.1	*NA*	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	---		0.05	U	---	
3,5-Dinitroaniline	mg/kg	TBC	NA	*NA*	0.09	U	0.09	U	0.09	U	0.089	U	0.09	U	---		0.09	U	---	
4-Amino-2,6-Dinitrotoluene	mg/kg	1.54	0.73	*NA*	0.07	U	0.07	U	0.07	U	0.069	U	0.07	U	---		0.07	U	---	
HMX	mg/kg	359	27	*NA*	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	---		0.12	U	---	
m-Nitrotoluene	mg/kg	2.9*	2	*NA*	0.07	U	0.07	U	0.07	U	0.069	U	0.07	U	---		0.07	U	---	
Nitrobenzene	mg/kg	4.8*	1.31	*NA*	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U	---		0.04	U	---	
Nitroglycerin	mg/kg	0.61*	71	*NA*	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	---		0.5	U	---	
Nitroguanidine	mg/kg	610*	NA	*NA*	---		---		---		---		---		---		---		---	
o-Nitrotoluene	mg/kg	0.61*	2.4	*NA*	0.09	U	0.09	U	0.09	U	0.089	U	0.09	U	---		0.09	U	---	
PETN	mg/kg	TBC	8,600	*NA*	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	---		0.5	U	---	
p-Nitrotoluene	mg/kg	24*	4.4	*NA*	0.07	U	0.07	U	0.07	U	0.069	U	0.07	U	---		0.07	U	---	
RDX	mg/kg	8.03	7.5	*NA*	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	---		0.16	U	---	
Tetryl	mg/kg	24.4	0.99	*NA*	0.09	U	0.09	U	0.09	U	0.089	U	0.09	U	---		0.09	U	---	
Metals																				
Aluminum	mg/kg	3,496	NA	*17,700*	11,100		16,700		12,500		13,000		10,700		NA		9,150		NA	
Antimony	mg/kg	2.82	0.27	*0.96*	**2.8**		0.75		0.083	U	0.082	U	0.082	U	NA		0.082	U	NA	
Arsenic	mg/kg	0.524	18	*15.4*	**16.2**		**11.9**		**10**		**12.8**		**10**		NA		**11.2**		NA	
Barium	mg/kg	351	330	*88.4*	**180**		**128**		67.3		58.8		48.5		NA		49.7		NA	
Beryllium	mg/kg	16*	21	*0.88*	**1**		0.64		0.57		0.69		0.48		NA		0.41		NA	
Cadmium	mg/kg	6.41	0.36	*0*	**2.8**		**0.69**		**0.12**		**0.41**		**0.071**		NA		**0.057**		NA	
Calcium	mg/kg	NA	NA	*15,800*	10,400		13,900		3,080		2,810		1,410		NA		1,650		NA	
Chromium (as Cr^{+3})	mg/kg	8,147	26	*17.4*	**39.9**		**187**		**30.8**		**38.6**		**24.7**		NA		**24.2**		NA	
Cobalt	mg/kg	19.9	13	*10.4*	8.2		8.3		9.3		10.2		8.7		NA		7.6		NA	
Copper	mg/kg	311	28	*17.7*	**95.5**		**726**		**21.4**		16.5		11.8		NA		11		NA	
Iron	mg/kg	2,313	NA	*23,100*	**30,200**		**26,900**		**27,400**		**26,300**		23,100		NA		22,500		NA	
Lead	mg/kg	400**	11	*26.1*	**109**		**131**		**37**		**37.1**		**35.5**		NA		**29.8**		NA	
Magnesium	mg/kg	NA	NA	*3,030*	2,900		**4,380**		**3,570**		**3,830**		2,880		NA		2,320		NA	
Manganese	mg/kg	35.1	220	*1,450*	707		674		451		383		316		NA		395		NA	
Mercury	mg/kg	2.27	0.00051	*0.036*	**0.55**		**0.078**		0.029		**0.07**		0.026		NA		0.031		NA	

Table D-1
Phase I RI Surface Soil Analytical Data Summary
Sand Creek Disposal Road Landfill

				Location Code:	SCSS-063		SCSS-064		SCSS-065		SCSS-066		SCSS-067		SCSS-068		SCSS-068		SCSS-068	
				Sample Number:	SCSS-063M-0001-SO		SCSS-064M-0001-SO		SCSS-065M-0001-SO		SCSS-066M-0001-SO		SCSS-067M-0001-SO		SCSS-068D-0001-SO		SCSS-068M-0001-SO		SCSS-086D-0001-SO	
				Sample Date:	9/22/2010		9/22/2010		9/22/2010		9/22/2010		9/21/2010		9/21/2010		9/21/2010		9/21/2010	
				Depth:	0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft	
				Sample Purpose:	REG		REG		REG		REG		REG		REG		REG		FD	
		Screening Criteria																		
Parameter	Units	FWCUG[a]	ECOSV[b]	BSV	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Nickel	mg/kg	155	38	*21.1*	**27.6**		**48.2**		**22**		**25.6**		**21.3**		NA		20.9		NA	
Potassium	mg/kg	NA	NA	*927*	810		**1,480**		**1,120**		**1,140**		821		NA		693		NA	
Selenium	mg/kg	39*	0.52	*1.4*	**1.9**		0.48		0.13		0.072	U	0.18	J	NA		0.24		NA	
Silver	mg/kg	38.6	4.2	*0*	**120**		**0.95**		**1.3**		0.017	U	0.017	U	NA		0.017	U	NA	
Sodium	mg/kg	NA	NA	*123*	70.6		**150**		36.5		39.1		22.1		NA		20.5		NA	
Thallium	mg/kg	0.612	1	*0*	**2.7**		**1.1**		**0.76**		**0.72**		**0.97**		NA		**0.62**		NA	
Vanadium	mg/kg	44.9	7.8	*31.1*	18.3		23.8		18.6		18.4		16.8		NA		14.8		NA	
Zinc	mg/kg	2,321	46	*61.8*	**303**		**235**		**68.8**		61.6		49.7		NA		48.2		NA	
Polychlorinated biphenyls																				
PCB-1016	mg/kg	0.203	0.371	*NA*	---		---		---		---		---		---		---		---	
PCB-1221	mg/kg	0.14*	0.371	*NA*	---		---		---		---		---		---		---		---	
PCB-1232	mg/kg	0.14*	0.371	*NA*	---		---		---		---		---		---		---		---	
PCB-1242	mg/kg	0.22*	0.371	*NA*	---		---		---		---		---		---		---		---	
PCB-1248	mg/kg	0.203	0.371	*NA*	---		---		---		---		---		---		---		---	
PCB-1254	mg/kg	0.12	0.371	*NA*	---		---		---		---		---		---		---		---	
PCB-1260	mg/kg	0.203	0.371	*NA*	---		---		---		---		---		---		---		---	
PCB-1262	mg/kg	0.203	0.371	*NA*	---		---		---		---		---		---		---		---	
PCB-1268	mg/kg	0.203	0.371	*NA*	---		---		---		---		---		---		---		---	
Pesticides																				
4,4'-DDD	mg/kg	0.2*	0.021	*NA*	---		---		---		---		---		---		---		---	
4,4'-DDE	mg/kg	2.63	TBC	*NA*	---		---		---		---		---		---		---		---	
4,4'-DDT	mg/kg	0.17*	0.21	*NA*	---		---		---		---		---		---		---		---	
Aldrin	mg/kg	0.053	TBC	*NA*	---		---		---		---		---		---		---		---	
alpha-BHC	mg/kg	0.077*	TBC	*NA*	---		---		---		---		---		---		---		---	
alpha-Chlordane	mg/kg	1.6*	0.0024	*NA*	---		---		---		---		---		---		---		---	
beta-BHC	mg/kg	0.77	TBC	*NA*	---		---		---		---		---		---		---		---	
Chlordane	mg/kg	0.16*	TBC	*NA*	---		---		---		---		---		---		---		---	
delta-BHC	mg/kg	0.27*	TBC	*NA*	---		---		---		---		---		---		---		---	
Dieldrin	mg/kg	0.056	TBC	*NA*	---		---		---		---		---		---		---		---	
Endosulfan I	mg/kg	37*	TBC	*NA*	---		---		---		---		---		---		---		---	
Endosulfan II	mg/kg	37*	TBC	*NA*	---		---		---		---		---		---		---		---	
Endosulfan Sulfate	mg/kg	TBC	TBC	*NA*	---		---		---		---		---		---		---		---	
Endrin	mg/kg	1.12	TBC	*NA*	---		---		---		---		---		---		---		---	
Endrin Aldehyde	mg/kg	TBC	TBC	*NA*	---		---		---		---		---		---		---		---	
Endrin Ketone	mg/kg	TBC	TBC	*NA*	---		---		---		---		---		---		---		---	
gamma-Chlordane	mg/kg	TBC	TBC	*NA*	---		---		---		---		---		---		---		---	
Heptachlor	mg/kg	0.198	0.00598	*NA*	---		---		---		---		---		---		---		---	
Heptachlor Epoxide	mg/kg	0.098	TBC	*NA*	---		---		---		---		---		---		---		---	
Lindane	mg/kg	0.198	0.005	*NA*	---		---		---		---		---		---		---		---	
Methoxychlor	mg/kg	31*	0.0199	*NA*	---		---		---		---		---		---		---		---	

Table D-1
Phase I RI Surface Soil Analytical Data Summary
Sand Creek Disposal Road Landfill

Location Code:					SCSS-063		SCSS-064		SCSS-065		SCSS-066		SCSS-067		SCSS-068		SCSS-068		SCSS-068	
Sample Number:					SCSS-063M-0001-SO		SCSS-064M-0001-SO		SCSS-065M-0001-SO		SCSS-066M-0001-SO		SCSS-067M-0001-SO		SCSS-068D-0001-SO		SCSS-068M-0001-SO		SCSS-086D-0001-SO	
Sample Date:					9/22/2010		9/22/2010		9/22/2010		9/22/2010		9/21/2010		9/21/2010		9/21/2010		9/21/2010	
Depth:					0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft	
Sample Purpose:					REG		REG		REG		REG		REG		REG		REG		FD	
		Screening Criteria																		
Parameter	Units	FWCUG[a]	ECOSV[b]	BSV	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Toxaphene	mg/kg	0.044*	TBC	*NA*	---		---		---		---		---		---		---		---	
Semivolatile Organic Compounds																				
1,2,4-Trichlorobenzene	mg/kg	6.2*	20	*NA*	0.022	U	0.022	U	0.022	U	0.022	U	0.021	U	NA		0.021	U	NA	
1,2-Dichlorobenzene	mg/kg	190*	2.96	*NA*	**0.05**	**J**	0.025	U	0.025	U	0.025	U	0.025	U	NA		0.024	U	NA	
1,3-Dichlorobenzene	mg/kg	2.4[d]*	37.7	*NA*	0.021	U	0.021	U	0.021	U	0.021	U	0.02	U	NA		0.02	U	NA	
1,4-Dichlorobenzene	mg/kg	2.4*	20	*NA*	**0.047**	**J**	0.02	U	0.02	U	0.02	U	0.019	U	NA		0.019	U	NA	
2,4,5-Trichlorophenol	mg/kg	610*	9	*NA*	0.13	U	0.13	U	0.14	U	0.13	U	0.13	U	NA		0.13	U	NA	
2,4,6-Trichlorophenol	mg/kg	6.1*	4	*NA*	0.13	U	0.13	U	0.14	U	0.13	U	0.13	U	NA		0.13	U	NA	
2,4-Dichlorophenol	mg/kg	18*	87.5	*NA*	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	NA		0.12	U	NA	
2,4-Dimethylphenol	mg/kg	120*	0.01	*NA*	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	NA		0.1	U	NA	
2,4-Dinitrophenol	mg/kg	12*	20	*NA*	0.71	U	0.72	U	0.72	U	0.71	U	0.71	U	NA		0.7	U	NA	
2,4-Dinitrotoluene	mg/kg	0.753	1.28	*NA*	0.025	U	0.025	U	0.025	U	0.025	U	0.025	U	NA		0.024	U	NA	
2,6-Dinitrotoluene	mg/kg	0.769	0.0328	*NA*	0.025	U	0.025	U	0.025	U	0.025	U	0.025	U	NA		0.024	U	NA	
2-Chloronaphthalene	mg/kg	630*	0.0122	*NA*	0.024	U	0.024	U	0.024	U	0.024	U	0.024	U	NA		0.023	U	NA	
2-Chlorophenol	mg/kg	39*	0.243	*NA*	0.35	U	0.35	U	0.35	U	0.35	U	0.35	U	NA		0.34	U	NA	
2-Methylnaphthalene	mg/kg	30.6	3.24	*NA*	**0.48**		**0.096**	**J**	0.026	U	0.026	U	0.026	U	NA		0.025	U	NA	
2-Nitroaniline	mg/kg	61*	74.1	*NA*	0.024	U	0.024	U	0.024	U	0.024	U	0.024	U	NA		0.023	U	NA	
2-Nitrophenol	mg/kg	TBC	1.6	*NA*	0.29	U	0.29	U	0.29	U	0.29	U	0.29	U	NA		0.28	U	NA	
3,3'-Dichlorobenzidine	mg/kg	1.1*	0.646	*NA*	0.15	U	0.16	U	0.16	U	0.15	U	0.15	U	NA		0.15	U	NA	
3-Nitroaniline	mg/kg	TBC	3.16	*NA*	0.023	U	0.023	U	0.023	U	0.023	U	0.022	U	NA		0.022	U	NA	
4,6-Dinitro-2-Methylphenol	mg/kg	0.49*	0.144	*NA*	0.28	U	0.28	U	0.28	U	0.28	U	0.28	U	NA		0.27	U	NA	
4-Bromophenyl Phenyl Ether	mg/kg	TBC	NA	*NA*	0.026	U	0.026	U	0.026	U	0.026	U	0.026	U	NA		0.025	U	NA	
4-Chloro-3-Methylphenol	mg/kg	610*	7.95	*NA*	0.39	U	0.39	U	0.4	U	0.39	U	0.39	U	NA		0.39	U	NA	
4-Chloroaniline	mg/kg	2.4*	1.1	*NA*	0.04	U	0.04	U	0.041	U	0.04	U	0.04	U	NA		0.04	U	NA	
4-Chlorophenyl Phenyl Ether	mg/kg	TBC	NA	*NA*	0.027	U	0.027	U	0.027	U	0.027	U	0.027	U	NA		0.026	U	NA	
4-Nitrobenzenamine	mg/kg	TBC	TBC	*NA*	0.031	U	0.031	U	0.031	U	0.031	U	0.031	U	NA		0.03	U	NA	
4-Nitrophenol	mg/kg	61.2	7	*NA*	0.41	U	0.41	U	0.42	U	0.41	U	0.41	U	NA		0.41	U	NA	
Acenaphthene	mg/kg	340*	29	*NA*	**0.047**	**J**	0.025	U	0.025	U	0.025	U	0.025	U	NA		0.024	U	NA	
Acenaphthylene	mg/kg	340[e]*	29	*NA*	**0.033**	**J**	0.025	U	**0.11**	**J**	0.025	U	0.025	U	NA		0.024	U	NA	
Anthracene	mg/kg	1,700*	29	*NA*	**0.16**	**J**	**0.026**	**J**	**0.23**	**J**	0.025	U	0.025	U	NA		0.024	U	NA	
Benzo(a)anthracene	mg/kg	0.221	1.1	*NA*	**0.59**		**0.078**	**J**	**0.79**		0.026	U	0.026	U	NA		0.025	U	NA	
Benzo(a)pyrene	mg/kg	0.022	1.1	*NA*	**0.53**		**0.078**	**J**	**0.61**		0.024	U	0.024	U	NA		0.023	U	NA	
Benzo(b)fluoranthene	mg/kg	0.221	1.1	*NA*	**0.77**		**0.12**	**J**	**1**		0.026	U	0.026	U	NA		0.025	U	NA	
Benzo(ghi)perylene	mg/kg	170*	1.1	*NA*	**0.36**	**J**	**0.066**	**J**	**0.3**	**J**	0.023	U	0.022	U	NA		0.022	U	NA	
Benzo(k)fluoranthene	mg/kg	2.21	1.1	*NA*	**0.3**	**J**	**0.045**	**J**	**0.29**	**J**	0.026	U	0.026	U	NA		0.025	U	NA	
Benzoic Acid	mg/kg	24,000*	1	*NA*	0.3	U	0.3	U	**0.57**	**J**	0.3	U	0.3	U	NA		0.29	U	NA	
Benzyl Alcohol	mg/kg	TBC	65.8	*NA*	0.085	U	0.086	U	0.086	U	0.085	U	0.085	U	NA		0.084	U	NA	
Bis(2-Chloroethoxy)methane	mg/kg	23	0.302	*NA*	0.024	U	0.024	U	0.024	U	0.024	U	0.024	U	NA		0.023	U	NA	
Bis(2-Chloroethyl)ether	mg/kg	0.21*	23.7	*NA*	0.026	U	0.026	U	0.026	U	0.026	U	0.026	U	NA		0.025	U	NA	
Bis(2-Chloroisopropyl)ether	mg/kg	4.6*	19.9	*NA*	0.031	U	0.031	U	0.031	U	0.031	U	0.031	U	NA		0.03	U	NA	

Table D-1
Phase I RI Surface Soil Analytical Data Summary
Sand Creek Disposal Road Landfill

				Location Code:	SCSS-063		SCSS-064		SCSS-065		SCSS-066		SCSS-067		SCSS-068		SCSS-068		SCSS-068	
				Sample Number:	SCSS-063M-0001-SO		SCSS-064M-0001-SO		SCSS-065M-0001-SO		SCSS-066M-0001-SO		SCSS-067M-0001-SO		SCSS-068D-0001-SO		SCSS-068M-0001-SO		SCSS-086D-0001-SO	
				Sample Date:	9/22/2010		9/22/2010		9/22/2010		9/22/2010		9/21/2010		9/21/2010		9/21/2010		9/21/2010	
				Depth:	0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft	
				Sample Purpose:	REG		REG		REG		REG		REG		REG		REG		FD	
		Screening Criteria																		
Parameter	Units	FWCUG[a]	ECOSV[b]	BSV	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Bis(2-Ethylhexyl)phthalate	mg/kg	35*	0.925	NA	0.089	U	0.09	U	0.091	U	0.089	U	0.089	U	NA		**0.1**	**J**	NA	
Butyl Benzyl Phthalate	mg/kg	260*	0.239	NA	0.075	U	0.076	U	0.076	U	0.075	U	0.075	U	NA		0.074	U	NA	
Carbazole	mg/kg	44.6	0.00008	NA	**0.1**	**J**	0.029	U	**0.034**	**J**	0.029	U	0.029	U	NA		0.028	U	NA	
Chrysene	mg/kg	22.1	1.1	NA	**0.57**		**0.1**	**J**	**0.76**		0.026	U	0.026	U	NA		0.025	U	NA	
Cresols (Total)	mg/kg	610*	TBC	NA	0.67	U	0.67	U	0.68	U	0.67	U	0.66	U	NA		0.66	U	NA	
Dibenzo(a,h)anthracene	mg/kg	0.022	1.1	NA	**0.097**	**J**	0.023	U	0.023	U	0.023	U	0.022	U	NA		0.022	U	NA	
Dibenzofuran	mg/kg	15.3	6.1	NA	**0.12**	**J**	**0.027**	**J**	**0.037**	**J**	0.025	U	0.025	U	NA		0.024	U	NA	
Diethyl Phthalate	mg/kg	4,900*	100	NA	0.066	U	0.066	U	0.067	U	0.066	U	0.065	U	NA		0.065	U	NA	
Dimethyl Phthalate	mg/kg	TBC	734	NA	0.065	U	0.065	U	0.066	U	0.065	U	0.064	U	NA		0.064	U	NA	
Di-n-Butyl Phthalate	mg/kg	610*	200	NA	**0.22**	**J**	**0.12**	**J**	**0.082**	**J**	0.081	U	**0.093**	**J**	NA		0.088	J	NA	
Di-n-Octyl Phthalate	mg/kg	TBC	709	NA	0.061	U	0.061	U	0.061	U	0.061	U	0.06	U	NA		0.06	U	NA	
Fluoranthene	mg/kg	163	29	NA	**1.4**		**0.17**	**J**	**1.7**		**0.04**	**J**	0.027	U	NA		0.026	U	NA	
Fluorene	mg/kg	243	29	NA	**0.051**	**J**	0.026	U	**0.059**	**J**	0.026	U	0.026	U	NA		0.025	U	NA	
Hexachlorobenzene	mg/kg	0.3*	0.199	NA	0.029	U	0.029	U	0.029	U	0.029	U	0.029	U	NA		0.028	U	NA	
Hexachlorobutadiene	mg/kg	6.1*	0.0398	NA	0.064	U	0.064	U	0.065	U	0.064	U	0.063	U	NA		0.063	U	NA	
Hexachlorocyclopentadiene	mg/kg	37*	10	NA	0.053	U	0.054	U	0.054	U	0.053	U	0.053	U	NA		0.053	U	NA	
Hexachloroethane	mg/kg	6.1*	0.596	NA	0.034	U	0.034	U	0.034	U	0.034	U	0.034	U	NA		0.033	U	NA	
Indeno(1,2,3-cd)pyrene	mg/kg	0.221	1.1	NA	**0.33**	**J**	**0.055**	**J**	**0.34**	**J**	0.024	U	0.024	U	NA		0.023	U	NA	
Isophorone	mg/kg	510*	139	NA	**0.2**	**J**	**0.13**	**J**	0.052	U	**0.07**	**J**	0.051	U	NA		**0.051**	**J**	NA	
Naphthalene	mg/kg	122	29	NA	**0.33**	**J**	**0.063**	**J**	**0.029**	**J**	0.022	U	0.021	U	NA		0.021	U	NA	
Nitrobenzene	mg/kg	0.48	1.31	NA	0.061	U	0.061	U	0.061	U	0.061	U	0.06	U	NA		0.06	U	NA	
N-Nitroso-di-n-Propylamine	mg/kg	0.12	0.544	NA	0.072	U	0.073	U	0.073	U	0.072	U	0.072	U	NA		0.071	U	NA	
N-Nitrosodiphenylamine	mg/kg	99*	0.545	NA	0.051	U	0.052	U	0.052	U	0.051	U	0.051	U	NA		0.051	U	NA	
o-Cresol	mg/kg	390	TBC	NA	0.43	U	0.44	U	0.44	U	0.43	U	0.43	U	NA		0.43	U	NA	
Pentachlorophenol	mg/kg	2.12	2.1	NA	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	NA		0.24	U	NA	
Phenanthrene	mg/kg	NA	29	NA	**0.74**		**0.16**	**J**	**0.78**		0.027	U	0.027	U	NA		0.026	U	NA	
Phenol	mg/kg	1,800*	30	NA	0.16	U	0.17	U	0.17	U	0.16	U	0.16	U	NA		0.16	U	NA	
Pyrene	mg/kg	122	1.1	NA	**1**		**0.16**	**J**	0.027	U	**0.035**	**J**	0.027	U	NA		0.026	U	NA	
Volatile Organic Compounds																				
1,1,1-Trichloroethane	mg/kg	870*	TBC	NA	---		---		---		---		---		0.011	U	---		0.012	U
1,1,2,2-Tetrachloroethane	mg/kg	0.056*	TBC	NA	---		---		---		---		---		0.0066	U	---		0.0073	U
1,1,2-Trichloroethane	mg/kg	0.11*	TBC	NA	---		---		---		---		---		0.0088	U	---		0.0097	U
1,1-Dichloroethane	mg/kg	0.33*	TBC	NA	---		---		---		---		---		0.012	U	---		0.013	U
1,1-Dichloroethylene	mg/kg	24*	TBC	NA	---		---		---		---		---		0.018	U	---		0.019	U
1,2-Dibromoethane	mg/kg	0.0034*	TBC	NA	---		---		---		---		---		0.011	U	---		0.012	U
1,2-Dichloroethane	mg/kg	0.043*	TBC	NA	---		---		---		---		---		0.013	U	---		0.015	U
1,2-Dichloropropane	mg/kg	0.094*	TBC	NA	---		---		---		---		---		0.0077	U	---		0.0085	U
1,2-Dimethylbenzene	mg/kg	NA	TBC	NA	---		---		---		---		---		0.0088	U	---		0.0097	U
2-Hexanone	mg/kg	21*	TBC	NA	---		---		---		---		---		0.075	U	---		0.082	U
Acetone	mg/kg	6,100*	TBC	NA	---		---		---		---		---		0.069	U	---		0.076	U

Table D-1
Phase I RI Surface Soil Analytical Data Summary
Sand Creek Disposal Road Landfill

				Location Code:	SCSS-063		SCSS-064		SCSS-065		SCSS-066		SCSS-067		SCSS-068		SCSS-068		SCSS-068	
				Sample Number:	SCSS-063M-0001-SO		SCSS-064M-0001-SO		SCSS-065M-0001-SO		SCSS-066M-0001-SO		SCSS-067M-0001-SO		SCSS-068D-0001-SO		SCSS-068M-0001-SO		SCSS-086D-0001-SO	
				Sample Date:	9/22/2010		9/22/2010		9/22/2010		9/22/2010		9/21/2010		9/21/2010		9/21/2010		9/21/2010	
				Depth:	0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft	
				Sample Purpose:	REG		REG		REG		REG		REG		REG		REG		FD	
		Screening Criteria																		
Parameter	Units	FWCUG[a]	ECOSV[b]	BSV	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Benzene	mg/kg	0.11*	TBC	*NA*	---		---		---		---		---		0.0055	U	---		0.0061	U
Bromochloromethane	mg/kg	16*	TBC	*NA*	---		---		---		---		---		0.0088	U	---		0.0097	U
Bromodichloromethane	mg/kg	0.027*	TBC	*NA*	---		---		---		---		---		0.0099	U	---		0.011	U
Bromoform	mg/kg	6.2*	TBC	*NA*	---		---		---		---		---		0.0066	U	---		0.0073	U
Bromomethane	mg/kg	0.73*	TBC	*NA*	---		---		---		---		---		0.033	U	---		0.036	U
Carbon Disulfide	mg/kg	82*	TBC	*NA*	---		---		---		---		---		0.016	U	---		0.018	U
Carbon Tetrachloride	mg/kg	0.061*	TBC	*NA*	---		---		---		---		---		0.012	U	---		0.013	U
Chlorobenzene	mg/kg	29*	TBC	*NA*	---		---		---		---		---		0.0088	U	---		0.0097	U
Chloroethane	mg/kg	TBC	TBC	*NA*	---		---		---		---		---		0.021	U	---		0.023	U
Chloroform	mg/kg	0.029*	TBC	*NA*	---		---		---		---		---		0.0099	U	---		0.011	U
Chloromethane	mg/kg	12*	TBC	*NA*	---		---		---		---		---		0.027	U	---		0.03	U
cis-1,2-Dichloroethene	mg/kg	16*	TBC	*NA*	---		---		---		---		---		0.011	U	---		0.012	U
cis-1,3-Dichloropropene	mg/kg	0.17*	TBC	*NA*	---		---		---		---		---		0.011	U	---		0.012	U
Dibromochloromethane	mg/kg	0.068*	TBC	*NA*	---		---		---		---		---		0.0088	U	---		0.0097	U
Ethylbenzene	mg/kg	5*	TBC	*NA*	---		---		---		---		---		0.0088	U	---		0.0097	U
Methyl Ethyl Ketone	mg/kg	2,800*	TBC	*NA*	---		---		---		---		---		0.11	U	---		0.12	U
Methyl Isobutyl Ketone	mg/kg	530*	TBC	*NA*	---		---		---		---		---		0.09	U	---		0.099	U
Methylene Chloride	mg/kg	5.6*	TBC	*NA*	---		---		---		---		---		0.044	U	---		0.049	U
Styrene	mg/kg	630*	TBC	*NA*	---		---		---		---		---		0.0066	U	---		0.0073	U
Tetrachloroethylene	mg/kg	2.2*	TBC	*NA*	---		---		---		---		---		0.0088	U	---		0.0097	U
Toluene	mg/kg	500*	TBC	*NA*	---		---		---		---		---		0.0077	U	---		0.0085	U
trans-1,2-Dichloroethene	mg/kg	15*	TBC	*NA*	---		---		---		---		---		0.012	U	---		0.013	U
trans-1,3-Dichloropropene	mg/kg	0.17*	TBC	*NA*	---		---		---		---		---		0.0077	U	---		0.0085	U
Trichloroethylene	mg/kg	0.091*	TBC	*NA*	---		---		---		---		---		0.011	U	---		0.012	U
Vinyl Chloride	mg/kg	0.006*	TBC	*NA*	---		---		---		---		---		0.015	U	---		0.017	U
Xylene, (Total)	mg/kg	63*	TBC	*NA*	---		---		---		---		---		0.02	U	---		0.022	U

Table D-1
Phase I RI Surface Soil Analytical Data Summary
Sand Creek Disposal Road Landfill

				Location Code:	SCSS-068		SCSS-069		SCSS-072		SCSS-073		SCSS-073		SCSS-074		SCSS-075		SCSS-076	
				Sample Number:	SCSS-086M-0001-SO		SCSS-069M-0001-SO		SCSS-072M-0001-SO		SCSS-073M-0001-SO		SCSS-087M-0001-SO		SCSS-074M-0001-SO		SCSS-075M-0001-SO		SCSS-076M-0001-SO	
				Sample Date:	9/21/2010		9/24/2010		11/9/2010		11/9/2010		11/9/2010		11/9/2010		11/9/2010		11/9/2010	
				Depth:	0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft	
				Sample Purpose:	FD		REG		REG		REG		FD		REG		REG		REG	
		Screening Criteria																		
Parameter	Units	FWCUG[a]	ECOSV[b]	BSV	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
General Chemistry																				
Nitrocellulose	mg/kg	1.8E+07*	NA	*NA*	---		---		---		---		---		---		---		13	UJ
Cyanide, Totalc	mg/kg	2.2[c]*	1.33	*0*	---		---		---		---		---		---		---		**0.39**	**J**
Hexavalent Chromium	mg/kg	1.64	130	*0*	---		---		---		---		---		---		---		---	
Total Solids	Percent	NA	NA	*NA*	98.5		97.3		98.4		98.1		98.1		97.8		98.2		97.6	
Explosives and Propellants																				
1,3,5-Trinitrobenzene	mg/kg	220*	0.376	*NA*	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U
1,3-Dinitrobenzene	mg/kg	0.61*	0.655	*NA*	0.08	U	0.08	U	0.08	U	0.081	U	0.079	U	0.08	U	0.08	U	0.08	U
2,4,6-Trinitrotoluene	mg/kg	3.65	6.4	*NA*	0.09	U	**3.9**		0.09	U	0.091	U	0.089	U	0.09	U	0.091	U	0.091	U
2,4-Dinitrotoluene	mg/kg	1.1	1.28	*NA*	0.2	U	**0.2**	**U**	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
2,6-Dinitrotoluene	mg/kg	6.1	0.0328	*NA*	0.07	U	0.07	U	0.07	U	0.07	U	0.069	U	0.07	U	0.07	U	0.07	U
2-Amino-4,6-Dinitrotoluene	mg/kg	1.54	2.1	*NA*	0.05	U	0.26	J	0.05	U	0.05	U	0.049	U	0.05	U	0.05	U	0.05	U
3,5-Dinitroaniline	mg/kg	TBC	NA	*NA*	0.09	U	0.09	U	0.09	U	0.091	U	0.089	U	0.09	U	0.091	U	0.091	U
4-Amino-2,6-Dinitrotoluene	mg/kg	1.54	0.73	*NA*	0.07	U	0.07	U	0.07	U	0.07	U	0.069	U	0.07	U	0.07	U	0.07	U
HMX	mg/kg	359	27	*NA*	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U
m-Nitrotoluene	mg/kg	2.9*	2	*NA*	0.07	U	0.07	U	0.07	U	0.07	U	0.069	U	0.07	U	0.07	U	0.07	U
Nitrobenzene	mg/kg	4.8*	1.31	*NA*	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U
Nitroglycerin	mg/kg	0.61*	71	*NA*	0.5	U	0.5	U	0.5	U	0.5	U	0.49	U	0.5	U	0.5	U	0.5	U
Nitroguanidine	mg/kg	610*	NA	*NA*	---		---		---		---		---		---		---		0.059	UJ
o-Nitrotoluene	mg/kg	0.61*	2.4	*NA*	0.09	U	0.09	U	0.09	U	0.091	U	0.089	U	0.09	U	0.091	U	0.091	U
PETN	mg/kg	TBC	8,600	*NA*	0.5	U	0.5	U	0.5	U	0.5	U	0.49	U	0.5	U	0.5	U	0.5	U
p-Nitrotoluene	mg/kg	24*	4.4	*NA*	0.07	U	0.07	U	0.07	U	0.07	U	0.069	U	0.07	U	0.07	U	0.07	U
RDX	mg/kg	8.03	7.5	*NA*	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U
Tetryl	mg/kg	24.4	0.99	*NA*	0.09	U	0.09	U	0.09	U	0.091	U	0.089	U	0.09	U	0.091	U	0.091	U
Metals																				
Aluminum	mg/kg	3,496	NA	*17,700*	8,350		26		7,980		9,480		8,210		9,100		9,780		7,990	
Antimony	mg/kg	2.82	0.27	*0.96*	0.76		0.16	U	0.89		**2.9**		**2.2**		**1.4**		**1.3**		**3.1**	
Arsenic	mg/kg	0.524	18	*15.4*	8.6		0.27	U	14.5		**21.8**		**23**		**18.3**		12.4		10.3	
Barium	mg/kg	351	330	*88.4*	47		1.5		52.8		**94.3**		**91.7**		**96.1**		54.5		74.8	
Beryllium	mg/kg	16*	21	*0.88*	0.4		0.0082	U	0.51		0.77		0.72		0.78		0.54		0.48	
Cadmium	mg/kg	6.41	0.36	*0*	**0.039**		0.012	U	**0.3**		**0.63**		**0.58**		**1.6**		**0.85**		**0.65**	
Calcium	mg/kg	NA	NA	*15,800*	1,210		27		3,790		10,300		7,340		6,240		1,100		**18,500**	
Chromium (as Cr^{+3})	mg/kg	8,147	26	*17.4*	**116**		0.26		**32**		**130**		**86.1**		**88.4**		**81**		**188**	
Cobalt	mg/kg	19.9	13	*10.4*	6.8		0.031	U	9.9		**10.8**		**11.3**		**19.7**		9.9		8.7	
Copper	mg/kg	311	28	*17.7*	10.4		0.49		16.4		**24.3**		**26.2**		**67**		13.1		10.1	
Iron	mg/kg	2,313	NA	*23,100*	20,500		87		22,600		**24,800**		**23,300**		**25,400**		**24,100**		19,000	
Lead	mg/kg	400**	11	*26.1*	**29.2**		0.88		8.9		**50.3**		**61.2**		**140**		13.2		18.2	
Magnesium	mg/kg	NA	NA	*3,030*	1,980		7		2,970		**3,040**		2,710		2,540		2,470		1,750	
Manganese	mg/kg	35.1	220	*1,450*	350		2.2		356		576		520		471		256		661	
Mercury	mg/kg	2.27	0.00051	*0.036*	0.032		**0.061**		**0.063**		**0.27**		**0.21**		**0.13**		**0.054**		**0.049**	

Table D-1
Phase I RI Surface Soil Analytical Data Summary
Sand Creek Disposal Road Landfill

				Location Code:	SCSS-068		SCSS-069		SCSS-072		SCSS-073		SCSS-073		SCSS-074		SCSS-075		SCSS-076	
				Sample Number:	SCSS-086M-0001-SO		SCSS-069M-0001-SO		SCSS-072M-0001-SO		SCSS-073M-0001-SO		SCSS-087M-0001-SO		SCSS-074M-0001-SO		SCSS-075M-0001-SO		SCSS-076M-0001-SO	
				Sample Date:	9/21/2010		9/24/2010		11/9/2010		11/9/2010		11/9/2010		11/9/2010		11/9/2010		11/9/2010	
				Depth:	0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft	
				Sample Purpose:	FD		REG		REG		REG		FD		REG		REG		REG	
		Screening Criteria																		
Parameter	Units	FWCUG[a]	ECOSV[b]	BSV	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Nickel	mg/kg	155	38	*21.1*	**28.7**		0.083	J	**21.7**		**32.7**		**26.9**		**25.9**		**21.8**		**25.3**	
Potassium	mg/kg	NA	NA	*927*	850		**1,650**		**940**		**1,350**		**1,080**		1,130		878		845	
Selenium	mg/kg	39*	0.52	*1.4*	0.22	J	0.19	J	**1.6**		**2.4**		**2.2**		0.98		1.4		**2.2**	
Silver	mg/kg	38.6	4.2	*0*	0.035	U	**0.52**		**2.7**		**2**		**3**		**0.69**		**0.095**	**J**	**0.11**	
Sodium	mg/kg	NA	NA	*123*	36.8		74		45		101		79.8		83.8		35.4		68.1	
Thallium	mg/kg	0.612	1	*0*	**0.62**		**1.1**		0.081	U	0.082	U	**0.47**		**0.23**	**J**	**0.14**	**J**	**0.73**	
Vanadium	mg/kg	44.9	7.8	*31.1*	13.8		0.023	U	14.2		19.8		20.3		19.2		18.1		15.9	
Zinc	mg/kg	2,321	46	*61.8*	43.4		0.96		54.4		**86.1**		**86.1**		**147**		50.1		46.9	
Polychlorinated biphenyls																				
PCB-1016	mg/kg	0.203	0.371	*NA*	---		---		---		---		---		---		---		0.01	UJ
PCB-1221	mg/kg	0.14*	0.371	*NA*	---		---		---		---		---		---		---		0.02	UJ
PCB-1232	mg/kg	0.14*	0.371	*NA*	---		---		---		---		---		---		---		0.028	UJ
PCB-1242	mg/kg	0.22*	0.371	*NA*	---		---		---		---		---		---		---		0.03	UJ
PCB-1248	mg/kg	0.203	0.371	*NA*	---		---		---		---		---		---		---		0.03	UJ
PCB-1254	mg/kg	0.12	0.371	*NA*	---		---		---		---		---		---		---		0.024	UJ
PCB-1260	mg/kg	0.203	0.371	*NA*	---		---		---		---		---		---		---		0.012	UJ
PCB-1262	mg/kg	0.203	0.371	*NA*	---		---		---		---		---		---		---		0.021	UJ
PCB-1268	mg/kg	0.203	0.371	*NA*	---		---		---		---		---		---		---		0.029	UJ
Pesticides																				
4,4'-DDD	mg/kg	0.2*	0.021	*NA*	---		---		---		---		---		---		---		**0.0023**	**J**
4,4'-DDE	mg/kg	2.63	TBC	*NA*	---		---		---		---		---		---		---		0.0003	UJ
4,4'-DDT	mg/kg	0.17*	0.21	*NA*	---		---		---		---		---		---		---		**0.0017**	**J**
Aldrin	mg/kg	0.053	TBC	*NA*	---		---		---		---		---		---		---		0.00051	UJ
alpha-BHC	mg/kg	0.077*	TBC	*NA*	---		---		---		---		---		---		---		0.00061	UJ
alpha-Chlordane	mg/kg	1.6*	0.0024	*NA*	---		---		---		---		---		---		---		**0.0015**	**J**
beta-BHC	mg/kg	0.77	TBC	*NA*	---		---		---		---		---		---		---		0.00061	UJ
Chlordane	mg/kg	0.16*	TBC	*NA*	---		---		---		---		---		---		---		0.0041	UJ
delta-BHC	mg/kg	0.27*	TBC	*NA*	---		---		---		---		---		---		---		0.0003	UJ
Dieldrin	mg/kg	0.056	TBC	*NA*	---		---		---		---		---		---		---		0.0003	UJ
Endosulfan I	mg/kg	37*	TBC	*NA*	---		---		---		---		---		---		---		0.00071	UJ
Endosulfan II	mg/kg	37*	TBC	*NA*	---		---		---		---		---		---		---		0.0003	UJ
Endosulfan Sulfate	mg/kg	TBC	TBC	*NA*	---		---		---		---		---		---		---		0.00091	UJ
Endrin	mg/kg	1.12	TBC	*NA*	---		---		---		---		---		---		---		0.00041	UJ
Endrin Aldehyde	mg/kg	TBC	TBC	*NA*	---		---		---		---		---		---		---		0.0011	UJ
Endrin Ketone	mg/kg	TBC	TBC	*NA*	---		---		---		---		---		---		---		0.00081	UJ
gamma-Chlordane	mg/kg	TBC	TBC	*NA*	---		---		---		---		---		---		---		0.0003	UJ
Heptachlor	mg/kg	0.198	0.00598	*NA*	---		---		---		---		---		---		---		**0.001**	**J**
Heptachlor Epoxide	mg/kg	0.098	TBC	*NA*	---		---		---		---		---		---		---		0.00051	UJ
Lindane	mg/kg	0.198	0.005	*NA*	---		---		---		---		---		---		---		**0.0013**	**J**
Methoxychlor	mg/kg	31*	0.0199	*NA*	---		---		---		---		---		---		---		**0.0016**	**J**

Table D-1
Phase I RI Surface Soil Analytical Data Summary
Sand Creek Disposal Road Landfill

				Location Code:	SCSS-068		SCSS-069		SCSS-072		SCSS-073		SCSS-073		SCSS-074		SCSS-075		SCSS-076	
				Sample Number:	SCSS-086M-0001-SO		SCSS-069M-0001-SO		SCSS-072M-0001-SO		SCSS-073M-0001-SO		SCSS-087M-0001-SO		SCSS-074M-0001-SO		SCSS-075M-0001-SO		SCSS-076M-0001-SO	
				Sample Date:	9/21/2010		9/24/2010		11/9/2010		11/9/2010		11/9/2010		11/9/2010		11/9/2010		11/9/2010	
				Depth:	0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft	
				Sample Purpose:	FD		REG		REG		REG		FD		REG		REG		REG	
		Screening Criteria																		
Parameter	Units	FWCUG[a]	ECOSV[b]	BSV	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Toxaphene	mg/kg	0.044*	TBC	*NA*	---		---		---		---		---		---		---		0.0051	UJ
Semivolatile Organic Compounds																				
1,2,4-Trichlorobenzene	mg/kg	6.2*	20	*NA*	0.021	U	0.022	U	0.021	U	0.021	U	0.021	U	0.021	U	0.021	U	**0.022**	
1,2-Dichlorobenzene	mg/kg	190*	2.96	*NA*	0.024	U	0.025	U	0.024	U	**0.039**	**J**	**0.1**	**J**	0.025	U	0.024	U	0.025	U
1,3-Dichlorobenzene	mg/kg	2.4[d]*	37.7	*NA*	0.02	U	0.021	U	0.02	U	0.02	U	**0.026**	**J**	0.02	U	0.02	U	0.021	U
1,4-Dichlorobenzene	mg/kg	2.4*	20	*NA*	0.019	U	0.019	U	0.019	U	0.019	U	**0.048**	**J**	0.019	U	0.019	U	0.02	U
2,4,5-Trichlorophenol	mg/kg	610*	9	*NA*	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U
2,4,6-Trichlorophenol	mg/kg	6.1*	4	*NA*	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U
2,4-Dichlorophenol	mg/kg	18*	87.5	*NA*	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U	0.12	U
2,4-Dimethylphenol	mg/kg	120*	0.01	*NA*	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
2,4-Dinitrophenol	mg/kg	12*	20	*NA*	0.7	U	0.71	U	0.7	U	0.7	U	0.71	U	0.71	U	0.7	U	0.71	U
2,4-Dinitrotoluene	mg/kg	0.753	1.28	*NA*	0.024	U	0.025	U	0.024	U	0.024	U	**0.092**	**J**	0.025	U	0.024	U	0.025	U
2,6-Dinitrotoluene	mg/kg	0.769	0.0328	*NA*	0.024	U	0.025	U	0.024	U	0.024	U	0.025	U	0.025	U	0.024	U	0.025	U
2-Chloronaphthalene	mg/kg	630*	0.0122	*NA*	0.023	U	0.024	U	0.023	U	0.023	U	0.024	U	0.024	U	0.023	U	0.024	U
2-Chlorophenol	mg/kg	39*	0.243	*NA*	0.35	U	0.35	U	0.35	U	0.35	U	0.35	U	0.35	U	0.34	U	0.35	U
2-Methylnaphthalene	mg/kg	30.6	3.24	*NA*	0.026	U	**0.064**	**J**	0.025	U	**0.24**	**J**	0.33	J	**0.53**		0.025	U	**0.045**	**J**
2-Nitroaniline	mg/kg	61*	74.1	*NA*	0.023	U	0.024	U	0.023	U	0.023	U	0.024	U	0.024	U	0.023	U	0.024	U
2-Nitrophenol	mg/kg	TBC	1.6	*NA*	0.29	U	0.29	U	0.28	U	0.29	U	0.29	U	0.29	U	0.28	U	0.29	U
3,3'-Dichlorobenzidine	mg/kg	1.1*	0.646	*NA*	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U	0.15	U
3-Nitroaniline	mg/kg	TBC	3.16	*NA*	0.022	U	0.023	U	0.022	U	0.022	U	0.022	U	0.022	U	0.022	U	0.023	U
4,6-Dinitro-2-Methylphenol	mg/kg	0.49*	0.144	*NA*	0.28	U	0.28	U	0.27	U	0.27	U	0.28	U	0.28	U	0.27	U	0.28	U
4-Bromophenyl Phenyl Ether	mg/kg	TBC	NA	*NA*	0.026	U	0.026	U	0.025	U	0.025	U	0.026	U	0.026	U	0.025	U	0.026	U
4-Chloro-3-Methylphenol	mg/kg	610*	7.95	*NA*	0.39	U	0.39	U	0.39	U	0.39	U	0.39	U	0.39	U	0.39	U	0.39	U
4-Chloroaniline	mg/kg	2.4*	1.1	*NA*	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U
4-Chlorophenyl Phenyl Ether	mg/kg	TBC	NA	*NA*	0.027	U	0.027	U	0.026	U	0.026	U	0.027	U	0.027	U	0.026	U	0.027	U
4-Nitrobenzenamine	mg/kg	TBC	TBC	*NA*	0.031	U	0.031	U	0.03	U	0.031	U	0.031	U	0.031	U	0.03	U	0.031	U
4-Nitrophenol	mg/kg	61.2	7	*NA*	0.41	U	0.41	U	0.41	U	0.41	U	0.41	U	0.41	U	0.41	U	0.41	U
Acenaphthene	mg/kg	340*	29	*NA*	0.024	U	0.025	U	0.024	U	**0.035**	**J**	**0.064**	**J**	**0.029**	**J**	0.024	U	0.025	U
Acenaphthylene	mg/kg	340[e]*	29	*NA*	0.024	U	0.025	U	0.024	U	**0.029**	**J**	0.025	U	**0.042**	**J**	0.024	U	0.025	U
Anthracene	mg/kg	1,700*	29	*NA*	0.024	U	0.025	U	0.024	U	**0.093**	**J**	**0.15**	**J**	**0.07**	**J**	0.024	U	0.025	U
Benzo(a)anthracene	mg/kg	0.221	1.1	*NA*	0.026	U	**0.062**	**J**	**0.027**	**J**	**0.37**	**J**	**0.39**	**J**	**0.3**	**J**	**0.046**	**J**	**0.052**	**J**
Benzo(a)pyrene	mg/kg	0.022	1.1	*NA*	0.023	U	**0.054**	**J**	**0.026**	**J**	**0.35**	**J**	**0.35**	**J**	**0.31**	**J**	**0.034**	**J**	**0.045**	**J**
Benzo(b)fluoranthene	mg/kg	0.221	1.1	*NA*	0.026	U	**0.12**	**J**	**0.039**	**J**	**0.58**		**0.52**		**0.51**		**0.11**	**J**	**0.077**	**J**
Benzo(ghi)perylene	mg/kg	170*	1.1	*NA*	0.022	U	0.023	UJ	0.022	U	**0.19**	**J**	**0.21**	**J**	**0.15**	**J**	**0.031**	**J**	0.023	U
Benzo(k)fluoranthene	mg/kg	2.21	1.1	*NA*	0.026	U	**0.047**	**J**	0.025	U	**0.2**	**J**	**0.17**	**J**	**0.14**	**J**	**0.035**	**J**	**0.027**	**J**
Benzoic Acid	mg/kg	24,000*	1	*NA*	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U
Benzyl Alcohol	mg/kg	TBC	65.8	*NA*	0.085	U	0.085	U	0.084	U	0.085	U	0.085	U	0.085	U	0.084	U	0.085	U
Bis(2-Chloroethoxy)methane	mg/kg	23	0.302	*NA*	0.023	U	0.024	U	0.023	U	0.023	U	0.024	U	0.024	U	0.023	U	0.024	U
Bis(2-Chloroethyl)ether	mg/kg	0.21*	23.7	*NA*	0.026	U	0.026	U	0.025	U	0.025	U	0.026	U	0.026	U	0.025	U	0.026	U
Bis(2-Chloroisopropyl)ether	mg/kg	4.6*	19.9	*NA*	0.031	U	0.031	U	0.03	U	0.031	U	0.031	U	0.031	U	0.03	U	0.031	U

Table D-1
Phase I RI Surface Soil Analytical Data Summary
Sand Creek Disposal Road Landfill

				Location Code:	SCSS-068		SCSS-069		SCSS-072		SCSS-073		SCSS-073		SCSS-074		SCSS-075		SCSS-076	
				Sample Number:	SCSS-086M-0001-SO		SCSS-069M-0001-SO		SCSS-072M-0001-SO		SCSS-073M-0001-SO		SCSS-087M-0001-SO		SCSS-074M-0001-SO		SCSS-075M-0001-SO		SCSS-076M-0001-SO	
				Sample Date:	9/21/2010		9/24/2010		11/9/2010		11/9/2010		11/9/2010		11/9/2010		11/9/2010		11/9/2010	
				Depth:	0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft	
				Sample Purpose:	FD		REG		REG		REG		FD		REG		REG		REG	
		Screening Criteria																		
Parameter	Units	FWCUG[a]	ECOSV[b]	BSV	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Bis(2-Ethylhexyl)phthalate	mg/kg	35*	0.925	*NA*	**0.13**	**J**	0.089	U	**1.7**		**0.19**	**J**	**0.95**	**J**	**0.49**	**J**	**0.91**	**J**	**0.27**	**J**
Butyl Benzyl Phthalate	mg/kg	260*	0.239	*NA*	0.074	U	0.075	U	0.074	U	0.074	U	0.075	U	0.075	U	0.074	U	0.075	U
Carbazole	mg/kg	44.6	0.00008	*NA*	0.029	U	0.029	U	0.028	U	**0.058**	**J**	**0.099**	**J**	**0.057**	**J**	0.028	U	0.029	U
Chrysene	mg/kg	22.1	1.1	*NA*	0.026	U	**0.061**	**J**	0.025	U	**0.4**	**J**	**0.39**	**J**	**0.34**	**J**	**0.14**	**J**	**0.051**	**J**
Cresols (Total)	mg/kg	610*	TBC	*NA*	0.66	U	0.67	U	0.66	U	0.66	U	0.66	U	0.66	U	0.66	U	0.67	U
Dibenzo(a,h)anthracene	mg/kg	0.022	1.1	*NA*	0.022	U	0.023	UJ	0.022	U	**0.069**	**J**	**0.092**	**J**	**0.055**	**J**	0.022	U	0.023	U
Dibenzofuran	mg/kg	15.3	6.1	*NA*	0.024	U	0.025	U	0.024	U	**0.072**	**J**	**0.1**	**J**	**0.11**	**J**	0.024	U	0.025	U
Diethyl Phthalate	mg/kg	4,900*	100	*NA*	0.065	U	0.066	U	**0.069**	**J**	0.065	U	0.065	U	0.065	U	**0.14**	**J**	0.066	U
Dimethyl Phthalate	mg/kg	TBC	734	*NA*	0.064	U	0.065	U	0.064	U	0.064	U	0.064	U	0.064	U	0.064	U	0.065	U
Di-n-Butyl Phthalate	mg/kg	610*	200	*NA*	0.081	U	**0.15**	**J**	**0.13**	**J**	**0.14**	**J**	**0.13**	**J**	**0.15**	**J**	**0.087**	**J**	**0.14**	**J**
Di-n-Octyl Phthalate	mg/kg	TBC	709	*NA*	0.06	U	0.061	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.061	U
Fluoranthene	mg/kg	163	29	*NA*	0.027	U	**0.14**	**J**	**0.046**	**J**	**0.76**		**0.89**		**0.64**		**0.3**	**J**	**0.081**	**J**
Fluorene	mg/kg	243	29	*NA*	0.026	U	0.026	U	0.025	U	**0.033**	**J**	**0.055**	**J**	**0.031**	**J**	0.025	U	0.026	U
Hexachlorobenzene	mg/kg	0.3*	0.199	*NA*	0.029	U	0.029	U	0.028	U	0.029	U	0.029	U	0.029	U	0.028	U	0.029	U
Hexachlorobutadiene	mg/kg	6.1*	0.0398	*NA*	0.063	U	0.064	U	0.063	U	0.063	U	0.063	U	0.063	U	0.063	U	0.064	U
Hexachlorocyclopentadiene	mg/kg	37*	10	*NA*	0.053	U	0.053	U	0.053	U	0.053	U	0.053	U	0.053	U	0.053	U	0.053	U
Hexachloroethane	mg/kg	6.1*	0.596	*NA*	0.034	U	0.034	U	0.034	U	0.034	U	0.034	U	0.034	U	0.033	U	0.034	U
Indeno(1,2,3-cd)pyrene	mg/kg	0.221	1.1	*NA*	0.023	U	0.024	UJ	0.023	U	**0.17**	**J**	**0.21**	**J**	**0.16**	**J**	**0.025**	**J**	0.024	U
Isophorone	mg/kg	510*	139	*NA*	**0.14**	**J**	0.051	U	0.051	U	0.051	U	0.051	U	0.051	U	0.051	U	0.051	U
Naphthalene	mg/kg	122	29	*NA*	0.021	U	**0.05**	**J**	0.021	U	**0.17**	**J**	**0.24**	**J**	0.021	U	0.021	U	**0.028**	**J**
Nitrobenzene	mg/kg	0.48	1.31	*NA*	0.06	U	0.061	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.061	U
N-Nitroso-di-n-Propylamine	mg/kg	0.12	0.544	*NA*	0.071	U	0.072	U	0.071	U	0.071	U	0.072	U	0.072	U	0.071	U	0.072	U
N-Nitrosodiphenylamine	mg/kg	99*	0.545	*NA*	0.051	U	0.051	U	0.051	U	0.051	U	0.051	U	0.051	U	0.051	U	0.051	U
o-Cresol	mg/kg	390	TBC	*NA*	0.43	U	0.43	U	0.43	U	0.43	U	0.43	U	0.43	U	0.43	U	0.43	U
Pentachlorophenol	mg/kg	2.12	2.1	*NA*	0.24	U	0.25	U	0.24	U	0.24	U	0.25	U	0.25	U	0.24	U	0.25	U
Phenanthrene	mg/kg	NA	29	*NA*	0.027	U	**0.093**	**J**	**0.026**	**J**	**0.45**		**0.7**		**0.43**		**0.09**	**J**	**0.05**	**J**
Phenol	mg/kg	1,800*	30	*NA*	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U	0.16	U
Pyrene	mg/kg	122	1.1	*NA*	0.027	U	**0.12**	**J**	**0.035**	**J**	**0.62**		**0.63**		**0.52**		**0.2**	**J**	**0.072**	**J**
Volatile Organic Compounds																				
1,1,1-Trichloroethane	mg/kg	870*	TBC	*NA*	---		---		---		---		---		---		---		---	
1,1,2,2-Tetrachloroethane	mg/kg	0.056*	TBC	*NA*	---		---		---		---		---		---		---		---	
1,1,2-Trichloroethane	mg/kg	0.11*	TBC	*NA*	---		---		---		---		---		---		---		---	
1,1-Dichloroethane	mg/kg	0.33*	TBC	*NA*	---		---		---		---		---		---		---		---	
1,1-Dichloroethylene	mg/kg	24*	TBC	*NA*	---		---		---		---		---		---		---		---	
1,2-Dibromoethane	mg/kg	0.0034*	TBC	*NA*	---		---		---		---		---		---		---		---	
1,2-Dichloroethane	mg/kg	0.043*	TBC	*NA*	---		---		---		---		---		---		---		---	
1,2-Dichloropropane	mg/kg	0.094*	TBC	*NA*	---		---		---		---		---		---		---		---	
1,2-Dimethylbenzene	mg/kg	NA	TBC	*NA*	---		---		---		---		---		---		---		---	
2-Hexanone	mg/kg	21*	TBC	*NA*	---		---		---		---		---		---		---		---	
Acetone	mg/kg	6,100*	TBC	*NA*	---		---		---		---		---		---		---		---	

Table D-1
Phase I RI Surface Soil Analytical Data Summary
Sand Creek Disposal Road Landfill

				Location Code:	SCSS-068		SCSS-069		SCSS-072		SCSS-073		SCSS-073		SCSS-074		SCSS-075		SCSS-076	
				Sample Number:	SCSS-086M-0001-SO		SCSS-069M-0001-SO		SCSS-072M-0001-SO		SCSS-073M-0001-SO		SCSS-087M-0001-SO		SCSS-074M-0001-SO		SCSS-075M-0001-SO		SCSS-076M-0001-SO	
				Sample Date:	9/21/2010		9/24/2010		11/9/2010		11/9/2010		11/9/2010		11/9/2010		11/9/2010		11/9/2010	
				Depth:	0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft		0 - 1 ft	
				Sample Purpose:	FD		REG		REG		REG		FD		REG		REG		REG	
		Screening Criteria																		
Parameter	Units	FWCUG[a]	ECOSV[b]	BSV	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Benzene	mg/kg	0.11*	TBC	*NA*	---		---		---		---		---		---		---		---	
Bromochloromethane	mg/kg	16*	TBC	*NA*	---		---		---		---		---		---		---		---	
Bromodichloromethane	mg/kg	0.027*	TBC	*NA*	---		---		---		---		---		---		---		---	
Bromoform	mg/kg	6.2*	TBC	*NA*	---		---		---		---		---		---		---		---	
Bromomethane	mg/kg	0.73*	TBC	*NA*	---		---		---		---		---		---		---		---	
Carbon Disulfide	mg/kg	82*	TBC	*NA*	---		---		---		---		---		---		---		---	
Carbon Tetrachloride	mg/kg	0.061*	TBC	*NA*	---		---		---		---		---		---		---		---	
Chlorobenzene	mg/kg	29*	TBC	*NA*	---		---		---		---		---		---		---		---	
Chloroethane	mg/kg	TBC	TBC	*NA*	---		---		---		---		---		---		---		---	
Chloroform	mg/kg	0.029*	TBC	*NA*	---		---		---		---		---		---		---		---	
Chloromethane	mg/kg	12*	TBC	*NA*	---		---		---		---		---		---		---		---	
cis-1,2-Dichloroethene	mg/kg	16*	TBC	*NA*	---		---		---		---		---		---		---		---	
cis-1,3-Dichloropropene	mg/kg	0.17*	TBC	*NA*	---		---		---		---		---		---		---		---	
Dibromochloromethane	mg/kg	0.068*	TBC	*NA*	---		---		---		---		---		---		---		---	
Ethylbenzene	mg/kg	5*	TBC	*NA*	---		---		---		---		---		---		---		---	
Methyl Ethyl Ketone	mg/kg	2,800*	TBC	*NA*	---		---		---		---		---		---		---		---	
Methyl Isobutyl Ketone	mg/kg	530*	TBC	*NA*	---		---		---		---		---		---		---		---	
Methylene Chloride	mg/kg	5.6*	TBC	*NA*	---		---		---		---		---		---		---		---	
Styrene	mg/kg	630*	TBC	*NA*	---		---		---		---		---		---		---		---	
Tetrachloroethylene	mg/kg	2.2*	TBC	*NA*	---		---		---		---		---		---		---		---	
Toluene	mg/kg	500*	TBC	*NA*	---		---		---		---		---		---		---		---	
trans-1,2-Dichloroethene	mg/kg	15*	TBC	*NA*	---		---		---		---		---		---		---		---	
trans-1,3-Dichloropropene	mg/kg	0.17*	TBC	*NA*	---		---		---		---		---		---		---		---	
Trichloroethylene	mg/kg	0.091*	TBC	*NA*	---		---		---		---		---		---		---		---	
Vinyl Chloride	mg/kg	0.006*	TBC	*NA*	---		---		---		---		---		---		---		---	
Xylene, (Total)	mg/kg	63*	TBC	*NA*	---		---		---		---		---		---		---		---	

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Uncensored Full Data Sets											
2												
3	User Selected Options											
4	Date/Time of Computation			ProUCL 5.13/27/2018 11:38:00 AM								
5	From File			AS and BaP discrete values subsurface.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Number of Bootstrap Operations			2000								
9												
10												
11	Arsenic											
12												
13	General Statistics											
14	Total Number of Observations					64	Number of Distinct Observations					54
15							Number of Missing Observations					1
16	Minimum					0.524	Mean					21.05
17	Maximum					214	Median					14.75
18	SD					37.02	Std. Error of Mean					4.628
19	Coefficient of Variation					1.759	Skewness					4.421
20												
21	Normal GOF Test											
22	Shapiro Wilk Test Statistic					0.346	Shapiro Wilk GOF Test					
23	5% Shapiro Wilk P Value					0	Data Not Normal at 5% Significance Level					
24	Lilliefors Test Statistic					0.443	Lilliefors GOF Test					
25	5% Lilliefors Critical Value					0.111	Data Not Normal at 5% Significance Level					
26	Data Not Normal at 5% Significance Level											
27												
28	Assuming Normal Distribution											
29	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
30	95% Student's-t UCL					28.77	95% Adjusted-CLT UCL (Chen-1995)					31.39
31							95% Modified-t UCL (Johnson-1978)					29.2
32												
33	Gamma GOF Test											
34	A-D Test Statistic					8.858	Anderson-Darling Gamma GOF Test					
35	5% A-D Critical Value					0.776	Data Not Gamma Distributed at 5% Significance Level					
36	K-S Test Statistic					0.325	Kolmogorov-Smirnov Gamma GOF Test					
37	5% K-S Critical Value					0.114	Data Not Gamma Distributed at 5% Significance Level					
38	Data Not Gamma Distributed at 5% Significance Level											
39												
40	Gamma Statistics											
41	k hat (MLE)					1.166	k star (bias corrected MLE)					1.122
42	Theta hat (MLE)					18.05	Theta star (bias corrected MLE)					18.76
43	nu hat (MLE)					149.2	nu star (bias corrected)					143.6
44	MLE Mean (bias corrected)					21.05	MLE Sd (bias corrected)					19.87
45							Approximate Chi Square Value (0.05)					116.9
46	Adjusted Level of Significance					0.0463	Adjusted Chi Square Value					116.3
47												
48	Assuming Gamma Distribution											
49	95% Approximate Gamma UCL (use when n>=50))					25.85	95% Adjusted Gamma UCL (use when n<50)					25.98
50												
51	Lognormal GOF Test											
52	Shapiro Wilk Test Statistic					0.748	Shapiro Wilk Lognormal GOF Test					

	A–E	F	G–K	L
53	5% Shapiro Wilk P Value	1.610E-14	Data Not Lognormal at 5% Significance Level	
54	Lilliefors Test Statistic	0.243	**Lilliefors Lognormal GOF Test**	
55	5% Lilliefors Critical Value	0.111	Data Not Lognormal at 5% Significance Level	
56	**Data Not Lognormal at 5% Significance Level**			
57				
58	**Lognormal Statistics**			
59	Minimum of Logged Data	-0.646	Mean of logged Data	2.56
60	Maximum of Logged Data	5.366	SD of logged Data	0.903
61				
62	**Assuming Lognormal Distribution**			
63	95% H-UCL	24.94	90% Chebyshev (MVUE) UCL	26.82
64	95% Chebyshev (MVUE) UCL	30.24	97.5% Chebyshev (MVUE) UCL	34.99
65	99% Chebyshev (MVUE) UCL	44.31		
66				
67	**Nonparametric Distribution Free UCL Statistics**			
68	**Data do not follow a Discernible Distribution (0.05)**			
69				
70	**Nonparametric Distribution Free UCLs**			
71	95% CLT UCL	28.66	95% Jackknife UCL	28.77
72	95% Standard Bootstrap UCL	28.67	95% Bootstrap-t UCL	34.06
73	95% Hall's Bootstrap UCL	27.47	95% Percentile Bootstrap UCL	28.98
74	95% BCA Bootstrap UCL	32.03		
75	90% Chebyshev(Mean, Sd) UCL	34.93	95% Chebyshev(Mean, Sd) UCL	41.22
76	97.5% Chebyshev(Mean, Sd) UCL	49.95	99% Chebyshev(Mean, Sd) UCL	67.09
77				
78	**Suggested UCL to Use**			
79	95% Chebyshev (Mean, Sd) UCL	41.22		
80				
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
82	Recommendations are based upon data size, data distribution, and skewness.			
83	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
84	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
85				

UCL Statistics for Uncensored Full Data Sets			
ARSENIC UCL without the 2 greatest values			
User Selected Options			
Date/Time of Computation	ProUCL 5.14/4/2018 2:24:31 PM		
From File	AS and BaP discrete values subsurface.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Arsenic			
General Statistics			
Total Number of Observations	61	Number of Distinct Observations	51
		Number of Missing Observations	4
Minimum	0.524	Mean	13.05
Maximum	23.4	Median	14.6
SD	4.764	Std. Error of Mean	0.61
Coefficient of Variation	0.365	Skewness	-0.674
Normal GOF Test			
Shapiro Wilk Test Statistic	0.935	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0.00401	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.153	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.113	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	14.07	95% Adjusted-CLT UCL (Chen-1995)	14
		95% Modified-t UCL (Johnson-1978)	14.06
Gamma GOF Test			
A-D Test Statistic	4.356	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.755	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.21	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.114	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.764	k star (bias corrected MLE)	3.59
Theta hat (MLE)	3.466	Theta star (bias corrected MLE)	3.634
nu hat (MLE)	459.3	nu star (bias corrected)	438
MLE Mean (bias corrected)	13.05	MLE Sd (bias corrected)	6.886
		Approximate Chi Square Value (0.05)	390.5
Adjusted Level of Significance	0.0461	Adjusted Chi Square Value	389.4
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	14.64	95% Adjusted Gamma UCL (use when n<50)	14.68
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.644	**Shapiro Wilk Lognormal GOF Test**	

	A	B	C	D	E	F	G	H	I	J	K	L
53					5% Shapiro Wilk P Value	0			Data Not Lognormal at 5% Significance Level			
54					Lilliefors Test Statistic	0.225			**Lilliefors Lognormal GOF Test**			
55					5% Lilliefors Critical Value	0.113			Data Not Lognormal at 5% Significance Level			
56					**Data Not Lognormal at 5% Significance Level**							
57												
58						**Lognormal Statistics**						
59					Minimum of Logged Data	-0.646					Mean of logged Data	2.43
60					Maximum of Logged Data	3.153					SD of logged Data	0.699
61												
62						**Assuming Lognormal Distribution**						
63					95% H-UCL	17.38					90% Chebyshev (MVUE) UCL	18.68
64					95% Chebyshev (MVUE) UCL	20.61					97.5% Chebyshev (MVUE) UCL	23.28
65					99% Chebyshev (MVUE) UCL	28.53						
66												
67						**Nonparametric Distribution Free UCL Statistics**						
68						**Data do not follow a Discernible Distribution (0.05)**						
69												
70						**Nonparametric Distribution Free UCLs**						
71					95% CLT UCL	14.05					95% Jackknife UCL	14.07
72					95% Standard Bootstrap UCL	14.03					95% Bootstrap-t UCL	14.07
73					95% Hall's Bootstrap UCL	14.04					95% Percentile Bootstrap UCL	14.04
74					95% BCA Bootstrap UCL	14						
75					90% Chebyshev(Mean, Sd) UCL	14.88					95% Chebyshev(Mean, Sd) UCL	15.71
76					97.5% Chebyshev(Mean, Sd) UCL	16.86					99% Chebyshev(Mean, Sd) UCL	19.12
77												
78						**Suggested UCL to Use**						
79					95% Chebyshev (Mean, Sd) UCL	15.71						
80												
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
82	Recommendations are based upon data size, data distribution, and skewness.											
83	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
84	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
85												
86	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
87	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
88												

UCL Statistics for Uncensored Full Data Sets			
User Selected Options			
Date/Time of Computation	ProUCL 5.14/2/2018 12:27:03 PM		
From File	AS and BaP discrete values subsurface.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Benzo(a)pyrene			
General Statistics			
Total Number of Observations	62	Number of Distinct Observations	16
		Number of Missing Observations	3
Minimum	0.022	Mean	0.0967
Maximum	1.7	Median	0.023
SD	0.272	Std. Error of Mean	0.0346
Coefficient of Variation	2.813	Skewness	4.956
Normal GOF Test			
Shapiro Wilk Test Statistic	0.316	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.426	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.112	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.154	95% Adjusted-CLT UCL (Chen-1995)	0.177
		95% Modified-t UCL (Johnson-1978)	0.158
Gamma GOF Test			
A-D Test Statistic	15.93	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.806	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.457	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.119	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.611	k star (bias corrected MLE)	0.592
Theta hat (MLE)	0.158	Theta star (bias corrected MLE)	0.163
nu hat (MLE)	75.74	nu star (bias corrected)	73.41
MLE Mean (bias corrected)	0.0967	MLE Sd (bias corrected)	0.126
		Approximate Chi Square Value (0.05)	54.68
Adjusted Level of Significance	0.0461	Adjusted Chi Square Value	54.29
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.13	95% Adjusted Gamma UCL (use when n<50)	0.131
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.498	**Shapiro Wilk Lognormal GOF Test**	

	A	B	C	D	E	F	G	H	I	J	K	L
53	5% Shapiro Wilk P Value					0	Data Not Lognormal at 5% Significance Level					
54	Lilliefors Test Statistic					0.439	**Lilliefors Lognormal GOF Test**					
55	5% Lilliefors Critical Value					0.112	Data Not Lognormal at 5% Significance Level					
56	**Data Not Lognormal at 5% Significance Level**											
57												
58	**Lognormal Statistics**											
59	Minimum of Logged Data					-3.817	Mean of logged Data					-3.345
60	Maximum of Logged Data					0.531	SD of logged Data					1.011
61												
62	**Assuming Lognormal Distribution**											
63	95% H-UCL					0.0787	90% Chebyshev (MVUE) UCL					0.0846
64	95% Chebyshev (MVUE) UCL					0.0967	97.5% Chebyshev (MVUE) UCL					0.113
65	99% Chebyshev (MVUE) UCL					0.146						
66												
67	**Nonparametric Distribution Free UCL Statistics**											
68	**Data do not follow a Discernible Distribution (0.05)**											
69												
70	**Nonparametric Distribution Free UCLs**											
71	95% CLT UCL					0.154	95% Jackknife UCL					0.154
72	95% Standard Bootstrap UCL					0.152	95% Bootstrap-t UCL					0.286
73	95% Hall's Bootstrap UCL					0.388	95% Percentile Bootstrap UCL					0.158
74	95% BCA Bootstrap UCL					0.19						
75	90% Chebyshev(Mean, Sd) UCL					0.2	95% Chebyshev(Mean, Sd) UCL					0.247
76	97.5% Chebyshev(Mean, Sd) UCL					0.313	99% Chebyshev(Mean, Sd) UCL					0.441
77												
78	**Suggested UCL to Use**											
79	95% Chebyshev (Mean, Sd) UCL					0.247						
80												
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
82	Recommendations are based upon data size, data distribution, and skewness.											
83	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
84	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
85												

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.14/2/2018 12:22:35 PM
From File	AS and BaP discrete values subsurface.xlsAS UCL without 214 value
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics			
Total Number of Observations	63	Number of Distinct Observations	53
		Number of Missing Observations	2
Minimum	0.524	Mean	17.98
Maximum	182	Median	14.7
SD	27.98	Std. Error of Mean	3.525
Coefficient of Variation	1.556	Skewness	5.29
Normal GOF Test			
Shapiro Wilk Test Statistic	0.329	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.417	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.111	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	23.87	95% Adjusted-CLT UCL (Chen-1995)	26.29
		95% Modified-t UCL (Johnson-1978)	24.26
Gamma GOF Test			
A-D Test Statistic	7.407	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.769	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.283	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.114	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.482	k star (bias corrected MLE)	1.422
Theta hat (MLE)	12.14	Theta star (bias corrected MLE)	12.65
nu hat (MLE)	186.7	nu star (bias corrected)	179.1
MLE Mean (bias corrected)	17.98	MLE Sd (bias corrected)	15.08
		Approximate Chi Square Value (0.05)	149.2
Adjusted Level of Significance	0.0462	Adjusted Chi Square Value	148.6
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	21.59	95% Adjusted Gamma UCL (use when n<50)	21.69
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.737	**Shapiro Wilk Lognormal GOF Test**	

	A–E	F	G–K	L
53	5% Shapiro Wilk P Value	7.216E-15	Data Not Lognormal at 5% Significance Level	
54	Lilliefors Test Statistic	0.225	**Lilliefors Lognormal GOF Test**	
55	5% Lilliefors Critical Value	0.111	Data Not Lognormal at 5% Significance Level	
56	**Data Not Lognormal at 5% Significance Level**			
57				
58	**Lognormal Statistics**			
59	Minimum of Logged Data	-0.646	Mean of logged Data	2.516
60	Maximum of Logged Data	5.204	SD of logged Data	0.836
61				
62	**Assuming Lognormal Distribution**			
63	95% H-UCL	22	90% Chebyshev (MVUE) UCL	23.68
64	95% Chebyshev (MVUE) UCL	26.52	97.5% Chebyshev (MVUE) UCL	30.45
65	99% Chebyshev (MVUE) UCL	38.18		
66				
67	**Nonparametric Distribution Free UCL Statistics**			
68	**Data do not follow a Discernible Distribution (0.05)**			
69				
70	**Nonparametric Distribution Free UCLs**			
71	95% CLT UCL	23.78	95% Jackknife UCL	23.87
72	95% Standard Bootstrap UCL	23.7	95% Bootstrap-t UCL	48.23
73	95% Hall's Bootstrap UCL	63.24	95% Percentile Bootstrap UCL	23.86
74	95% BCA Bootstrap UCL	27.69		
75	90% Chebyshev(Mean, Sd) UCL	28.56	95% Chebyshev(Mean, Sd) UCL	33.35
76	97.5% Chebyshev(Mean, Sd) UCL	39.99	99% Chebyshev(Mean, Sd) UCL	53.05
77				
78	**Suggested UCL to Use**			
79	95% Chebyshev (Mean, Sd) UCL	33.35		
80				
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
82	Recommendations are based upon data size, data distribution, and skewness.			
83	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
84	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
85				

APPENDIX B: Applicable or Relevant and Appropriate Requirements

Table B-1. Potential Action-specific ARARs

Media and Citation	Description of Requirement	Potential ARAR Status	Standard
Prohibition of air pollution nuisances (e.g., fugitive dust) OAC Section 3745-15-07	These rules prohibit a release of nuisance air pollution that endanger health, safety, or welfare of the public or cause personal injury or property damage.	Applies to any activity that could result in the release of a nuisance air pollutant. This would include dust from excavation or waste management processes.	Any person undertaking an activity is prohibited from emitting nuisance air pollution.
Storm water requirements at construction sites 40 CFR Part 450	These rules require that storm water controls be employed at construction sites that exceed 1 acre.	Applies to any construction activity that exceeds 1 acre.	Persons undertaking construction activities (including grubbing and land clearing) at an AOC where the construction footprint is over 1 acre must design and implement erosion and runoff controls.
Generation of contaminated waste material (i.e., soil, sediment, or debris) OAC Section 3745-52-11	These rules require that a generator determine whether a material generated is a hazardous waste.	Applies to any material that is or contains a solid waste. Must be characterized to determine whether the material is or contains a hazardous waste.	Any person that generates a waste as defined must use prescribed methods to determine if waste is considered characteristically hazardous.
Management of contaminated waste material that is or contains a hazardous waste OAC Sections 3745-52-30 through 3745-52-34	These rules require that hazardous waste is properly packaged, labeled, marked, placarded, and accumulated on site pending on-site or off-site disposal.	Applies to any hazardous waste, or media containing a hazardous waste, that is generated from on-site activities.	All hazardous waste must be accumulated in a compliant manner that includes proper packaging, labeling, marking, and placarding in accordance with the specified regulations. This includes inspecting containers or container areas where hazardous waste is accumulated on site.
Acquisition and use of manifests for hazardous waste shipments to off-site treatment, storage, or disposal facilities OAC Sections 3745-52-20 through 3745-52-23	These rules require that a Uniform Hazardous Waste Manifest be used for any off-site shipment of hazardous waste.	Applies to any shipment of hazardous waste to an off-site facility for treatment, storage, or disposal.	Requires a generator who transports or offers for transportation hazardous waste for off-site treatment, storage, or disposal to prepare a uniform hazardous waste manifest.

Table B-1. Potential Action-specific ARARs (continued)

Media and Citation	Description of Requirement	Potential ARAR Status	Standard
Soil contaminated with RCRA hazardous waste OAC Section 3745-270-48 UTS OAC Section 3745-270-49 Soil	These rules prohibit land disposal of RCRA hazardous waste subject to them, unless the waste is treated to meet certain standards that are protective of human health and the environment. Standards for treating hazardous-waste--contaminated soil prior to disposal are set forth in the two cited rules. Using the greater of either technology-based standards or UTS is prescribed.	LDRs apply only to RCRA hazardous waste. These rules are considered for ARAR status only upon generation of a RCRA hazardous waste. If any soil is determined to be RCRA hazardous and will be disposed of on site, this rule is potentially applicable to disposal of the soil. These rules may be relevant to the sewer sediment since the regulatory definition of soil includes soil mixtures with liquid (i.e., sediment).	All soil subject to treatment must be treated as follows: 1. For non-metals, treatment must achieve a 90% reduction in total constituent concentration (i.e., the primary constituent for which the waste is characteristically hazardous as well as for any organic or metal UHC), subject to three below. 2. For metals, carbon disulfide, cyclohexanone, and methanol, treatment must achieve a 90% reduction in constituent concentrations as measured in leachate from the treated media (tested according to the TCLP) or a 90% reduction in total constituent concentrations (when a metal removal treatment technology is used), subject to three below. 2. When treating any constituent subject to treatment to a 90% reduction standard would result in a concentration less than 10 times the UTS for that constituent, treatment to achieve constituent concentrations less than 10 times the UTS is not required. This is commonly referred to as “90% capped by 10 x UTS.”

Table B-1. Potential Action-specific ARARs (continued)			
Media and Citation	**Description of Requirement**	**Potential ARAR Status**	**Standard**
Debris Contaminated with RCRA Hazardous Waste OAC Section 3745-270-45	These rules prescribe conditions and standards for land disposal of debris contaminated with RCRA hazardous waste. Debris subject to this requirement for characteristic RCRA contamination that no longer exhibits the hazardous characteristic after treatment does not need to be disposed of as a hazardous waste. Debris contaminated with listed RCRA contamination remains subject to hazardous waste disposal requirements.	If RCRA hazardous debris is disposed of on site, these rules are potentially applicable to disposal of the debris.	Standards are extraction or destruction methods prescribed in OAC Section 3745-270-45. Treatment residues continue to be subject to RCRA hazardous waste requirements.
Soil/Debris Contaminated with RCRA Hazardous Waste – Variance OAC Section 3745-270-44	The Ohio EPA Director will recognize a variance approved by the USEPA from the alternative treatment standards for hazardous contaminated waste material.	Potentially applicable to RCRA hazardous waste material that is generated and placed back into a unit and that will be land disposed of on site.	Where the treatment standard is expressed as a concentration in a waste and the waste cannot be treated to the specific level, the generator may petition for a variance. A site-specific variance from the soil treatment standards can be used when treating concentrations of hazardous constituents greater higher than those specified in the soil treatment standards minimizes short- and long-term threats to human health and the environment. In this way, on a case-by-case basis, risk-based LDR treatment standards approved through a variance process could supersede the soil treatment standards.
Solid waste material that is contaminated but not a hazardous waste for disposal. OAC Section 3745-27-05	Establishes standard for disposal of solid waste within the state of Ohio.	Potentially applicable to contaminated solid waste material disposed of offsite under state solid waste disposal requirements.	Establishes allowable methods of solid waste disposal and prohibits management by open burning or dumping.
Permits-to-install, exemptions and permits-by-rule OAC Section 3745-31-03	A permit-by-rule (PBR) is a specific permit provision in the OAC that applies to certain types of low-emitting air pollution sources.	Potentially applicable if a thermal treatment system is selected for remedy.	Requires a generator to obtain a PBR exemption for low emitting air pollution sources prior to operating a thermal treatment system.

AOC = Area of concern.
ARAR = Applicable or Relevant and Appropriate Requirements
CFR = Code of Federal Regulations.
LDR = Land disposal restrictions. OAC = Ohio Administrative Code.
RCRA = Resource Conservation and Recovery Act. TCLP = Toxicity characteristic leaching procedure.
UHC = Underlying hazardous constituent. USEPA = U.S. Environmental Protection Agency.
UTS = Universal Treatment Standard.

Table B-2. Location-specific ARARs

Media and Citation	Description of Requirement	Potential ARAR Status	Standard
Presence of wetlands as defined in 10 CFR 1022.4(v).	Establishes the requirements to evaluate any action taken within a wetland to ensure that impacts are minimized or averted as required in 10 CFR 1022.3 (a) – (d).	Potentially applicable for activities that result in the impact of a wetland as defined.	To the extent possible, avoid the long- and short-term adverse effects associated with destruction, occupancy, and modification of wetlands. Measures to mitigate adverse effects of actions in a wetland include, but are not limited to, minimum grading requirements, runoff controls, design and construction constraints, and protection of ecologically sensitive areas in 10 CFR 1022.12(a)(3). To the extent practicable, take action to minimize destruction, loss, or degradation of wetlands and to preserve, restore, and enhance the nature and beneficial value of wetlands. Potential effects of any new construction in wetlands that are not in a floodplain shall be evaluated to identify and, as appropriate, implement alternative actions that may avoid or mitigate adverse impacts on wetlands.

ARAR = Applicable or Relevant and Appropriate Requirements.
CFR = Code of Federal Regulations.

APPENDIX C: Estimated Cost Details

EE/CA Study for Sand Creek Disposal Road Landfill, Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio
Summary of Alternatives

RVAAP Sand Creek Disposal Road Landfill		Duration	Cost Based on 2018 Data		
			Soil		
			Capital Cost	O&M Cost	Total
1	**Alternative -1: No Action**	**0**	**$0**	**$0**	**$0**
2	**Alternative 2:** Alternative 2 – Excavation with Off-site Disposal For Soil with Arsenic (and Ex-situ Thermal Treatment for Soil with PAHs to attain Unrestricted (Residential) Land Use.	**<1 yr**	**$142,400**	**$0**	**$142,400**

Notes:

1. Costs were estimated for comparison purposes only and are believed to be accurate within a range of -30% to +50%. Use of these costs for other purposes, such as, budgeting or construction cost estimating is not appropriate.
2. Estimated Capital Costs include preparation of the Remedial Design, award of a contract, contract cost, and oversight of the contract.

Engineering Evaluation/Cost Analysis (EE/CA) for RVAAP Sand Creek Disposal Road Landfill Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio

Summary of Removal Volumes

EE/CA Estimated Soil Removal at Sand Creek Disposal Road Landfill.

Media	Sample Numbers	In-situ volume (yd^3)	Volume for disposal (yd^3)
Soil with Arsenic as COC	SCss-062M-0001-SO	71	85
Soil with Arsenic as COC	SCsb-037M-0001-SO	12.3	16
Soil with PAHs as COC	SCss-060M-0001-SO	38	46
Soil with PAHs as COC	SCsb-049M-0001-SO	3.7	10
			157

[a]Includes 20% swell factor.
yd^3 = Cubic yard.

*101 cu.yds. Excavation and off-site disposal

*56 cu.yds for Thermal treatment

Note: Disposal Volume was estimated by using a factor of 1.2 to account for swelling

Note: At the soil boring sample locations (SCsb-037M-0001-SO and SCsb-049M-0001-SO), it is assumed that the removal would be done by excavating a 6-ft by 6-ft area centered on the boring location in 1-ft to 2-ft depths. The soil in this area would be disposed of. This is a conservative approach to ensure that no contaminated soil associated with the target boring is missed. As the excavation is deepened, soil outside of the 6 ft-by 6-ft target area would have to be cut back to keep the excavation from collapsing. The soil outside of the 6 ft-by 6-ft target area would be stockpiled and used as backfill once the excavation is complete. It is assumed that each excavation would be advanced to a depth of one foot below the target depth identified for removal.

Engineering Evaluation/Cost Analysis (EE/CA) for RVAAP Sand Creek Disposal Road Landfill – Cost Components

Key Parameters and Assumptions:

Item	**Units**	**Value**	**Notes**
Component Costs			
Contract Award			
Government Cost	each	$10,000	
Action Memorandum			
Government Cost	each	$17,000	
RD			
Contractor Cost	each	$39,000	
Oversight and Project Management	each	$4,000	
Soil Remediation			
Contractor Cost *Details of specific costs (breakdown) are presented separately following this Table.*	157 cu.yds. 101 cu.yds for off-site disposal 56 cu.yds for thermal treatment	$38,400	Includes pre-removal delineation sampling, removal, confirmation sampling, waste characterization, trucking, thermal treatment, disposal, backfill, site restoration, and project management
Completion Report			
Contractor Cost	each	$31,000	
Oversight and Project Management	each	$3,000	
	TOTAL	**$142,400**	

Detailed Cost Estimate for Remediation

EE/CA for RVAAP-34 Sand Creek Disposal Road Landfill Former Ravenna Army Ammunition Plant (RVAAP)
Summary of Alternatives

RVAAP-34 Sand Creek Alternatives		Duration	Non Discounted Cost		
			Soil		
			Capital Cost	O&M Cost	Total
1	No Action	0	$0	$0	$0
2a	Excavation and Off-site Disposal of Soil with Arsenic levels requiring remediation	<1 yr	$27,986	$0	$27,986
2b	Ex-Situ Thermal Treatment of Soil with PAH levels requiring remediation	<1 yr	$10,405	$0	$10,405
2	Total for 2a and 2b	<1 yr	$38,391	$0	$38,391

Notes:

1. The base year of comparison and cost data will be CY2018.

2. Costs were estimated for comparison purposes only and are believed to be accurate within a range of -30% to +50%. Use of these costs for other purposes, including but not limited to, budgetary or construction cost estimating is not appropriate.

EE/CA for RVAAP-34 Sand Creek Disposal Road Landfill,
Former Ravenna Army Ammunition Plant (RVAAP)
Summary of Removal Areas and Volumes

Locations Requiring Remediation	Media	Treatment Interval (ft bgs)	Surface Area (ft2)	In Situ		In Situ with Constructability [1]		Ex Situ [1,2]	
				Volume (ft3)	Volume (yd3)	Volume (ft3)	Volume (yd3)	Volume (ft3)	Volume (yd3)
SCss-062M (As)	Surface Soil	0-1	1912.5	1912.5	71	1912.5	71	2295	85
SCsb-037M (As)	Soil	0-10	36	360	13.3	360	13.3	432	16
TOTAL for Soil Containing Arsenic									101
SCss-060 (PAHs)	Surface Soil	0-1	1031.25	1031.25	38.2	1031.25	38.2	1238	46
SCss-049 (PAHs)	Soil	0-6	36	216	8	216	8	259	10
TOTAL for Soil Containing PAH									56
							TOTAL		157

[1] Typically a constructability factor is used to account for over excavation, sloping of sidewalls, and addresses limitations of removal equipment. In this case, two borings are being over-excavated. An area 6 feet by 6 feet will be disposed of to ensure appropriate soil is removed and that volume is already accounted for in the in-situ volume. The additional over-excavation needed to slope side walls back will not be disposed of. In the case of the removals to one foot of depth, side walls are not a factor. Therefore, a constructability factor is not applied in this case.

[2] Includes 20% swell factor

EE/CA for RVAAP-34 Sand Creek Disposal Road Landfill

Alternative 2a - Excavation and Off-site Disposal of Soil with Arsenic Levels of Concern

Key Parameters and Assumptions

Key Parameters and Assumptions:

Item	Unit	Value	Notes
Capital Cost			
Pre-excavation Delineation and Waste Characterization Sampling			
Samples	ea	4	Two delineation samples analyzed for total Arsenic. Waste characterization includes 2 composite samples TCLP Metals, RCRA Characteristics, and Paint Filter.
Sampling Labor	hrs	8	Assumes 1 sampling technician at 8 hours to collect and ship samples.
Sampling Labor	$/hr	75	
Truck Rental / Gas	$/event	100	1 truck x $80/day. Add $20 for gas.
Sample Materials	ea	4	Reference ECHOS 33 02 0401/0402 for ISM, processing, disposable sampling and decontamination materials.
Sample Materials	$/ea	35	
Analytical Cost	$/event	460	Analyze samples for Arsenic (2 @ $70) and TCLP Metals, RCRA Characteristics, and Paint Filter (2 @ $160).
Soil Excavation			
Soil Excavation Volume (In situ)	cy	84	
Soil Excavation Volume (Ex situ)	cy	101	Includes soil volume to be transported and disposed. Ex situ volumes include 20% swell factor.
Volume to Weight Conversion	tons/cy	1.60	In situ soil conversion.
Soil Excavation Mass	tons	162	Includes soil mass to be transported and disposed.
Soil Excavation Surface Area	sf	2,400	

EE/CA for RVAAP-34 Sand Creek Disposal Road Landfill
Alternative 2a - Excavation and Off-site Disposal of Soil with Arsenic Levels of Concern
Key Parameters and Assumptions

Key Parameters and Assumptions:

Mobilization/Demobilization	ls	1,500	Includes mob/demob of excavation equipment.
Excavate Soils	day $/day	1 4,994.39	Includes 2 cy excavator, 1-22 cy off highway truck, 1 O.E., 3 T.D., 1 L.S. spotter, 2 L.S. to prep trucks/and misc. Reduced productivity by 33% for loading trucks, precise excavations, and security/S&H requirements. Assume trucks are direct loaded. Average 200 cy/day and 1 day. RSMeans Crew B12-E.
Standby Time	day $/day	3 857	Assume 3 days equipment standby while analysis is being performed. Assume no additional hot spot excavation.
Nonhazardous Waste Transport and Offsite Disposal	tons $/ton	162 54.08	Based on shipping waste to American Landfill, Waynesburg, Ohio (approximately 80 mi RT). Assumes a minimum of 22 tons /load. Rate includes $16.60/ton tax from Portage County.
Confirmation Sampling			
Samples	ea hrs	2	Includes 2 ISM samples for confirmation (Arsenic)
Sampling Labor	$/hr	4	Assumes 1 sampling technician at 4 hours to collect and ship samples.
Sampling Labor	$/event	75	
Truck Rental / Gas	ea	100	1 truck x $80/day. Add $20 for gas.
Sample Materials	$/ea	2	
Sample Materials	$/event	35	
Analytical Cost		135	Analyze samples for Arsenic (2@70).
Restoration	cy		
Native Soil Backfill Native Soil Backfill	$/cy	101 35.09	Includes native soil backfill. Assume productivity has been reduced by 25% to account for security and safety requirements. Includes 12-in lift of native fill assuming 20% swell. ECHOS 17030423 and RSMeans 312323160040, Unclassified Fill, 6" Lifts, offsite Source @ 20 miles, Includes delivery, spreading, and compaction.
Seeding, Vegetative Cover Seeding, Vegetative Cover	MSF $/MSF	44 107.07	Seeding with mulch and fertilizer. Assume 1 acre is revegetated for restored areas and equipment damage. RSMeans 329219142200.
Plans and Reports	hrs		
Corrective Action Completion Report		240	Includes Construction QC data and preparing report.
Technical Labor	$/hr	95	

EE/CA for RVAAP-34 Sand Creek Disposal Road Landfill

Alternative 2a - Excavation and Off-site Disposal of Soil with Arsenic Levels of Concern

Cost Estimate

CAPITAL COSTS

Activity (unit)	Quantity	Unit Cost	Total
Pre-excavation Delineation and Waste Characterization Sampling			
Sampling Labor (hrs) Truck	8	$75.00	$600
Rental / Gas (event)	1	$100.00	$100
Sample Materials (ea)	4	$35.00	$140
Sample Analysis (event)	1	$460.00	$460
Soil Excavation			
Mobilization/Demobilization (ls)	1	$1,500.00	$1,500
Excavate Soil (days)	1	$4,994.39	$4,994
Standby Time (day)	3	$856.89	$2,571
NonhazardousTransport and Offsite Disposal (ton)	162	$54.08	$8,761
Confirmation Sampling			
Sampling Labor (hrs) Truck	4	$75.00	$300
Rental / Gas (event)	1	$100.00	$100
Sample Materials (ea)	2	$35.00	$70
Sample Analysis (event)	1	$135.00	$135
Restoration			
Native Soil Backfill (cy)	101	$35.09	$3,544
Seeding, Vegetative Cover (MSF)	44	$107.07	$4,711
Subtotal for 2a (Arsenic Soils – Off Site Disposal)			$27,986
Total for Alternate 2			$38,391

EE/CA for RVAAP-34 Sand Creek Disposal Road Landfill
Alternative 2b - Ex-Situ Thermal Treatment of Soil with PAHs of Concern
Key Parameters and Assumptions

Key Parameters and Assumptions:

Item	Unit	Value	Notes
Capital Cost			
Pre-excavation Delineation and Waste Characterization Sampling			Delineation sampling includes 2 ISM sampling locations analyzed
Samples	ea	4	for PAHs. Waste characterization includes 2 composite samples TCLP VOCs, SVOCs, RCRA Characteristics, and Paint Filter.
Sampling Labor	hrs	8	Assumes 1 sampling technician at 8 hours to collect and ship samples.
Sampling Labor	$/hr	75	1 truck x $80/day. Add $20 for gas.
Truck Rental / Gas	$/event	100	
Sample Materials	ea	4	
Sample Materials	$/ea	35	
Analytical Cost	$/event	740	Analyze samples for PAHs (2 @ $70) and TCLP VOCs, SVOCs, Metals, RCRA Characteristics, and Paint Filter (2 @ $300).
Soil Excavation			
Soil Excavation Volume (In situ)		46	Includes soil volume to undergo thermal treatment. Ex situ volumes include a 20% swell factor.
Soil Excavation Volume (Ex situ)	cy cy	56	
Volume to Weight Conversion	tons/cy	1.60	In situ soil conversion.
Soil Excavation Mass	tons sf	90	Includes soil mass to be treated
Soil Excavation Surface Area		2,230	

EE/CA for RVAAP-34 Sand Creek Disposal Road Landfill
Alternative 2b - Ex-Situ Thermal Treatment of Soil with PAHs of Concern
Key Parameters and Assumptions

Key Parameters and Assumptions:

Item	Unit	Value	Notes
Mobilization/Demobilization	ls day	0	Mobilization not included. VEG unit is assumed to be onsite for other larger projects. Mobilization of other equipment included in 2a above.
Excavate Soils		1	
	$/day	4,994.39	Includes 2 cy excavator, 1-22 cy off highway trucks, 1 O.E., 2 T.D 1 L.S. spotter, 2 L.S. to prep trucks/and misc. Reduced productivity by 33% for loading trucks, precise excavations, and security/S&H requirements. Assume trucks are direct loaded. Average 200 cy/day and 1 day. RSMeans Crew B12-E.
Standby Time	day	0	Covered in cost of 2a above.
	$/day	857	Assume no additional hot spot excavation.
Thermal Treatment of Contaminated Soil	cy	56	Source: Endpoint Technology cost estimate using Vapor Energy Generator (VEG) Soil Remediation.
	$/cy	42.64	
Hazardous Waste	drums	0	Based on shipping one drum of hazardous waste soils to US Ecology Disposal Facility.
Transport and Offsite Disposal	$/drum	686.40	
Confirmation Sampling			
Samples	ea hrs	2	Includes 2 samples for confirmation (PAHs at $70 each)
Sampling Labor	$/hr	2	Assumes 1 sampling technician at 4 hours to collect and ship samples.
Sampling Labor	$/event	75	
Truck Rental / Gas	ea	1	1 truck x $80/day. Add $20 for gas.
Sample Materials		2	
Sample Materials	$/ea	35	
Analytical Cost	$/event	140	Analyze samples for PAHs (2 @ $70).
Restoration			Includes native soil backfill. Assume productivity has been reduced by 25% to account for security and safety requirements.
Native Soil Backfill	cy	28	Quantity is based on 4-in of native soil over the removal area to facilitate vegetation growth. Pricing basis from ECHOS 17030423 and RSMeans 312323160040, Unclassified Fill, 6" Lifts, offsite Source @ 20 miles, Includes delivery, spreading, and compaction.
Native Soil Backfill	$/cy	35.09	
Seeding, Vegetative Cover	MSF	0	Seeding with mulch and fertilizer. Price for a whole acre was included in 2a above. No additional cost for 2b is needed.
Seeding, Vegetative Cover	$/MSF	107.07	
Plans and Reports			
Corrective Action Completion Report	hrs	280	Includes Construction QC data and preparing report.
Technical Labor	$/hr	95	

EE/CA for RVAAP-34 Sand Creek Disposal Road Landfill
Alternative 2b - Ex-Situ Thermal Treatment of Soil with PAHs of Concern
Cost Estimate

CAPITAL COSTS

Activity (unit)	Quantity	Unit Cost	Total
<u>Pre-excavation Delineation and Waste Characterization Sampling</u>			
Sampling Labor (hrs) Truck	8	$75.00	$600
Rental / Gas (event)	1	$100.00	$100
Sample Materials (ea)	4	$35.00	$140
Sample Analysis (event)	1	$740.00	$740
<u>Soil Excavation</u>			
Mobilization/Demobilization (ls)	0	$0	$0
Excavate Soil (day)	1	$4,994.39	$4,994
Standby Time (day)	0	$856.89	$0
Thermal Treatment of Contaminated Soil (cy)	56	$42.64	$2,388
Hazardous Transport and Offsite Disposal (drums)	0	$686.40	$0
<u>Confirmation Sampling</u>			
Sampli ng Labor (hrs.)	2	$75.00	$150
Truck Rental with Gas	1	$100.00	$100
Sample Materials (ea)	2	$35.00	$70
Sample Analysis (event)	1	$140.00	$140
<u>Restoration</u>			
Native Soil Backfill (cy)	28	$35.09	$983
Seeding, Vegetative Cover (MSF)	0	$107.07	$0
<u>Plans and Reports</u>			
Corrective Action Completion Report (ea)	0	$95.00	$0
Subtotal for 2b (PAH Soils – Ex-situ Thermal)			$10,405
Total for Alternate 2			$38,391