DRAFT

FEASIBILITY STUDY

for Central Burn Pits

(RVAAP-49)

Ravenna Army Ammunition Plant
Ravenna, Ohio

March 2006

Contract No. GS-10F-0076J
Delivery Order No. W912QR-05-F-0033

US Army Corps of Engineers®
Louisville District

SAIC®
From Science to Solutions™

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

Prepared by:
Science Applications International Corporation
8866 Commons Boulevard, Suite 201
Twinsburg, Ohio 44087

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES (CONTINUED)

LIST OF FIGURES

LIST OF PHOTOGRAPHS

LIST OF APPENDICES

LIST OF ACRONYMS

ALM	Adult Lead Model
amsl	above mean sea level
AOC	Area of Concern
ARAR	Applicable and Relevant or Appropriate Requirements
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
BRAC	Base Realignment and Closure
C&DD	Construction & Demolition Debris
CAMU	Corrective Action Management Unit
CBP	Central Burn Pits
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	chemical of concern
COEC	chemicals of ecological concern
COPEC	chemical of potential ecological concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CSF	cancer slope factor
CSM	conceptual site model
DERR	Division of Emergency and Remedial Response
DFFO	Director’s Final Findings and Orders
DNT	dinitrotoluene
DOT	Department of Transportation
EBG	Erie Burning Grounds
EPC	exposure point concentration
ERA	ecological risk assessment
ESA	Endangered Species Act
ESCM	ecological site conceptual models
ESL	ecological screening level
ESV	ecological screening value
EU	exposure unit
EWH	Exceptional Warmwater Habitat
FBQ	Fuze and Booster Quarry Landfill/Ponds
FRTR	Federal Remediation Technologies Roundtable
FS	Feasibility Study
FWHHRAM	Facility Wide Human Health Risk Assessor’s Manual
GAF	gastrointestinal absorption factor
GDCS	generic direct-contact standards
GI	gastrointestinal
GOCO	government-owned, contractor-operated
GRA	general response actions
GSA	United States General Services Administration

LIST OF ACRONYMS (CONTINUED)

HE	high explosive
HHRA	human health risk assessment
HI	hazard index
HQ	Hazard quotient
IBI	Index of Biotic Integrity
ICI	Invertebrate Community Index
IEUBK	Integrated Exposure Uptake Biokinetic Model for Lead in Children
ILCR	incremental lifetime cancer risk
IRP	Installation Restoration Program
LDR	land disposal requirement
LL12	Load Line 12
LOAEL	lowest-observed-adverse-effect level
MCL	maximum contaminant level
MCLG	maximum contaminant level goals
MDC	maximum detected concentration
MNA	monitored natural attenuation
MTR	minimum technical requirements
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NFA	no further action
NGB	National Guard Bureau
NOAEL	no-observed-adverse-effect level
NPDES	National Pollutant Discharge Elimination System
O&M	operation and maintenance
OAC	Ohio Administrative Code
ODA2	Open Demolition Area #2
OHARNG	Ohio Army National Guard
Ohio EPA	Ohio Environmental Protection Agency
PAH	polycyclic aromatic hydrocarbon
PBC	Performance Based Contract
PBT	persistent, bioaccumulative, and toxic
PCB	polychlorinated biphenyl
PP	Proposed Plan
PPE	personal protective equipment
PRG	USEPA Region 9 preliminary remediation goal
PWS	Performance Work Statement
QHEI	Qualitative Habitat Evaluation Index
RAB	Restoration Advisory Board
RAGS	Risk Assessment Guidance for Superfund
RAO	Remedial Action Objective

LIST OF ACRONYMS (CONTINUED)

RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RfC	reference concentration
RfD	reference dose
RGO	remedial goal option
RI	Remedial Investigation
RM	river mile
RME	reasonable maximum exposure
ROD	Record of Decision
RQL	Ramsdell Quarry Landfill
RRSE	Relative Risk Site Evaluation
RTLS	Ravenna Training and Logistics Site
RVAAP	Ravenna Army Ammunition Plant
SAIC	Science Applications International Corporation
SERA	Screening Ecological Risk Assessment
SRC	site-related contaminant
S/S	stabilization/solidification
SVOC	semi-volatile organic compound
TBC	to be considered
TCLP	toxicity characteristic leaching procedure
TDS	total dissolved solids
TEF	toxicity equivalent factor
TERP	transportation and emergency response plan
THI	target hazard index
TNT	Trinitrotoluene
TR	target risk
TRV	toxicity reference values
TSCA	Toxic Substances Control Act
TU	temporary unit
UCL_{95}	95% upper confidence limit
UHC	underlying hazardous constituent
USACE	United States Army Corps of Engineers
USACHPPM	United States Army Center for Health Promotion and Prevention Medicine
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
USP&FO	United States Property and Fiscal Officer
UTS	universal treatment standards
UV	ultraviolet
VAP	Voluntary Action Program

LIST OF ACRONYMS (CONTINUED)

VOC	volatile organic compound
WQC	water quality criteria
WQS	water quality standard
WWH	warmwater habitat
WWTP	waste water treatment plant

1.0 INTRODUCTION

Science Applications International Corporation (SAIC) has been contracted by the United States Army Corps of Engineers (USACE) Louisville District to provide environmental services to achieve interim remedy for soils (including dry sediments) of six high priority areas of concern (AOCs) at the Ravenna Army Ammunition Plant (RVAAP) in Ravenna, Ohio by September 30, 2007:

- RVAAP-01 Ramsdell Quarry Landfill (RQL);
- RVAAP-02 Erie Burning Grounds (EBG);
- RVAAP-04 Open Demolition Area #2 (ODA2);
- RVAAP-12 Load Line 12 (LL12);
- RVAAP-16 Fuze and Booster Quarry Landfill/Ponds (FBQ); and
- RVAAP-49 Central Burn Pits (CBP).

This work is being performed under a firm fixed price basis in accordance with United States General Services Administration (GSA) Environmental Advisory Services Contract GS-10-F-0076J under a Performance Based Contract (PBC) as specified in the Performance Work Statement (PWS) issued by the Army on February 10, 2005 (USACE 2005h). In addition, planning and performance of all elements of this work will be in accordance with the requirements of the Director's Final Findings and Orders (DFFO) dated June 10, 2004 (Ohio EPA 2004).

1.1 PURPOSE

The Feasibility Studies (FSs) for the six high priority AOCs present remedial alternatives to address contaminated soil (including dry sediment). Remediation of impacts to aqueous media (groundwater and surface water) and subaqueous sediment are not included under the scope of the PBC. Implementation of an alternative to address only soil is considered as an interim action or remedy. Groundwater and surface water media are to be addressed under future decisions. The following steps summarize the process supporting development and implementation of interim remedies for soil at the six high priority AOCs:

1. Complete Remedial Investigation (RI) Reports;
2. Complete FS and Reports;
3. Prepare Proposed Plan(s) (PP);
4. Prepare Record of Decision(s) (ROD);
5. Prepare Remedial Design (RD) Work Plans;
6. Implement the RD Work Plans; and
7. Prepare Remedial Action Reports.

The CBP RI phase is complete with the submittal of the Supplemental Phase II RI which is appended to this FS. The RI phase of the work includes evidence of impacts that require further evaluation in a FS. This report documents the FS for soil/dry sediment media at CBP in compliance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980.

This FS evaluates remedial actions to reduce risks to the environment and human health at CBP in accordance with remedial action objectives (RAOs) and to obtain interim remedy for soils/dry sediments. RAOs are developed in the FS to protect receptors from impacted environmental media and chemicals of concern (COCs) identified in the CBP RI Report (USACE 2005f). Applicable and relevant or appropriate requirements (ARARs) also are identified.

Depending on the outcome of the evaluation in this FS, a preferred alternative will be submitted for public review and comment. Public comments will be considered in the final selection of a remedy which will be documented in a ROD. Responses to public comments will be addressed in the responsiveness summary of the ROD.

1.2 SCOPE

This FS evaluates necessary CERCLA remediation requirements for chemical contamination in soils/dry sediment to achieve interim remedy at CBP. In addition, residual soils are evaluated to demonstrate that the evaluated remedy is protective of groundwater with respect to the anticipated future land use. Remediation of aqueous media (i.e., groundwater, surface water, and subaqueous sediments) is not included in the scope of this FS; therefore, the remedies evaluated in this FS are considered interim. Preliminary information from facility-wide studies indicates surface water and groundwater have not been impacted from CBP.

Ohio Army National Guard (OHARNG) has established future land uses for CBP based on anticipated training mission and utilization of the Ravenna Training and Logistics Site (RTLS) (USACE 2004c). These anticipated future land uses in conjunction with the evaluation of unrestricted land use and associated receptors form the basis for identifying and evaluating remedial alternatives in this FS.

This FS Report contains an evaluation of a trespasser scenario in addition to the anticipated current/future receptors identified in the RVAAP Facility Wide Human Health Risk Assessor's Manual (FWHHRAM; USACE 2004b) (i.e., National Guard Trainee, National Guard Dust/Fire Control Worker, Security Guard/Maintenance Worker, Hunter/Trapper/Fisher, and Resident Subsistence Farmer [adult and child]). An Adult and Juvenile Trespasser scenario was evaluated to supplement the baseline human health risk assessment (HHRA) detailed in the RI Report per the FWHHRAM Amendment #1 (USACE 2005c) to provide risk managers with information to support determination of the need for continued security at the facility.

1.3 REPORT ORGANIZATION

The organization of this report is based on the United States Environmental Protection Agency (USEPA) guidance and includes eight major sections. This report presents the findings of the FS conducted for CBP and is organized as follows:

- Section 2: Background Information;
- Section 3: Remedial Action Objectives;

- Section 4: Applicable or Relevant and Appropriate Requirements;
- Section 5: Technology Types and Process Options;
- Section 6: Development of Remedial Alternatives;
- Section 7: Analysis of Remedial Alternatives;
- Section 8: Agency Coordination and Public Involvement;
- Section 9: Conclusions; and
- Section 10: References.

Section 2 summarizes facility and AOC background information. Section 3 outlines the development of RAOs for the constituents and media of concern. Section 4 presents the ARARs. Section 5 reviews the identification and screening of technology types and process options considered for possible use in site remediation. Section 6 develops the proposed remedial alternatives, which are analyzed in detail in Section 7. Section 8 summarizes partnering and public involvement activities. Section 9 presents conclusions. References are found in Section 10, followed by the appendices. The appendices provide information supporting the evaluations presented in the body of this FS Report:

- Appendix 2A: evaluation of trespasser (adult and juvenile) exposure scenario;
- Appendix 2B: presentation/evaluation of Supplemental Phase II RI sampling results for CBP; and
- Appendix 7A: detailed cost estimate.

Appendix 2B and text in this FS Report summarize the results of the Supplemental Phase II RI implemented in November 2005. The supplemental investigation completes delineation of extent at CBP. This FS presents and incorporates these supplemental results into the assessment of CBP.

2.0 BACKGROUND INFORMATION

2.1 FACILITY-WIDE BACKGROUND INFORMATION

2.1.1 General Site Description

RVAAP is a 1,481-acre portion of the 21,419-acre RTLS of OHARNG. A total of 19,938 acres of the former 21,419-acre RVAAP was transferred to the United States Property and Fiscal Officer (USP&FO) for Ohio in 1996 and 1999 for use by OHARNG as a military training site. The current RVAAP consists of 1,481 acres in several distinct parcels scattered throughout the confines of the OHARNG RTLS. The RVAAP and RTLS are co-located on contiguous parcels of property and the RTLS perimeter fence encloses both installations. Since the Installation Restoration Program (IRP) encompasses past activities over the entire 21,419 acres of the former RVAAP, the site description of the RVAAP includes the combined RTLS and RVAAP properties. The RVAAP was previously operated as a government-owned, contractor-operated (GOCO) United States Army facility. Currently, the installation is jointly operated by the United States Army Base Realignment and Closure (BRAC) Office and OHARNG.

The RVAAP is located within the confines of the RTLS which is in northeastern Ohio within Portage and Trumbull Counties, approximately 4.8 kilometers (3 miles) east northeast of the town of Ravenna and approximately 1.6 kilometers (1 mile) northwest of the town of Newton Falls (Figure 2-1). The RVAAP portions of the installation are solely located within Portage County. The installation consists of a 17.7-kilometer (11-mile) long, 5.6-kilometer (3.5-mile)-wide tract bounded by State Route 5, the Michael J. Kirwan Reservoir, and the CSX System Railroad on the south; Garrett, McCormick and Berry roads on the west; State Route 534 to the east, and the Norfolk Southern Railroad on the north. The installation is surrounded by several communities: Windham on the north, Garrettsville 9.6 kilometers (6 miles) to the northwest, Newton Falls 1.6 kilometers (1 mile) to the east, Charlestown to the southwest, and Wayland 4.8 kilometers (3 miles) southeast.

Industrial operations at the former RVAAP consisted of 12 munitions-assembly facilities referred to as “load lines.” Load Lines 1 through 4 were used to melt and load 2,4,6-trinitrotoluene (TNT) and Composition B into large-caliber shells and bombs. The operations on the load lines produced explosive dust, spills, and vapors that collected on the floors and walls of each building. Periodically, the floors and walls were cleaned with water and steam. The liquid, containing 2,4,6-TNT and Composition B, was known as “pink water” for its characteristic color. Pink water was collected in concrete holding tanks, filtered, and pumped into unlined ditches for transport to earthen settling ponds. Load Lines 5 through 11 were used to manufacture fuzes, primers, and boosters. Potential contaminants in these load lines include lead compounds, mercury compounds, and explosives. From 1946 to 1949, LL12 was used to produce ammonium nitrate for explosives and fertilizers prior to its use as a weapons demilitarization facility.

In 1950, the facility was placed in standby status and operations were limited to renovation, demilitarization, and normal maintenance of equipment, along with storage of munitions. Production activities were resumed from July 1954 to October 1957 and again from May 1968 to August 1972. In addition to production missions, various demilitarization activities were conducted at facilities constructed at Load Lines 1, 2, 3, and 12. Demilitarization activities included disassembly of munitions and explosives melt-out and recovery operations using hot water and steam processes. Periodic demilitarization of various munitions continued through 1992.

In addition to production and demilitarization activities at the load lines, other facilities at RVAAP include sites that were used for the burning, demolition, and testing of munitions. These burning and demolition grounds consist of large parcels of open space or abandoned quarries. Potential contaminants at these AOCs include explosives, propellants, metals, waste oils, and sanitary waste. Other types of AOCs present at RVAAP include landfills, an aircraft fuel tank testing facility, and various general industrial support and maintenance facilities.

2.1.2 Demography and Land Use

RVAAP/RTLS consists of 8,668.3 hectares (21,419 acres) and is located in northeastern Ohio, approximately 37 kilometers (23 miles) east-northeast of Akron and 48.3 kilometers (30 miles) west-northwest of Youngstown. RVAAP/RTLS occupies east-central Portage County and southwestern Trumbull County. United States Census Bureau population estimates for 2001 indicate that the populations of Portage and Trumbull counties are 152,743 and 223,982, respectively. Population centers closest to RVAAP/RTLS are Ravenna, with a population of 12,100, and Newton Falls, with a population of 4,866.

The RVAAP/RTLS facility is located in a rural area and is not close to any major industrial or developed areas. Approximately 55% of Portage County, in which the majority of RVAAP/RTLS is located, consists of either woodland or farmland acreage. The closest major recreational area, the Michael J. Kirwan Reservoir (also known as West Branch Reservoir), is located adjacent to the western half of RVAAP/RTLS south of State Route 5.

RVAAP is in the process of regulatory environmental closure and is operated by the BRAC Office. The BRAC Office controls environmental AOCs at RVAAP. The National Guard Bureau (NGB) controls non-AOC areas and has licensed these areas to OHARNG for training purposes. Training and related activities at RTLS include field operations and bivouac training, convoy training, equipment maintenance, C-130 aircraft drop zone operations, helicopter operations, and storage of heavy equipment. As environmental AOCs are investigated and addressed or remediated, if needed, transfer of these AOCs from the BRAC Office to NGB is conducted.

Until May 1999, approximately 364 hectares (900 acres) of land and some existing facilities at RVAAP were used by the NGB for training purposes administered by OHARNG. In May 1999, NGB assumed operational control of 16,164 acres of RVAAP and licensed OHARNG to use the facility for training and other activities. In December 2001, operational control of an additional 1,528 hectares (3,774 acres) of RVAAP was transferred to NGB bringing the total to 8,039 hectares (19,938 acres).

OHARNG has prepared a comprehensive Environmental Assessment and an Integrated National Resources Management Plan to address future use of RTLS property (OHARNG 2001). The perimeter of RVAAP/RTLS is currently fenced and the perimeter is patrolled intermittently by the facility caretaker contractor. Access to RVAAP/RTLS is strictly controlled and any contractors, consultants, or visitors who wish to gain access to the facility must follow procedures established by RVAAP/RTLS and the facility caretaker contractor.

2.1.3 RVAAP/RTLS Physiographic Setting

RVAAP/RTLS is located within the Southern New York Section of the Appalachian Plateau physiographic province (USGS 1968). This province is characterized by elevated uplands underlain primarily by Mississippian- and Pennsylvanian-age bedrock units that are horizontal or gently dipping. The province is characterized by its rolling topography with incised streams having dendritic drainage patterns. The Southern New York Section has been modified by glaciation, which rounded ridges and filled major valleys and blanketed many areas with glacially derived unconsolidated deposits (i.e., sand, gravel, and finer-grained outwash deposits). As a result of glacial activity in this section, old stream drainage patterns were disrupted in many locales, and extensive wetland areas developed.

2.2 CENTRAL BURN PITS

2.2.1 Site History

CBP is located in the east-central area at the intersection of Paris-Windham Road and Lumber Yard Road, and covers approximately 20 acres (Figure 2-2). It was originally used as a lumber and building materials storage area, and later used for open burning of non-explosive wastes, electrical components, wooden boxes, and scrap and the disposal of other non-hazardous waste material. Operation of the burn pits is believed to have started shortly after RVAAP began operations and continued into the mid-1970s, although actual dates are unknown. The burn pits are comprised of bare mounds of slag and debris, and there are approximately 15 located within the AOC. Three burn areas, characterized by debris, scrap materials, and distressed vegetation, were identified in the eastern portion of the AOC near Lumber Yard Road. The AOC is bordered by old railroad beds to the north (Track 39) and south (Track 33), and Sand Creek to the west-northwest.

2.2.2 Site and Surface Features

The topography across the majority of CBP is relatively flat due to historical grading and fill activities. Undisturbed topography is characterized by gently undulating contours. Sand Creek forms the western AOC boundary. Elevations vary from 292 to 298 meters (960 to 980 ft) (Figure 2-3). Structural features include former rail lines Track 39 and Track 33. Other features include piles and berms in the central area and burn areas in the eastern area. Miscellaneous materials including glass, ceramics, and rail road ties have been noted. Several berms and piles are seen in Photograph 2-1. There are no buildings at CBP. Soils in the area consist primarily of silty loams. Two drainage systems are present; one associated with Track 33, and the other drains water from the central bare areas to the northeast corner of the site. All ditches discharge to the adjacent Sand Creek.

Photograph 2-1. Berms/Piles at CBP, April 2005

2.2.3 Site Investigations

Figure 2-4 shows the locations of soil, sediment, and surface water sample locations and groundwater monitoring wells for previous and current site investigations.

2.2.3.1 Previous Investigations

Two previous investigations have been conducted at CBP. The "Relative Risk Site Evaluation for Newly Added Sites at the RVAAP, Ravenna, Ohio, Hazardous and Medical Waste Study No. 37-EF-5360-99, 19-23 October 1998," by the United States Army Center for Health Promotion and Prevention Medicine (USACHPPM) evaluated 13 new sites, resulting in CBP being classified as a high-priority AOC. The Phase I RI (USACE, 2005f) sampled soil (0-3 ft bgs) and subsurface soil (3-30 ft bgs), sediment, surface water, and groundwater in order to characterize contamination at the site.

2.2.3.2 Supplemental Phase II RI

Results of the supplemental Phase II RI sampling activities conducted in November 2005 are included in this FS. The primary objectives of the Supplemental Phase II RI of CBP were to conduct surface (0-1 ft bgs) and subsurface (1-3 ft bgs) soil sampling to define the nature and extent of contamination at CBP and to collect additional data from the piles and berms at CBP to assess disposition requirements/options. Piles and berms (Figure 2-5) identified at CBP during the Phase I RI and subsequent site visits were not evaluated in the Phase I RI. During a field reconnaissance in September 2005, field measurements of the approximate dimensions of these piles and berms were collected. The dimensions and estimated volumes are summarized in Table 2-1. Complete results of the Phase II Supplemental RI along with an assessment of the impacts, if any, on the completed HHRA and ecological risk assessment (ERA) are provided in Appendix 2B and summarized in the appropriate sections of this FS.

Table 2-1. CBP Piles and Berms

Surface Features	Approximate Dimensions	Shape	Estimated Volume
Berm A[1]	Length = 570 ft, Width = 19 ft Height = 3 ft	Rectangular	32,5500 cu feet 1,200 cu yards
Pile B	Height = 8 ft, Radius = 10 ft	Pile	1,260 cu feet 47 cu yards
Pile C	Height = 8 ft, Radius = 10 ft	Pile	1,260 cu feet 47 cu yards
Berm D[2]	Length = 340 ft, Width = 15 ft Height = 3 ft	Rectangular	15,300 cu feet 570 cu yards
Pile E	Length = 12 ft, Width = 8 ft Height = 4 ft	Rectangular	380 cu feet 14 cu yards
Pad F	Length = 6 ft, Width = 6 ft	Rectangular	NA
Berm H	Length = 245 ft, Width = 13 ft Height = 4 ft	Rectangular	12,740 cu feet 470 cu yards
Pile I[3]	Length = 304 ft, Width = 12 ft Height = 4 ft	Rectangular	14,600 cu feet 540 cu yards
Berm K	Length = 120 ft, Width = 9 ft Height = 1.5 ft	Rectangular	1,620 cu feet 60 cu yards
Pile L	Height = 8 ft, Radius = 5 ft	Pile	310 cu feet 11 cu yards
Pile M	Height = 3 ft, Radius = 19 ft	Pile	1,700 cu feet 63 cu yards
Pile N	Height = 4.5 ft, Radius = 10 ft	Pile	710 cu feet 26 cu yards
Pile P[4]	Height = 8 ft, Radius = 10 ft	Pile	1,260 cu feet 47 cu yards

[1] Berm A was re-surveyed after the Supplemental Phase II sampling and length was adjusted.
[2] Berm D encompasses Berm D and Berm G from the Supplemental Phase II Sampling and Analysis Plan
[3] Pile I was re-surveyed after the Supplemental Phase II sampling and length was adjusted.
[4] Pile P identified during site walkover with Ohio EPA November 14, 2005.

2.2.4 Nature and Extent

Nature and extent of contamination at CBP was determined based on the evaluation of the Phase I RI and Supplemental Phase II RI data. Figure 2-4 shows the locations of soil, sediment, and surface water sample locations, and groundwater monitoring wells.

2.2.4.1 Soil Sampling (0-3 ft bgs)

During the Phase I RI at CBP, one explosive compound (2,4,6-TNT) was detected in one soil sample (SS-010) in each sample interval (0-1 ft bgs and 1-3 ft bgs). The concentration in the deeper sample was less than that of the shallow sample. One propellant (nitrocellulose) was detected at five sample locations in the 0 to 1 ft interval. At one sample location nitrocellulose was also detected in the 1 to 3 ft interval. The concentration in the deeper sample was less than that of the shallow sample. All samples from both intervals had at least one inorganic detected that exceeded background and/or Region 9 Residential Preliminary Remediation Goals (PRGs). Arsenic was the most common analyte present above established criteria. Cyanide exceeded the Region 9 residential PRG in 13 sample locations in the 0 to 1 ft interval and five sample locations from the 1 to 3 ft interval. At least one pesticide was detected in three sample locations (0-1 ft), although none exceeded Region 9 residential PRGs. The concentrations in two of the samples were below detection limits. The polychlorinated biphenyl (PCB) Aroclor-1254 was detected in three soil samples (0-1 ft). All concentrations were below Region 9 residential PRGs. No volatile organic compounds (VOCs) or semi-volatile organic compounds (SVOCs) were detected in any soil sample (0-1 ft bgs and 1-3 ft bgs). All soil samples submitted for asbestos analysis resulted in no asbestos detected.

No explosives, VOCs, or pesticides were detected in any of the surface samples from the nine soil borings completed. One surface soil boring sample contained nitrocellulose and nitroguanidine and one sample contained nitrocellulose. All surface samples from the soil borings had at least one inorganic that exceeded background or Region 9 residential PRGs values. One surface soil boring sample contained eight SVOCs, seven of which exceeded background and/or Region 9 residential PRGs.

The results of the Supplemental Phase II RI identified one explosive (nitrobenzene) in soil (0-1 ft bgs and 1-3 ft bgs). The maximum detection was 0.05 mg/kg in CBP-036 and CBP-037 shallow (0-1 ft bgs) soil samples. These results are below the reporting limits for nitrobenzene. The extent of explosives in soil at CBP has been defined to reporting limits with the additional data collected.

The results of the two discrete soil sample locations (CBP-035 and CBP-036 [0-1 ft bgs and 1-3 ft bgs]) were collected to define the extent of manganese contamination which exceeded background at location SS-026. All four of the samples were well below the facility-wide background values for manganese (1,450 mg/kg for surface and 3,030 mg/kg for subsurface). Therefore the extent of inorganic contamination in soil at CBP has been defined with the additional data collected.

The areas exhibiting the greatest numbers and concentrations of explosives and inorganics have been identified and delineated. Adequate data has been collected and the uncertainties of the Phase II RI have been addressed.

2.2.4.2 Subsurface Soil Borings Samples (>3 ft bgs)

Eight soil samples (2-ft composites) were collected from between 17 and 24 feet bgs. No explosives, propellants, pesticides, PCBs, VOCs, or SVOCs were detected in any of the soil boring samples (>3 ft bgs). All eight soil boring samples (>3 ft bgs) contained at least one inorganic above background and/or Region 9 residential PRGs.

2.2.4.3 Multi-increment Soil Samples

Multi-increment samples were collected from the twelve identified piles and berms at CBP. One multi-increment sample was collected for each pile/berm identified. In general, three high explosives (HEs) (2,6-Dinitrotoluene, nitrobenzene, and tetryl) were detected in at least one sample. All detections were below Region 9 residential PRGs.

Twenty-four inorganic chemicals were detected in at least one sample. Five were essential nutrients. Two of these (iron and potassium) were below background in all samples. Three (calcium, magnesium, and sodium) exceed background in one or more samples. Detected concentrations of four metals (cobalt, nickel, thallium, and vanadium) were below background in all samples. Detected concentrations of two metals (beryllium and selenium) were above background but below Region 9 residential PRGs in several samples. Thirteen metals were detected above background and Region 9 residential PRGs in one or more samples.

Pile M (Figure 2-5) had a lead concentration result of 8,560 mg/kg and also had a lead Toxicity Characteristic Leaching Procedure (TCLP) result of 15.4 mg/L. This exceeds the maximum concentration of lead (5.0 mg/L) for toxicity characteristics and would probably have to be disposed of as hazardous waste. Also, Pile N had a detected value of 25 mg/kg of hexavalent chromium.

2.2.4.4 Sediment

No explosives, pesticides, or PCBs were detected in any of the sediment samples. A propellant (nitrocellulose) was detected at two sediment locations. All nine sediment samples contained at least one inorganic above background and/or Region 9 residential PRGs. Acetone was detected in one sediment sample and methylene chloride was detected in another. These concentrations did not exceed background or Region 9 residential PRGs. Eight SVOCs were detected in one sample (SD-002). All concentrations were below detection limits. One compound, benzo(a)pyrene, was detected above the Region 9 residential PRG.

2.2.4.5 Surface Water

All three surface water samples were taken from Sand Creek. No explosives, propellants, pesticides, PCBs, VOCs, or SVOCs were detected in any of the surface water samples. Calcium and magnesium exceeded their background values in all three surface water samples, and arsenic exceeded the Region 9 residential PRG at two locations.

2.2.4.6 Groundwater

No explosives, propellants, pesticides, PCBs, or SVOCs were detected in any of the groundwater samples. All eight groundwater samples contained at least one inorganic that exceeded background. Acetone was detected in one sample.

2.2.5 Fate and Transport Analysis

The primary contaminant migration pathways of concern for contaminants at CBP are overland runoff and transport in surface drainage channels, including Sand Creek. Contamination concentrations in soil were low, so leaching from the soil is not a significant pathway. No organic chemicals were detected in the groundwater, indicating that leaching and migration within groundwater is not of significant concern.

2.2.6 Human Health Risk Assessment

A baseline HHRA was performed in the Phase I RI (USACE 2005f) to assess the potential current and future risks associated with human exposure to site-related contaminants found at CBP. Future land use scenarios include ownership by the National Guard Bureau (NGB) for training purposes; use by recreational hunters and fishermen; and use as a residential farm. Risks were evaluated for a National Guard trainee and a National Guard resident/trainer; a hunter/trapper; security maintenance worker; and a resident farmer (adult and child). COCs were selected and toxicological and exposure factors were applied to evaluate risk. The baseline HHRA indicates potential risks for some receptors under specific conditions (Table 2-2).

Table 2-2. Summary of HHRA Risk Results for Direct Contact at the Central Burn Pit

Receptor	Total HI	Total ILCR	COCs	Notes
National Guard Trainee (Representative Receptor)				
Deep Surface Soil[a]	4.1	1.6E-05	As, Cr, Mn	HQ>1 for Mn inhalation. ILCR exceeds USEPA and Ohio EPA target risk. Primary risk driver is Cr evaluated as hexavalent chromium, risk from As is below Ohio EPA target risk.
Sediment	0.045	2.3E-06	As	Exceeds USEPA *deminimis* risk but below Ohio EPA target risk.
Surface Water	--	--	--	--
Groundwater	0.36	5.8E-05	As	Exceeds USEPA and Ohio EPA target risk.
Security Guard/Maintenance Worker				
Shallow Surface Soil[a]	0.10	8.1E-06	As, B(*a*)P	Exceeds USEPA *deminimis* risk but below Ohio EPA target risk.

Table 2-2. Summary of HHRA Risk Results for Direct Contact at the Central Burn Pit (continued)

Receptor	Total HI	Total ILCR	COCs	Notes
Hunter				
Shallow Surface Soil[a]	0.0010	8.9E-08	None	Below USEPA and Ohio EPA target risk values for all media.
Sediment	0.0010	9.8E-08	None	--
National Guard Resident				
Shallow Surface Soil[a]	0.20	1.3E-05	As, B(*a*)P	Exceeds USEPA and Ohio EPA target risk. Primary risk driver is As, risk from B(*a*)P is below Ohio EPA target risk.
Subsurface Soil[a]	0.13	1.0E-05	As	Exceeds USEPA and Ohio EPA target risk.
Sediment	0.26	1.5E-05	As, B(*a*)P	Exceeds USEPA and Ohio EPA target risk. Primary risk driver is As, risk from B(*a*)P is below Ohio EPA target risk.
Surface Water	--	--	--	--
Groundwater	2.3	3.7E-04	As	Exceeds USEPA and Ohio EPA target risk.
Resident Subsistence Farmer[b]				
Shallow Surface Soil[a]	1.7	6.0E-05	As, Aroclor-1254, B(*a*)P	Exceeds USEPA and Ohio EPA target risk. Primary risk driver is As, risk from other COCs is below Ohio EPA target risk.
Subsurface Soil[a]	1.2	4.8E-05	As	Exceeds USEPA and Ohio EPA target risk.
Sediment	0.45	1.5E-05	As, B(*a*)P	Exceeds USEPA and Ohio EPA target risk. Primary risk driver is As, risk from B(*a*)P is below Ohio EPA target risk.
Surface Water	--	--	--	--
Groundwater	11		As	Exceeds USEPA and Ohio EPA target risk.

As = arsenic
B(*a*)P = benzo(*a*)pyrene
COC = Chemical of concern.
Cr = chromium (evaluated as hexavalent chromium)
HI = Hazard index.
ILCR = Incremental lifetime cancer risk.
Mn = manganese
-- = no COPCs identified in surface water.

[a] Shallow surface soil includes samples from 0-1 ft below ground surface (bgs); Deep surface soil includes samples from 0-4 ft bgs; Subsurface soil includes samples from 1-30 ft bgs.

[b] Noncancer risks were calculated separately for Adult and Child Resident Subsistence Farmer scenarios. The maximum HI (for the child) are presented here. Cancer risks were calculated for a combined adult and child "Lifelong" Resident Subsistence Farmer scenario.

Supplemental discrete soil samples were collected from surface (0-1 ft bgs) and subsurface (1-3 ft bgs) soil at CBP to complete the analysis of nature and extent of contamination. These supplemental data are presented in Appendix 2B and summarized in Section 2.2.3 and 2.2.4 of this FS. Evaluation of the supplemental soil data shows that these new data do not change the conclusions of the HHRA at CBP for shallow (0-1 ft bgs) surface soil or subsurface (1-30 ft bgs) soil. The supplemental data confirm the majority of the chromium in deep surface soil (0-4 ft bgs) is not hexavalent chromium and chromium is not a risk driver for the National Guard Trainee. Thus, the only COCs for the National Guard Trainee exposed to deep surface soil are arsenic and manganese.

Multi-increment samples were collected from the berms/piles at CBP to assess disposition requirements/options and are not included in the HHRA. Evaluation of the supplemental waste berm/pile data shows three HEs detected in the berms/piles. All were below Region 9 residential PRGs. Several metals were detected at concentrations exceeding background and/or Region 9 residential PRGs. Piles M and N are burn piles and contain both the highest concentrations and the largest number of metals above background and risk-based screening values.

2.2.7 Ecological Risk Assessment

The screening ecological risk assessment (SERA) process provides a very conservative evaluation of the potential for risk to ecological receptors by comparing the maximum detected concentration (MDC) of chemicals in soil, sediment, and surface water to conservative medium-specific ecological screening values (ESVs). Chemicals with no ESV are also retained. As part of this screen, all chemicals classified as persistent, bioaccumulative, and toxic (PBT) are retained regardless of their concentration or frequency of detection. Inorganic PBT compounds include cadmium, lead, mercury, and zinc. Organic PBT chemicals include any compound whose log K_{ow} is at least 3.0. Chemicals retained by the SERA process are considered chemicals of potential ecological concern (COPECs). For the Level II Screen, specific receptors are not identified because the ESVs are conservative screening toxicity benchmarks that are intended to protect multiple receptors.

The baseline ecological risk assessment (BERA) continues the SERA process. The focus is on soil, sediment, and surface water and on specific ecological receptors, e.g., mammals, birds, and aquatic organisms. Its input chemicals are COPECs and the BERA process produces chemicals of ecological concern (COECs). COECs are identified as chemicals having a Hazard Quotient (HQ) > 1.0 for one or more of the ecological receptors that were evaluated in the BERA, and chemicals for which there were no toxicity reference values (TRVs) associated with an expected level of effect. The HQ is calculated as the quotient of the exposure concentration or dose and the TRV. Terrestrial receptors evaluated included plants, soil-dwelling invertebrates (earthworms), mammalian herbivores (deer mice and white-tailed deer), insectivorous mammals (shrews), and top predators (red foxes and red-tailed hawks). Sediment and surface water receptors evaluated included sediment biota, aquatic biota, herbivores (mallard ducks and muskrats), and top predators (mink and great blue heron).

Ecological impact was evaluated for plants; soil and sediment invertebrates; aquatic organisms; and terrestrial wildlife. Three types of mammals and birds were evaluated: insectivores/herbivores, carnivores, and piscivores. The results of the ecological risk calculations are summarized in Table 2-3 for soil and in Table 2-4 for all media.

The BERA (Level III Baseline) identified multiple COECs in surface soil (0-1 ft bgs) from the CBP after the completion of the "conservative scenario" that entailed using reasonable maximum exposure (RME) concentrations (i.e., lower of the maximum detected concentration and the 95% upper confidence level [UCL_{95}] of the mean) and no-observed-adverse-effect level (NOAEL) TRVs for wildlife receptors (USACE 2005f). The COECs were called chemicals of potential concern (COPCs) in the RI for the CBP (USACE 2005f) but the COPC designation was comparable to Ohio EPA's designation of COEC. The ERA for CBP included an additional screening step in the conservative scenario by comparing against Lowest-observed-adverse-effect level (LOAEL) TRVs, and also conducted an "average scenario" in which mean concentrations for calculating exposures were compared against both NOAEL and LOAEL TRVs, consistent with USEPA guidance for re-evaluation of COPCs (USEPA 1997). The Ohio EPA guidance for ERA (Ohio EPA 2003) does not describe the use of either the conservative scenario comparison using LOAEL TRVs or the average scenarios using either NOAEL or LOAEL TRVs, so the results from those analyses (USACE 2005f) are not comparable to the ecological risk results from the other 5 AOCs that did not include these analyses. The soil COECs were identified herein for the sake of equivalency as either the chemicals having an HQ > 1.0 for one or more of the ecological terrestrial receptors following the conservative scenario comparison against NOAEL TRVs, or chemicals for which there were no TRVs associated with an expected level of effect (NOAELs for wildlife, but LOAELs for plants and terrestrial invertebrates). Surface soil (0-1 ft bgs) COECs have the potential to pose a hazard or risk to plants and animals.

For surface soil, 27 total COECs were identified, including 17 inorganics and 1 PCB (arochlor-1254) COECs based on having an HQ > 1 for one or more receptors and 9 COECs [5 inorganics (calcium, magnesium, potassium, sodium, and silver), 1 pesticide (heptachlor epoxide), and 3 explosives (2,4,6-TNT, nitrocellulose, and nitroguanidine)] based on having no TRVs for at least one receptor (Table 2-3). For COECs based on HQs > 1, aluminum had the largest HQ for plants (622), followed by the HQ for iron for earthworms (535). Other large HQs included zinc (176), mercury (155), chromium for earthworms (143), cyanide (74), manganese (62) for earthworms, and lead (49) for robins.

Note that for the "average scenario" analysis using NOAEL TRVs for wildlife, there were only 5 inorganic COECs based on an HQ > 1 for at least one receptor. The COECs included arsenic, cadmium, chromium, lead, and zinc. The largest HQ was 48 for lead for robins, followed by an HQ of 10 for zinc for robins. For the average scenario analysis using LOAEL TRVs for wildlife, there was only 1 HQ > 1 (HQ = 5 for lead for robins). Thus, the average scenario analysis using LOAEL TRVs resulted in a reduction in the total number of COECs from 27 for the conservative analysis using NOAEL TRVs to 14 COECs.

In summary, based on the conservative scenario (RME concentrations and NOAEL TRVs for wildlife receptors), surface soil had 27 total COECs, including 18 based on having HQs > 1 for multiple ecological receptors and 10 COECs based on having no TRV for one or more receptors. Aluminum had the largest HQ for plants (622), followed by the HQ for iron for earthworms (535). Although some of the HQs likely overestimate the risk of their COECs to ecological receptors due to low availability of the chemicals for biological uptake from soil (e.g., aluminum), the presence of multiple COECs with HQs > 1 and lack of TRVs for multiple receptors indicates the potential for adverse effects to ecological receptors from these chemicals in CBP surface soil (0-1 ft bgs). Note, that based on the average scenario that used mean concentrations and LOAEL TRVs for wildlife, the total number of COECs decreased to 14, which included just one based on an HQ >1.

The BERA (Level III screen) was also performed to find any COECs in surface water and sediment for the CBP location (USACE 2005f). Regarding surface water, there were no inorganic and no organic COPECs. By logic, there were no inorganic and no organic COECs.

Table 2-3. Overview of Surface Soil (0-1 ft bgs) COECs at CBP – BERA (Level III)

Medium	COECs[a] with 3 Highest HQs[a]		Other COECs with HQs[a] > 1	
	COEC	HQ	COEC	Range of HQs
Surface Soil	Aluminum	622	Mercury	155
	Iron	535	Chromium	3 to 143
	Zinc	176	Cyanide	74
			Manganese	62
			Lead	12 to 49
			Copper	21
			Vanadium	19
			Selenium	13
			Arsenic	3 to 8
			Arochlor-1254	3 to 6
			Thallium	4
			Barium	2
			Cadmium	1 to 2
			Cobalt	1
			Nickel	1

COECs = chemicals of ecological concern
[a] Note: these HQs are based on Lowest Observed Adverse Effect Levels for plants and invertebrates, but No Observed Adverse Effect Levels for wildlife, and RME concentrations
RME = reasonable maximum exposure (lower of maximum detect or 95% upper confidence level of the mean)
HQ = hazard quotient

Regarding sediment, the inorganic COPECs (7) based on comparison of maximum chemical concentrations to ESVs were further reduced to COECs (3) based on comparison of average chemical concentration screening to benthos screening levels and then to yet higher effects levels described in the full text:

- Barium;
- Cyanide (total); and
- Manganese.

The organic COPECs (1 explosive and 5 SVOCs) were reduced to 2 COECs (2 SVOCs):

- Benzo(a)anthracene; and
- Pyrene.

Thus, there were 5 retained sediment COECs for risks to benthic invertebrates. There were additional short assessments applied to these five COECs and they were (1) the magnitude of criterion exceedance, (2) frequency of chemical detection and spatial distribution, (3) contaminant bioavailability, (4) habitat, and (5) alternative benchmarks. In every case, there was no reason to do any further analyses; the five COECs did not exhibit any real ecological risk. In addition, the facility-wide biology and surface water study (USACE 2005i) looked at various parameters in nearby Sand Creek (downstream and upstream stretches) and at both locations the stream was reported as being healthy and functioning and that use attainment was being met according to Ohio EPA guidance.

In summary, there were no surface water COECs and the five sediment COECs had no to little credible reasons for concern. This lack of concern according to the RI analysis was corroborated by the presence of a healthy and functioning aquatic ecosystem in nearby (Sand Creek downstream and upstream stretches) according to the facility-wide biology and surface water study. In short, there is no, to little, ecological risk from the sediment and surface water at CBP.

Table 2-4. Summary of CBP SERA Potential Risks

Type of Species	Screening Results	Notes
Terrestrial plants and soil invertebrates	Copper, lead and zinc retained as COPECs.	Several COPECs, though not retained, are potentially bioaccumulative, so they were evaluated further in wildlife.
Sediment Invertebrates	No COPECs retained.	None of the COPECs were bioaccumulative, so no further evaluation was conducted.
Aquatic Organisms	No COPECs retained.	None of the COPECs were bioaccumulative, so no further evaluation was conducted.
Terrestrial Wildlife – Carnivores	Conservative scenario and NOAEL resulted in no chemicals having an HQ >1. No COPECs retained.	Because conservative scenario and NOAEL did not result in HQ >1, the empirical data were not different from background.
Terrestrial Wildlife – Insectivores/ Herbivores	Average scenario and NOAEL resulted in HQ>1 for: arsenic (vole and shrew); lead (robin and shrew), cadmium, chromium, and zinc (robin only).	Because conservative bioavailability assumptions were made, few LOAEL exceedances, lack of habitat in areas with greatest chemical concentrations, and similarity of site average concentrations to background concentrations, risks were determined to be acceptable.

Supplemental discrete soil samples were collected from surface (0-1 ft bgs) and subsurface (1-3 ft bgs) soil at CBP to complete the analysis of nature and extent of contamination. These supplemental data are presented in Appendix 2B and summarized in Section 2.2.3 and 2.2.4 of this FS. Evaluation of the supplemental soil data shows that these new data do not change the conclusions of the ERA at CBP for surface (0-1 ft bgs) or subsurface (1-30 ft bgs) soil.

2.3 RISK CHARACTERIZATION FOR TRESPASSER (ADULT AND JUVENILE) SCENARIO

The baseline human health risk assessment (HHRA) provided in the RI Report for CBP evaluates the potential health risks to humans resulting from exposure to contamination at CBP. The HHRA presented in the CBP Phase I RI Report is based on the methods outlined in the FWHHRAM (USACE 2004b) which addresses five receptors to be evaluated at RVAAP/RTLS [National Guard Trainee, National Guard Dust/Fire Control Worker, Security Guard/Maintenance Worker, Hunter/Trapper/Fisher, and Resident Subsistence Farmer (adult and child)].

In addition to the receptors in the FWHHRAM, an Adult and Juvenile Trespasser is evaluated in this FS per the FWHHRAM Amendment #1 (USACE 2005c) to supplement the baseline HHRA provided in the RI Report to provide risk managers with information relating to potential trespasser exposure. This supplemental risk characterization is presented in Appendix 2A and is incorporated into subsequent sections of this FS as appropriate.

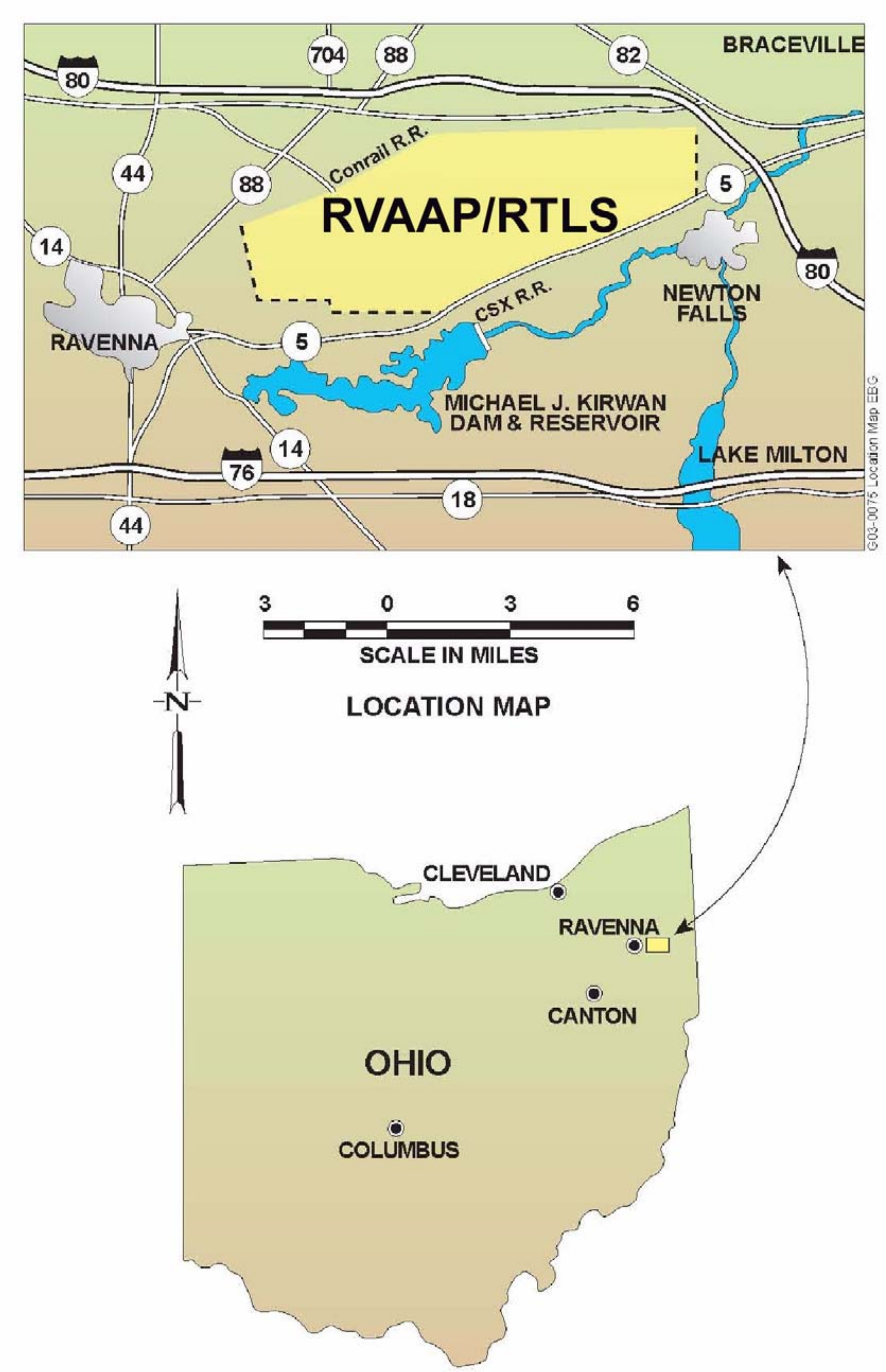

Figure 2-1. General Location and Orientation of RTLS/RVAAP

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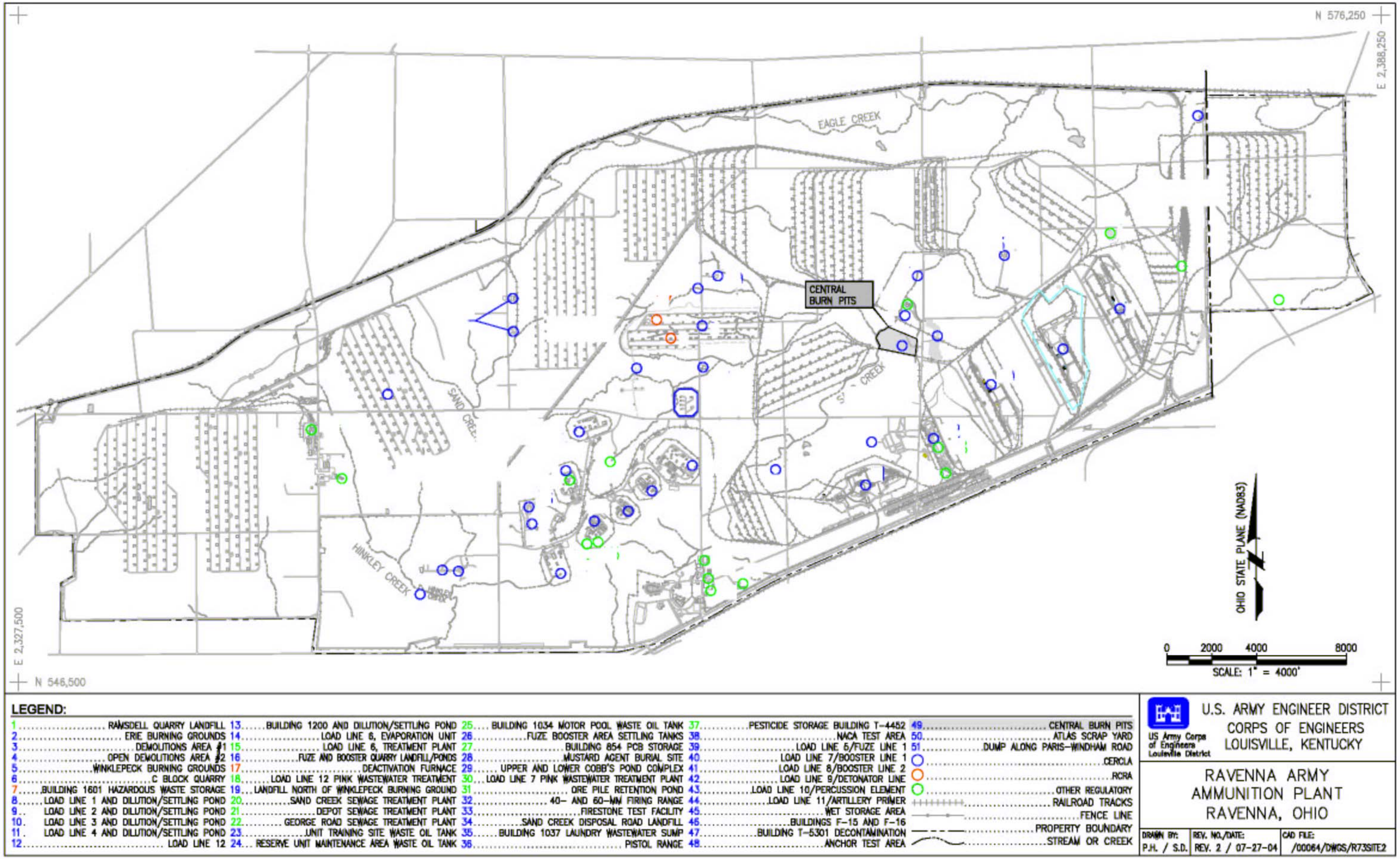

Figure 2-2. RVAAP/RTLS Installation Map

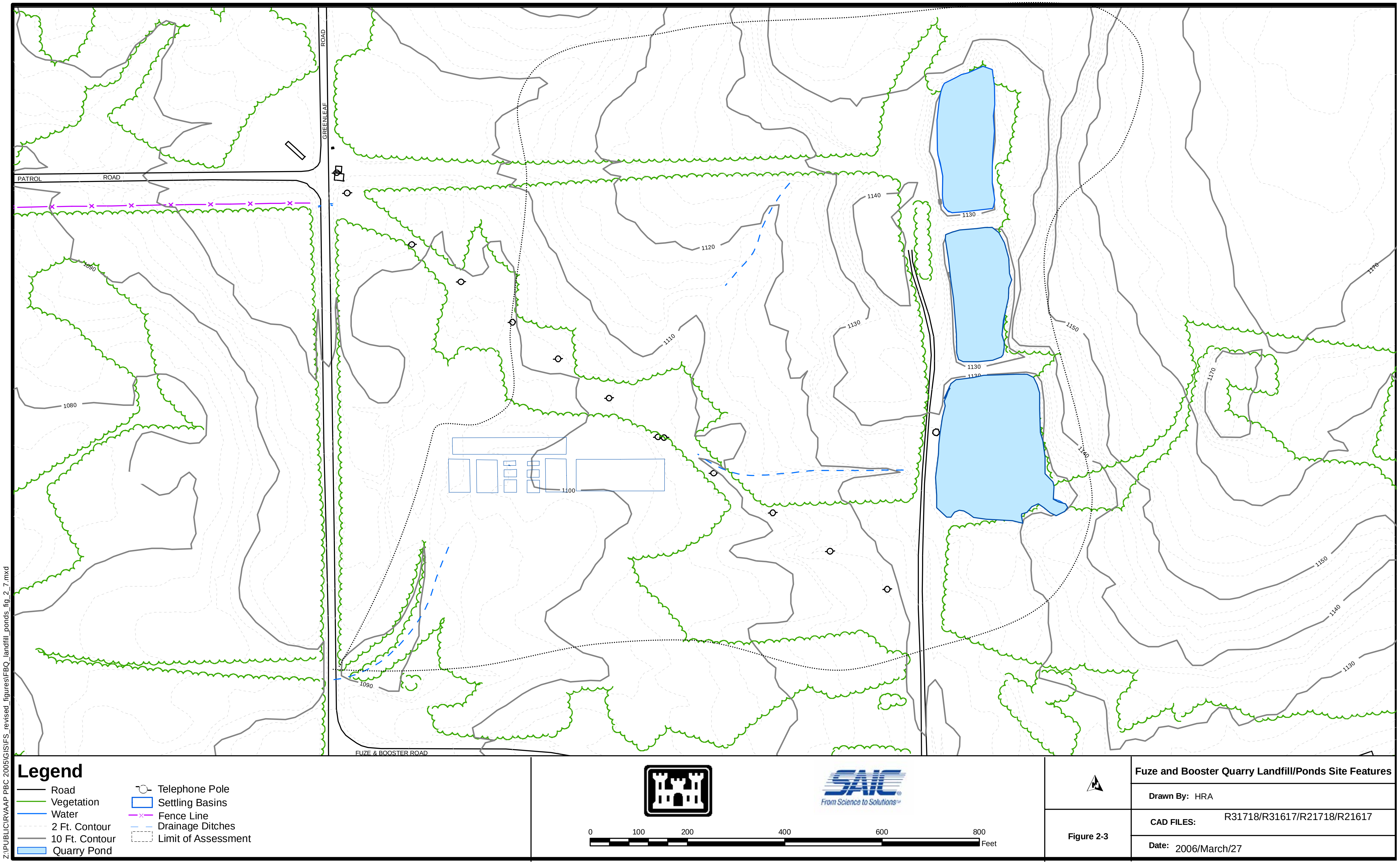

Figure 2-3. Site Features of CBP

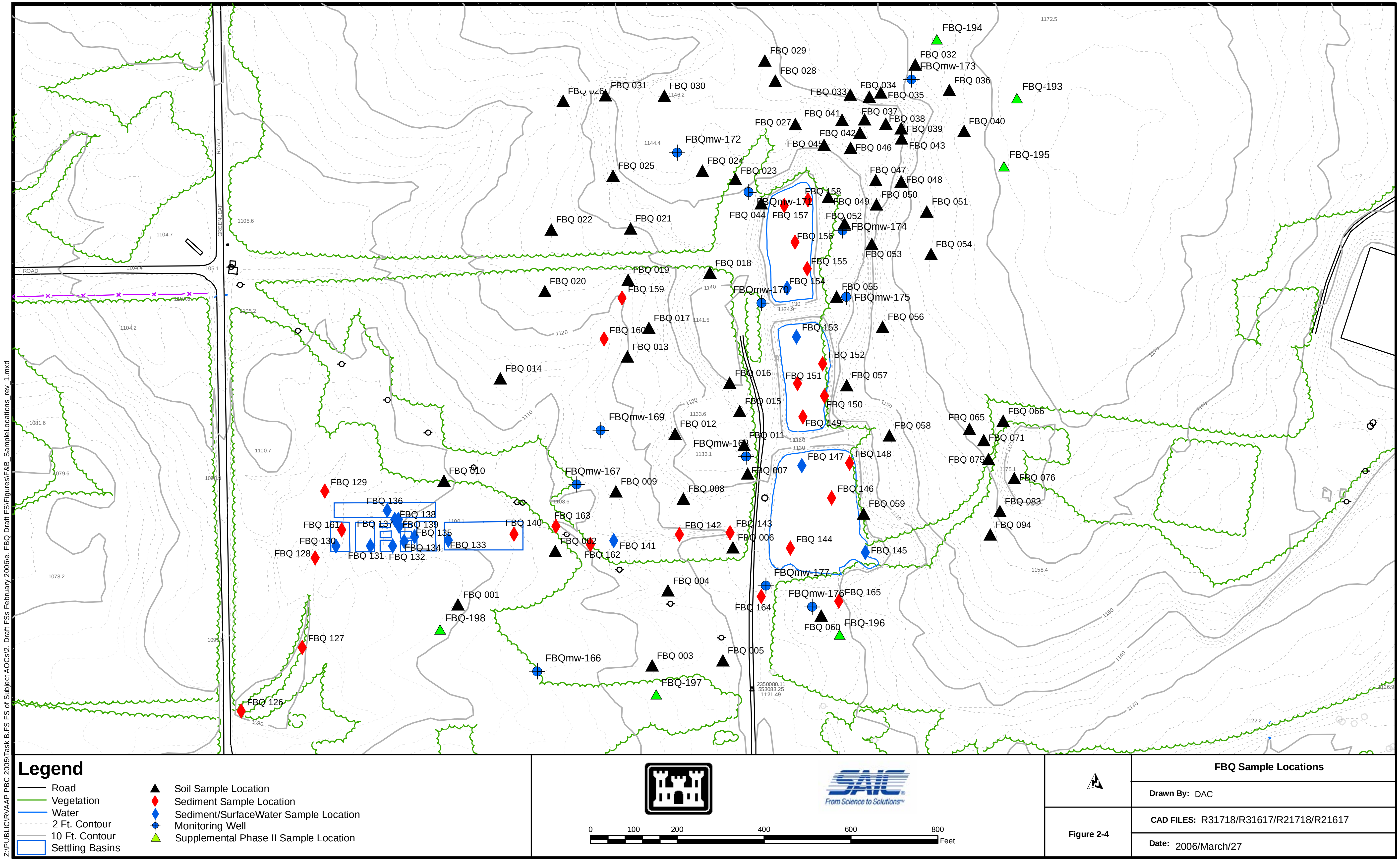

Figure 2-4. Sample Locations, Proposed Sample Locations, and Monitoring Well Locations at CBP

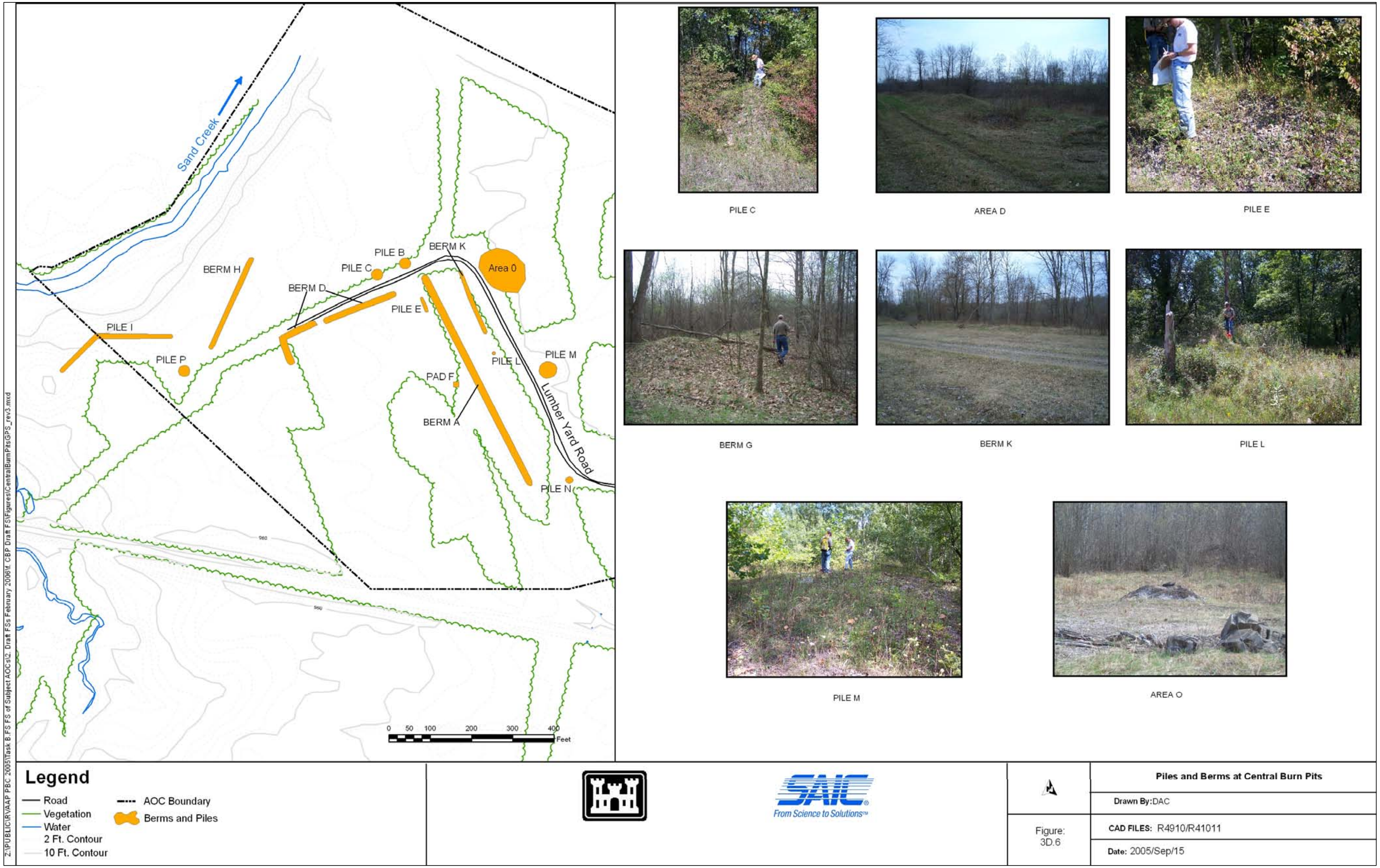

Figure 2-5. Piles and Berms at Central Burn Pits

3.0 REMEDIAL ACTION OBJECTIVES

This section of the FS describes the RAOs for CBP. RAOs specify the requirements that remedial alternatives must fulfill in order to protect human health and the environment from contaminants and provide the basis for identifying remedial technologies in Section 5. The primary objectives of this section are:

1. To present the RAOs for CBP;
2. To identify media-specific preliminary cleanup goals to meet these RAOs;
3. To identify areas of soil, sediment, surface water, and groundwater where remediation may be needed to meet the RAOs; and
4. To identify the extent of contamination to be used in volume calculations for evaluating removal/treatment alternatives.

The discussion in this section is organized as follows:

- RAOs are presented in Section 3.1.
- Anticipated future land use is discussed in Section 3.2.
- Human health preliminary cleanup goals and the identification of COCs requiring further evaluation for remedial alternatives to meet these RAOs are presented in Section 3.3.
- Ecological weight-of-evidence for meeting RAOs are presented in Section 3.4.
- An assessment of the potential for impacted soils to affect groundwater at the AOC and at an exposure point downgradient of the AOC is summarized in Section 3.5.
- A summary of the COCs and corresponding preliminary cleanup goals established for each medium from the information presented in Sections 3.1 through 3.4 is presented in Section 3.6.

3.1 REMEDIAL ACTION OBJECTIVES

RAOs specify the requirements remedial alternatives must fulfill to protect human health and the environment from site-related contaminants (SRCs) at CBP. In order to provide this protection, media-specific objectives that identify major contaminants and associated media-specific cleanup goals are developed. These objectives specify COCs, exposure routes and receptors, and acceptable constituent concentrations for long-term protection of receptors. The CBP is not included as a Military Munitions Response Program (MMRP) site of concern at RVAAP based on available historical and operational information; therefore, no removal actions or land use controls are currently planned with respect munitions and explosives of concern (MEC). The baseline risk assessment conducted for CBP is summarized in Section 2 of this FS and detailed in Sections 6 (HHRA) and 7 (ERA) of the Phase I RI Report (USACE 2005f).

As discussed in Section 2, the HHRA includes baseline risk calculations for a number of receptors for representative (National Guard use) and unrestricted land use scenarios. Table 3-1 lists the representative receptor and the unrestricted receptor for each land use scenario at CBP.

Table 3-1. Land Use Scenarios Assessed in the CBP FS

AOC	Land Use Scenario	Receptor
CBP	Restricted	National Guard Trainee
	Unrestricted	Resident Subsistence Farmer

The representative receptor corresponds to active (National Guard Trainee) and restricted (Security Guard/Maintenance Worker, Fire/Dust Suppression Worker) National Guard land uses. The Resident Subsistence Farmer provides a baseline for evaluating whether CBP may be eligible for unrestricted release. Other receptors, in addition to the representative receptor and Resident Subsistence Farmer, are evaluated in the baseline HHRA for CBP. The representative receptor chosen for CBP are protective of other activities that may occur under anticipated future land use. In addition to the receptors evaluated in the HHRA, an Adult and Juvenile Trespasser is evaluated in this FS (Appendix 2A).

Cleanup goals are based on the evaluation of both the representative and unrestricted scenarios. More information can be found in Section 3.3 regarding representative receptors, risk calculations, and preliminary cleanup goals.

The ERA performed for CBP identifies a variety of ecological receptor populations that could be at risk and identifies the COPECs and COECs that could contribute to potential risks from exposure to contaminated media. Ohio EPA guidance (Ohio EPA 2003) allows a decision about remediation to be made at the completion of each level of risk assessment. A decision whether it is necessary to remediate because of potential harm to ecological receptors at CBP is not included in the RI Report. Section 3.4 provides weight-of-evidence input for that decision.

CERCLA remediation and interim remedy requirements with respect to soils and dry sediment will be performed to achieve interim remedy at CBP. Remediation with respect to groundwater, surface water, and subaqueous sediments are not included in the scope of this FS, therefore, any remedies will be considered interim. However, interim remedy with respect to soils also must be protective of groundwater. The following RAOs are developed accordingly for impacted soil/dry sediment at CBP:

- Restore impacted soils/dry sediments at CBP to a condition consistent with likely land use by the representative group (i.e., representative OHARNG land use receptors) by achieving cleanup goals for COCs in impacted soil/dry sediment. Preliminary cleanup goals will be used as target concentrations (e.g., UCL_{95} of the mean of site data should be $\leq$ the preliminary cleanup goal) of COCs that may remain at CBP.

- Remedy of impacted soil/dry sediments to be protective of other environmental media (groundwater, surface water, and sediment) consistent with likely land use by the representative group (i.e., representative OHARNG land use receptors) for COCs.
- Minimize transport of soil COCs to other environmental media (groundwater, surface water, sediment, and air) during implementation of the remedial action.
- Prevent releases and other impacts that could adversely affect ecological receptors during implementation of the remedial alternative(s).

At CBP, preliminary cleanup goals are developed for impacted environmental media including groundwater, surface water, and subaqueous sediments in addition to soil/dry sediment to facilitate future considerations with respect to selection of remedies for these media.

3.2 ANTICIPATED FUTURE LAND USE

OHARNG has prepared a comprehensive Environmental Assessment and an Integrated National Resources Management Plan to address future use of RTLS property (OHARNG 2001). OHARNG has established future land use for CBP as Dismounted Training, No Digging based on anticipated training, mission, and utilization of the RTLS (USACE 2004b). Future land use is discussed in more detail in Section 3.3.

3.3 IDENTIFICATION HUMAN HEALTH PRELIMINARY CLEANUP GOALS FOR CBP

This section documents the proposed land use and corresponding preliminary cleanup goals to support the remedial alternative selection process for soil remediation at CBP. Preliminary cleanup goals are the chemical-specific numeric cleanup goals used to meet the remedial action objectives for protection of human health.

The HHRA performed for CBP is detailed in the RI Report and summarized in Section 2 of this FS. The risk assessment included in the RI Report documents a variety of potential human receptor populations [e.g., National Guard Trainee, National Guard Dust/Fire Control Worker, Security Guard/Maintenance Worker, Hunter/Trapper/Fisher, and Resident Subsistence Farmer (adult and child)] that could be at risk, and identify the COCs that could contribute to potential risks from exposure to contaminated media at CBP. In addition to the receptors in the HHRA, a Trespasser (Adult and Juvenile) is evaluated in this FS (Appendix 2A). The HHRA also documents the calculation of risk-based remedial goal options (RGOs) for human receptors for all media (i.e., soil, surface water, sediment, and groundwater), all COCs, and all receptor populations evaluated in the RI Report. These risk-based remedial goal options (RGOs) are referred to as risk-based cleanup goals in this FS.

Chemical-specific preliminary cleanup goals are established for restricted and unrestricted land use from these risk-based cleanup goals, background concentrations, and other information in this section. Preliminary cleanup goals for restricted land use are established for a representative receptor for likely future land use by OHARNG. The representative receptor provides a conservative surrogate for other possible receptors (e.g., preliminary cleanup goals for the National Guard Trainee are also protective of a hunter or a security guard). The potential for the representative receptor to be protective of a trespasser to the site is also addressed. In addition to the representative receptor, preliminary cleanup goals are established for a Resident Subsistence Farmer (adult and child) to provide a baseline for evaluating whether this site may be eligible for unrestricted release.

The risk-based cleanup goals were calculated using the methodology presented in the Risk Assessment Guidance for Superfund (RAGS), Part B (USEPA 1989), while incorporating site-specific exposure parameters applicable to the five potential receptors outlined in the FWHHRAM. The process for calculating risk-based cleanup goals was a rearrangement of the cancer risk or non-cancer hazard equations, with the goal of obtaining the concentration that will produce a specific risk or hazard level. For example, the risk-based cleanup goal for hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) at the cancer risk level of 1E-05 for the National Guard Trainee is the concentration of RDX that produces a risk of 1E-05 when using the exposure parameters specific to the National Guard Trainee receptor and the cancer slope factor for RDX. Equations, exposure parameters, and toxicity values (cancer slope factors and non-cancer reference doses) are provided in the HHRA and were taken from the FWHHRAM (USACE 2004b).

The FWHHRAM (USACE 2004b) identifies 1E-05 as a target for cumulative incremental lifetime cancer risk (ILCR) (target risk [TR]) for carcinogens and an acceptable target hazard index (THI) of 1 for non-carcinogens consistent with Ohio EPA guidance (Ohio EPA 2004b), with the caveat that exposure to multiple COCs might require downward adjustment of these targets for chemical-specific risks. The chemical-specific TR and THI are dependent on several factors, including the number of carcinogenic and non-carcinogenic COCs and the target organs and toxic endpoints of these COCs. For example, if numerous (i.e., more than 10) non-carcinogenic COCs with similar toxic endpoints are present, it might be appropriate to select chemical-specific preliminary cleanup goals with a THI of 0.1 to account for exposure to multiple contaminants. AOC-specific TR and THI levels are established in Section 3.3.3.

The risk-based cleanup goals assumed combined exposure through ingestion, inhalation of vapors and fugitive dust, and dermal contact with contaminated media. For chemicals having both a cancer and non-cancer endpoint, risk-based cleanup goals were calculated for both cancer risk and non-cancer hazard at the appropriate TR and THI. The preliminary cleanup goal is selected as the lower of the risk-based cleanup goal for cancer risk and non-cancer hazard and the adult and child receptor (for the Resident Subsistence Farmer), unless the risk-based cleanup goal is below background concentration. If the applicable risk-based cleanup goal concentration is less than background, the background concentration is selected as the preliminary cleanup goal.

The list of human health COCs for evaluation of remedial alternatives are identified for CBP based on risk management considerations including:

- Comparison of exposure point concentration (EPC) to preliminary cleanup goal concentrations (including background concentrations);

- Comparison of EPC to upgradient concentrations for sediment, surface water, and groundwater;

- Consideration of soil as the primary source of contamination (i.e., if soil concentrations are below background at an AOC, that AOC is not contributing to contamination in other media); and

- Other site-specific and receptor-specific considerations.

The remainder of this section provides the following detailed information:

- Land use and potential receptors at CBP (Section 3.3.1);

- A summary of COCs identified in the HHRA (Section 3.3.2);

- Identification of the appropriate TR level and THI for establishing preliminary cleanup goals based on the number and type of COCs identified in the HHRA (Section 3.3.3);

- Chemical-specific preliminary cleanup goals (Section 3.3.4); and

- Risk management considerations and the identification of COCs to be carried through the evaluation of remedial alternatives (Section 3.3.5).

3.3.1 Land Use and Potential Receptors at CBP

The intended future land use for CBP is for National Guard training. Specifically, this area will be used for dismounted training. This future use could include the three National Guard receptor types (Trainee, Security Guard/Maintenance Worker, and Fire/Dust Suppression Worker). The National Guard Trainee is exposed to soil through incidental ingestion, dermal contact, and inhalation of vapors and fugitive dust 24 hours/day, 39 days/year for 25 years (for a total of 936 hours/year). The other two National Guard receptors are exposed for much shorter periods of time (i.e., 4 hours/day, 15 days/year [60 hours/year] for 25 years for the fire/dust-suppression worker and 1 hour/day, 250 days/year [250 hours/year] for 25 years for the security guard/maintenance worker). Therefore, the National Guard Trainee is the most conservative of the three National Guard receptors, and preliminary cleanup goals established for this receptor will also be protective of other National Guard receptors. The National Guard Trainee is also protective of a Juvenile Trespasser conservatively assumed to visit the site 2 hours/day, 50 days/year (100 hours/year) for 10 years and an Adult Trespasser assumed to visit the site 2 hours/day, 75 days/year (150 hours/year) for 30 years. The National Guard Trainee is used as the representative receptor for the intended land use and preliminary cleanup goals for the National Guard Trainee are presented here as the primary preliminary cleanup goals applicable to CBP soil.

While the intended future land use for CBP does not include recreational use, preliminary cleanup goals established for the National Guard Trainee will be protective of a recreational receptor exposed to contaminants in soil during hunting, trapping, and fishing because these recreational activities are assumed to result in exposure only 4.57 hours/day, 7 days/year (32 hours/year) for 30 years.

The intended future land use at CBP does not include commercial/industrial development. The National Guard Trainee has similarities to a commercial/industrial receptor (e.g., 25-year adult exposure). The total exposure time for an industrial worker (2,000 hours/year) is approximately double that of the National Guard Trainee; however, exposure to airborne contaminants (i.e., fugitive dust) is greater for the National Guard Trainee because of high dust generation by tracked vehicles used in training. Based on this, it appears the National Guard Trainee would be a more conservative assumption than the commercial/industrial receptor in assessing human health risks via inhalation. However, if commercial/industrial development is proposed in future land use planning, it may be necessary to reevaluate potential receptors.

In addition to the representative receptor described above the Resident Subsistence Farmer (adult and child) provides a baseline for evaluating whether this site may be eligible for unrestricted release; however, CBP is not currently a candidate for unrestricted release as it is being transferred to the OHARNG. The Resident Subsistence Farmer is considered a "worst-case" exposure scenario and is considered to be protective for all other potential land uses.

A summary of the preliminary cleanup goals for the COCs identified for evaluation of remedial alternatives is provided below for the representative receptor and unrestricted land use.

3.3.2 Chemicals of Concern

COCs are defined as chemicals with an incremental lifetime cancer risk greater than 1E-06 and/or a hazard index (HI) greater than 1 for a given receptor. COCs were identified in the HHRA for each exposure medium and receptor evaluated.

3.3.2.1 COCs in Soil and Sediment

COCs for soil and sediment for the National Guard Trainee and Resident Subsistence Farmer (adult and child) are summarized below.

- Two COCs were identified in deep surface soil (0-4 ft bgs) for the National Guard Trainee in the HHRA presented in the *Final Central Burn Pits RI* (USACE 2005f) and the Supplemental Phase II RI of Central Burn Pits (Appendix 2B) including one non-carcinogen (manganese) and one carcinogen (arsenic). Chromium was identified as a COC in the HHRA (USACE 2005f) because it was conservatively evaluated as hexavalent chromium in the absence of hexavalent chromium data. Subsequent to the HHRA, additional soil samples were collected at CBP and analyzed for both total chromium and hexavalent chromium. These data and their impact on the conclusions of the HHRA are provided in Appendix 2B. Evaluation of these data results in both chromium and hexavalent chromium being eliminated as COPCs in soil at CBP; therefore, chromium is not a COC for this medium.

- One COC (arsenic) was identified in sediment for the National Guard Trainee.

- No non-carcinogenic COCs were identified for the Resident Subsistence Farmer. Two carcinogenic COCs were identified for this receptor including one metal (arsenic) and one SVOC [benzo(a)pyrene]. Arsenic was also identified as a subsurface soil (1-30 ft bgs) COC for this receptor.

- One COC (arsenic) was identified in sediment for the Resident Subsistence Farmer.

A Trespasser (Adult and Juvenile) is evaluated in Appendix 2A to supplement the representative receptor and unrestricted land use. No soil or sediment COCs are identified for the Juvenile Trespasser, arsenic is identified as a COC in shallow surface soil (0-1 ft bgs) and sediment for the Adult Trespasser.

3.3.2.2 COCs in Surface Water

No surface water COCs were identified in the HHRA for the representative receptor or unrestricted land use at the CBP. Further, no surface water COCs were identified for the Trespasser (Adult and Juvenile).

3.3.2.3 COCs in Groundwater

One COC (arsenic) was identified in the HHRA for both the representative receptor and unrestricted land use at the CBP.

3.3.3 Target Risk for Preliminary Cleanup Goals

The FWHHRAM (USACE 2004b) identifies a 1E-05 target for cumulative ILCR (target risk [TR]) for carcinogens and an acceptable THI of 1 for non-carcinogens consistent with Ohio EPA guidance, with the caveat that exposure to multiple COCs might require downward adjustment of these targets. For example, if numerous (i.e., more than 10) non-carcinogenic or carcinogenic COCs with similar toxic endpoints are present, it might be appropriate to select chemical-specific preliminary cleanup goals with a TR of 1E-06 or a THI of 0.1 to account for exposure to multiple contaminants. The TR and THI selected for CBP are dependent on several factors, including the number of carcinogenic and non-carcinogenic COCs and the target organs and toxic endpoints of these COCs.

A chemical-specific TR of 1E-05 and THI of 1.0 are identified as appropriate for establishing preliminary cleanup goals for soil and sediment at CBP based on the small number of COCs present and the types of COCs (carcinogenic or non-carcinogenic). The National Guard Trainee is the representative receptor for CBP. Only two soil COCs and one sediment COC were identified for this receptor; one non-carcinogen (manganese) and one carcinogen (arsenic). Two soil and one sediment COCs (both carcinogens) were identified for the residential receptors.

Only one groundwater COC was identified for both the National Guard Trainee and the Resident Subsistence Farmer scenarios; therefore, a chemical-specific TR of 1E-05 and THI of 1.0 is appropriate for establishing preliminary cleanup goals for groundwater at CBP.

3.3.4 Preliminary Cleanup Goals

3.3.4.1 Soil and Sediment Preliminary Cleanup Goals

Risk-based cleanup goals calculated in the HHRA for COCs in soil and sediment, background concentrations for inorganics, and preliminary cleanup goals are presented for the National Guard Trainee in Tables 3-2 and 3-3 respectively.

Table 3-2. Soil Preliminary Cleanup Goals for National Guard Trainee Scenario at CBP[a]

COC	EPC (mg/kg)	Risk-Based cleanup goal from HHRA (mg/kg)		Background[b] (mg/kg)	Preliminary Cleanup Goal (mg/kg)
		HI = 1.0	ILCR = 1E-05		
Inorganics					
Arsenic	15	1500	31	15.4	31
Manganese	1200	350	--	1450	1800[c]

[a] Deep (0 to 4 ft below ground surface) surface soil is used for National Guard Trainee.

[b] Final facility-wide background values for the Ravenna Army Ammunition Plant from the Phase II Remedial Investigation Report for the Winklepeck Burning Grounds at the Ravenna Army Ammunition Plant, Ravenna, Ohio (USACE 1999). Background values for soil are available for two soil depths: surface (0 to 1 ft below ground surface) and subsurface (1 to 12 ft below ground surface); the minimum value for these two aggregates is reported.

[c] Value is EPA Region 9 residential PRG (http://www.epa.gov/region09/waste/ sfund/prg/index.html)

-- = Toxic endpoint not evaluated for this COC.

Estimated EPCs of arsenic and manganese are less than the preliminary cleanup goals established for these COCs for the National Guard Trainee Scenario.

Table 3-3. Sediment Preliminary Cleanup Goals for National Guard Trainee Scenario at CBP

COC	EPC (mg/kg)	Risk-Based Cleanup Goal from HHRA (mg/kg)		Background[a] (mg/kg)	Preliminary Cleanup Goal (mg/kg)
		HI = 1.0	ILCR = 1E-05		
Inorganics					
Arsenic	20	1500	93.4	19.5	93.4

[a] Final facility-wide background values for the Ravenna Army Ammunition Plant from the Phase II Remedial Investigation Report for the Winklepeck Burning Grounds at the Ravenna Army Ammunition Plant, Ravenna, Ohio (USACE 1999). Background values for soil are available for two soil depths: surface (0 to 1 ft below ground surface) and subsurface (1 to 12 ft below ground surface); the minimum value for these two aggregates is reported.

-- = Toxic endpoint not evaluated for this COC.

The estimated EPC of arsenic is less than the preliminary cleanup goal established for this metal for the National Guard Trainee Scenario.

Risk-based cleanup goals calculated in the HHRA for COCs in soil and sediment, background concentrations for inorganics, and preliminary cleanup goals for the Resident Subsistence Farmer are presented in Tables 3-4 and 3-5 respectively.

Table 3-4. Soil Preliminary Cleanup Goals for Resident Subsistence Farmer Scenario at CBP

COC	EPC[a] (mg/kg)	Risk-Based Cleanup Goal from HHRA (mg/kg)				Background[b]		Preliminary Cleanup Goal	
		Adult		Child					
		HI = 1.0	ILCR = 1E-05	HI = 1.0	ILCR = 1E-05	Surface	Sub surface	Surface	Sub surface
Inorganics									
Arsenic	15 (15)	130	3.1	22	NC	15.4	19.8	15.4	19.8
Semivolatiles									
Benzo(a)pyrene	0.22	--	0.37	--	NC	NA	NA	0.37	NA

[a] Shallow (0 to 1 ft below ground surface) surface soil and subsurface soil (1-30 ft bgs) are used for Resident Subsistence Farmer. EPCs are presented for surface soil. EPCs for subsurface soil are in (parentheses).

[b] Final facility-wide background values for the Ravenna Army Ammunition Plant from the Phase II Remedial Investigation Report for the Winklepeck Burning Grounds at the Ravenna Army Ammunition Plant, Ravenna, Ohio (USACE 1999).

-- = Toxic endpoint not evaluated for this COC.

NA = Not applicable. Background concentrations are used for inorganic COCs only and benzo(a)pyrene is not identified as a COC in subsurface soil (1-30 ft bgs).

NC = Not calculated.

Estimated EPCs of both arsenic and benzo(a)pyrene are less than the preliminary cleanup goals for these COCs for the Resident Subsistence Farmer Scenario in shallow surface (0-1 ft bgs) and subsurface soil (1-3 ft bgs).

Table 3-5. Sediment Preliminary Cleanup Goals for Resident Subsistence Farmer Scenario at CBP

COC	EPC (mg/kg)	Risk-Based Cleanup Goal from HHRA (mg/kg)				Background[a]	Preliminary Cleanup Goal
		Adult		Child			
		HI = 1.0	ILCR = 1E-05	HI = 1.0	ILCR = 1E-05		
Inorganics							
Arsenic	20	604	14.3	102	NC	19.5	19.5

[a] Final facility-wide background values for the Ravenna Army Ammunition Plant from the Phase II Remedial Investigation Report for the Winklepeck Burning Grounds at the Ravenna Army Ammunition Plant, Ravenna, Ohio (USACE 1999).

-- = Toxic endpoint not evaluated for this COC.

NA = Not applicable. Background concentrations are used for inorganic COCs only and benzo(a)pyrene is not identified as a COC in subsurface soil (1-30 ft bgs).

NC = Not calculated.

3.3.4.2 Groundwater Preliminary Cleanup Goals

Risk-based cleanup goals calculated in the HHRA for COCs in groundwater, background concentrations for inorganics, and preliminary cleanup goals are presented for the National Guard Trainee in Table 3-6.

Table 3-6. Groundwater Preliminary Cleanup Goals for National Guard Trainee Scenario at CBP

COC	EPC (mg/L)	Risk-Based Cleanup Goal from HHRA (mg/L)		Background[a] (mg/L)	Preliminary Cleanup Goal (mg/L)
		HI = 1.0	ILCR = 1E-05		
Inorganics					
Arsenic	0.035	0.098	0.0061	0.012	0.012

[a] Final facility-wide background values for the Ravenna Army Ammunition Plant from the Phase II Remedial Investigation Report for the Winklepeck Burning Grounds at the Ravenna Army Ammunition Plant, Ravenna, Ohio (USACE 1999).

Risk-based cleanup goals calculated in the HHRA for COCs in groundwater, background concentrations for inorganics, and preliminary cleanup goals are presented for the Resident Subsistence Farmer in Table 3-7.

Table 3-7. Groundwater Preliminary Cleanup Goals for Resident Subsistence Farmer Scenario at CBP

COC	EPC (mg/L)	Risk-Based Cleanup Goal from HHRA (mg/L)				Background[a] (mg/L)	Preliminary Cleanup Goal (mg/L)
		Adult		Child			
		HI = 1.0	ILCR= 1E-05	HI= 1.0	ILCR = 1E-05		
Inorganics							
Arsenic	0.035	0.011	0.00033	0.31	NC	0.012	0.012

[a] Final facility-wide background values for the Ravenna Army Ammunition Plant from the Phase II Remedial Investigation Report for the Winklepeck Burning Grounds at the Ravenna Army Ammunition Plant, Ravenna, Ohio (USACE 1999).
NC = Not calculated.

3.3.5 Risk Management Considerations

3.3.5.1 Soil and Sediment

For representative land use, no soil or sediment COCs are identified for evaluation of remedial alternatives. Soil and sediment COCs identified in the HHRA for the representative receptor are not recommended for evaluation of remedial alternatives for the following reasons:

- The EPCs for arsenic and manganese in deep surface soil (0-4 ft bgs) are less than the background and preliminary cleanup goals established for the National Guard Trainee (Table 3-8).

- All detected concentrations and the EPC for arsenic in sediment are less than the preliminary cleanup goal established for the National Guard Trainee (Table 3-8).

For unrestricted land use, no soil or sediment COCs are identified for evaluation of remedial alternatives for the following reasons:

- The EPC for arsenic in shallow surface soil (0-1 ft bgs) (16 mg/kg) barely exceeds the background concentration (15 mg/kg) for surface soil (0-1 ft bgs) but is below the background

- concentration (20 mg/kg) for subsurface soil (1-30 ft bgs). CBP is a highly disturbed area making it difficult to distinguish between original surface and subsurface soil. Further, any residential development would require excavation resulting in exposure of subsurface soil. Because residential development would result in exposure to subsurface soil (with a background of 20 mg/kg), and the EPC for arsenic in surface soil is only 16 mg/kg, arsenic is not recommended for evaluation of remedial alternatives.

- The EPC for arsenic in subsurface soil (1-30 ft bgs) is less than the preliminary cleanup goal established for the Resident Subsistence Farmer (Table 3-9).

- Benzo(a)pyrene was detected only once in shallow surface soil (0-1 ft bgs) and the detected concentration is less than the preliminary cleanup goal for the Resident Subsistence Farmer Scenario (Table 3-9).

- The sediment EPC for arsenic equals the preliminary cleanup goal for the Resident Subsistence Farmer Scenario (Table 3-9).

3.3.5.2 Surface Water

No surface water COCs were identified in the HHRA; therefore, no COCs are recommended for evaluation of remedial alternatives.

3.3.5.3 Groundwater

Only one groundwater COC (arsenic) was identified in the HHRA for both the representative receptor and unrestricted land use at the CBP. As shown in Tables 3-10 and 3-11, the EPC for arsenic exceeds the preliminary cleanup goals for this metal for both the National Guard Trainee and the Resident Subsistence Farmer. Arsenic is not recommended for evaluation of remedial alternatives because the EPC in both surface (0-1 ft bgs) and subsurface (1-30 ft bgs) soil are less than the background concentration in subsurface soil indicating no AOC-related source to groundwater.

Table 3-8. Soil and Sediment COCs for Evaluation of Remedial Alternatives for Representative Receptor (National Guard Trainee) at CBP

COC[a]	Freq. of Detect	Measured Concentration (mg/kg)			Bkg[d] (mg/kg)	Detects > Bkg[e]	Preliminary Cleanup Goal[f] (mg/kg)	Detects > Preliminary Cleanup Goal[e]	Risk Management Considerations	Rec[g]
		Avg.	Max[b]	EPC[c]						
Deep Surface Soil (0-4 ft bgs)										
Arsenic	71/ 72	12	33	15	15	12	31	1	EPC less than background and preliminary cleanup goal	NC
Manganese	72/ 72	980	5780	1220	1450	13	1800	11	EPC less than background and preliminary cleanup goal	NC
Sediment										
Arsenic	9/ 9	11	20	20	20	1	93	0	EPC equal to background and preliminary cleanup goal	NC

[a] Chemical of concern (COC) identified in the HHRA.

[b] Maximum detected concentration.

[c] Exposure point concentration (EPC) is 95th percent upper confidence limit (UCL) or maximum detected concentration depending on number of samples and data distribution.

[d] Final facility-wide background values for the Ravenna Army Ammunition Plant from the *Phase II Remedial Investigation Report for the Winklepeck Burning Grounds at the Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 1999).

[e] Number of detected concentrations exceeding the background criterion or preliminary cleanup goal.

[f] Preliminary cleanup goal from Tables 3-2 and 3-3.

[g] Recommendation for COCs for evaluation of remedial alternatives.

NA = not available.

NC = not recommended as a COC for remedial alternative evaluation.

Table 3-9. Soil and Sediment COCs for Evaluation of Remedial Alternatives for Unrestricted Land Use at CBP

COC[a]	Freq. of Detect	Measured Concentration (mg/kg)			Bkg[d] (mg/kg)	Detects > Bkg[e]	Preliminary Cleanup Goal[f] (mg/kg)	Detects > Preliminary Cleanup Goal[e]	Risk Management Considerations	Rec[g]
		Avg.	Max[b]	EPC[c]						
Shallow Surface Soil (0-1 ft bgs)										
Arsenic	42/ 43	12	33	16	15	9	15	9	EPC less than subsurface background and preliminary cleanup goal	NC
Benzo(a)pyrene	1/ 9	0.056	0.22	0.22	NA	NA	0.37	0	EPC less than preliminary cleanup goal	NC
Subsurface Soil (1-30 ft bgs)										
Arsenic	37/ 37	13	31	15	20	5	20	5	EPC less than background/preliminary cleanup goal	NC
Sediment										
Arsenic	9/ 9	11	20	20	20	1	20	1	EPC less than background and preliminary cleanup goal	NC

[a] Chemical of concern (COC) identified in the HHRA.

[b] Maximum detected concentration.

[c] Exposure point concentration (EPC) is 95th percent upper confidence limit (UCL) or maximum detected concentration depending on number of samples and data distribution.

[d] Final facility-wide background values for the Ravenna Army Ammunition Plant from the *Phase II Remedial Investigation Report for the Winklepeck Burning Grounds at the Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 1999).

[e] Number of detected concentrations exceeding the background criterion or preliminary cleanup goal.

[f] Preliminary cleanup goal from Tables 3-4 and 3-5.

[g] Recommendation for COCs for evaluation of remedial alternatives.

FSCOC = COC for evaluation of remedial alternatives.

NA = not applicable. Background criteria are used only for naturally occurring inorganic constituents.

NC = not recommended as a COC for remedial alternative evaluation.

Table 3-10. Groundwater COCs for Evaluation of Remedial Alternatives for National Guard Trainee at CBP

COC[a]	Freq. of Detect	Measured Concentration (mg/L)			Bkg[d] (mg/L)	Detects > Bkg[e]	Preliminary Cleanup Goal[f] (mg/L)	Detects > Preliminary Cleanup Goal[e]	Risk Management Considerations	Rec[g]
		Avg.	Max[b]	EPC[c]						
Groundwater										
Arsenic	7/ 8	0.010	0.035	0.035	0.012	2	0.012	2	No AOC-related source	NC

[a] Chemical of concern (COC) identified in the HHRA.

[b] Maximum detected concentration.

[c] Exposure point concentration (EPC) is 95th percent upper confidence limit (UCL) or maximum detected concentration depending on number of samples and data distribution.

[d] Final facility-wide background values for the Ravenna Army Ammunition Plant from the *Phase II Remedial Investigation Report for the Winklepeck Burning Grounds at the Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 1999).

[e] Number of detected concentrations exceeding the background criterion or preliminary cleanup goal.

[f] Preliminary cleanup goal from Table 3-6.

[g] Recommendation for COCs for evaluation of remedial alternatives.

NA = not available.

NC = not recommended as a COC for remedial alternative evaluation.

Table 3-11. Groundwater COCs for Evaluation of Remedial Alternatives for Unrestricted Land Use at CBP

COC[a]	Freq. of Detect	Measured Concentration (mg/L)			Bkg[d] (mg/L)	Detects > Bkg[e]	Preliminary Cleanup Goal[f] (mg/L)	Detects > Preliminary Cleanup Goal[e]	Risk Management Considerations	Rec[g]
		Avg.	Max[b]	EPC[c]						
Groundwater										
Arsenic	7/ 8	0.010	0.035	0.035	0.012	2	0.012	2	No AOC-related source	NC

[a] Chemical of concern (COC) identified in the HHRA.

[b] Maximum detected concentration.

[c] Exposure point concentration (EPC) is 95th percent upper confidence limit (UCL) or maximum detected concentration depending on number of samples and data distribution.

[d] Final facility-wide background values for the Ravenna Army Ammunition Plant from the *Phase II Remedial Investigation Report for the Winklepeck Burning Grounds at the Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 1999).

[e] Number of detected concentrations exceeding the background criterion or preliminary cleanup goal.

[f] Preliminary cleanup goal from Table 3-7.

[g] Recommendation for COCs for evaluation of remedial alternatives.

NA = not available.

NC = not recommended as a COC for remedial alternative evaluation.

3.4 ECOLOGICAL PROTECTION

The ERA performed for CBP is available in the RI Report (USACE 2005f) and summarized in Section 2 of this FS. Ohio EPA Levels I, II, and III were performed for CBP and show observed concentrations and TRVs where HQs exceed one. The ERA in the RI Report identifies a variety of ecological receptor populations that could be at risk and identifies the COPECs and COECs that could contribute to potential risks from exposure to contaminated media.

The ERA for CBP also reported the ecological field work conducted at the site: ecological reconnaissance of existing vegetation and animal life. These findings were published in the RI Report and are summarized in Section 3.4.2.1 of this FS. A facility-wide biology and surface water study provides further information for consideration at CBP. This information has been published in a separate report (USACE 2005a) and is summarized in the RI Report with a further short summary in this FS (section 3.4.2.1). All the studies document the presence of healthy and functioning terrestrial and aquatic ecosystems.

These two pieces of information, risk assessment predictions (e.g., HQs) and field observations, were combined in a weight-of-evidence assessment. This combination of information shows that (1) while ESV exceedance and HQs being greater than one suggest risk to plants and selected animals, (2) the field observations reveal the ecological system with the plants and animals is functioning well and organisms appear to be healthy. Further, where surface water is involved, the use attainments are being met per Ohio guidance. Because of the combined finding that ecological systems are healthy as well as other reasons; no ecological preliminary cleanup goals are recommended and no remediation for ecological risks is justified at CBP. The rationale for this is explained in detail below.

3.4.1 Ecological Preliminary Cleanup Goals for CBP

Ohio EPA guidance (Ohio EPA 2003) allows decisions regarding the need for remediation to be made at the completion of each level of the ERA process. The remedial alternatives evaluation process includes the development of preliminary cleanup goals or COEC concentrations used to define areas where remediation is needed to achieve protectiveness for ecological resources. A decision whether it is necessary to remediate because of potential harm to ecological receptors and whether it is necessary to set preliminary cleanup goals for ecological receptors at CBP is not included in the RI Report. The following weight-of-evidence discussions provide input for that decision. A Level II SERA and a Level III BERA was conducted at CBP.

It is recommended that no quantitative ecological preliminary cleanup goals to protect ecological receptors be developed at CBP. This recommendation is based principally on four major conclusions:

- Field observations published in the RI (USACE 2005f) indicate there are currently few adverse ecological effects, and there is ample nearby habitat to maintain ecological communities at CBP and elsewhere on RVAAP/RTLS. Further, there is evidence that the nearby Sand Creek and by implication terrestrial habitats yet further away have not received migrating contaminants from CBP

- because those areas show no negative ecological effects anywhere according to the Facility-wide Biological and Surface Water Study (USACE 2005i). These observations imply that soil remediation to protect ecological resources is not necessary.

- Soil HQs are generally not highly elevated and metal concentrations are similar to background for all COECs.

- A few ecological effects from military training activities (dismounted training and no digging) may occur; for example, clearing of some vegetation in an already rather altered and disturbed habitat may occur in the future. Any remediation of habitat would tend to be re-disturbed by repeated military training activities and, thus, reduce the benefits of remediation.

- Removal of sediment or soil to further reduce any adverse ecological effects would destroy habitat without substantial benefit to the ecological resources at CBP.

Stewardship of the environment will be a major consideration in the phases of planning, design, and implementation of the military mission of the National Guard trainee. Presently, ecological risk is possible albeit the HQs are mostly under 1 and, if not, mostly under 150 for conservative scenarios (zinc at 180 and aluminum excluded). Biological measurements (healthy stream ecology downgradient of site) near CBP corroborate the generally low HQs (i.e., low ecological risk). A small amount of habitat alteration by training exercises (dismounted training and no digging) could occur and result in vegetation cut-back (simpler or different habitat patches), shorter food chains in those patches (simpler habitat), and lower exposure (fewer organisms). However, these few changes would be minor compared to the existing habitat disturbance (cut-over areas, roads, and piles). These predictions and observations, along with the low concentrations of various COECs, make a case for no remediation recommended for ecological resources at CBP.

3.4.2 Ecological Cleanup Goal Development Weight of Evidence

This section provides the detailed rationale for why remediation for protection of ecological receptors, and the associated development of quantitative ecological preliminary cleanup goals, is not warranted for ecological risks at this time. The rationale has the following elements:

- Onsite or near-site field studies show a healthy aquatic ecosystem and full attainment status according to Ohio EPA guidance, despite the identification of COECs with HQs greater than 1.

- Soil HQs are generally not highly elevated and metal concentrations are similar to background for all COECs.

- Land use at the site (military training) is expected to alter ecological habitats, and military mission overrides the results of the HQ and field-truthing study.

- No unique ecological resources are found at CBP, and nearby habitat offers home ranges for wildlife to escape from military land use activities.

- Significant contaminant migration is not expected to occur from soil to nearby aquatic environments.

- Mitigations are of two types (chemical and physical) where removal of impacted soil or sediment (i.e., chemical) would lower the exposure and ecological risk, and physical alteration such as vegetation removal is a trade-off.

Each of these elements is explained below regarding the need for ecological preliminary cleanup goals or remediation to protect ecological receptors and a recommendation follows.

3.4.2.1 Ecological Reconnaissance and USEPA/USACE Biology and Surface Water Study Shows Functioning Ecological System

Level IV of the ERA process (Ohio EPA 2003) is an evaluation of exposures and any observable adverse ecological effects at the site. Observation of a healthy ecological community can mitigate the conclusions resulting from risk calculations based on theoretical exposure models. Although a Level IV risk assessment was not done, some field observations have been made at CBP. These observations indicate that despite the presence of COPECs, little adverse ecological effect has occurred at the site.

A facility-wide biology and surface water investigation has been completed by USACE with cooperation of Ohio EPA (USACE 2005i). In the investigation, water and sediment samples were taken from locations along major stream and tributaries, ponds, and wetlands throughout RVAAP/RTLS at locations that could have been impacted by former facility activities and sites where the streams entered RVAAP/RTLS. Fish were caught, identified, and released in the sampling locations corresponding to the water and sediment sample locations. Invertebrate biota were collected by Hester-Dendy samplers set in the same locations and by qualitative sampling of organic debris and rocks in the stream reach. Funnel traps were additionally placed in ponds and wetlands for further invertebrate sampling. Sand Creek near CBP was among the sampled water bodies. The details of the study, locations, techniques, and results from this study are published in the Ravenna Facility-wide Surface Water Study: Streams and Ponds (USACE 2005i).

By way of summary of surface water quality, for all eight of the Sand Creek sampling locations, including the one near CBP, there were no exceedances of the Ohio Water Quality Standard (WQS) aquatic life maximum or average water quality criteria. None of the chemicals measured in this study exceeded criteria protective of the Warmwater Habitat (WWH) aquatic life use. Concentrations of all but one [bis(2-ethylhexyl) phthalate] of the organic parameters tested (explosives, semi-volatiles, pesticides, and PCBs) were reported as non-detect. (Page 5-2 of RAGS Part A 1989 confirms phthalate esters as common laboratory contaminants.) In addition, metals concentrations were very low, with many of the results less than laboratory detection limits. Parameters with measurable concentrations were below applicable Ohio WQS aquatic life criteria. All ammonia-N measurements were less than laboratory detection limits (0.10 mg/l), and nitrate-N values were measured at low concentrations, with all values less than Ohio least impacted reference conditions (below Erie Ontario Lake Plain ecoregion 75th percentile value). Low nutrient and dissolved solids levels in Sand Creek were largely reflective of the undeveloped condition of the watershed.

For the sediment summary, sediment collected from all eight locations in Sand Creek reflected non-contaminated conditions. All metals tested in sediments were below Ohio sediment reference values (Ohio EPA 2003) – levels established from chemical results collected at biological reference sites. All tested explosive compounds, pesticides, PCBs, and most semi-volatile organic compounds were not detected in sediment samples collected from Sand Creek. The few detected semi-volatile compounds were measured at low levels. Di-n-butyl phthalate was detected (estimated concentration) at four of eight Sand Creek sediment sites; however, all values were below ecological screening levels (ESLs). Phthalates are potential lab contaminants. (Page 5-2 of RAGS Part A 1989 confirms phthalate esters as common laboratory contaminants.) Ammonia and total phosphorus levels were measured in all Sand Creek sediment samples below screening guidelines (Persaud et. al. 1993). Cyanide was not detected above ESLs at the Sand Creek location near CBP.

All eight Sand Creek sites evaluated in this survey revealed very good to excellent stream habitats. Qualitative Habitat Evaluation Index (QHEI) scores for Sand Creek sites ranged between 70.0 and 85.5, with an average score of 75.2. These scores demonstrate the potential to support WWH biological communities. Sand was a predominating bottom substrate at nearly all of the sampling sites, with gravel and cobble prevalent at half of the locations. Muck, along with sand, predominated at River Mile (RM) 2.4 (near CBP and upstream wastewater treatment plan [WWTP] tributary). The stream channel was natural within the study area and was represented by pool, run, and riffle areas, with minor amounts of glide habitat. Instream channel development was good, and surrounding land use was largely forest and shrub. Of the eight sites sampled in Sand Creek, the site close to CBP (RM 2.4) was partially impounded by a beaver dam.

Macroinvertebrate communities were very good to exceptional in Sand Creek. Invertebrate Community Index (ICI) scores ranged between 44 and 54. These ICI values achieved the ecoregional biocriterion established for the designated WWH use, as well as meeting the Exceptional Warmwater Habitat (EWH) criterion. The macroinvertebrate community results from the eight Sand Creek sites indicated no biological impairment.

Fish communities ranged from marginally good to good in Sand Creek, one sampling location of which is near CBP. Index of Biotic Integrity (IBI) scores ranged between 36 and 44. These IBI values achieved the ecoregional biocriterion established for WWH streams and rivers in Ohio. Mountain brook lamprey, an Ohio Endangered Species, were collected in Sand Creek at the lower three sampling locations (RMs 1.9, 1.5, and 0.8) and could be present at RM 2.4 near CBP. Based on the fish community results from the eight Sand Creek sites, no biological impairment associated with chemical contaminants was observed.

3.4.2.2 Intensive and Potentially Extensive Habitat Alteration Anticipated

At CBP, habitat alteration, because of National Guard dismounted-training activities, may be appreciable at any one acre. Some areas at the CBP might be cleared of vegetation to permit the training. Other places could have some soil compaction and potentially harmed vegetation. In addition, fluid leaks could inevitably contaminate the surface soil (0-1 ft bgs), and exhaust fumes could be harmful to plants and animals during intensive maneuvers. Subsurface activities are not planned. Digging and occupying fighting positions, tank defilade positions, tank ditches, and battle positions that extend below ground surface will be prohibited. Thus, there are many military mission activities that could result in habitat alteration in a few locations, such as where vegetation is modified beyond the already altered and disturbed habitats at CBP. This includes soil compaction, vegetation damage and removal, and shorter food chains. The resulting altered habitats would no longer be as desirable to vegetation and wildlife.

Extensiveness or the number of acres of future habitat alteration is not known at this time. It is assumed that up to 60% of the area may be altered because of combined vegetation removal and other activities. Mostly, the vegetation would be disturbed, while the soil would be disturbed to a lesser extent. CBP consists of about 20 acres of habitat. Thus, assumed acreage or extensiveness could be up to 12 acres for intensive change. The area of habitat to be altered is small compared to the total facility acreage. By contrast, CBP is part of a facility that is 22,000 acres in size; therefore, this area represents 20 out of 22,000 acres, or about 0.1% of the total area. If the 12 acres are used, this would be about 0.05% of the total RVAAP/RTLS area. This small percentage utilized for military missions means that environmental stewardship (e.g., vegetation for wildlife, timber) could be practiced in relatively large areas elsewhere at RVAAP/RTLS. Contemplated changes to this small area (0.05% of CBP) would be inconsequential to ecological function and sustainability.

In summary, intensity and extensity of any habitat alteration from military training involves only a few acres within many thousands of acres of adjacent habitats at RVAAP/RTLS. For example, most of CBP (about 20 acres) consists of old field and forest communities including corridors and patches of trees (see next Section 3.4.2.3 on nearby habitats). There are many, many hundreds of acres of these types of habitat at RVAAP/RTLS. The other habitat types at CBP are also part of the great diversity of habitat types near CBP and across the thousands of acres at RVAAP/RTLS.

3.4.2.3 Nearby Habitats Offer Home Ranges to Wildlife

Vegetation and animals are found at CBP, descriptions of which are detailed in the RI Report (USACE 2005f): Briefly, vegetation consists of many old-field communities with corridors and patches of forest vegetation. Animals consist of soil invertebrates, many species of insects, mammals, and birds. However, no known threatened and endangered species or unique natural resources are present at the load lines; substantiation of this is provided in Section 7 (ERA, natural resources section) of the RI Report for CBP. Therefore, National Guard training would be carried out in an environment in which the impact would be limited to "normal" ecological resources.

As stated above, ecological resources are "normal," and nearby habitat is available to receive wildlife that leaves the training area. Some vegetation, especially bushes and old-field vegetation, as well as some trees, is expected to be removed from within CBP. Old-field vegetation could be mowed or cleared in another way. Wildlife is expected to be disturbed by the movement and noise of training equipment as well as trainees. Wildlife species, such as small mammals and small birds with limited home ranges, can leave and enter adjacent old fields and forest patches and vegetative corridors. As implied earlier, RVAAP/RTLS has thousands of acres of habitat like that at CBP, and wildlife can find new home ranges there; therefore, any lack of protection as a result of not deriving and applying from ecological preliminary cleanup goals would be minimal because sufficient reservoirs of habitats and wildlife exist to maintain RVAAP/RTLS-wide ecological communities.

3.4.2.4 Low Levels of Soil Contamination

All but one of the 18 COECs identified in surface soil (0-1 ft bgs) at CBP are metals. The EPCs for 6 of these metals are less than their background criteria (Table 3-12). The EPCs for another 8 of these metals are less than three times their background criteria. The remaining three metals have no background criteria for comparison. The only organic COEC is Arochlor-1254 (detected in 3 of 20 surface soil samples) with HQs greater than one ranging from 3 to 6.

Table 3-12. Background Concentrations of Surface Soil (0-1 ft bgs) COECs at CBP

Analyte	Results >Detection Limit	Average Result	Maximum Detect	Exposure Concentration	Background	Number of Detects>Bkg.
Aluminum	43/ 43	13200	29700	14900	17700	5
Arsenic	42/ 43	12	33	16	15	9
Barium	43/ 43	126	417	153	88	21
Cadmium	27/ 43	0.34	2.2	0.59	0	27
Chromium	43/ 43	16	49	18	17	12
Cobalt	42/ 43	7.2	22	13	10	11
Copper	43/ 43	50	1260	40	18	9
Cyanide, Total	19/ 43	2.9	92	2.1	0	19
Iron	43/ 43	22000	107000	28500	23100	17
Lead	43/ 43	59	493	74	26	18
Manganese	43/ 43	1090	5780	1430	1450	8
Mercury	42/ 43	0.0362	0.071	0.040	0.040	16
Nickel	43/ 43	12	27	14	21	4
Selenium	29/ 43	0.79	2.0	1.2	1.4	7
Thallium	2/ 43	0.30	0.22	0.22	0	2
Vanadium	43/ 43	20	37	22	31	3
Zinc	43/ 43	142	1500	172	62	20

3.4.2.5 No to Low Contaminant Migration

The facility-wide surface water sampling and assessment revealed that, in general, surface water quality in the streams at RVAAP/RTLS was good to excellent with few exceedances of Ohio Water Quality Standards. Intact riparian buffers around the streams contributed to good habitat and absence of substantial silt deposits. Evidence suggests that an additional remedial investigation effort, on an installation-wide basis, of the streams included in that report is not warranted. Contamination is not currently present in the sediments in the sampled reaches, and the surface water appears to be similarly free of contaminants. However, this does not preclude investigating surface water and sediment on an individual basis as required by Ohio EPA.

At CBP, off-site migration is possible via a conveyance in the northwestern portion of the AOC towards Sand Creek. Sand Creek lies up to 1,000 feet from the AOC boundary. Migration is not likely for three reasons. First, site conditions – slope, soil type, plant cover – are only slightly conducive to erosion. Second, there is no indication that organic compounds in soil are presently leaching to surface water and sediment in the pond, and this may apply to inorganics as well. Third, and more importantly, site conditions are unlikely to change in a way that would lead to increases in surface water or sediment concentrations as a result of erosion or leaching from the soil. Thus, it is expected that exposure and risk to aquatic receptors will not change. If contamination has reached Sand Creek, there is little to no evidence of it. The biological sampling station (downstream of CBP) exhibits healthy aquatic biology and full attainment statue.

On-site migration is not possible because there are no on-site water bodies, and it takes water to move contaminants. In the case of erosion on-site migration is not likely because of the relatively flat nature of the land.

3.4.2.6 Mitigation Trade-off of Reducing Chemical Risk but Harming Environment

There is a trade-off of two kinds of risk: physical alterations and residual contamination. That is, the localized ecosystem either can have clean soil because of removal and replacement but have a highly disturbed habitat as a result, or it can have exposure to contaminants in the soil in a habitat that is minimally disturbed. In some cases, it can be appropriate to allow plants and animals low in the food chain to be exposed to potentially toxic concentrations, sparing important habitat, if animals higher in the food chain (especially top carnivores) are not receiving toxic exposures. In other cases, especially when human health is threatened, it is necessary to alter or destroy habitat to prevent exposure to soil contaminants (Suter et al. 1995). In the case of CBP activities, the military training mission requires activities that will alter some already disturbed habitat and could create some intermittent noise. Wildlife is expected to respond by moving away from the noise and likely returning to their cover and food when the noise abates.

There may be little benefit to removing contaminated soil or sediment because COPEC concentrations are not necessarily at harmful levels. For example, of 14 metal COPECs with stated background criteria, 10 had average concentrations below the background criteria, and the remaining 4 had average concentrations less than twice background. This small factor means that concentrations are not likely to be an exposure and risk issue.

3.5 FATE AND TRANSPORT ASSESSMENT OF COCS IN SOILS

The CBP RI Report (USACE 2005f) concluded no potential impact to groundwater from COCs in soils at this AOC. Therefore, soil remediation for protection of groundwater is not required.

3.6 COCS FOR REMEDIAL ALTERNATIVE EVALUATION

The final list of COCs for evaluation of remedial alternatives were identified in the previous sections (Sections 3.3, 3.4, and 3.5) and based on risk management considerations including:

- Comparison of EPC to preliminary cleanup goal concentrations (including background concentrations);

- Comparison of EPC to upgradient concentrations for sediment, surface water, and groundwater;

- Consideration of soil as the primary source of contamination (i.e., if soil concentrations are below background at an AOC, that AOC is not contributing to contamination in other media); and

- Other site-specific and receptor-specific considerations.

No COCs are identified for evaluation of remedial alternatives for the representative receptor or unrestricted land use at CBP; therefore, no further action is recommended for soil/dry sediment. Characterization of debris piles, which are placed materials and not conventional environmental media, was performed during the supplemental Phase II RI to determine waste disposition characteristics as applicable.The multi-increment sample results from Piles M and N indicate they contain inorganic contaminants at much higher levels than surrounding soil. Process knowledge and visual characteristics indicate that these piles contain a substantial percentage of burning residues and, on this basis, are considered as a waste material rather than conventional environmental media. Supplemental Phase II sampling indicated that Pile M has a lead concentration of 8,560 mg/kg and also a lead TCLP result of 15.4 mg/L. This TCLP result exceeds the maximum concentration of lead (5.0 mg/L) for toxicity characteristics and the debris pile material potentially classifies as a characteristically hazardous waste. Also, Pile N had a detected value of 25 mg/kg of hexavalent chromium, which, although not characteristically hazardous, is highly elevated compared to the surrounding soil. Based on process knowledge for the piles, there are no ARARs pursuant to RCRA or Ohio hazardous waste regulations that mandate the need for removal or treatment of the debris piles. However, alternatives that permanently reduce contaminant toxicity, mobility, or volume through treatment are statutorily favored under CERCLA (55FR 8720). Consistent with this CERCLA statutory preference, Piles M and N are candidates for removal, treatment as applicable to attain Land Disposal Restriction (LDR) criteria, and disposal. Removal of these piles will reduce overall residual risk remaining at CBP upon completion of the action. Furthermore, limited removal will prevent precipitation and wind-borne dispersal of the contaminated material across a wider area consistent with the CERCLA objective to reduce contaminant mobility.

4.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Agencies responsible for remedial actions under CERCLA must ensure selected remedies meet ARARs. The following sections describe proposed ARARs for CBP.

4.1 INTRODUCTION

CERCLA Sections 121(d)(1) and (2) provide that remedial actions selected for a site must attain a degree of cleanup of hazardous substances, pollutants, and contaminants that: (1) assures protection of human health and the environment; and (2) complies with ARARs. ARARs are developed in accordance with the statutory and regulatory provisions set forth in CERCLA and the National Contingency Plan (NCP).

A remedial action will comply with ARARs if the remedial action attains the standard established in the ARAR for a particular hazardous substance. When a hazardous substance, pollutant, or contaminant will remain onsite at the completion of a remedial action, then that substance must meet any limit or standard set forth in any legally ARAR, criteria, or limitation under a federal environmental law. These standards apply unless such standard, requirement, criteria, or limitation is waived in accordance with CERCLA Section 121(d)(4). Any promulgated standard, requirement, criteria, or limitation under a State environmental or facility siting law that is more stringent than any federal standard, requirement, criteria, or limitation, and that has been identified by the state in a timely manner, can be an ARAR as well.

Regulatory language interpreting and implementing the statutory directive is found in the NCP. One provision, 40 Code of Federal Regulation (CFR) § 300.400(g), provides that the lead agency (US Department of the Army) and support agency (Ohio EPA) shall identify applicable requirements based upon an objective determination of whether the requirement specifically addresses a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Under 40 CFR § 300.430(e), the lead agency has the ultimate authority to decide what requirements are ARARs for the potential remedial activities.

Identifying ARARs involves determining whether a requirement is legally applicable, and if it is not legally applicable, then whether a requirement is relevant and appropriate. Individual ARARs for each site must be identified on a site-specific basis. Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria or limitations promulgated under federal or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site (40 CFR § 300.5).

If it is determined that a requirement is not legally applicable to a specific release, the requirement may still be relevant and appropriate to the circumstances of the release. Determining whether a rule is relevant and appropriate is a two-step process that involves determining whether the rule is relevant, and, if so, whether it is appropriate. A requirement is relevant if it addresses problems or situations sufficiently similar to the circumstances of the remedial action contemplated. It is appropriate if its use is well suited to the site.

In addition to ARARs, the lead and support agencies may identify other advisories, criteria, or guidance to be considered for a particular release. The "to be considered" (TBC) category consists of advisories, criteria, or guidance that were developed by USEPA, other federal agencies, or states that may be useful in developing CERCLA remedies. TBCs will be considered as guidance or justification for a standard used in the remediation if no other standard is available for a situation to help determine the necessary level of cleanup for protection of health or the environment. This may occur if no ARAR is available for a particular contaminant or concern, or if there are multiple contaminants and/or multiple pathways not considered when establishing the standards in the ARAR so that use of the ARAR does not allow the remedial action to be protective of human health or the environment.

While onsite actions must comply with both applicable and relevant and appropriate requirements, offsite actions must comply with only applicable requirements. Also, a determination of relevance and appropriateness may be applied to only portions of a requirement, so that only parts of a requirement need be complied with, whereas a determination of applicability is made for the requirement as a whole, so that the entire requirement must be complied with.

CERCLA provides for a permit waiver for remedial actions that are conducted onsite and in accordance with the NCP. Although the administrative requirement of permits has been waived by the statute, substantive requirements of rules that would otherwise be enforced through permits are still applicable. The Ohio EPA Division of Emergency and Remedial Response (DERR) has addressed this issue in two policies, one in final form and one in draft form. The policy in final form, Final Policy Number DERR-00-RR-001, ARARs, 7/30/1998, states that: "…cleanup projects will not be subject to the administrative requirements of permits, including permit applications, public notice, etc.", particularly when the cleanup project is governed by an enforcement order. The policy in draft form, Draft Policy Number DERR-00-RR-034, Use of ARARs in the Ohio EPA Remedial Response Program, 9/2/03, states that: "It has been DERR's policy to require responsible parties to acquire and comply with all necessary permits, including all substantive and administrative requirements." Permit waivers are specifically addressed in Section VII. General Provisions (Paragraph No. 12) of the DFFO:

"e. It is Ohio EPA's position that if state law related to a remedial or removal action requires a permit, then a permit must be acquired in accordance with CERCLA Section 120(a)(4). It is Respondent's position that these Orders implement a CERCLA-based remediation program and that a permit is not required in accordance with CERCLA Section 121(e). The Parties agree that the remedial or removal actions anticipated at the RVAAP are not of the type that routinely requires a permit under state law. If Ohio EPA determines that a permit is required for a particular remedial or removal action at the RVAAP, the Parties will meet and attempt in good faith to resolve to [sic] this issue."

Any remedial response action at RVAAP must be conducted in accordance with the DFFOs, which provide that, irrespective of ARARs, "all activities undertaken … pursuant to these Orders shall be performed in accordance with the requirements of CERCLA, the NCP, and all other applicable federal and state laws and regulations."

4.2 POTENTIAL ARARS FOR CBP

USEPA classifies ARARs as chemical-specific, action-specific, and location-specific in order to provide guidance for identifying and complying with ARARs (USEPA 1988):

- Chemical-specific ARARs are health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, allow numerical values to be established. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment (USEPA 1988).

- Action-specific ARARs are rules, such as performance or design or other activity-based rules, which place requirements or limitations on actions.

- Location-specific ARARs are rules that place restrictions on the concentration of hazardous substances or the conduct of activities solely because they occur in special locations (USEPA 1988).

As explained in the following paragraph, rules from each of these categories are ARARs only to the extent that they relate to the degree of cleanup.

CERCLA Section 121 governs cleanup standards at CERCLA sites. ARARs originate in the subsection of CERCLA that specifies the degree of cleanup at each site, CERCLA Section 121(d). In Section 121(d)(2), CERCLA expressly directs that ARARs are to address specific contaminants of concern at each site, specifying the level of protection to be attained by any chemicals remaining at the site. CERCLA Section 121(d)(2) provides that with respect to hazardous substances, pollutants, or contaminants remaining onsite at the completion of a remedial action, an ARAR is:

> "any standard, requirement, criteria, or limitation under any Federal environmental law … or any promulgated standard, requirement, criteria, or limitation under a State environmental or facility siting law that is more stringent than any Federal standard, requirement, criteria, or limitation"

CERCLA Section 121(d)(2) further provides that the remedial action attain a level of control established in rules determined to be ARARs.

As such, 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 site. 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 that the degree of cleanup will be protective of human health and the environment under the circumstances presented by the release.

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 onsite after the remedial action, and to the extent that they ensure a degree of cleanup which is protective of human health and the environment under the circumstances presented by the release.

4.2.1 Potential ARARs for Piles of Debris Waste

Depending on its chemical contaminants, waste debris may be managed as clean fill, as construction and demolition debris (C&DD), as solid waste, or as hazardous waste. C&DD that is identified as solid waste or hazardous waste is managed in accordance with those program requirements. Clean hard fill and C&DD are managed in accordance with State of Ohio C&DD rules at Ohio Administrative Code (OAC) Chapter 3745-400. Potential ARARs for waste piles of debris include rules for disposal of construction and demolition debris and for use of clean hard fill.

Generally, C&DD encompasses materials from any manmade physical structure that are not identified as solid wastes, hazardous wastes, or materials from mining operations, nontoxic fly ash, spent nontoxic foundry sand and slag. (OAC § 3745-400—1(F)) “Clean hard fill” means C&DD that consists only of reinforced or nonreinforced concrete, asphalt concrete, brick, block, tile, and/or stone which can be reused as construction material. (OAC § 3745-400-1(E))

Potential ARAR OAC § 3745-400-05 establishes requirements and limits regarding where clean hard fill, as defined in the previous paragraph, can be used. The rule provides that clean hard fill may be reused as construction material, or it may be used to bring a site up to a consistent grade, or it may be disposed of in a licensed C&DD or other landfill. If used to grade a site where generated, no paperwork is required, but if clean hard fill is taken offsite and used to grade a site, then a “Notice of Intent to Fill” must be filed with the Ohio EPA. If use of clean hard fill creates a nuisance or a safety hazard, that problem must be addressed with a cover or other appropriate measures. (OAC § 3745-400-05) Clean hard fill may be stored onsite for two years after active use of the pile has ceased (removing and adding to the pile), after which time storage constitutes illegal disposal.

Potential ARAR OAC § 3745-400-04 establishes requirements and limits regarding disposal of C&DD. The rule provides that C&DD may be disposed of in a licensed solid waste landfill, in a licensed C&DD landfill, by open burning under a permit, or in any other manner that is not prohibited by State laws and rules, as long as disposal does not create a nuisance, health hazard, water pollution, or a violation of solid or hazardous waste rules.

OAC § 3745-400-03 provides for three exclusions of facilities from C&DD requirements: (1) those facilities where construction debris, brush, and trees from clearing are used as fill at the same facility; (2) any site where clean hard fill is used in legitimate fill activities; and (3) sites where debris is reused, recycled, or stored rather than disposed of. OAC § 3745-400-06 provides a location restriction for a new

C&DD facility: that one cannot be established within a 100-year floodplain, although this requirement can be waived under certain conditions.

4.2.2 Potential Soil ARARs for RCRA Hazardous Waste

If soil contamination at CBP is determined to be Resource Conservation and Recovery Act (RCRA) hazardous material, certain hazardous waste requirements are triggered. Some RCRA requirements prescribe standards for treatment of hazardous materials. These requirements are generally not ARARs because they do not relate directly to the degree of cleanup or to specific chemicals but rather to the method used to obtain the degree of cleanup. Some RCRA requirements prescribe standards for disposal of hazardous materials. Standards that directly address land disposal may be potential ARARs at CBP. These are: (1) LDRs prohibiting disposal of specific chemicals until they are treated to a protective level, and (2) minimum technical requirements (MTRs) for land disposal units.

USEPA cautions that LDRs should not be used to determine site-specific cleanup levels for soils (USEPA 2002). The purpose of LDRs is to require appropriate treatment of RCRA hazardous wastes that are to be land disposed of in order to minimize short and long-term threats to human health or the environment. Performing treatment to meet certain standards is different from the CERCLA approach to remediation, which is analyzing risk and then developing soil cleanup standards based on the risk present, and may result in soil cleanup levels that are different from those of a risk-based approach. Nevertheless, if RCRA hazardous materials are managed in a way that generates RCRA hazardous waste, and if that waste is land disposed of onsite, then the material must meet the standards established in the LDRs.

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

If soils are managed in a manner that generates hazardous waste, such as removing soil to an above-ground container and depositing the soil within the land unit for disposal, then LDRs become potential ARARs. LDRs attach to the waste at the time that it is removed from the unit under an AOC approach, or at the time that the soil is excavated and lifted out of the unit. Potential LDR ARARs in Ohio are variances from treatment standards at OAC § 3745-700-44, LDR standards for contaminated debris at OAC § 3745-47, Universal Treatment Standards (UTS) at OAC § 3745-270-48, and Alternative Standards for Contaminated Soil at OAC § 3745-270-49. Action-specific ARARs are summarized in Table 4-1.

Ohio has adopted the alternative soil treatment standards as promulgated by USEPA in its Phase IV LDR rule, effective August 1998. Basically, the rules provide that if RCRA hazardous wastes are present, then the material must meet either 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, he may use the generic treatment standards at OAC § 3745-270-40 which apply to all hazardous wastes. Only the alternative soil treatment standards are explained in this document. Under the alternative soil treatment standards, all soils subject to treatment must be treated as follows:

1. For non-metals, treatment must achieve 90% reduction in total constituent concentration (primary constituent for which the waste is characteristically hazardous as well as for any organic or metal underlying hazardous constituent [UHC]), subject to item 3 below.

2. For metals and carbon disulfide, cyclohexanone, and methanol, treatment must achieve 90% reduction in constituent concentrations as measured in leachate from the treated media (tested according to the TCLP or 90% reduction in total constituent concentrations (when a metal removal treatment technology is used), subject to item 3 below.

3. When treatment of 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 10xUTS."

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 greater (i.e., 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 CBP, then the design and treatment standards established at OAC §3745-57-72 will be potentially relevant and appropriate to the response action. Only CAMU-eligible waste can be disposed of in a CAMU. CAMU-eligible waste includes hazardous and non-hazardous wastes that are managed for implementing cleanup, depending on the Director’s approval or prohibition of specific wastes or waste streams. Use of 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 that is designed and constructed to maintain less than a thirty centimeter depth of leachate over the liner. A composite liner means a system consisting of two components; each component has detailed specifications and installation requirements. The Director may approve alternate requirements if he can make the findings 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.

Table 4-1. Potential Action ARARs for Disposal of RCRA Hazardous Waste

Media and Citation	Description of Requirement	Potential ARAR Status	Standard
Soil Contaminated with RCRA Hazardous Waste OAC § 3745-400-49 OAC § 3745-400-48 UTS	These rules prohibit land disposal of RCRA hazardous wastes subject to them, unless the waste is treated to meet certain standards that are protective of human health and the environment. Standards for treatment of hazardous contaminated soil prior to disposal are set forth in the two cited rules. Use of the greater of either technology-based standards or UTS is prescribed.	LDRs apply only to RCRA hazardous waste. This rule is considered for ARAR status only upon generation of a RCRA hazardous waste. If any soils are determined to be RCRA hazardous, and if they will be disposed of onsite, then this rule is potentially Applicable to disposal of the soils.	All soils subject to treatment must be treated as follows: For non-metals, treatment must achieve 90% reduction in total constituent concentration (primary constituent for which the waste is characteristically hazardous as well as for any organic or metal UHC), subject to 3) below; For metals and carbon disulfide, cyclohexanone, and methanol, treatment must achieve 90% reduction in constituent concentrations as measured in leachate from the treated media (tested according to the TCLP or 90% reduction in total constituent concentrations (when a metal removal treatment technology is used), subject to 3) below. When treatment of 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 10xUTS."
Debris Contaminated with RCRA Hazardous Waste OAC § 3745-400-49 OAC § 3745-400-47	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 onsite, then these rules are potentially Applicable to disposal of the debris.	Standards are extraction or destruction methods prescribed in OAC § 3745-400-47. Treatment residues continue to be subject to RCRA hazardous waste requirements.

Table 4-1. Potential Action ARARs for Disposal of RCRA Hazardous Waste (continued)

Media and Citation	Description of Requirement	Potential ARAR Status	Standard
Soils/Debris Contaminated with RCRA Hazardous Waste – Variance OAC § 3745-400-44	The Director will recognize a variance approved by the USEPA from the alternative treatment standards for hazardous contaminated soil or for hazardous debris.	Potentially applicable to RCRA hazardous soil or debris that is generated and placed back into a unit and that will be land disposed of onsite.	A site-specific variance from the soil treatment standards can be used when treatment to concentrations of hazardous constituents greater (i.e., 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.
Soils Disposed of in a Corrective Action Management Unit (CAMU) OAC § 3745-57-53	Only CAMU-eligible waste can be disposed of in a CAMU. CAMU-eligible waste includes hazardous and non-hazardous waste that are managed for implementing cleanup, depending on the Director's approval or prohibition of specific wastes or waste streams. Use of 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.	Potentially applicable to RCRA hazardous waste that is disposed of in a CAMU.	Design standards include a composite liner and a leachate collection system that is designed and constructed to maintain less than a thirty centimeter depth of leachate over the liner. A composite liner means a system consisting of two components; each of which has detailed specifications and installation requirements. The Director may approve alternate requirements if he can make the findings 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 de facto cleanup standards for wastes disposed of in a CAMU.

CAMU = Corrective Action Management Unit
LDR = Land Disposal Restrictions
OAC = Ohio Administrative Code
RCRA = Resource Conservation and Recovery Act
UHC = Underlying Hazardous Constituent
UTS = Universal Treatment Standard

4.2.3 Potential Location ARARs for Solid Wastes, RCRA Hazardous Wastes, C&DD Wastes or Clean Fill

Location requirements include those established for potential remedial activities conducted within wetlands or within a floodplain area, or with respect to threatened and endangered species. Generally, for wetlands and floodplains, rules require that alternatives to remedial activity within the sensitive area be pursued, and if that is not feasible, then adverse effects from any actions taken within the sensitive area be mitigated to the extent possible. These requirements do not relate to specific chemicals, nor do they further 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 to the extent possible. Under CERCLA Section 121(d), relevance and appropriateness are related to the circumstances presented by the release of a hazardous substance, with the goal of attaining a degree of cleanup and control of further releases that ensures protection of human health and the environment.

Rules ensuring protection of sensitive resources do not represent requirements that are relevant and appropriate to circumstances presented by the release of a hazardous substance, with a goal of attaining a degree of cleanup and control of further releases that ensure protection of human health and the environment. Location requirements for wetlands and floodplains do not relate to the degree of cleanup as much as they relate to protection of these sensitive areas from the effects of remedial activities. This purpose of the rule requirements does not address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site as an ARAR; that is, the rule requirements are not sufficiently relevant and appropriate under CERCLA Section 121(d) as related to the circumstances of the release, degree of cleanup, or protectiveness of remedial action, to include these requirements as ARARs.

The Endangered Species Act (ESA) exists to protect the habitat or body of flora and fauna that are threatened or endangered. Once again, these rules do not relate to specific chemicals, nor do they further the degree of cleanup in the sense of protecting human health or the environment from the effects of harmful substances. The purpose of these rules is to protect sensitive areas and plant and animal life to the degree possible. This purpose does not address problems or situations sufficiently similar to those encountered at the CERCLA site that its use is well suited to the particular site as an ARAR; that is, the rule requirements are not sufficiently relevant and appropriate under CERCLA Section 121(d) as related to the circumstances of the release, degree of cleanup, or protectiveness of the remedial action, to include these requirements as ARARs.

Having determined that these requirements are not ARARs, it bears repeating that any action taken by the Federal Government must be conducted in accordance with requirements established under the National Environmental Policy Act (NEPA), ESA, and federal and state wetlands and floodplains construction and placement of materials considerations, even though these laws and rules do not establish standards, requirements, limitations, or criteria relating to the degree of cleanup for chemicals remaining onsite at the close of the response action.

5.0 TECHNOLOGY TYPES AND PROCESS OPTIONS

This section describes the identification of technology types and process options for the berms and piles at CBP determined to require disposition. The purpose of the identification is to determine suitable technologies and process options that may potentially be utilized to address any needed disposition of Piles M and N at CBP:

- Identifying suitable general classes of response actions, or general response actions (GRAs) (Section 5.1).

- Identifying technologies and process options applicable to the general response actions and performing an initial screening for soils (Section 5.2).

The Federal Remediation Technologies Roundtable (FRTR) has provided guidance for the evaluation of remedial technologies. FRTR provides a screening matrix which assesses the effects potential technologies have on the types of contaminants. This guidance was used as a point of reference throughout this initial screening of technologies.

5.1 GENERAL RESPONSE ACTIONS

This section describes the GRAs and remedial technologies that are potentially applicable to Piles M and N at CBP. GRAs are actions that will satisfy the RAOs (Section 3.1) for a specific medium, and may include various process options. GRAs are not remedial alternatives but are potential components of remedial alternatives. GRAs include no action, land use controls, monitoring, containment, removal, and disposal/handling.

5.1.1 No Action

In this GRA, no action would be undertaken to reduce any hazard to human health or the environment. Any current actions, controls, or monitoring would be discontinued. This action complies with the CERCLA requirement to provide an appropriate option or component of a remedial alternative if no unacceptable risks are present and to provide a baseline against which other alternatives can be compared.

5.1.2 Land Use Controls and Five-Year Reviews

Generally, land use controls reduce the potential for exposure to contaminants, but do not reduce contaminant volume or toxicity. These controls are utilized to supplement and affect the engineering component(s) of a remedy (e.g., removal, etc.) during short- and long-term implementation.

The primary goal of land use controls is to restrict the use of, or limit access to, real property using physical, legal, and/or administrative mechanisms to ensure protectiveness of the remedy. Particular land use controls under consideration at CBP include measures that will restrict land use changes over the long-term, such as governmental controls and enforcement tools. Governmental controls could include building restrictions and zoning controls, while enforcement tools may involve administrative orders, consent decrees or proprietary measures such as negative easements. Informational devices can be governmental (i.e., such as handing out information as part of a permit process) or proprietary (i.e., entering a notice on a deed) and are more short term than governmental controls. Land use controls can be used to supplement engineering controls; however, land use controls are not to be used as the sole remedy at a CERCLA site unless the use of active measures such as containment of source material are determined to not be practicable [(40 CFR § 300.430(a)(1)(iii)(D)].

If land use controls are selected as a component of a remedial alternative achieving restricted land use, the effectiveness of the remedy must undergo five-year reviews (USEPA 2001). The primary goal of the five-year reviews is to evaluate the implementation and performance of a remedy in order to determine if the remedy is or will be protective of human health and the environment. The five-year reviews may be discontinued upon the site achieving preliminary cleanup goals for unlimited use and unrestricted release.

5.1.3 Containment

Containment can effectively reduce contaminant mobility and the potential for exposure. However, containment actions do not reduce contaminant volume or toxicity. When consolidation is used in conjunction with containment, the overall area of contamination is reduced, thereby reducing the area of potential exposure to individuals. The primary containment technology considered for Piles M and N at CBP is capping with consolidation. Capping involves covering an area with a low-permeability material (e.g., native soil, clay, concrete, asphalt, synthetic liner, or multi-layered) to reduce infiltration of water and the migration of COCs.

5.1.4 Removal

Removal of impacted piles would reduce the potential for long-term human and environmental exposure. For example, impacted material could be excavated and disposed of either onsite in a designated location or offsite in an appropriately licensed disposal facility. Excavation would minimize long-term direct human contact with and the local migration of impacted material.

5.1.5 Treatment

The treatment options evaluated for impacted piles at CBP include various physical, chemical, biological, and thermal technologies. Physical processes involve either physically binding the contaminants to reduce their mobility or the potential for exposure or extracting them from a medium to reduce volumes. Chemical treatment processes add chemicals (in situ or ex situ) to react with contaminants to reduce their toxicity or mobility. Biological treatment involves using microbes to degrade or concentrate contaminants. Thermal treatment such as incineration uses high temperatures to volatilize, decompose, or melt contaminants.

5.1.6 Disposal and Handling

Disposal and handling of piles would involve the permanent and final placement of waste materials in a manner that protects human health and the environment. Pile material could be disposed of onsite in an engineered facility, or offsite in a permitted or licensed facility such as a regulated landfill. Transportation could be accomplished using a variety of modes. Truck, railcar, and/or barge transportation could be used to move waste materials onsite or ship waste materials offsite.

5.2 INITIAL SCREENING OF TECHNOLOGIES

This section describes the identification and initial screening of potential technologies for disposition of Piles M and N at CBP. Technology types and process options for CBP were selected on the basis of their applicability to the environmental media of interest (e.g., soil). Process options were either retained or eliminated from further consideration on the basis of technical implementability and effectiveness with respect to soil/waste material chemical contamination. Results of the initial technology screening are summarized in Table 5-1.

5.2.1 No Action

No action would be taken to implement remedial technologies to reduce any hazard to human health or the environment. Any current actions, controls, or monitoring would be discontinued. This action complies with the CERCLA requirement to provide an appropriate option or component of a remedial alternative if no unacceptable risks are present. The No Action technology shall be retained as a process option to be further evaluated.

5.2.2 Land Use Controls and Five-Year Reviews

Actions being considered include land use controls and five-year reviews. Land use controls are legal, administrative, and physical, mechanisms employed to restrict the use of, or limit access to, real property to prevent or reduce risks to human health and the environment. The implementability of these mechanisms depends on:

- The entity assuming responsibility for initiating, implementing, and maintaining the controls;

- The arrangements made between property owners in different governmental jurisdictions and the authority of local governments; and

- Specific characteristics of the site.

Legal impediments and costs affect implementability and schedules. The NCP has outlined criteria to evaluate when the use of land use controls would be acceptable as a component of a remedial alternative. Sites containing residual contamination above acceptable concentrations for unrestricted land use require five-year reviews to determine whether the integrity of the controls remains intact. When the site achieves preliminary cleanup goals that allow for unlimited use and unrestricted exposure, then at that time five-year reviews may be discontinued.

At CBP, there are no COCs with regard to chemical contamination in soils. For unrestricted land use, no soil or sediment COCs are identified for evaluation of remedial alternatives. Land use controls and five-year reviews would not be required and is not retained for further evaluation.

5.2.3 Containment

Containment actions prevent or minimize contaminant migration and eliminate exposure pathways. Contaminated medium is neither chemically nor physically changed nor are the volumes of contaminated media reduced. The containment action considered for impacted pile material at CBP is capping. Capping can reduce surface water infiltration through contaminated media and minimize the release of dust and vapors to the atmosphere. Process options consist of varying cap construction materials of native soil, clay, synthetic liner, multi-layered, asphalt, and concrete.

Native and/or clay soils can be used to construct a cap to provide an exposure barrier to contaminated media. In conjunction with surface controls, such a cap can be effective in reducing contaminant migration by wind and water erosion. However, soil caps are susceptible to weather effects including cracking. Synthetic liners or multi-layered caps of different media would not be as susceptible to cracking and also would provide adequate exposure barriers. Asphalt and concrete caps have similar limitations as native and clay soil caps if not properly maintained. Existing building slabs and paved surfaces can be effective in reducing direct human contact and wind and water erosion.

Capping is a mature, commercially available technology for site remediation. Permanent caps may provide sustained isolation of contaminants and prevent the mobilization of soluble compounds over the long term and eliminate exposure pathways. Capping tends to be less expensive than other remedial technologies. The use of simple compacted soil covers or asphalt/concrete covers are far more susceptible to weathering (erosion, ultraviolet light, and freeze/thaw cycle). Therefore, capping systems require periodic inspection and repair to maintain effectiveness. Capping systems that utilize synthetic liners or a combination of different media (e.g., RCRA caps) would be less susceptible to cracking due to climatic effects. Capping does not lessen toxicity, mobility, or volume of hazardous wastes, but does mitigate vertical migration. In addition, the presence of a cap may hinder any additional treatment should the contaminated media be found to require treatment at a later date.

Capping for Piles M and N is not retained as an option to be further evaluated at CBP because it is not practical for the small area involving the debris piles requiring remediation.

5.2.4 Removal

Removing contaminated soil involves bulk excavation techniques via conventional excavation equipment. The techniques utilized are dependent upon the areas and locations to be excavated. Large mechanical excavators would be used for easily accessible areas. Where space is limited, smaller mechanical devices or hand tools may be required. Excavation would require the use of dust and surface runoff controls to ensure the safety of workers and the general public. Runoff controls are especially important for any areas draining to a wetland. Excavated soils can then be transported and disposed of at an onsite or offsite disposal facility. Alternatively, soils can be treated to destroy or immobilize COCs.

Contaminated soil removal is retained as an option to be further evaluated for CBP. Debris pile materials containing contaminants at levels greater than RCRA LDR standards will require treatment/stabilization to achieve less than LDR standards prior to disposal.

5.2.5 Treatment

Process options evaluated for treatment include various ex situ physical, chemical, biological, and thermal options.

5.2.5.1 Ex Situ Physical/Chemical Treatment

Ex situ physical/chemical treatment options apply to contaminated pile material which have first been removed by excavation (i.e., removal).

Chemical Extraction: Chemical extraction is the application of a chemical extractant to collect and concentrate contaminants from soil. The collected contaminants are then placed in a separator (e.g., centrifuge) to remove the solvent for disposal. Two types of chemical extraction are typically performed, acid extraction and solvent extraction.

Acid extraction uses hydrochloric acid to extract heavy metal contaminants from soils. In this process, soils are first screened to remove coarse solids. Hydrochloric acid is then introduced into the soil in the extraction unit. The residence time in the unit generally ranges between 10 and 40 minutes depending on the soil type, contaminants and contaminant concentrations. The soil-extractant mixture is continuously pumped out of the mixing tank and separated using hydrocyclones. The separated soil is dewatered and mixed with an acid-neutralizing agent (e.g., lime) to neutralize any remaining acid. The acid solution is regenerated using a precipitant and flocculent to remove dissolved metals (FRTR 2005).

Solvent extraction is accomplished with the use of an organic solvent. This process is often combined with other technologies such as stabilization, incineration, or soil washing, but can be used as a stand-alone technology in some instances. The solvent must be carefully selected since soils may contain residual solvent concentrations subsequent to treatment. Solvent extraction processes are highly effective in treating SVOCs and metals, but ineffective for HEs.

Chemical extraction is retained for further evaluation.

Chemical Redox: Chemical redox processes involve the addition of appropriate chemicals to raise or lower the oxidation state of the reactant. Oxidation chemically converts hazardous contaminants to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert. The oxidizing agents most commonly used are ozone, hydrogen peroxide, hypochlorites, chlorine, and chlorine dioxide. Non-halogenated SVOCs are resistant to oxidation, and metals may form toxic byproducts or become mobilized. Potentially large amounts of chemical waste products would be generated through this option, requiring additional waste treatment and disposal. This process primarily has been proven effective for treating mobile inorganics such as cyanide and chromium. Chemical redox is retained for further evaluation.

Dehalogenation: Dehalogenation uses various methods to remove a halogen molecule from organic chemicals within the soil. This method is only effective at treating halogenated VOCs and SVOCs, which are not present in large quantities in CBP piles; therefore, it is eliminated from further evaluation.

Soil Washing: Soil washing achieves volume reduction of contaminated soils in two ways: by dissolving or suspending the contaminants in the wash solution or by concentrating the contaminants into a smaller volume through particle size separation. Soil washing systems that incorporate both techniques are generally the most effective. Soil washing involves pre-treating contaminated soils to remove larger objects, then washing the soils with water (with or without additives to improve contaminant extraction) to remove target constituents. Conventional soil washing systems are not typically effective for soils containing large amounts of clay and silt. Incorporating other physical and chemical processes can enhance the effectiveness of soil washing. During the soil washing operation, the majority of the process water is filtered and recycled back into the treatment system. A small volume of this water stream would require periodic discharge. Following treatment, the reduced soil fraction may be further treated (such as solidification) if required. The resulting “clean” soils could be placed back onsite or reused at another site.

Soil washing is commonly applied to soils impacted with SVOCs, fuels, heavy metals and select VOCs and pesticides. This process has limited application experience in treating HEs. Soil washing is not retained for further evaluation.

Stabilization/Solidification (S/S): Ex situ S/S immobilizes contaminants within excavated soils using chemical fixation and vitrification. These processes are highly effective for immobilizing inorganic contaminants, preventing exposures or migrations to exposure points. Treating HEs or SVOCs may be limited. S/S is retained for further evaluation.

5.2.5.2 Biological Treatment

Enhanced Bioremediation: Technologies involve destruction or transformation techniques in which favorable environments are created for microorganisms or plant systems to grow and use contaminants as a food or energy source. Processes include slurry-phase, solid phase, and anaerobic biodegradation. Biological treatment is generally most effective for treating organic contaminants. Bioremediation in soil is typically not applicable for treating inorganic contaminants (metals such as arsenic and manganese) and of limited effectiveness for polycyclic aromatic hydrocarbons (PAHs) and HEs. Consequently, enhanced bioremediation is not retained for further evaluation.

Monitored Natural Attenuation (MNA): MNA is a passive remedial measure that relies on natural processes to reduce the contaminant concentration over time. MNA is a viable remedial process option if it can reduce contamination within a reasonable time frame, given the particular circumstances of the site, and if it can result in the achievement of remediation objectives. Use of MNA as a component of a remedial alternative is appropriate along with the use of other measures, such as source control or containment measures. MNA, like enhanced bioremediation is generally of negligible to limited effectiveness for inorganic contaminants, PAHs and HEs. Similarly, MNA is not retained for further evaluation.

5.2.5.3 Thermal Treatment

Thermal treatment uses high temperatures to volatilize, decompose, or oxidize the contaminants. Various forms of thermal treatment technology including incineration, pyrolysis, and low temperature thermal desorption are described below:

- Incineration: High temperatures are applied in the presence of oxygen to combust organic compounds, converting them to carbon dioxide and water.

- Pyrolysis: Organic compounds are decomposed by high heat in the absence of oxygen, resulting in gaseous compounds and fixed carbon ash.

- Thermal Desorption: Heat volatilizes water and organics, which are collected and passed through a vapor treatment system.

Thermal treatment processes are generally used for the treatment of organic compounds and would not be effective for treating inorganic compounds. These options are not retained for further evaluation due to the potential for hazardous by-products from metal contamination in the soils.

5.2.6 Disposal and Handling

Both onsite and offsite disposal options were considered for the disposal of contaminated materials in Piles M and N. Handling options involved truck, railcar or barge alternatives to transport wastes.

5.2.6.1 Onsite Disposal

Onsite disposal of pile material in an engineered structure has been retained for further consideration. Land encapsulation is a proven and well-demonstrated technology. A facility would be designed and constructed to contain the excavated materials or residuals after treatment. Onsite, engineered structure has been determined to be potentially applicable although such a facility may not be practicable due to logistical issues.

5.2.6.2 Offsite Disposal

Among the offsite disposal options considered were a new facility at a location in Ohio, or an existing federal or commercially licensed facility. A new offsite disposal facility in Ohio could be designed to reduce potential exposure and minimize the migration of impacted material. A properly designed disposal facility is considered protective of public health. This option could be considered if land is made available or treatment significantly reduces waste volume. Therefore, a newly constructed offsite disposal facility has been determined to be potentially applicable and is retained for further consideration.

Existing federal or commercially licensed and permitted disposal facilities exist for the types of waste at RVAAP/RTLS and are retained for further consideration. Offsite disposal at an existing site is retained for further evaluation.

5.2.6.3 Handling

Offsite disposal requires waste materials to be transported to the selected disposal facility. A number of transportation options exist including trucks, railcars, and barges. These modes of transportation could be used individually or in combination to haul waste materials from RVAAP/RTLS to the disposal facility. The scenarios for transportation could include trucking to a rail loading facility, direct trucking to the disposal facility, or trucking to a barge loading facility. Railcar is not considered feasible as no operable spur is present at CBP. Similarly, barges are not retained as a sufficient navigable waterway is not located proximate to the site. Trucks have been used successfully for the types of waste that will be generated at the RVAAP and will be retained for further consideration.

5.2.7 Process Options Retained from Initial Screening

Table 5-2 summarizes the process options retained through the initial screening process to be considred for addressing disposition requirements of the berms and piles at CBP.

Table 5-2. Summary of Process Options Retained Initial Screening for CBP Piles

Process Option
No Action
Bulk Removal
Excavation
Ex Situ Physical/Chemical Treatment
Chemical Extraction
Chemical Redox
Stabilization/Solidification
Disposal
Onsite Engineered Land Encapsulation
Offsite Newly Constructed Facility
Onsite Existing Facility
Handling
Truck

5.3 DETAILED SCREENING OF TECHNOLOGIES

The remedial action technologies retained from the initial screening process described in Section 5.2 were further evaluated against criteria of effectiveness, implementability, and cost (three of the NCP balancing criteria). The rationale for either retaining or eliminating options is presented below and summarized in Table 5-3.

5.3.1 Criteria Used for Detailed Screening

Remedial action technologies retained from the initial screening process were further evaluated using three criteria (i.e., effectiveness, implementability, and cost) to determine the most appropriate technologies for remediating Piles M and N at CBP. The remedial options retained from detailed screening process were used in developing the remedial alternatives described in Section 6.

5.3.1.1 <u>Effectiveness</u>

The effectiveness criterion assesses the ability of a remedial technology to protect human health and the environment by reducing the toxicity, mobility, or volume of contaminants. Each technology was evaluated for the ability to achieve RAOs, potential impacts to human health and the environment during construction and implementation, and overall reliability of the technology.

5.3.1.2 <u>Implementability</u>

Each process option technology was evaluated for implementability in terms of technical feasibility, administrative feasibility, and availability of the necessary materials, equipment, and work force. The assessment considers each technology’s short and long-term implementability. Short-term implementability considerations include constructability of the remedial technology, near term reliability, and the ability to obtain necessary approvals, with other agencies, and the likelihood of obtaining a favorable community response. Long-term implementability evaluates the ease of undertaking additional remedial actions if necessary, monitoring the effectiveness of the remedy, and operation and maintenance (O&M).

5.3.1.3 <u>Cost</u>

The cost criterion evaluates each remedial process in terms of relative capital and O&M costs. Costs for each technology are rated qualitatively, on the basis of engineering judgment, in terms of cost effectiveness. Therefore, a low cost remedial technology would be rated as highly cost effective, while a costly technology would be evaluated as being of low cost effectiveness.

5.3.2 No Action

The no action alternative provides a baseline for comparison with all other remedial alternatives and is required by CERCLA. Under this alternative, any land use controls, remedial actions, and/or monitoring will be discontinued. This alternative provides no additional protection for human health and the environment. No remedial actions would be taken to reduce, contain, or remove contaminated materials and no effort would be made to prevent or minimize human and environmental exposure to residual contaminants. Offsite migration of contaminants would not be mitigated under this alternative.

As discussed in Section 3.6, no COCs are identified for evaluation of remedial alternatives for the representative receptor or unrestricted land use at CBP; therefore, no action is recommended for soil/dry sediment. Characterization of debris piles, which are placed materials and not conventional environmental media, was performed during the supplemental Phase II RI (See Appendix 2B) to determine waste disposition characteristics as applicable. The multi-increment sample results from Piles M and N indicate they contain inorganic contaminants at much higher levels than surrounding soil. Process knowledge and visual characteristics indicate that these piles contain a substantial percentage of burning residues and, on this basis, are considered as a waste material rather than conventional environmental media. Supplemental Phase II sampling indicated that Pile M has a lead concentration of 8,560 mg/kg and also a lead TCLP result of 15.4 mg/L. This TCLP result exceeds the maximum concentration of lead (5.0 mg/L) for toxicity characteristics and the debris pile material potentially classifies as a characteristically hazardous waste. Also, Pile N had a detected value of 25 mg/kg of hexavalent chromium, which, although not characteristically hazardous, is highly elevated compared to the surrounding soil. Based on process knowledge for the piles, there are no ARARs pursuant to RCRA or Ohio hazardous waste regulations that mandate the need for removal or treatment of the debris piles. However, alternatives that permanently reduce contaminant toxicity, mobility, or volume through treatment are statutorily favored under CERCLA (55FR 8720). Under the no action alternative, there would be no reduction in the mobility, volume, or toxicity of site-related contaminants in these two piles.

5.3.3 Removal

Removal technologies protect human health and the environment by physically separating the impacted materials from potential receptors. The removal process option (i.e., excavation of piles) was retained for CBP for detailed screening.

Effectiveness: Pile removal is effective in protecting human health and the environment. The potential for exposure to fugitive dust, contaminant leaching, and generation of contaminated surface water runoff would be greatly reduced with implementation of this option.

Implementability: Excavation is easily implemented using readily available resources and conventional earth-moving equipment. Some ancillary construction activities may be necessary such as temporary roads, a staging area for loading and unloading, erosion control, excavation dewatering, water treatment, dust control, and additional clearing and grubbing. Administrative coordination between remediation activities and OHARNG operations would need to be well planned to minimize impacts.

Cost: The cost effectiveness of pile removal is rated moderate to low. Capital costs related to removal are moderate. O&M costs would be low.

Removal technologies are retained.

5.3.4 Physical/Chemical Treatment

Debris pile materials containing contaminants at levels greater than RCRA LDR standards, will require treatment/stabilization to achieve less than LDR standards prior to disposal. Site-specific laboratory or pilot scale data are not currently available to assess the potential effectiveness of the physical treatment technologies. Published literature, previous experience at other sites, and vendor information were used to judge effectiveness, implementability, and cost.

5.3.4.1 Ex Situ Chemical Extraction

Chemical extraction utilizes a solvent to extract contaminants from soil media. Detailed screening results are described below.

Effectiveness: Chemical extraction is a proven effective technology for numerous organic and inorganic contaminants. The treatment effectiveness for metals is uncertain. Laboratory and conceptual design studies would need to be conducted on pile material from CBP to assess treatment processes. Both chemical extraction and soil washing likely would produce waste streams requiring additional treatment and/or disposal.

Implementability: Chemical extraction or soil washing would be moderately difficult to implement onsite. Formulating a solvent mixture capable of treating RVAAP's COCs may be problematic. In addition, chemical extraction typically involves solvent recovery by conventional distillation. Heating solvent containing HEs may present safety issues. Alternatively, discharging solvent from chemical extraction or soil washing processes may require substantial pretreatment and approval processing from regulatory agencies.

Cost: Chemical extraction is moderate to low in terms of cost effectiveness. The small total volumes of contaminated soil and high start up costs for the treatment systems reduce the cost effectiveness of these technologies.

Chemical extraction is not retained for CBP due to the questionable effectiveness of the technology, difficulty of implementation, and low potential cost effectiveness.

5.3.4.2 Ex Situ Chemical Redox

Chemical redox involves the addition of chemicals to raise or lower the oxidation state of a reactant. Detailed screening results are described below.

Effectiveness: Chemical redox is a proven effective technology for numerous inorganic contaminants. Laboratory and conceptual design studies would need to be conducted on pile material from CBP to assess treatment processes. Chemical redox would likely produce waste streams requiring additional treatment and/or disposal.

Implementability: Chemical redox would be moderately difficult to implement onsite. Formulating a solvent mixture capable of treating RVAAP's COCs may be problematic. Alternatively, discharging solvent from chemical redox may require substantial pretreatment and approval processing from regulatory agencies.

Cost: Chemical redox is moderate to low in terms of cost effectiveness. The small total volumes of contaminated material and high start up costs for the treatment systems reduce the cost effectiveness of these technologies.

Chemical redox is not retained for CBP due to the questionable effectiveness of the technology, difficulty of implementation, and low potential cost effectiveness.

5.3.4.3 Ex Situ Stabilization/Solidification

Effectiveness: Ex situ S/S consists of chemical fixation or vitrification. S/S via chemical fixation is one of the oldest most established remediation technologies available. It has been successfully used to reduce the mobility of metal and organic-contaminants in waste. Treatment effectiveness generally is limited for SVOCs and HEs. Treatment by S/S poses minimal risks to the local community and workers. Some dust may be generated during excavation; however, the amount generated would be equivalent to that generated with any remedial alternative requiring excavation and soil handling. Most chemical fixation processes result in a significant volume increases (up to double the original volume) and are typically most effective at treating metal-contaminated waste to meet disposal facility acceptance criteria.

Vitrification is typically used to address highly concentrated mobile contaminants, unlike those at the CBP. Vitrification poses a much higher risk to onsite workers compared to other treatment operations due to the high temperatures and specialized equipment required. Verifying that all of the contaminated media have been successfully vitrified can be difficult, since the resulting glass matrix acts as a barrier to sampling not only at the glass matrix-soil interface, but also within the glass matrix itself.

Implementability: Ex situ S/S via chemical fixation is easy to moderate to implement at CBP. Contaminated media would require excavation and transport to a central staging area for onsite treatment. The S/S materials likely would be of greater volume than original waste amounts. The treated waste would then be manifested and sent offsite by a licensed transporter for disposal at a licensed disposal facility. Qualified vendors and equipment are readily available to perform this treatment operation.

Vitrification is moderate to difficult to implement. Vitrification has successfully treated organic and metal contaminants, but generally for much higher contaminants concentrations and smaller quantities of wastes. While some volume reduction occurs during melting, the total volume of the final waste material often increases due to the addition of glass formers. Qualified vendors and equipment are available to perform this treatment operation.

<u>Cost</u>: The cost effectiveness of chemical fixation technologies for CBP is moderate. Disposal costs may be significantly increased due to the larger waste volumes requiring disposal. Vitrification is low in terms of cost effectiveness with high capital costs for implementation.

Ex situ S/S via chemical fixation is retained for CBP. Vitrification is not retained due to the uncertainties associated with confirmation sampling, high cost, and potential dangers to onsite workers during implementation.

5.3.5 Disposal and Handling

Initial screening results indicated three disposal options and one handling option are potentially applicable to CBP. Detailed screening evaluations for these remedial technologies are presented below.

5.3.5.1 <u>Onsite Disposal at a New Engineered Structure</u>

This option involves the design and construction of a new disposal facility onsite.

<u>Effectiveness</u>: Onsite disposal at a new engineered structure would be effective for physically separating impacted materials from potential receptors. Effectiveness concerns for onsite disposal include the ability of the site to meet engineering design criteria (i.e., geologic conditions, foundation soils, groundwater, seismic activity) for the siting and licensing of a disposal cell in the state of Ohio.

<u>Implementability</u>: The design and construction of a new disposal facility onsite would be difficult. Siting studies, facility design, environmental assessments and/or environmental impact statements, and public review would be required prior to implementation of this option. The public may have concerns regarding a new onsite disposal facility if adequate disposal capacity existed elsewhere. These requirements could result in unacceptable delays. During the site selection process, activities related to the construction and operation of the facility would be analyzed, and studies would be required to eliminate or minimize unacceptable impacts. The State of Ohio siting and licensing process also would render this alternative technology difficult to implement administratively. This option will also introduce long term surveillance, monitoring, and maintenance requirements.

<u>Cost</u>: A new onsite disposal cell would be low in terms of cost effectiveness. Capital costs would be substantial and be accompanied by moderate to high O&M costs for maintenance. There would be no disposal fees associated with a dedicated onsite facility.

The design and construction of a new disposal facility onsite is not retained for CBP. The difficulty in implementing this option combined with low cost effectiveness render this option undesirable.

5.3.5.2 <u>Offsite Disposal at a New Engineered Structure</u>

This option involves the design and construction of a new offsite disposal facility.

Effectiveness: The design and construction of a new offsite disposal facility would be effective in protecting human health and the environment by physically separating impacted materials from potential receptors.

Implementability: Establishing a new disposal facility offsite would be similarly difficult as the design and construction of an onsite structure. The new offsite facility would face the technical requirements and potential public concerns as described below.

Cost: The cost effectiveness of a new offsite disposal cell would be low. Capital costs would be high with moderate to high O&M costs. There would be no disposal fees associated with a dedicated offsite facility.

The design and construction of a new disposal facility offsite is not retained for CBP. This option is difficult to implement and has a low cost effectiveness thereby making this option undesirable.

5.3.5.3 Offsite Disposal at an Existing Facility

This option involves the utilization of an existing disposal facility to manage wastes.

Effectiveness: The use of an existing disposal facility would be effective in protecting human health and the environment. Many licensed and permitted facilities can accept waste streams similar to those anticipated to be generated at RVAAP. These facilities are very effective at isolating the material so as to prevent its impacting human health or the environment. By removing, but not treating contaminated pile material, no reduction in toxicity, mobility, or volume is achieved. However, future risk is reduced by removing this material from the RVAAP site. Debris pile materials containing contaminants at levels greater than RCRA LDR standards will require treatment/stabilization to achieve less than LDR standards prior to disposal. Offsite disposal options would be effective in terms of containing wastes generated by the RVAAP site remediation and separating impacted materials from potential receptors.

Implementability: Using an existing facility to dispose of waste would be easily implemented based on previous disposal activities conducted at RVAAP. Additional contracts would need to be negotiated if impacted material is to be sent to a facility not currently contracted. A number of properly permitted facilities are available in the United States that could serve as locations for disposal of some or all of the potential waste streams. Additionally, a number of licensed transporters should be available to haul properly documented waste.

Since several facilities may be contracted to receive different waste streams, a mechanism would need to be in place to ensure that the waste was properly segregated and that the regulatory agencies are satisfied with the procedures.

Cost: The cost effectiveness of utilizing a licensed and permitted disposal facility is rated to be moderate. There would be no long-term O&M costs since unrestricted land use goals are achieved regardless of the disposition of Piles M and N.

Offsite disposal at an existing facility is retained.

5.3.5.4 Handling

Effectiveness: The transportation options for hauling contaminated pile material involve the individual use of trucks for shipment from the site to the selected disposal facility. Trucks have been used extensively at other sites and are very effective due to their adaptability to site and route conditions. Trucks become less effective with greater haul distances due to safety concerns.

Implementability: The use of trucks is commonly implemented for transporting contaminated material. Truck transportation uses readily available resources and conventional transportation equipment. Waste would be manifested or a bill-of-lading secured with all supporting documentation and a licensed transporter secured.

Cost: The cost effectiveness of transporting wastes by truck is moderate to low, depending on hauling distance.

Truck transportation is retained.

5.4 RETAINED PROCESS OPTIONS

Table 5-4 summarizes the process options retained through the detailed screening process impacted piles at CBP.

Table 5-4. Retained Process Options for CBP Piles

General Response Action	Technology Type	Process Option
Removal	Bulk Removal	Excavation
Treatment	Ex Situ Physical/Chemical	Stabilization/Solidification (Chemical Fixation)
Disposal and Handling	Offsite	Trucks

These options were used in combination in the development of remedial alternatives described in Section 6 of this FS to address Piles M and N at CBP.

Table 5-1. Initial Screening of Technology Types and Process Options for CBP Piles

General Response Action	Technology Type	Process Options	Description	Screening Comments
No Action	None	None	No remedial technologies implemented to reduce hazards to potential human or ecological receptors.	Required to be carried through CERCLA analysis.
Land Use Controls and 5-year reviews	Controls	Government Controls	The regulatory authority of a state or local government agency to make land use restrictions and zoning ordinances is used to control the use of the land.	Not applicable. Even with Piles M and N on site, CBP can be released for unrestricted land use with respect to soils and sediment.
		Enforcement Tools	Administrative orders and consent decrees available under CERCLA, can prohibit certain land uses by a party or require proprietary controls be put in place.	
		Informational Devices	Registries or advisories put in place to provide information that residual or capped contamination is onsite.	
		Legal Mechanisms	Easements, deed restrictions, etc. placed on a property as part of a contractual mechanism.	
		Physical Mechanisms	Fences, berms, warning signs, and security personnel put in place to prevent contact with contaminated media.	
	Environmental Monitoring	Soil	Periodic monitoring of surface and subsurface soils to ensure that contaminant migration is not occurring into unimpacted media.	
		Sediment	Periodic monitoring of sediment in run-off and known deposition points will determine whether contaminants are being transported in surface waters.	

Table 5-1. Initial Screening of Technology Types and Process Options for CBP Piles (continued)

General Response Action	Technology Type	Process Options	Description	Screening Comments
Containment	Capping	Native Soil/Sediment	Uses native soils or sediment to cover contamination and reduce migration by wind and water erosion.	Not applicable. Impractical to construct a capping system for piles.
		Clay	Installation of clay cap to limit water infiltration. Susceptible to weathering effects (e.g. cracking).	
		Synthetic Liner	Synthetic materials used to limit water infiltration, not as susceptible to cracking as clay.	
		Multi-Layered	Multiple layers of different soil types used to limit water infiltration, not as susceptible to cracking as clay.	
		Asphalt/Concrete	Limits water infiltration, susceptible to cracking if not properly maintained.	
Removal	Bulk Removal	Excavation	Mechanically or hydraulically operated units such as excavators, front-end loaders, and bulldozers, and/or hand tools are used for trenching and other surface or subsurface excavation.	Potentially applicable.

Table 5-1. Initial Screening of Technology Types and Process Options for CBP Piles (continued)

General Response Action	Technology Type	Process Options	Description	Screening Comments
Treatment	Ex Situ Physical/ Chemical	Chemical Extraction	Acids or solvents are applied to contaminated material to remove contaminants, then passed through a separator to remove contaminants from the extraction.	Potentially applicable.
		Chemical Redox	Addition of chemicals to raise or lower oxidation state of contaminants, chemically converting hazardous materials to less hazardous or non-toxic.	Potentially applicable.
		Dehalogenation	Uses various methods to remove a halogen molecule from organics, reducing toxicity.	Not applicable. Not effective for CBP pile contaminants.
		Soil Washing	Reduces contaminated media volume by dissolving or suspending contaminants, or physically separating uncontaminated portions from contaminated portions.	Not applicable. Not effective for CBP pile contaminants
		Stabilization/Solidification	Immobilizes contaminants in the matrix in which they are found, using various techniques such as cement injection or vitrification.	Potentially applicable.
	Biological	Bioremediation	A favorable environment is created for microbe, fungus, or plant systems to utilize and breakdown contaminants.	Not applicable. Not effective for CBP pile contaminants.
		MNA	Passive remedial measure relies on natural processes to reduce contaminant concentration.	
	Ex Situ Thermal Treatment	Incineration	High temperatures are applied to combust (in the presence of oxygen) organic contaminants.	Not applicable. Not effective for CBP pile contaminants.
		Pyrolysis	Organic compounds are decomposed by applying heat in the absence of oxygen, resulting in gaseous components and a solid residue of fixed-carbon ash.	Not applicable. Not effective for CBP pile contaminants.
		Thermal Desorption	Heat is applied to volatilize water and organics, which are carried to a gas treatment system.	Not applicable. Not effective for CBP pile contaminants.

Table 5-1. Initial Screening of Technology Types and Process Options for CBP Piles (continued)

General Response Action	Technology Type	Process Options	Description	Screening Comments
Disposal and Handling	Onsite	Engineered Land Encapsulation	An onsite facility is constructed to house contaminated media, preventing contaminant migration.	Potentially applicable.
	Offsite	Newly Constructed Facility	A newly constructed offsite facility designed specifically to house the contaminated media being removed from the site.	Potentially applicable.
		Existing Facility	An existing disposal facility that meets the requirements to house contaminated media from the site.	Potentially applicable.
	Handling	Truck	Transportation of wastes from the site to the disposal facility.	Potentially applicable.
		Railcar		Not applicable. No operable rail spur located proximate to site.
		Barge		Not applicable. No sufficient navigable waterway located proximate to site.

Table 5-3. Detailed Screening of Technology Types and Process Options for CBP Piles

General Response Action	Technology Type	Process Options	Detailed Screening Criteria			Screening Results
			Effectiveness	Implementability	Cost	
No Action	None	None	Not effective. Required to be carried through the CERCLA analysis.	Easy	Highly cost effective. No costs associated with implementation.	Retained
Removal	Bulk Removal	Excavation	Effective.	Easy	Moderate to low cost effectiveness	Retained
Treatment	Ex Situ Physical/Chemical	Chemical Extraction	Treatment effectiveness for CBP piles uncertain pending treatability studies. Will produce waste streams requiring additional treatment or disposal.	Moderately difficult	Moderate to low cost effectiveness. Small pile material volumes and treatment systems high start up cost reduce cost effectiveness of system.	Not Retained
		Chemical Redox				
		Stabilization/Solidification	Generally limited effectiveness in treating high levels of SVOCs. A treatability study will be required to determine effectiveness for CBP piles. May result in net increases in waste volumes.	Easy to moderate	Moderate cost effectiveness	Retained
Disposal and Handling	Onsite	Engineered Land Encapsulation	Effective at physically separating contaminants from possible receptors.	Difficult	Low cost effectiveness	Not Retained
	Offsite	Newly Constructed Facility	Effective at physically separating contaminants from possible receptors.	Difficult	Low cost effectiveness	Not Retained
		Existing Facility	Effective at physically separating contaminants from possible receptors.	Easy	Moderate cost effectiveness	Not Retained
	Handling	Trucks	Effective.	Easy	Moderate to low effectiveness, depending on distance	Retained

6.0 DEVELOPMENT OF REMEDIAL ALTERNATIVES

This section describes the remedial alternatives assembled for impacted Piles M and N at CBP. The remedial alternatives were constructed by combining general response actions, technology types, and process options retained from the screening processes described in the previous section. Remedial alternatives should assure adequate protection of human health and the environment, achieve RAOs, meet ARARs, and permanently and significantly reduce the volume, toxicity, and/or mobility of COCs.

The remedial alternatives presented herein address impacted Piles M and N (Section 3.6) and the remedial alternatives encompass a range of potential remedial actions:

- Alternative 1: No Action; and
- Alternative 2: Excavation of Waste Piles, Treatment, and Offsite Disposal.

Alternative 1 is the no action response required under the NCP. Alternative 2 addresses impacts through removal and treatment of impacted media via chemical fixation prior to disposal at an offsite facility. Disposal without treatment is not evaluated as a separate alternative because debris pile materials containing contaminants at levels greater than RCRA LDR standards will require treatment/stabilization to achieve less than LDR standards prior to disposal.

6.1 ALTERNATIVE 1: NO ACTION

Under Alternative 1, current land use controls and monitoring programs at CBP will discontinue and no additional actions regarding access or land use controls will be implemented. Alternative 1 provides no protection to human health and the environment over current conditions. This remedial alternative is required under the NCP as a no action baseline against which other remedial alternatives can be compared.

6.2 ALTERNATIVE 2: EXCAVATION OF WASTE PILES, TREATMENT, AND OFFSITE DISPOSAL

Alternative 2 consists of excavating Piles M and N, treatment of the materials, and subsequent offsite disposal. This remedial alternative would require coordination of remediation, treatment and monitoring activities with OHARNG and the Army. Such coordination will minimize health and safety risks to onsite personnel and minimize disruption to their activities consistent with a safe and effective remediation.. The timeframe to complete the remedial alternative is relatively short. The amount of time to complete this remedial action includes the time to select a treatment technology, develop a Remedial Design Plan, implement the plan, and conduct the confirmatory sampling. No O&M period is included since unrestricted land use goals are achieved regardless of the disposition of Piles M and N.

Select treatment technology. S/S via chemical fixation has been screened as the technology to treat impacted pile material and is the basis for cost estimates. Treatability studies would be performed to evaluate and confirm the effectiveness, implementability, and cost of various S/S options. Impacted materials would be processed using a variety of techniques and fixative admixtures to determine optimal treatment performance parameters. The evaluation of S/S herein does not preclude the addition or use of any viable technologies that may become available in the future, but provides a representative treatment scenario for comparison purposes to the other remedial alternatives.

Remedial design plan. Treatability study results will be incorporated into the remedial design plan to develop treatment protocols and performance parameters. This plan also would detail site preparation activities, the extent of the excavation, implementation and sequence of construction and treatment activities, decontamination, and segregation, transportation, and disposal of various waste streams. Short term land use controls will be necessary during the active construction period to ensure a safe remediation.

Excavation. Piles M and N would be excavated and transported to a staging area for loading trucks. The volume of Pile M is 63 yd^3 and Pile N is 26 yd^3. Pile removal would be accomplished using standard construction equipment such as excavators, bulldozers, front-end loaders, and scrapers. Excavation would be guided using a limited quantity of analytical samples. Oversize debris would be crushed or otherwise processed to meet disposal facility requirements. Movement of pile materials would be performed using dump trucks and conventional construction equipment. Erosion control materials such as silt fences and straw bales would be installed to minimize erosion. Impacted materials would be kept moist or covered with tarps to minimize dust generation. Excavation would take place in stages to limit impacts to current site activities. The safety of remediation workers, onsite employees, and the general public would be covered in a site-specific health and safety plan. The health and safety plan would address potential exposures and monitoring requirements to ensure protection.

Conduct treatment. Developing treatment capabilities onsite would begin by establishing a specific location at which to install the treatment process. Utilities and water service may be required to support treatment activities. Further preparation of the site also may be required including the construction of a concrete pad for treatment equipment, material storage, etc.

Chemical fixation of contaminants in impacted pile materials would be conducted at a centralized treatment area. Excavated material may require sieving through a coarse separation-sizing screen to remove any debris or large objects and break up soil clumps. Fixative admixtures would be mixed with excavated material at dosage rates and contact times in accordance with performance parameters determined by the treatability study. Applying and mixing admixtures to impacted materials could be conducted with standard construction equipment such as excavators, bulldozers, and front end loaders. Alternatively specialized equipment such as soil mixers may be required based on the characteristics of materials involved and performance parameters. Treated materials would be sampled to confirm treatment goals were attained. Following successful treatment, stabilized materials would be loaded into trucks and shipped to an offsite disposal facility.

Treated materials would be hauled to a disposal facility by trucks lined with polyethylene sheeting (inter-model containers similarly lined also could be used) and covered with specially designed tarps or hard covers. All trucks would be inspected prior to ingressing and egressing the site. The appropriate bill-of-lading (in accordance with Department of Transportation [DOT] regulations for shipment of treated materials on public roads) would accompany the waste shipment. Only regulated and licensed transporters and vehicles would be used. The transport vehicles would travel pre-designated routes and an emergency response plan would be developed in the event of a vehicle accident.

Transportation activities would be performed in accordance with a site-specific transportation and emergency response plan (TERP) developed in the remedial design plan. The TERP would evaluate the vehicles to be used for transport of treated materials; the safest transportation routes (e.g., minimizing use of high traffic roads, public facilities, or secondary roads unsuited for trucks), and emergency response procedures for responding to a vehicle accident.

Offsite disposal. Treated materials would be disposed of at an offsite facility licensed and permitted to accept the characterized waste stream. The selection of an appropriate facility will consider the types of wastes, location, transportation options, and cost. Utilizing specific disposal facilities for different waste streams may reduce disposal costs.

Confirmatory sampling would be conducted after excavation of each area. The sampling would confirm preliminary cleanup standards have been achieved for the soil underlying the debris piles.

Site Restoration. Excavated areas should not need to be backfilled with clean soil (removal of the piles should leave the impacted area at the surrounding ground surface). In the event that fill is needed, it would be tested prior to placement to ensure compliance with acceptance criteria established in the design work plan. The site will also be re-vegetated.

Table 6-1. Summary of Remedial Alternatives

Alternative 1 – No Action This remedial alternative provides no further remedial action and is included as a baseline for comparison with other remedial alternatives. Land use controls and environmental monitoring would be discontinued. The site will no longer have legal, physical, or administrative mechanisms to restrict site access. Additional actions regarding land use controls, monitoring, or access restrictions will not be implemented. Five-year reviews would not be conducted in accordance with CERCLA 121(c).
Alternative 2 – Excavation of Waste Piles, Treatment, and Offsite Disposal This remedial alternative involves the removal, treatment, and transportation of impacted material at Piles M and N. Impacted materials would be excavated and transported to a staging area for treatment. Treatment would consist of mixing S/S admixtures with excavated materials per the performance parameters established through a treatability study. Sampling will be conducted to ensure successful treatment. Treated materials would be excavated and transported to an offsite disposal facility licensed and permitted to accept these wastes. Confirmation sampling would be conducted to ensure preliminary cleanup goals have been achieved for the EU including the soil formerly underlying the piles. Areas successfully remediated may not need backfilling, for the site may be level to the surrounding ground surface. Alternative 2 does not include O & M as CBP can be released for unrestricted land use regardless of the dispositiong of Piles M and N; however, this alternative does include some future environmental monitoring.

7.0 ANALYSIS OF REMEDIAL ALTERNATIVES

7.1 INTRODUCTION

This section presents a detailed analysis of the two remedial alternatives that have been formulated for further evaluation. From this set of alternatives, one will ultimately be chosen as the remedy for contaminated debris piles at CBP. All the alternatives will result in the site being released as unrestricted, for there are no soils requiring removal to meet HHRA or ecological preliminary cleanup goals. However, the Supplemental Phase II sampling results from Piles M and N indicate they contain inorganic contaminants at much higher levels than surrounding soil. Based on process knowledge for the piles, there are no ARARs pursuant to RCRA or Ohio hazardous waste regulations that mandate the need for removal or treatment of the debris piles. However, consistent with the CERCLA statutory preference for alternatives that permanently reduce contaminant toxicity, mobility, or volume through treatment, Piles M and N are candidates for removal.

Under the CERCLA remedy selection process, the preferred remedial alternative is suggested in the PP and set forth in final form in the ROD. A detailed evaluation of each alternative is performed in this section to provide the basis and rationale for identifying a preferred remedy and preparing the PP.

To ensure the FS analysis provides information of sufficient quality and quantity to justify the selection of a remedy, it is helpful to understand the requirements of the remedy selection process. This process is driven by the requirements set forth in CERCLA Section 121. In accordance with these requirements (USEPA 1988), remedial actions must:

- Be protective of human health and the environment;

- Attain ARARs;

- Be cost effective;

- Use permanent solutions and alternative treatment technologies to the maximum extent practicable; and

- Satisfy the preference for treatment that, as a principle element, reduces volume, toxicity, or mobility.

CERCLA emphasizes long-term effectiveness and related considerations for each remedial alternative. These statutory considerations include:

- Long-term uncertainties associated with land disposal;

- The goals, objectives, and requirements of the Solid Waste Disposal Act;

- The persistence, toxicity, and mobility of hazardous substances, and their propensity to bio-accumulate;

- Short- and long-term potential for adverse health effects from human exposure;

- Long-term maintenance costs;

- The potential for future remedial action costs if the remedial alternative in question were to fail; and

- The potential threat to human health and the environment associated with excavation, transportation, and re-disposal, or containment.

These statutory requirements are implemented through the use of nine evaluation criteria presented in the NCP. These nine criteria are grouped into threshold criteria, balancing criteria, and modifying criteria, as described below. A detailed analysis of each alternative against the evaluation criteria is contained in the following sections. The detailed analysis includes further definition of each alternative, if necessary, compares the alternatives against one another and presents considerations common to alternatives.

7.1.1 Threshold Criteria

Two of the NCP evaluation criteria relate directly to statutory findings that must be made in the ROD. These criteria are thus considered to be threshold criteria that must be met by any remedy in order to be selected. The criteria are:

1. Overall protection of human health and the environment; and
2. Compliance with ARARs.

Each alternative must be evaluated to determine how it achieves and maintains protection of human health and the environment. Similarly, each remedial alternative must be assessed to determine how it complies with ARARs, or, if a waiver is required, an explanation of why a waiver is justified. An alternative is considered to be protective of human health and the environment if it complies with media-specific preliminary cleanup goals.

7.1.2 Balancing Criteria

The five balancing criteria represent the primary criteria upon which the detailed analysis of alternatives and the comparison of alternatives are based. They are:

1. Long-term effectiveness and permanence;
2. Reduction of toxicity, mobility, or volume through treatment;
3. Short-term effectiveness;
4. Implementability; and

5. Cost.

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. 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.

Reduction of toxicity, mobility, or volume through treatment is an evaluation of the ability of the alternative to reduce the toxicity, mobility, or volume of the waste. The irreversibility of the treatment process and the type and quantity of residuals remaining after treatment also are assessed.

Short-term effectiveness addresses the protection of workers and the community during the remedial action, the environmental effects of implementing the action, and the time required to achieve media-specific preliminary cleanup goals.

Implementability addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during implementation. Technical feasibility assesses the ability to construct and operate a technology, the reliability of the technology, the ease in undertaking additional remedial actions, and the ability to monitor the effectiveness of the alternative. Administrative feasibility is addressed in terms of the ability to obtain approval from federal, state, and local agencies.

Cost analyses provide an estimate of the dollar cost of each alternative. The cost estimates in this report are based on estimating reference manuals, historical costs, vendor quotes, and engineering estimates. Costs are reported in base year 2005 dollars, or present value (future costs are converted to base year 2005 dollars using a 3.1 percent discount factor). The present value analysis is a method to evaluate expenditures, either capital or O&M, which occur over different time periods. Present value calculations allow for cost comparisons of different remedial alternatives on the basis of a single cost figure. The capital costs have not been discounted due to their relatively short implementation duration. The cost estimates are for guidance in project evaluation and implementation and are believed to be accurate within a range of -30 percent to +50 percent in accordance with USEPA guidance (USEPA 1988). Actual costs could be higher than estimated due to unexpected site conditions or potential delays. Details and assumptions used in developing cost estimates for each of the alternatives are provided in Appendix 7A.

7.1.3 Modifying Criteria

The two modifying criteria below will be evaluated as part of the ROD after the public has had an opportunity to comment on the PP. They are:

1. State acceptance; and
2. Community acceptance.

State Acceptance considers comments received from agencies of the State of Ohio. The primary state agency supporting this investigation is the Ohio EPA. Comments will be obtained from state agencies on the FS and the preferred remedy presented in the PP. This criterion will be addressed in the responsiveness summary of the ROD.

Community Acceptance considers comments made by the community, including stakeholders, on the alternatives being considered. Input has been encouraged during the ongoing investigation process to ensure the remedy ultimately selected for the RVAAP site is acceptable to the public. Comments will be accepted from the community on the FS and the preferred remedy presented in the PP. This criterion will be addressed in the responsiveness summary of the ROD. Because the actions above have not yet taken place, the detailed analysis of alternatives presented below cannot account for these criteria at this time. Therefore, the detailed analysis is carried out only for the first seven of the nine criteria.

Detailed analyses of the retained remedial alternatives for CBP are presented below. Each relevant set of alternatives are described and evaluated against the criteria outlined in Section 7.1.

7.2 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES FOR CBP

Two remedial alternatives were retained for CBP:

- Alternative 1: No Action (i.e., no remedial actions or controls conducted onsite); and
- Alternative 2: Excavation of Waste Piles, Treatment, and Offsite Disposal.

Each of these alternatives subsequently was analyzed in detail against the seven NCP evaluation criteria as described below. The detailed analysis of these alternatives is summarized in Table 7-1. Disposal without treatment is not evaluated as a separate alternative because debris pile materials containing contaminants at levels greater than RCRA LDR standards will require treatment/stabilization to achieve less than LDR standards prior to disposal.

7.2.1 Alternative 1: No Action

Under this alternative, impacted piles M and N would remain in place at CBP. Existing land use controls and access controls (e.g., RVAAP/RTLS perimeter fence) would not necessarily be continued. Environmental monitoring would not be performed and no restrictions on land use would be pursued. However, CBP is assumed to be utilized in accordance with the OHARNG Integrated National Resources Management Plan (OHARNG 2001) and consistent with the OHARNG established future land use for CBP which forms the basis for the exposure scenarios evaluated under restricted and unrestricted land use (Section 3.2).

7.2.1.1 <u>Overall Protection of Human Health and the Environment</u>

Alternative 1 is protective of human health for both anticipated future OHARNG land use and for unrestricted land use for soil and sediment. The HHRA for CBP indicates potential future human health risks from soil and sediment are below the target risk of 1E-05 and below or within the CERCLA acceptable range of 1E-06 to 1E-04 ILCR under the restricted land use scenario (represented by the National Guard Trainee) and the unrestricted land use scenario (represented by the Resident Farmer) with the exception of arsenic in deep surface soil (0-4 ft bgs), shallow surface soil (0-1 ft bgs), and subsurface soil (1-30 ft bgs). Because the estimated risks from arsenic are essentially the same as the estimated risk from background for these receptors, no action is needed for this metal. The EPCs of all COCs identified in the HHRA are below preliminary cleanup goals for both the representative restricted and unrestricted land uses.

In addition to soil and sediment contamination, numerous waste/debris piles are present at the CBP. Two of these piles (Pile M and N) are associated with burning activities. Pile M has high levels of lead, for which it failed TCLP analysis and Pile N has high levels of hexavalent chromium. Alternative 1 will leave these piles in place at CBP.

There would be no mitigation of identified risks to ecological receptors from COPECs in soil under this alternative. Ecological functions and sustainability are expected to continue.

7.2.1.2 Compliance with ARARs

Potential ARARs for remediation of Piles M and N at CBP are presented in Section 4 and summarized in Table 4-1. These federally enforceable standards would be protective of representative receptors under both restricted and unrestricted land use who could be exposed to contaminants at CBP.

Alternative 1 would comply with chemical- and action-specific ARARs under restricted or unrestricted land use.

7.2.1.3 Long-Term Effectiveness and Permanence

Alternative 1 includes no methods to prevent exposure to or the spread of contamination. This alternative assumes that controls will not remain in place and does not provide any additional new controls in the future. Piles M and N are associated with burning activities. Pile M has high levels of lead, for which it failed TCLP analysis and Pile N has high levels of hexavalent chromium. Alternative 1 will leave these piles in place with no additional controls for source reduction or removal, treatment, or containment.

7.2.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

No reduction in contaminant toxicity, mobility, or volume is achieved, because no treatment process is proposed under this alternative. No monitoring would be performed to evaluate any potential decrease of mobility of contaminants onsite.

7.2.1.5 Short-Term Effectiveness

There are no significant short-term human health risks associated with Alternative 1 beyond baseline conditions. There would be no additional short-term health risks to the community, because no remedial actions would be implemented. There would be no transportation risks nor would workers be exposed to any additional health risks. Alternative 1 would not directly cause adverse impacts on soils, air quality, water resources, or biotic resources.

7.2.1.6 Implementability

No actions are proposed under this alternative.

7.2.1.7 Cost

The present value cost to complete Alternative 1 is zero. There are also no capital costs associated with this alternative.

7.2.2 Alternative 2. Excavation of Waste Piles, Treatment, and Offsite Disposal

Alternative 2 includes excavation combined with treatment and offsite disposal of Piles M and N. Piles M and N at CBP would be treated by S/S via chemical fixation. Treated soils would be shipped to a permitted, offsite disposal facility. Excavation, use of road cover, monitoring, and handling of waste materials are components of this alternative.

7.2.2.1 Overall Protection of Human Health and the Environment

Alternative 2 is protective of human health for both anticipated future OHARNG land use and for unrestricted land use for soil and sediment. The HHRA for CBP indicates potential future human health risks from soil and sediment are below the target risk of 1E-05 and below or within the CERCLA acceptable range of 1E-06 to 1E-04 ILCR under the restricted land use scenario (represented by the National Guard Trainee) and the unrestricted land use scenario (represented by the Resident Farmer) with the exception of arsenic in deep surface soil (0-4 ft bgs), shallow surface soil (0-1 ft bgs), and subsurface soil (1-30 ft bgs). Because the estimated risks from arsenic are essentially the same as the estimated risk from background for these receptors, no action is needed for this metal. The EPCs of all COCs identified in the HHRA are below preliminary cleanup goals for both the representative restricted and unrestricted land uses.

In addition to soil and sediment contamination, numerous waste/debris piles are present at the CBP. Two of these piles (Pile M and N) are associated with burning activities. Pile M has high levels of lead, for which it failed TCLP analysis and Pile N has high levels of hexavalent chromium. Alternative 2 will result in removal of these two contaminated piles, thus further reducing risk at CBP.

The remedial actions taken to protect human health also will reduce risks to ecological receptors that occupy or visit this site. With engineering precautions, the adverse effects of these impacts would be mitigated. Ecological functions and sustainability are expected to continue because of the small size of the remediated piles.

7.2.2.2 Compliance with ARARs

Potential ARARs for remediation of Piles M and N are presented in Section 4 and summarized in Table 4-1. These federally enforceable standards would be protective of representative receptors for unrestricted land use who could be exposed to contaminants in Piles M and N at CBP.

This alternative would comply with chemical- and action-specific ARARs under unrestricted land use. Debris pile materials containing contaminants at levels greater than RCRA LDR standards will be treated/stabilized to achieve less than LDR standards prior to disposal.

7.2.2.3 Long-Term Effectiveness and Permanence

The excavation and removal of impacted pile materials would result in a permanent reduction in site risks. The excavated materials would be protective of human health under future use scenarios without dependence on land use controls. This alternative is permanent; no COCs were identified for remediation in soils/dry sediment and Piles M and N would be removed and placed in a permanent disposal facility after treatment. Therefore, no long-term management and no CERCLA 5-year reviews would be required.

7.2.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 2 includes S/S treatment to immobilize contaminants within a chemically fixated matrix. The bioavailability of the contaminants may also be reduced. Toxicity is generally unchanged by S/S treatment technologies. This technology may result in an overall increase in waste volumes.

7.2.2.5 Short-Term Effectiveness

The short-term effectiveness of Alternative 2 includes potential worker exposure during the excavation and treatment process. In addition, the surrounding community could be exposed during transportation of contaminated material. Workers would follow a health and safety plan and wear appropriate personal protective equipment (PPE) to minimize exposures. Mitigation measures such as erosion and dust control during construction would minimize short-term impacts.

Excavated soils will be transported by truck to a disposal facility. Risks will be mitigated during transport by inspecting vehicles before and after use, performing decontamination when needed, covering the transported waste, observing safety protocols, following pre-designated routes, and limiting the distance waste is transported in vehicles. Transportation risks (e.g., from continuous leaks) increase with distance and volume. Transportation of contaminated materials to an offsite disposal facility would strictly comply with all applicable state and federal regulations. Pre-designated routes would be used and an emergency response program developed to respond to potential accidents.

Alternative 2 remedial actions would require less than two months to complete. Following completion of excavation, treatment, and restoration, the CBP would be released for unrestricted land use.

7.2.2.6 Implementability

Effectiveness and implementation concerns for this alternative include:

- The ability of the S/S process to meet treatment goals;
- Logistical and technical problems for pilot demonstrations and scale-up to full-scale operations; and
- Local resistance to onsite treatment.

Alternative 2 is considered to be technically implementable provided treatment performance criteria can be attained. Commercial S/S technologies are currently available, although site-specific treatability/pilot studies will be required prior to remedial actions to determine applicability to the CBP site.

Careful planning would be required between remedial action planners and OHARNG to minimize disruptions and/or impacts to OHARNG operations. Access routes for heavy equipment to remediation areas would be selected to minimize disruption. Additional steps would be taken to minimize hazards posed to onsite personnel. This planning will increase the difficulty of implementing Alternative 2, but also will reduce risks to onsite personnel.

Other aspects of this alternative, such as 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. Borrow sites have not been selected, but are anticipated to be locally available if needed.

Alternative 2 overall acceptability would be affected by the administrative requirements for transport and disposal. The DOT regulates the transport of most materials. Local engineering departments would be consulted to evaluate the impact of the truck traffic on the roads that surround the RVAAP/RTLS site.

7.2.2.7 Cost

The present value cost to complete Alternative 2 is approximately $124,269 (in base year 2005 dollars with a 3.1 percent discount factor). Costs include implementation of the removal, disposal and subsequent confirmation sampling. See Appendix 7A for a detailed description of Alternative 2 costs.

7.2.3 Comparative Analysis of CBP Alternatives Using NCP Criteria

In this section, a comparative analysis of the two remedial alternatives applicable to CBP is conducted to identify relative advantages and disadvantages of each based on the detailed analysis above. The comparative analysis provides a means by which remedial alternatives can be directly compared to one another with respect to common criteria. Overall protection and compliance with ARARs are threshold criteria that must be met by any alternative to be eligible for selection. The other criteria, consisting of short- and long-term effectiveness; reduction of contaminant toxicity, mobility, or volume through treatment; ease of implementation; and cost are the primary balancing criteria used to select a preferred remedy among alternatives satisfying the threshold criteria. A summary table illustrating the comparative analysis is provided in Table 7-2. The process for obtaining community and state acceptance is described in Section 8.

Two remedial alternatives were retained for CBP:

- Alternative 1: No Action; and
- Alternative 2: Excavation of Waste Piles, Treatment, and Offsite Disposal.

Each of these alternatives subsequently was analyzed in detail against the seven NCP evaluation criteria as described below.

7.2.3.1 <u>Overall Protection of Human Health and the Environment</u>

Each of the two alternatives developed for the CBP are protective of human health and the environment. Alternative 1 allows contaminated waste piles to remain on site. Alternative 2 removes contaminated Piles M and N and will reduce overall residual risk remaining at CBP. Furthermore, this alternative will prevent dispersal of the contaminated material across a wider area consistent with the CERCLA objective to reduce contaminant mobility.

7.2.3.2 <u>Compliance with ARARs</u>

Potential ARARs for CBP are presented in Section 4 and summarized in Table 4-1. Both Alternatives would comply with chemical- and action-specific ARARs under unrestricted land use. Under Alternative 2, debris pile materials containing contaminants at levels greater than RCRA LDR standards will be treated/stabilized to achieve less than LDR standards prior to disposal.

7.2.3.3 <u>Long-Term Effectiveness and Permanence</u>

Alternative 1 includes no long-term management measures to prevent exposures to or the spread of contamination and is rated low. Alternative 2 is considered permanent and effective in the long term since the alternative will result in source reduction/removal and treatment of Piles M and N, thus preventing precipitation and wind-borne dispersal of the contaminated material across a wider area consistent with the CERCLA objective to reduce contaminant mobility. Alternative 2 is accordingly rated high.

7.2.3.4 Reduction in Contaminant Volume, Toxicity, and Mobility through Treatment

Alternative 1 does not reduce contaminant toxicity, volume or mobility and is subsequently rated low. Alternative 2 reduces the mobility of contaminants through treatment and is rated medium.

7.2.3.5 Short-Term Effectiveness

Alternative 1 has no short term risks to the community beyond baseline conditions and is therefore rated high. Alternative 2 involves the potential excavation and handling/treatment of impacted pile materials and may expose workers to contaminated materials. Although mitigation measures are anticipated to reduce or eliminate these exposures/risks, Alternative 2 is rated medium.

7.2.3.6 Implementability

Both alternatives are considered implementable on a technical and availability-of-services basis. Alternative 1 is a No Action alternative and is therefore rated high. Alternative 2 should be easily implementable and is rated medium.

7.2.3.7 Cost

Costs were estimated for comparison purposes only and are believed accurate within a range of -30% to +50%. The estimated present value cost (in base year 2005 dollars with a 3.1 percent discount factor) to complete each of the alternatives is as follows:

Alternative 1:	$	0
Alternative 2:	$	124,269

Table 7-1. Summary of Detailed Analysis of Remedial Alternatives for CBP

NCP Evaluation Criteria	Alternative 1 No Action	Alternative 2 Excavation of Piles M and N, Treatment, and Offsite Disposal
1. Overall Protectiveness		
Human Health Protection	Protective for anticipated OHARNG future land use and unrestricted land use. Leaves contaminated waste piles in place.	Protective for anticipated OHARNG future land use and unrestricted land use. Contaminated waste piles are removed from the site.
Environmental Protection	No mitigation of calculated risks to ecological receptors; however, ecological risks are not likely to be high.	Remedial actions taken to protect human health also will reduce risks to ecological receptors that occupy or visit this site.
2. Compliance with ARARs		
ARARs	Compliant.	Compliant
3. Long-Term Effectiveness and Permanence		
Magnitude of Residual Risk	Residual risk/ hazard below target.	Residual risk/ hazard below target.
Adequacy and Reliability of Controls	No land use controls.	No land use controls required.
Long-Term Management	None.	None.
4. Reduction of Toxicity, Mobility, or Volume through Treatment		
Reduction through Treatment	None (no treatment).	Mobility reduction for stabilization/ solidification.
5. Short-Term Effectiveness		
Community	No immediate risk to community.	Increase in risk due to construction, treatment, and transportation activities. Controlled by mitigating measures.
Workers	No activities to take place, therefore no risk to workers.	Workers may be exposed to impacted soils, chemicals required for soil treatment, and heavy equipment hazards. Site safety measures would mitigate risk.
Ecological Resources	No ecological impacts beyond existing conditions.	Potential short term environmental impacts minimized by engineering controls.
Engineering Controls	None.	Potential releases controlled with management and engineering practices.
Time to Complete[1]	0 years	2 months
O&M Period	0 years	0 years
6. Implementability		
Technical Feasibility	Not applicable.	Moderately feasible, depending upon effectiveness of treatment techniques.
Administrative Feasibility	Not applicable.	Relatively easy.
Cost		
Estimated Cost[2]	$0	$124,269

[1] Time to complete remedial action after completion of remedial design, assuming timely project funding. Does not include O&M period; however, some future environmental monitoring may be conducted.

[2] Estimated costs calculated as net present value in base year 2005 dollars using a 3.1 percent discount factor.

Table 7-2. Summary of Comparative Analysis of Remedial Alternatives for CBP

NCP Evaluation Criteria	Alternative 1 No Action	Alternative 2 Excavation of Waste Piles, Treatment, and Offsite Disposal
1. Overall Protectiveness	Protective	Protective
2. Compliance with ARARs	Compliant	Compliant
3. Long-Term Effectiveness and Permanence	Low	High
4. Reduction of Toxicity, Mobility, or Volume through Treatment	Low	Medium
5. Short-Term Effectiveness	High	Low
6. Implementability	High	Low
7. Cost	High $0	Low $124,269

8.0 AGENCY COORDINATION AND PUBLIC INVOLVEMENT

The Army is the lead agency under the Defense Environmental Restoration Program responsible for achieving interim remedy of the six high priority AOCs at RVAAP/RTLS, including CBP. This section reviews actions that have been conducted and that are planned in the future to ensure regulatory agencies and the public have been provided with appropriate opportunities to stay informed of progress of the six high priority environmental AOCs site remediation and to provide meaningful input on the planning effort as well as the final selection of a remedy.

8.1 STATE ACCEPTANCE

State Acceptance considers comments received from agencies of the State of Ohio on the actions being considered. For the process supporting closure (or interim remedy) of the six high priority AOCs, including CBP, Ohio EPA is the lead regulatory agency and this FS has been prepared in consultation with Ohio EPA. Ohio EPA has provided input during the ongoing investigation and report development process to ensure the action ultimately selected for the six high priority AOCs, including CBP, meets the needs of the State of Ohio and fulfills the requirements of the DFFO (Ohio EPA 2004). Comments will be solicited from Ohio EPA on the FS and on the PP. The Army will obtain Ohio EPA concurrence prior to the final selection of the interim remedy for CBP.

8.2 COMMUNITY ACCEPTANCE

Community acceptance considers comments provided by the community on the actions being considered. CERCLA 42 U.S.C. 9617(a) emphasizes early, constant, and responsive community relations. The Army has prepared a Community Relations Plan (USACE 2003b) for this project 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 (RAB) meetings with local officials, interest groups, and the general public. The public also is provided the opportunity to comment on draft documents submitted to the Administrative Record that support interim remedy of CBP, including the previously completed RI Report and this FS Report.

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/RTLS site have been made available to the public for review and comment. The ***Administrative Record*** for this project is available at the following location:

Ravenna Army Ammunition Plant
Building 1037 Conference Room
8451 St. Route 5
Ravenna, Ohio 44266-9297

Access to RVAAP/RTLS is restricted but can be obtained by contacting facility management at (330) 358-7311. 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 Canals
Newton Falls, Ohio 44444-1694

Also, RVAAP has an online resource for site restoration news and information. This website can be viewed at www.rvaap.org.

Similar to state agencies, comments will be received from the community upon issuance of the FS and the PP. The Army will request public comments on the PP for CBP, as required by the CERCLA regulatory process and the RVAAP Community Relations Plan. These comments will be considered in the final selection of an interim remedy for CBP. Responses to these comments will be addressed in the responsiveness summary of the ROD.

9.0 CONCLUSIONS AND RECOMMENDED ALTERNATIVE

9.1 CONCLUSIONS

The primary purpose of this FS is to develop, screen, and evaluate remedial alternatives for CBP using data collected during previous investigations. This FS establishes RAOs and evaluates the need for remedial action to reduce risks to the environment and to obtain interim remedy of CBP with respect to soils/dry sediments (Facility-wide programs are responsible for the monitoring of surface water and groundwater which have indicated soils at CBP have not acted as a source of impact). Current land use at CBP is restricted and CBP will be transferred to OHARNG and therefore is not a candidate for unrestricted release in the immediate future. The RAO analysis performed in this FS indicates no soil or sediment COCs are identified for evaluation of remedial alternatives for restricted or unrestricted land use. However, Supplemental Phase II RI data indicates Piles M and N contain inorganic contaminants at much higher levels than surrounding soil. There are no ARARs pursuant to RCRA or Ohio hazardous waste regulations that mandate the need for removal or treatment of the debris piles. However, alternatives that permanently reduce contaminant toxicity, mobility, or volume through treatment are statutorily favored under CERCLA (55FR 8720). Consistent with this CERCLA statutory preference, Piles M and N are candidates for removal. Excavation of these piles will reduce overall residual risk remaining at CBP upon completion of the action. Furthermore, limited excavation will prevent precipitation and wind-borne dispersal of the contaminated material across a wider area consistent with the CERCLA objective to reduce contaminant mobility.

The next step in the CERCLA process is to prepare a PP to solicit public input with respect to no further action at CBP. The PP will present the RAO analysis performed in the FS supporting no further action at CBP with respect to impacted soils/dry sediments and will address any necessary disposition of the piles/berms at CBP based on the results of the recently completed supplemental Phase II RI sampling activities.

The ROD will document the final remedy for CBP. Comments on the PP received from state and federal agencies and the public will be considered in drafting the ROD for CBP. The ROD will provide a brief summary of the history, characteristics, risks, and the basis for no further action at CBP under restricted land use. The ROD also will include a responsiveness summary, addressing comments received on the PP.

9.2 RECOMMENDED ALTERNATIVE

Alternative 2 (Removal of Waste Piles with Treatment and Disposal) is the recommended alternative for CBP. The RAO analysis performed in this FS indicates no soil or sediment COCs are identified for evaluation of remedial alternatives for restricted or unrestricted land use. However, the removal and disposition of these piles will result in a reduction in overall residual risk remaining at CBP and will prevent dispersal of the contaminated material across a wider area consistent with the CERCLA objective to reduce contaminant mobility.

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Appendix 2A
Risk Characterization for Trespasser Scenario

TABLE OF CONTENTS

LIST OF TABLES

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2A.0 RISK CHARACTERIZATION FOR TRESPASSER SCENARIO

2A.1 INTRODUCTION

The baseline HHRA provided in the RI Report for CBP evaluates the potential health risks to humans resulting from exposure to contamination at CBP. The HHRA presented in the RI Report is based on the methods outlined in the RVAAP FWHHRAM (USACE 2004b) dated January 2004, which addresses five receptors to be evaluated at RVAAP [National Guard Trainee, National Guard Dust/Fire Control Worker, Security Guard/Maintenance Worker, Hunter/Trapper/Fisher, and Resident Subsistence Farmer (adult and child)].

An additional receptor (trespasser scenario) was added in an addendum to the FWHHRAM (USACE 2005c) released in November 2005. The Trespasser (Juvenile and Adult) is evaluated in this FS to supplement the baseline HHRA provided in the RI Report and to comply with the revised FWHHRAM and provide risk managers with information to support determination of the need for continued security at the facility. This supplemental risk characterization is organized into the same six major sections used in the baseline HHRA:

- data evaluation and COPCs are discussed in Section 2A.2,
- exposure assessment is presented in Section 2A.3,
- toxicity assessment is summarized in Section 2A.4,
- results of the risk characterization are presented in Section 2A.5,
- the uncertainty analysis is presented in Section 2A.6, and
- the conclusions of the HHRA are summarized in Section 2A.7.

2A.2 DATA EVALUATION

Data evaluation and COPC screening were conducted as part of the baseline HHRA in the Phase I RI Report for CBP (USACE 2005f).

Under this scenario, the Trespasser (Juvenile and Adult) may be exposed to COPCs in shallow surface soil (0-1 ft bgs), sediment, and surface water. This receptor is not exposed to COPCs in subsurface soil or groundwater. A summary of the exposure media evaluated for the Trespasser (Juvenile and Adult) scenario is provided in Table 2A-1.

Table 2A-1. Exposure Media Evaluated for the Trespasser (Juvenile and Adult) Scenario

	Exposure Media		
AOC	**Shallow Surface Soil[a]**	**Sediment**	**Surface Water**
CBP	1 EU	1 EU	No COPCs

[a] Shallow surface soil defined as 0-1 ft bgs for the Trespasser scenario.
AOC = area of concern.
EU = exposure unit.
No COPCs = no chemicals of potential concern (COPCs) identified for this exposure medium in the RI Report.

A summary of the COPCs identified for each medium in the baseline HHRA is provided in Table 2A-2.

Table 2A-2. COPCs for each Exposure Medium

COPC	Shallow Surface Soil (0-1 ft bgs)	Sediment
Quantitative COPCs[a]		
Inorganics		
Aluminum	X	X
Arsenic	X	X
Chromium[b]	X	
Copper	X	
Lead[c]	X	
Manganese	X	X
Vanadium	X	X
Organics		
Aroclor-1254	X	
Benzo(a)pyrene	X	X
Qualitative COPCs[d]		
Organics		
Nitrocellulose	X	

[a] Quantitative COPCs have approved toxicity values that allow for further quantitative evaluation in the human health risk assessment.
[b] Chromium is conservatively evaluated with the toxicity values for hexavalent chromium.
[c] Although lead does not have toxicity values for which to quantify risks and/or hazards, it can be evaluated quantitatively with blood lead models from the U. S. Environmental Protection Agency.
[d] Qualitative COPCs do not have approved toxicity values that allow for further quantitative evaluation in the human health risk assessment.
COPC = Chemical of potential concern.
X = Chemical is a COPC for this medium.

2A.3 EXPOSURE ASSESSMENT

One receptor [Trespasser (Juvenile and Adult)] is evaluated in this supplemental HHRA. RVAAP/ RTLS is a controlled access facility (it is fenced, gated, and patrolled by security guards); however, a trespasser could enter the property and be exposed to contaminants in shallow surface soil (0-1 ft bgs), sediment, and surface water at CBP. The Juvenile Trespasser is assumed to visit the site approximately once per week (i.e., 50 days/year) between the ages of 8 and 18. The Adult Trespasser is assumed to visit the site slightly more often (75 days/year) for as long as he lives in the area (i.e., 30 years). In reality, the most likely adult trespassers are hunters or National Guard trainees entering unauthorized areas with a much lower frequency than the Hunter/Fisher/Trapper and National Guard Trainee receptors that are included in the baseline HHRA. A Juvenile Trespasser (ages 8 to 18) and Adult Trespasser are evaluated quantitatively for exposure to contaminated shallow surface soil and sediment via incidental ingestion, inhalation of VOCs and particulates, and dermal contact. As described in the FWHHRAM Amendment #1, the Trespasser (Juvenile and Adult) is also evaluated for exposure to contaminated surface water via incidental ingestion and dermal contact; however, no surface water COPCs were identified at CBP.

Exposure equations for each of these pathways are provided in the FWHHRAM (USACE 2004b). Exposure parameters used to calculate potential chemical intakes by the Trespasser (Juvenile and Adult) are from Table 5 of the FWHHRAM Amendment 1 (USACE 2005c) and are provided in Table 2A-3.

Chemical-specific exposure parameters are provided for all COPCs in Table 2A-4 at the end of this appendix.

Table 2A-3. Exposure Parameters for Trespasser (Juvenile and Adult) Scenario[a]

Exposure Pathway and Parameter	Units	Value
	Surface Soil[b]	
Incidental Ingestion		
Soil ingestion rate (Adult/Juvenile)	kg/day	0.0001 / 0.0002
Exposure time	hours/day	2
Exposure frequency (Adult/Juvenile)	days/year	75 / 50
Exposure duration (Adult/Juvenile)	years	30 / 10
Body weight (Adult/Juvenile)	kg	70 / 45
Carcinogen averaging time	days	25,550
Non-carcinogen averaging time (Adult/Juvenile)	days	10,950 / 3,650
Fraction ingested	unitless	1
Conversion factor	days/hour	0.042
Dermal Contact		
Skin area (Adult/Juvenile)	m^2/event	0.57 / 0.815
Adherence factor (Adult/Juvenile)	mg/cm^2	0.4 / 0.2
Absorption fraction	unitless	Chemical Specific – Table 2A-4
Exposure frequency (Adult/Juvenile)	events/year	75 / 50
Exposure duration (Adult/Juvenile)	years	30 / 10
Body weight (Adult/Juvenile)	kg	70 / 45
Carcinogen averaging time	days	25,550
Non-carcinogen averaging time (Adult/Juvenile)	days	10,950 / 3,650
Conversion factor	$(kg\text{-}cm^2)/(mg\text{-}m^2)$	0.01
Inhalation of VOCs and Dust		
Inhalation rate	m^3/day	20
Exposure time	hours/day	2
Exposure frequency (Adult/Juvenile)	days/year	75 / 50
Exposure duration (Adult/Juvenile)	years	30 / 10
Body weight (Adult/Juvenile)	kg	70 / 45
Volatilization factor	m^3/kg	Chemical Specific – Table 2A-4
Particulate emission factor	m^3/kg	9.24E+08
Carcinogen averaging time	days	25,550
Non-carcinogen averaging time (Adult/Juvenile)	days	10,950 / 3,650
Conversion factor	days/hour	0.042
	Sediment	
Incidental Ingestion		
Soil ingestion rate (Adult/Juvenile)	kg/day	0.0001 / 0.0002
Exposure time	hours/day	2
Exposure frequency (Adult/Juvenile)	days/year	75 / 50

Table 2A-3. Exposure Parameters for Trespasser (Juvenile and Adult) Scenario[a] (continued)

Exposure Pathway and Parameter	Units	Value
Exposure duration (Adult/Juvenile)	years	30 / 10
Body weight (Adult/Juvenile)	kg	70 / 45
Carcinogen averaging time	days	25,550
Non-carcinogen averaging time (Adult/Juvenile)	days	10,950 / 3,650
Fraction ingested	unitless	1
Conversion factor	days/hour	0.042
Dermal Contact		
Skin area (Adult/Juvenile)	m^2/event	0.57 / 0.815
Adherence factor (Adult/Juvenile)	mg/cm^2	0.4 / 0.2
Absorption fraction	unitless	Chemical Specific – Table 2A-4
Exposure frequency (Adult/Juvenile)	events/year	75 / 50
Exposure duration (Adult/Juvenile)	years	30 / 10
Body weight (Adult/Juvenile)	kg	70 / 45
Carcinogen averaging time	days	25,550
Non-carcinogen averaging time (Adult/Juvenile)	days	10,950 / 3,650
Conversion factor	$(kg\text{-}cm^2)/(mg\text{-}m^2)$	0.01
Inhalation of VOCs and Dust		
Inhalation rate	m^3/day	20
Exposure time	hours/day	2
Exposure frequency (Adult/Juvenile)	days/year	75 / 50
Exposure duration (Adult/Juvenile)	years	30 / 10
Body weight (Adult/Juvenile)	kg	70 / 45
Volatilization factor	m^3/kg	Chemical Specific – Table 2A-4
Particulate emission factor	m^3/kg	9.24E+08
Carcinogen averaging time	days	25,550
Non-carcinogen averaging time (Adult/Juvenile)	days	10,950 / 3,650
Conversion factor	days/hour	0.042

[a] Exposure parameters are from Table 5 of the FWHHRAM Amendment 1 (USACE 2005c).
[b] Surface soil is defined as 0-1 ft bgs (shallow surface soil).

EPCs were calculated for each exposure medium in the baseline HHRA as detailed in the RI Report. These EPCs are provided in Tables 2A-9 through 2A-16 at the end of this appendix.

2A.4 TOXICITY ASSESSMENT

Toxicity factors from EPA sources are provided in Table 2A-5 (noncancer reference dose [RfDs]) and Table 2A-6 (cancer slope factors [CSFs]) at the end of this appendix. These are the same toxicity factor values used to evaluate the five receptors evaluated in the baseline HHRA for CBP.

Chronic RfDs are developed for protection from long-term exposure to a chemical (from 7 years to a lifetime); subchronic RfDs are used to evaluate short-term exposure (from 2 weeks to 7 years) (EPA 1989). The Juvenile Trespasser scenario assumes an exposure duration of 10 years and the Adult Trespasser assumes an exposure duration of 30 years; therefore, only chronic RfDs are used in this supplemental HHRA.

Reference air concentrations (RfCs) and inhalation unit risks were converted to RfDs and CSFs using default adult inhalation rate and body weight [i.e., (RfC × 20 m3/day)/70 kg = RfD, Unit Risk × 70 kg × 1,000 μg/mg)/20 m3/day = CSF] (EPA 1989).

Dermal RfDs and CSFs are estimated from oral toxicity values using chemical-specific gastrointestinal absorption factors (GAFs) to calculate total absorbed dose as recommended by EPA (2004). The GAF values used and resulting dermal toxicity values are listed in Tables 2A-5 and 2A-6 at the end of this appendix.

As discussed in the baseline HHRA, total chromium is evaluated using the toxicity values for hexavalent chromium at CBP. This is the form of chromium with the most conservative toxicity values.

Per the FWHHRAM (USACE 2004b) toxicity equivalent factors (TEFs) are applied to carcinogenic polycyclic aromatic hydrocarbons (cPAHs) to convert the cPAHs to an equivalent concentration of benzo(a)pyrene.

No RfDs or CSFs are available for one COPC (nitrocellulose) because the non-carcinogenic and/or carcinogenic effects of this chemical has not yet been determined. Although this chemical may contribute to health effects from exposure to contaminated media, its effects cannot be quantified at the present time.

No RfDs or CSFs are available for lead. EPA (1999) recommends the use of the interim adult lead model (ALM) to support its goal of limiting risk of elevated fetal blood lead concentrations due to lead exposures to women of child-bearing age. This model is used to estimate the probability that the fetal blood lead level will exceed 10 μg/dL as a result of maternal exposure. Complete documentation of the model is available at http://www.epa.gov/superfund/programs/lead/products/adultpb.pdf (EPA 2003). The model-supplied default values were used for all parameters, with the exception of the site-specific media concentration and exposure frequency. Input parameters and results of this model are provided in Tables 2A-7 (Juvenile Trespasser) and 2A-8 (Adult Trespasser) at the end of this appendix. The Integrated Exposure Uptake Biokinetic (IEUBK) model for lead in children (available at http://www.epa.gov/superfund/programs/lead/ieubk.htm) was not used to evaluate the Juvenile Trespasser because this receptor is assumed to be age 8 to 18 years and the IEUBK applies to children age 0 to 6 years.

2A.5 RISK CHARACTERIZATION RESULTS FOR TRESPASSER FOR CBP

Risk characterization integrates the findings of the exposure and toxicity assessments to estimate the potential for receptors to experience adverse effects as a result of exposure to contaminated media. Risk characterization for the Trespasser (Juvenile and Adult) in this supplemental HHRA follows the same methodology used for risk characterization for the other receptors evaluated in the baseline HHRA for CBP.

Risk characterization results including identification of COCs are presented for CBP in the following subsections. COCs are defined as COPCs having an ILCR greater than 1.0E-06 and/or an HI greater than 1.

2A.5.1 CBP Surface Soil (0-1 ft bgs)

Detailed hazard and risk results for direct contact with COPCs in shallow surface soil (0-1 ft bgs) are presented in Tables 2A-9 and 2A-10 (Juvenile Trespasser) and 2A-11 and 2A-12 (Adult Trespasser) at the end of this appendix. Direct contact includes incidental ingestion of soil, inhalation of VOCs and particulates (i.e., dust) from soil, and dermal contact with soil.

The total HIs for the Juvenile Trespasser and Adult Trespasser exposed to shallow surface soil (0-1 ft bgs) are 0.025 and 0.029 respectively, which are below the threshold of 1.0; thus, no non-carcinogenic shallow surface soil COCs are identified at CBP for either receptor.

The total risk across all COPCs for the Juvenile Trespasser exposed to shallow surface soil is 8.8E-07, which is below the threshold of 1E-06; thus, no carcinogenic shallow surface soil COCs are identified at CBP for this receptor. The total risk across all COPCs for the Adult Trespasser exposed to shallow surface soil is 3.1E-06, which is above the threshold of 1E-06. Arsenic is identified as a carcinogenic COC for the Adult Trespasser exposed to shallow surface soil at CBP; however, the arsenic risk (2.3E-06) is not in excess of Ohio EPA’s level of concern of 1E-05.

Lead was identified as a surface soil COPC at CBP. Lead model results for the Juvenile Trespasser and Adult Trespasser are provided in Tables 2A-7 and 2A-8, respectively, at the end of this appendix. The estimated probability of fetal blood lead concentrations exceeding acceptable levels is less than 1% for both a Juvenile Trespasser and an Adult Trespasser exposed to shallow surface soil at CBP; therefore, lead is not a COC.

2A.5.2 CBP Sediment

Detailed hazard and risk results for contact with COPCs in sediment are presented in Tables 2A-13 and 2A-14 (Juvenile Trespasser) and Tables 2A-15 and 2A-16 (Adult Trespasser) at the end of this appendix. Direct contact includes incidental ingestion of sediment, inhalation of VOCs and particulates (i.e. dust) from sediment, and dermal contact with sediment.

The total HIs for the Juvenile Trespasser and Adult Trespasser exposed to sediment are 0.026 and 0.029, respectively, which are below the threshold of 1.0; thus, no non-carcinogenic sediment COCs are identified at CBP for either receptor.

The total risk across all COPCs for the Juvenile Trespasser exposed to sediment is 1E-06, which is equal to the threshold of 1E-06; however, because all individual chemicals have total risk less than 1.0E-06, no carcinogenic sediment COCs are identified at CBP for this receptor. The total risk across all COPCs for the Adult Trespasser exposed to sediment is 3.5E-06, which is above the threshold of 1E-06. Arsenic is identified as a carcinogenic COC for the Adult Trespasser exposed to sediment at CBP; however, the arsenic risk (2.9E-06) is below Ohio EPA's level of concern of 1E-05.

2A.5.3 CBP Surface Water

No COPCs were identified for surface water at CBP in the RI Report; therefore, no COCs were identified for this medium at CBP.

2A.5.4 Summary of Risk Characterization Results for Trespasser at CBP

Risks, hazards, and COCs are summarized in Table 2A-17 for Trespasser (Juvenile and Adult) exposed to shallow surface soil (0-1 ft bgs), sediment, and surface water at CBP.

Table 2A-17. Summary of Risks and Hazards for Trespasser (Juvenile and Adult) at CBP

Exposure Medium	Total HI	Non-carcinogenic COCs	Total ILCR	Carcinogenic COCs
Juvenile Trespasser				
Shallow Surface Soil (0-1 ft bgs)	0.025	None	8.8E-07	None
Sediment	0.026	None	1.0E-06	None
Surface Water	NA	None	NA	None
Adult Trespasser				
Shallow Surface Soil (0-1 ft bgs)	0.029	None	3.1E-06	arsenic
Sediment	0.029	None	3.5E-06	arsenic
Surface Water	NA	None	NA	None

COC = Chemical of concern.
HI = Hazard index.
ILCR = Incremental lifetime cancer risk.
NA = not applicable, no COPCs were identified for surface water at CBP.

2A.6 UNCERTAINTY ANALYSIS

Uncertainties associated with each step of the risk assessment process (i.e., data evaluation, exposure assessment, toxicity assessment, and risk characterization) are described in the baseline HHRA for CBP.

While anticipated future land use has been identified as the RTLS (USACE 2004b), and OHARNG will manage the property, there is uncertainty surrounding the future land use. To address this uncertainty, a Trespasser (Juvenile and Adult) is evaluated in this supplemental risk assessment.

2A.7 SUMMARY AND CONCLUSIONS

This supplemental HHRA was conducted to evaluate risks and hazards associated with impacted media at CBP for a Trespasser (Juvenile and Adult) scenario. The following steps were used to generate conclusions regarding human health risks and hazards:

- identification of COPCs (in the baseline HHRA included in the RI Report for CBP),
- calculation of risks and hazards, and
- identification of COCs.

At CBP all HIs for the Trespasser (Juvenile and Adult) are below the threshold value of 1.0; thus, no non-carcinogenic COCs are identified. The total ILCRs for the Juvenile Trespasser exposed to shallow surface soil (0-1 ft bgs) and sediment are at or below the threshold value of 1E-06; thus, no carcinogenic COCs are identified for this receptor. The total ILCRs for the Adult Trespasser exposed to shallow surface soil and sediment are just above the threshold value of 1E-06; arsenic is identified as the only carcinogenic

COC for the Adult Trespasser exposed to shallow surface soil and sediment. No COPCs and consequently, no COCs, are identified for surface water at CBP.

Table 2A-4. Chemical-Specific Exposure Parameters

COPC	Dermal Absorption Factor[a] (unitless)	Permeability Constant[b] (cm/hr)	Volatilization Factor[c] (m^3/kg)
Inorganics			
Aluminum	1.0E-03	2.1E-03	--
Arsenic	3.0E-02	1.9E-03	--
Chromium (as Chromium VI)	1.0E-03	1.0E-03	--
Copper	1.0E-03	3.1E-04	--
Manganese	1.0E-03	1.3E-03	--
Vanadium	1.0E-03	1.4E-03	--
Organics			
Aroclor-1254	1.4E-01	1.3E+00	--
Benzo(a)pyrene	1.3E-01	1.2E+00	--

[a] Chemical-specific absorption factor values from EPA, 2004. When chemical-specific values are not available the following default values are used for soil and sediment only:
SVOCs = 0.1, VOCs = 0.01, inorganics = 0.001 per EPA Region 4 Supplemental Guidance to RAGS.

[b] From Risk Assessment Information System (RAIS) *http://risk.lsd.ornl.gov/tox/tox_values.shtml* for surface water.

[c] Volatilization factors (VFs) calculated using the 1996 EPA Soil Screening Guidance Methodology, using site-specific parameter values for Cleveland, Ohio. Only used for soil and sediment VOCs.

COPC = Chemical of potential concern.
RAGS = Risk Assessment Guidance for Superfund.
SVOC = semivolatile organic compound
EPA = United States Environmental Protection Agency
VOC = volatile organic compound
-- = No value available.

Table 2A-5. Non-carcinogenic Reference Doses for COPCs

COPC	Oral Chronic RfD (mg/kg-day)	Confidence Level	% GI absorption[a]	Dermal Chronic RfD (mg/kg-day)	Inhalation Chronic RfD (mg/kg-day)	RfD Basis (vehicle)	Critical Effect	Uncertainty/ Modifying Factor
Inorganics								
Aluminum	1.0E+00	NA	1	1.0E+00	1.4E-03	NA	NA	(O) UF=10
Arsenic	3.0E-04	Medium (O)	0.95	3.0E-04	--	Oral, oral-water	Hyperpigmentation and keritosis and possible vascular complication	(O) UF=3
Chromium (as Cr VI)	3.0E-03	Low (O)	0.025	7.5E-05	2.9E-05	Oral (rat)	Reduced liver/spleen weight	(O) UF=100
Copper	4.0E-02	NA	1	4.0E-02	--	NA	NA	
Manganese (food)	1.4E-01	Medium (O)	0.04	5.6E-03	1.4E-05	Oral	(O) lethargy, tremors, mental disturbance, muscle tonus, and central nervous system effects	(O) UF=1 (O) MF=1
Manganese (soil/water)	4.6E-02	Medium (O)	0.04	1.8E-03	1.4E-05	Oral: water, inhalation	(O) lethargy, tremors, mental disturbance, muscle tonus, and central nervous system effects	(O) UF=1 (O) MF=1 (I) UF=1000
Vanadium	7.0E-03	Low	0.026	1.8E-04	--	Oral (rat)	Decreased hair cystine	UF=100
Organics								
Aroclor 1254	2.0E-05	Medium	0.9	1.8E-05	--	Oral	Ocular exudate, inflamed and prominent Meibomian glands	(O) MF=1 (O) UF=300

[a] % GI absorption values from EPA 2004.
(O) indicates oral, (I) indicates inhalation.
RfD = Reference dose.

MF = Modifying factor (the default modifying factor is 1).
UF = Uncertainty factor.
NA = Not available

-- = No value available

Table 2A-6. Cancer Slope Factors for COPCs

COPC	Oral Slope Factor (mg/kg-day)$^{-1}$	% GI absorption[a]	Dermal Slope Factor (mg/kg-day)$^{-1}$	Inhalation Slope Factor (mg/kg-day)$^{-1}$	EPA Class	TEF	Type of Cancer
Inorganics							
Arsenic	1.5E+00	0.95	1.5E+00	1.5E+01	A	--	Respiratory system tumors
Chromium (as Cr VI)	--	0.025	--	4.2E+01	A	--	Lung tumors
Organics							
Aroclor 1254 (soil/food)	2.0E+00	0.9	2.2E+00	2.0E+00[b]	B2	--	Hepatocellular carcinomas, melanoma of the skin, cancer of the liver, biliary tract, or gall bladder
Aroclor 1254 (water)	4.0E-01	0.9	4.4E-01	3.5E-01[b]	B2	--	Hepatocellular carcinomas, melanoma of the skin, cancer of the liver, biliary tract, or gall bladder
Benzo(a)pyrene	7.3E+00	0.58	7.3E+00	3.1E+00	B2	1	Stomach, nasal cavity, larynx, tracheak, and pharnyx

[a] % GI absorption values from EPA 2004.

TEF = Toxicity Equivalency Factor is based on the relative potency of each carcinogenic polycyclic aromatic hydrocarbon (PAH) relative to that of benzo(a)pyrene.

-- = No value available.

Table 2A-7. CBP Shallow Surface (0-1 ft bgs) Soil Calculations of Blood Lead Concentrations for Juvenile Trespasser

Exposure Variable	PbB Equation[1]		Description of Exposure Variable	Units	Juvenile Trespasser	
	1*	2*			GSDi = 1.8	GSDi = 2.1
PbS	X	X	Soil lead concentration	ug/g or mg/kg	59.3	59.3
$R_{fetal/maternal}$	X	X	Fetal/maternal PbB ratio	--	0.9	0.9
BKSF	X	X	Biokinetic Slope Factor	ug/dL per ug/day	0.4	0.4
GSD_i	X	X	Geometric standard deviation PbB	--	1.8	2.1
PbB_0	X	X	Baseline PbB	ug/dL	2.2	1.7
IR_S	X		Soil ingestion rate (including soil-derived indoor dust)	g/day	0.2	0.2
IR_{S+D}		X	Total ingestion rate of outdoor soil and indoor dust	g/day	0.2	0.2
W_S		X	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--	--
K_{SD}		X	Mass fraction of soil in dust	--	--	--
$AF_{S, D}$	X	X	Absorption fraction (same for soil and dust)	--	0.12	0.12
$EF_{S, D}$	X	X	Exposure frequency (same for soil and dust)	days/yr	50	50
$AT_{S, D}$	X	X	Averaging time (same for soil and dust)	days/yr	365	365
PbB_{adult}	**PbB of adult receptor, geometric mean**			**ug/dL**	**2.3**	**1.8**
$PbB_{fetal, 0.95}$	**95th percentile PbB among fetuses of adult workers**			**ug/dL**	**5.4**	**5.4**
PbB_t	**Target PbB level of concern (e.g., 10 ug/dL)**			**ug/dL**	**10.0**	**10.0**
$P(PbB > PbB_t)$	**Probability that PbB > PbB_t, assuming lognormal distribution**			**%**	**0.4%**	**0.7%**

[1] Equation 1 does not apportion exposure between soil and dust ingestion (excludes W_S, K_{SD}). When $IR_S = IR_{S+D}$ and $W_S = 1.0$, the equations yield the same $PbB_{fetal,0.95}$.

* Equation 1, based on Eq. 1, 2 in USEPA (2003). U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee.

$PbB_{adult} = (PbS * BKSF * IR_{S+D} * AF_{S,D} * EF_{S,D} / AT_{S,D}) + PbB_0$

$PbB_{fetal, 0.95} = PbB_{adult} * (GSD_i^{1.645} * R_{fetal/maternal})$

Table 2A-8. CBP Shallow Surface Soil (0-1 ft bgs) Calculations of Blood Lead Concentrations for Adult Trespasser

Exposure Variable	PbB Equation[1]		Description of Exposure Variable	Units	Adult Trespasser	
	1*	2*			GSDi = 1.8	GSDi = 2.1
PbS	X	X	Soil lead concentration	ug/g or mg/kg	59.3	59.3
$R_{fetal/maternal}$	X	X	Fetal/maternal PbB ratio	--	0.9	0.9
BKSF	X	X	Biokinetic Slope Factor	ug/dL per ug/day	0.4	0.4
GSD_i	X	X	Geometric standard deviation PbB	--	1.8	2.1
PbB_0	X	X	Baseline PbB	ug/dL	2.2	1.7
IR_S	X		Soil ingestion rate (including soil-derived indoor dust)	g/day	0.1	0.1
IR_{S+D}		X	Total ingestion rate of outdoor soil and indoor dust	g/day	0.1	0.1
W_S		X	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--	--
K_{SD}		X	Mass fraction of soil in dust	--	--	--
$AF_{S, D}$	X	X	Absorption fraction (same for soil and dust)	--	0.12	0.12
$EF_{S, D}$	X	X	Exposure frequency (same for soil and dust)	days/yr	75	75
$AT_{S, D}$	X	X	Averaging time (same for soil and dust)	days/yr	365	365
PbB_{adult}	**PbB of adult receptor, geometric mean**			**ug/dL**	**2.3**	**1.8**
$PbB_{fetal, 0.95}$	**95th percentile PbB among fetuses of adult workers**			**ug/dL**	**5.3**	**5.4**
PbB_t	**Target PbB level of concern (e.g., 10 ug/dL)**			**ug/dL**	**10.0**	**10.0**
$P(PbB > PbB_t)$	**Probability that PbB > PbB_t, assuming lognormal distribution**			**%**	**0.3%**	**0.6%**

[1] Equation 1 does not apportion exposure between soil and dust ingestion (excludes W_S, K_{SD}). When $IR_S = IR_{S+D}$ and $W_S = 1.0$, the equations yield the same $PbB_{fetal,0.95}$.

* Equation 1, based on Eq. 1, 2 in USEPA (2003). U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee.

$PbB_{adult} = (PbS * BKSF * IR_{S+D} * AF_{S,D} * EF_{S,D} / AT_{S,D}) + PbB_0$

$PbB_{fetal, 0.95} = PbB_{adult} * (GSD_i^{1.645} * R_{fetal/maternal})$

Table 2A-9. Juvenile Trespasser Shallow Surface Soil (0-1 ft bgs) Non-carcinogenic Hazards - Direct Contact

COPC	EPC (mg/kg)	Daily Intake (mg/kg-d)			Hazard Quotient (HQ)			Total HI across all pathways	COC[a]
		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation		
CBP									
Aluminum	1.5E+04	7.5E-04	7.4E-05	8.2E-08	7.5E-04	7.4E-05	5.7E-05	8.9E-04	
Arsenic	1.6E+01	8.2E-07	2.4E-06	8.8E-11	2.7E-03	8.0E-03		1.1E-02	
Chromium	1.8E+01	9.1E-07	8.9E-08	9.9E-11	3.0E-04	1.2E-03	3.5E-06	1.5E-03	
Copper	3.9E+01	2.0E-06	1.9E-07	2.1E-10	4.9E-05	4.8E-06		5.4E-05	
Manganese	1.4E+03	7.2E-05	7.0E-06	7.8E-09	1.6E-03	3.8E-03	5.5E-04	5.9E-03	
Vanadium	2.2E+01	1.1E-06	1.1E-07	1.2E-10	1.6E-04	6.0E-04		7.6E-04	
Inorganics Pathway Total					5.6E-03	1.4E-02	6.1E-04	2.0E-02	
Aroclor-1254	1.4E-01	7.2E-09	9.9E-08	7.8E-13	3.6E-04	4.9E-03		5.3E-03	
Benzo(a)pyrene	2.2E-01	1.1E-08	1.4E-07	1.2E-12					
Organics Pathway Total					3.6E-04	4.9E-03		5.3E-03	
Pathway Total - Chemicals					5.9E-03	1.9E-02	6.1E-04	2.5E-02	

[a] COPCs are identified as chemicals of concern (COCs) if the total HI across all pathways is > 1 (H).
COPC = Chemical of Potential Concern.
EPC = Exposure Point Concentration.
HI = Hazard Index.

Table 2A-10. Juvenile Trespasser Shallow Surface Soil (0-1 ft bgs) Carcinogenic Risks - Direct Contact

COPC	EPC (mg/kg)	Daily Intake (mg/kg-d)			Risk			Total Risk across all pathways	COC[a]
		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation		
CBP									
Aluminum	1.5E+04	1.1E-04	1.1E-05	1.2E-08					
Arsenic	1.6E+01	1.2E-07	3.4E-07	1.3E-11	1.8E-07	5.1E-07	1.9E-10	6.9E-07	
Chromium	1.8E+01	1.3E-07	1.3E-08	1.4E-11			5.9E-10	5.9E-10	
Copper	3.9E+01	2.8E-07	2.7E-08	3.0E-11					
Manganese	1.4E+03	1.0E-05	1.0E-06	1.1E-09					
Vanadium	2.2E+01	1.6E-07	1.6E-08	1.7E-11					
Inorganics Pathway Total					1.8E-07	5.1E-07	7.8E-10	6.9E-07	
Aroclor-1254	1.4E-01	1.0E-09	1.4E-08	1.1E-13	2.1E-09	2.8E-08	2.2E-13	3.0E-08	
Benzo(a)pyrene	2.2E-01	1.6E-09	2.0E-08	1.7E-13	1.2E-08	1.5E-07	5.4E-13	1.6E-07	
Organics Pathway Total					1.4E-08	1.8E-07	7.6E-13	1.9E-07	
Pathway Total - Chemicals					1.9E-07	6.9E-07	7.8E-10	8.8E-07	

[a] COPCs are identified as chemicals of concern (COCs) if the total ILCR across all pathways is > 1E-06 (R).

COPC = Chemical of Potential Concern.

EPC = Exposure Point Concentration.

ILCR = Incremental Lifetime Cancer Risk.

Table 2A-11. Adult Trespasser Shallow Surface Soil (0-1 ft bgs) Non-carcinogenic Hazards - Direct Contact

COPC	EPC (mg/kg)	Daily Intake (mg/kg-d)			Hazard Quotient (HQ)			Total HI across all pathways	COC[a]
		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation		
					CBP				
Aluminum	1.5E+04	3.6E-04	1.0E-04	7.9E-08	3.6E-04	1.0E-04	5.5E-05	5.2E-04	
Arsenic	1.6E+01	3.9E-07	3.2E-06	8.5E-11	1.3E-03	1.1E-02		1.2E-02	
Chromium	1.8E+01	4.4E-07	1.2E-07	9.5E-11	1.5E-04	1.6E-03	3.3E-06	1.8E-03	
Copper	3.9E+01	9.4E-07	2.6E-07	2.0E-10	2.4E-05	6.4E-06		3.0E-05	
Manganese	1.4E+03	3.5E-05	9.5E-06	7.5E-09	7.5E-04	5.2E-03	5.3E-04	6.4E-03	
Vanadium	2.2E+01	5.4E-07	1.5E-07	1.2E-10	7.7E-05	8.1E-04		8.8E-04	
Inorganics Pathway Total					2.7E-03	1.8E-02	5.8E-04	2.2E-02	
Aroclor-1254	1.4E-01	3.5E-09	1.3E-07	7.5E-13	1.7E-04	6.7E-03		6.8E-03	
Benzo(a)pyrene	2.2E-01	5.4E-09	1.9E-07	1.2E-12					
Organics Pathway Total					1.7E-04	6.7E-03		6.8E-03	
Pathway Total - Chemicals					2.9E-03	2.5E-02	5.8E-04	2.9E-02	

[a] COPCs are identified as chemicals of concern (COCs) if the total HI across all pathways is > 1 (H).
COPC = Chemical of Potential Concern.
EPC = Exposure Point Concentration.
HI = Hazard Index.

Table 2A-12. Adult Trespasser Shallow Surface Soil (0-1 ft bgs) Carcinogenic Risks - Direct Contact

COPC	EPC (mg/kg)	Daily Intake (mg/kg-d)			Risk			Total Risk across all pathways	COC[a]
		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation		
CBP									
Aluminum	1.5E+04	1.6E-04	4.3E-05	3.4E-08					
Arsenic	1.6E+01	1.7E-07	1.4E-06	3.7E-11	2.5E-07	2.1E-06	5.5E-10	2.3E-06	R
Chromium	1.8E+01	1.9E-07	5.2E-08	4.1E-11			1.7E-09	1.7E-09	
Copper	3.9E+01	4.0E-07	1.1E-07	8.7E-11					
Manganese	1.4E+03	1.5E-05	4.1E-06	3.2E-09					
Vanadium	2.2E+01	2.3E-07	6.3E-08	5.0E-11					
Inorganics Pathway Total					2.5E-07	2.1E-06	2.3E-09	2.3E-06	
Aroclor-1254	1.4E-01	1.5E-09	5.7E-08	3.2E-13	3.0E-09	1.1E-07	6.4E-13	1.2E-07	
Benzo(a)pyrene	2.2E-01	2.3E-09	8.2E-08	5.0E-13	1.7E-08	6.0E-07	1.5E-12	6.2E-07	
Organics Pathway Total					2.0E-08	7.1E-07	2.2E-12	7.3E-07	
Pathway Total - Chemicals					2.7E-07	2.8E-06	2.3E-09	3.1E-06	

[a] COPCs are identified as chemicals of concern (COCs) if the total ILCR across all pathways is > 1E-06 (R).

COPC = Chemical of Potential Concern.

EPC = Exposure Point Concentration.

Table 2A-13. Juvenile Trespasser Sediment Non-carcinogenic Hazards - Direct Contact

COPC	EPC (mg/kg)	Daily Intake (mg/kg-d)			Hazard Quotient (HQ)			Total HI across all pathways	COC[a]
		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation		
				CBP					
Aluminum	1.9E+04	9.7E-04	9.5E-05	1.0E-07	9.7E-04	9.5E-05	7.3E-05	1.1E-03	
Arsenic	2.0E+01	1.0E-06	3.0E-06	1.1E-10	3.4E-03	1.0E-02		1.3E-02	
Manganese	2.6E+03	1.3E-04	1.3E-05	1.4E-08	2.9E-03	7.0E-03	1.0E-03	1.1E-02	
Vanadium	3.0E+01	1.5E-06	1.5E-07	1.7E-10	2.2E-04	8.3E-04		1.0E-03	
Inorganics Pathway Total					7.4E-03	1.8E-02	1.1E-03	2.6E-02	
Benzo(a)pyrene	2.1E-01	1.1E-08	1.4E-07	1.2E-12					
Organics Pathway Total									
Pathway Total - Chemicals					7.4E-03	1.8E-02	1.1E-03	2.6E-02	

Table 2A-14. Juvenile Trespasser Sediment Carcinogenic Risks - Direct Contact

COPC	EPC (mg/kg)	Daily Intake (mg/kg-d)			Risk			Total Risk across all pathways	COC[a]
		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation		
CBP									
Aluminum	1.9E+04	1.4E-04	1.4E-05	1.5E-08					
Arsenic	2.0E+01	1.5E-07	4.3E-07	1.6E-11	2.2E-07	6.4E-07	2.4E-10	8.6E-07	
Manganese	2.6E+03	1.9E-05	1.8E-06	2.0E-09					
Vanadium	3.0E+01	2.2E-07	2.2E-08	2.4E-11					
Inorganics Pathway Total					2.2E-07	6.4E-07	2.4E-10	8.6E-07	
Benzo(a)pyrene	2.1E-01	1.5E-09	1.9E-08	1.6E-13	1.1E-08	1.4E-07	5.1E-13	1.5E-07	
Organics Pathway Total					1.1E-08	1.4E-07	5.1E-13	1.5E-07	
Pathway Total - Chemicals					2.3E-07	7.8E-07	2.4E-10	1.0E-06	

[a] COPCs are identified as chemicals of concern (COCs) if the total ILCR across all pathways is > 1E-06 (R).
COPC = Chemical of Potential Concern.
EPC = Exposure Point Concentration.
ILCR = Incremental Lifetime Cancer Risk.

1

Table 2A-15. Adult Trespasser Sediment Non-carcinogenic Hazards - Direct Contact

COPC	EPC (mg/kg)	Daily Intake (mg/kg-d)			Hazard Quotient (HQ)			Total HI across all pathways	COC[a]
		Ingestion	Dermal	Inhalation	Ingestion	Dermal	Inhalation		
CBP									
Aluminum	1.9E+04	4.7E-04	1.3E-04	1.0E-07	4.7E-04	1.3E-04	7.1E-05	6.7E-04	
Arsenic	2.0E+01	4.9E-07	4.0E-06	1.1E-10	1.6E-03	1.3E-02		1.5E-02	
Manganese	2.6E+03	6.3E-05	1.7E-05	1.4E-08	1.4E-03	9.4E-03	9.6E-04	1.2E-02	
Vanadium	3.0E+01	7.4E-07	2.0E-07	1.6E-10	1.1E-04	1.1E-03		1.2E-03	
Inorganics Pathway Total					3.6E-03	2.4E-02	1.0E-03	2.9E-02	
Benzo(a)pyrene	2.1E-01	5.1E-09	1.8E-07	1.1E-12					
Organics Pathway Total									
Pathway Total - Chemicals					3.6E-03	2.4E-02	1.0E-03	2.9E-02	

[a] COPCs are identified as chemicals of concern (COCs) if the total HI across all pathways is > 1 (H).
COPC = Chemical of Potential Concern.
EPC = Exposure Point Concentration.
HI = Hazard Index.

Table 2A-16. Adult Trespasser Sediment Carcinogenic Risks - Direct Contact

COPC	EPC (mg/kg)	Daily Intake (mg/kg-d)			Risk			Total Risk across all pathways	COC[a]
		Ingestion	**Dermal**	**Inhalation**	**Ingestion**	**Dermal**	**Inhalation**		
CBP									
Aluminum	1.9E+04	2.0E-04	5.5E-05	4.3E-08					
Arsenic	2.0E+01	2.1E-07	1.7E-06	4.6E-11	3.2E-07	2.6E-06	6.9E-10	2.9E-06	R
Manganese	2.6E+03	2.7E-05	7.4E-06	5.9E-09					
Vanadium	3.0E+01	3.2E-07	8.7E-08	6.9E-11					
Inorganics Pathway Total					3.2E-07	2.6E-06	6.9E-10	2.9E-06	
Benzo(a)pyrene	2.1E-01	2.2E-09	7.8E-08	4.8E-13	1.6E-08	5.7E-07	1.5E-12	5.9E-07	
Organics Pathway Total					1.6E-08	5.7E-07	1.5E-12	5.9E-07	
Pathway Total - Chemicals					3.3E-07	3.2E-06	6.9E-10	3.5E-06	

[a] COPCs are identified as chemicals of concern (COCs) if the total ILCR across all pathways is > 1E-06 (R).

COPC - Chemical of Potential Concern.

EPC = Exposure Point Concentration.

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Appendix 2B
Supplemental Phase II RI Sampling Results

ATTACHMENT A

SOIL SAMPLING LOGS

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ATTACHMENT A
SOIL SAMPLING LOGS

DISCRETE SURFACE AND SUBSURFACE SOIL SAMPLES

MULTI-INCREMENT SAMPLES

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DISCRETE SURFACE AND SUBSURFACE SOIL SAMPLES

MULTI-INCREMENT SOIL SAMPLES

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HTRW DRILLING LOG

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-004

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: NA

SHEET 1 OF 2

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC - Jed Thomas

6. MAKE/MODEL OF DRILL: *na*

7. SIZES AND TYPES OF SAMPLING EQUIPMENT:
S.S. Hand Auger (3-in)
S.S. Bowl & spoon

8. BOREHOLE LOCATION: Central Burn Pits

9. SURFACE ELEVATION/DATUM: N/A

10. DRILL DATE/TIME STARTED: 0920 COMPLETED: 0930

15. DEPTH GROUNDWATER ENCOUNTERED: N/A

16. DEPTH TO WATER/ELAPSED TIME AFTER BOREHOLE COMPLETION: *NA*

12. OVERBURDEN THICKNESS: N/A

13. DEPTH DRILLED INTO BEDROCK: N/A

17. OTHER WATER LEVEL MEASUREMENTS (INLCLUDE DATE/TIME): NA

14. TOTAL DEPTH OF BOREHOLE: 1 ft.

18. GEOTECHNICAL SAMPLES: N/A UNDISTURBED: — DISTURBED: —

19. TOTAL NUMBER OF CORE BOXES: N/A

20. CHEMICAL SAMPLES: ~~METALS~~ ~~EXPL~~ [✓ OTHER:] Total Chromium

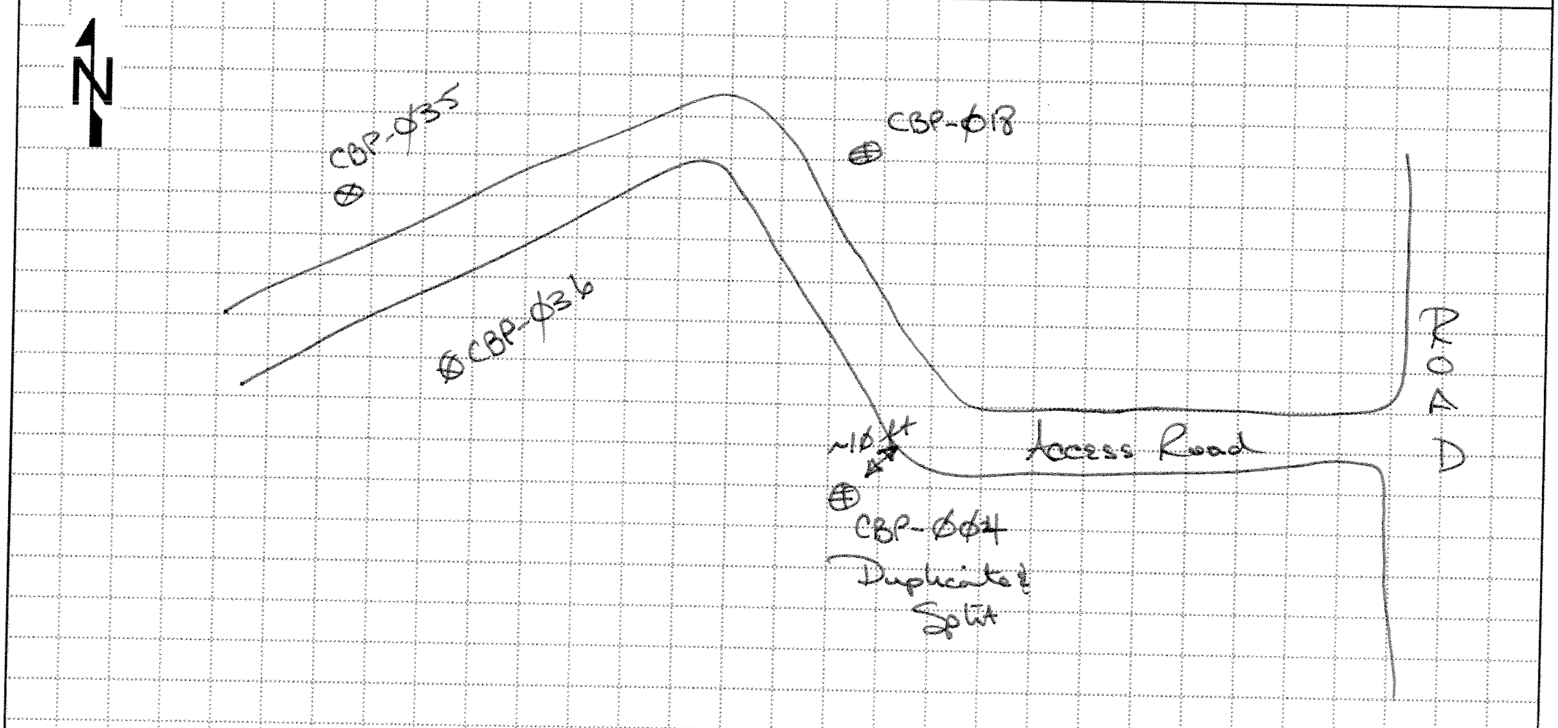
21. TOTAL CORE RECOVERY %: N/A

22. DISPOSITION OF BOREHOLE: DATE STARTED/INSTALLED: 11/16/05 DATE COMPLETED/ABANDONED: 11/16/05

BACKFILL TYPE: ☐ GROUT ☒ BENTONITE ☐ TEMPORARY WELL POINT ☐ MONITORING WELL

LOCATION SKETCH/COMMENTS

SCALE: None



QC by Jed Thomas

PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: B. Williams 11/16/05

BOREHOLE NUMBER: CBP-004

HTRW DRILLING LOG (continued)

DISTRICT
USACE - Louisville

BOREHOLE NUMBER
CBP-004

1. COMPANY NAME
SAIC

2. DRILL SUBCONTRACTOR

SHEET 2 OF 2

3. PROJECT Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION RVAAP

5. NAME OF DRILLER SAIC - Jed Thomas

6. DIRECTION OF BOREHOLE ☒ VERTICAL ☐ INCLINED DEGREES

7. NOTES PID MAKE/MODEL: Perkins Elmer Photovac 2020 PID SERIAL#: ED KR 20 BW 303

ELEVATION	DEPTH ~~(0.1 Feet)~~ (FT)	USCS	CLASSIFICATION OF MATERIALS	ANALYTICAL SAMPLE NUMBER	MONITORING (PPM)	REMARKS
	BW		10YR 2/1 Black medium (to course) BW sand with silt; roots; damp to moist; course angular gravel; loose.	CBPss-052-0122-50	0.0	Slag; burnt-septic like odor Refusal at 1.0 ft
	0.5	SM		CBPss-052-~~0125~~ 0129-50 BW	DUPLICATE	
	0.8			CBPss-052-~~0126~~ -50 ~~0130~~ BW -~~0135~~ BW BW	SPLIT	
	1.0	SP	10YR 4/4 dark yellowish brown; Same material as above; Some pieces of loose material are hard crust-like aggregate that breaks with minimal finger pressure but does not crush with finger pressure; less roots. 1.0 ft	→ CBPss-052-0135-50 (Split)		
	BW 3					
	BW 4		Bottom of borehole			
	BW 5					
	BW 6		BW 11/16/05			
	BW 7					
	BW 8					
	BW 9					
	BW 10					

QC by Jed Thomas

PROJECT
Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE
B. Williams 11/16/05

BOREHOLE NUMBER
CBP-004

HTRW DRILLING LOG

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-018 BW

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: NA

SHEET 1 OF 2

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC - Martha Clough

6. MAKE/MODEL OF DRILL: *na*

7. SIZES AND TYPES OF SAMPLING EQUIPMENT: S.S. Hand Auger (3-in) S.S. Bowl & Spoon BW

8. BOREHOLE LOCATION: Central Burn Pits

9. SURFACE ELEVATION/DATUM: N/A

10. DRILL DATE/TIME STARTED: ~~0920~~ 0915 BW COMPLETED: ~~0940~~ 0935 BW

15. DEPTH GROUNDWATER ENCOUNTERED: 0.2 inches BGS

16. DEPTH TO WATER/ELAPSED TIME AFTER BOREHOLE COMPLETION: *NA*

12. OVERBURDEN THICKNESS: N/A

13. DEPTH DRILLED INTO BEDROCK: N/A

17. OTHER WATER LEVEL MEASUREMENTS (INLCLUDE DATE/TIME): NA

14. TOTAL DEPTH OF BOREHOLE: 1 ft.

18. GEOTECHNICAL SAMPLES N/A — UNDISTURBED: — DISTURBED: —

19. TOTAL NUMBER OF CORE BOXES: N/A

20. CHEMICAL SAMPLES ~~METALS~~ ~~EXPL~~ [✓ OTHER:] Total Chromium

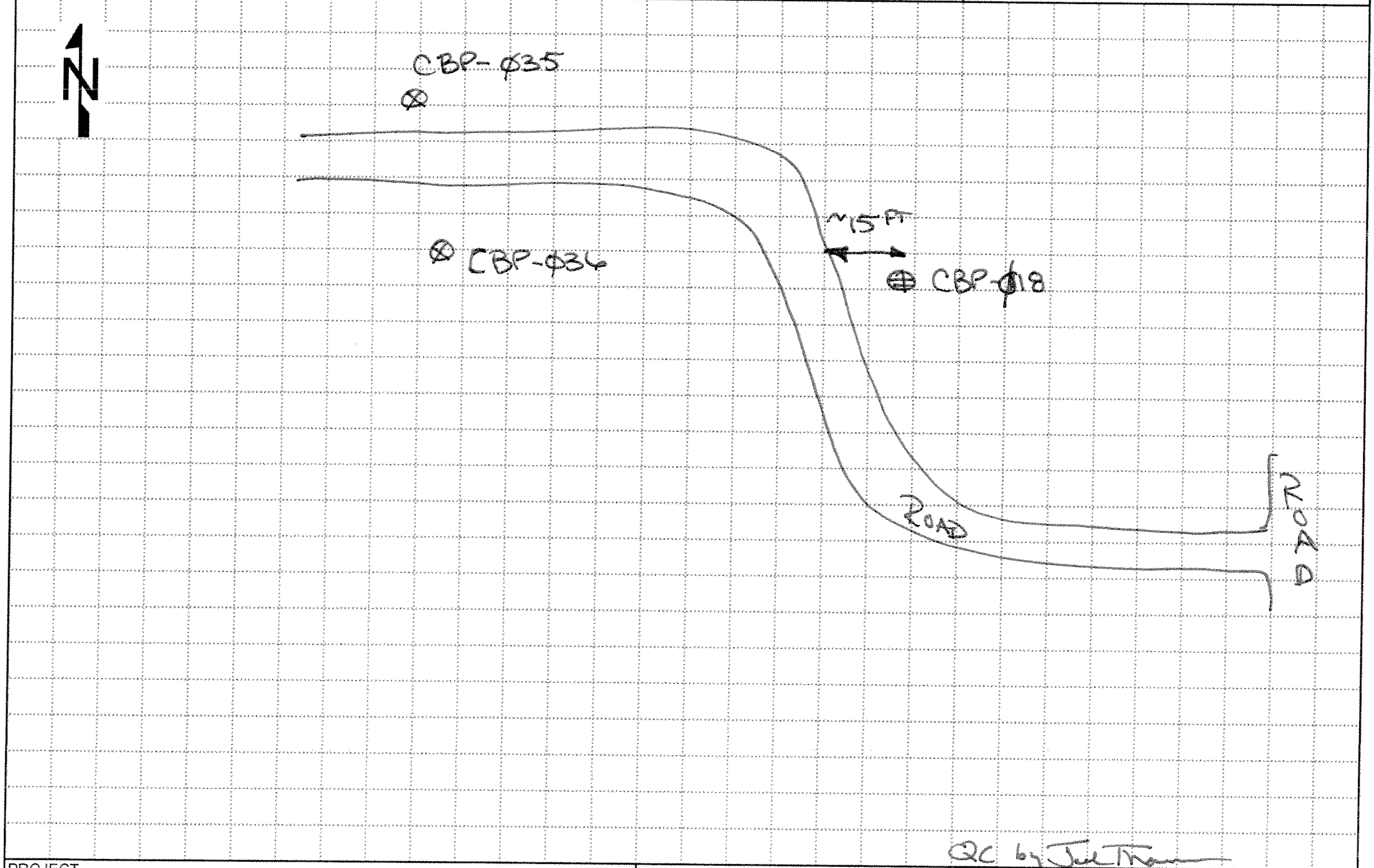
21. TOTAL CORE RECOVERY %: N/A

22. DISPOSITION OF BOREHOLE DATE STARTED/INSTALLED: 11/16/05 DATE COMPLETED/ABANDONED: 11/16/05

BACKFILL TYPE: ☐ GROUT ☒ BENTONITE ☐ TEMPORARY WELL POINT ☐ MONITORING WELL

LOCATION SKETCH/COMMENTS

SCALE: None



QC by

PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: B. Williams 11/16/05

BOREHOLE NUMBER: CBP-018 BW

HTRW DRILLING LOG (continued)	DISTRICT USACE - Louisville	BOREHOLE NUMBER CBP-018
1. COMPANY NAME SAIC	2. DRILL SUBCONTRACTOR N/A	SHEET 2 OF 2

3. PROJECT Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION RVAAP

5. NAME OF DRILLER SAIC- Martha Clough

6. DIRECTION OF BOREHOLE ☒ VERTICAL ☐ INCLINED DEGREES

7. NOTES PID MAKE/MODEL Perkins Elmer Photovac 2020 PID SERIAL#: ED KR 303

ELEVATION	DEPTH ~~(0.1 Feet)~~ ft	USCS	CLASSIFICATION OF MATERIALS	ANALYTICAL SAMPLE NUMBER	MONITORING (PPM)	REMARKS
	BW 0.5 ~~1~~ 0.8 BW 1.0 ~~2~~	SM*	SANDS AND SILT 2.5Y 3/1 very dark gray; BURN DEBRIS: Burnt wood, 1/8 inch thick chips of black press board-like material (1-1.5 inches wides), bentonite from previous soil boring, metal, gravel; & roots; wet 1.0ft	CBPss-~~053~~ BW -053-0123 -SO	0.0	FORMER LOCATION FOUND; *Primarily burn debris; Martha Clough; Water in hole
	BW ~~3~~ BW 4 BW 5 BW 6 BW 7 BW 8 BW 9 BW 10		Bottom of borehole BW 11/16/05			

QC by [illegible]

PROJECT	INSPECTOR SIGNATURE/DATE	BOREHOLE NUMBER
Supplemental Phase II at CBP, FBQ, and ODA2	B. Williams 11/16/05	CBP-018

HTRW DRILLING LOG

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-033

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: NA

SHEET 1 OF 2

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC - Jed Thomas

6. MAKE/MODEL OF DRILL: na

7. SIZES AND TYPES OF SAMPLING EQUIPMENT: S.S. Hand Auger (3. in)
S.S. Bowl & Spoon

8. BOREHOLE LOCATION: Central Burn Pits

9. SURFACE ELEVATION/DATUM: N/A

10. DRILL DATE/TIME STARTED: 0950 COMPLETED:

15. DEPTH GROUNDWATER ENCOUNTERED: N/A

16. DEPTH TO WATER/ELAPSED TIME AFTER BOREHOLE COMPLETION: NA

12. OVERBURDEN THICKNESS: N/A

13. DEPTH DRILLED INTO BEDROCK: N/A

14. TOTAL DEPTH OF BOREHOLE: 0-1 ft

17. OTHER WATER LEVEL MEASUREMENTS (INLCLUDE DATE/TIME): NA

18. GEOTECHNICAL SAMPLES: N/A UNDISTURBED: — DISTURBED: —

19. TOTAL NUMBER OF CORE BOXES: N/A

20. CHEMICAL SAMPLES: METALS EXPL OTHER:

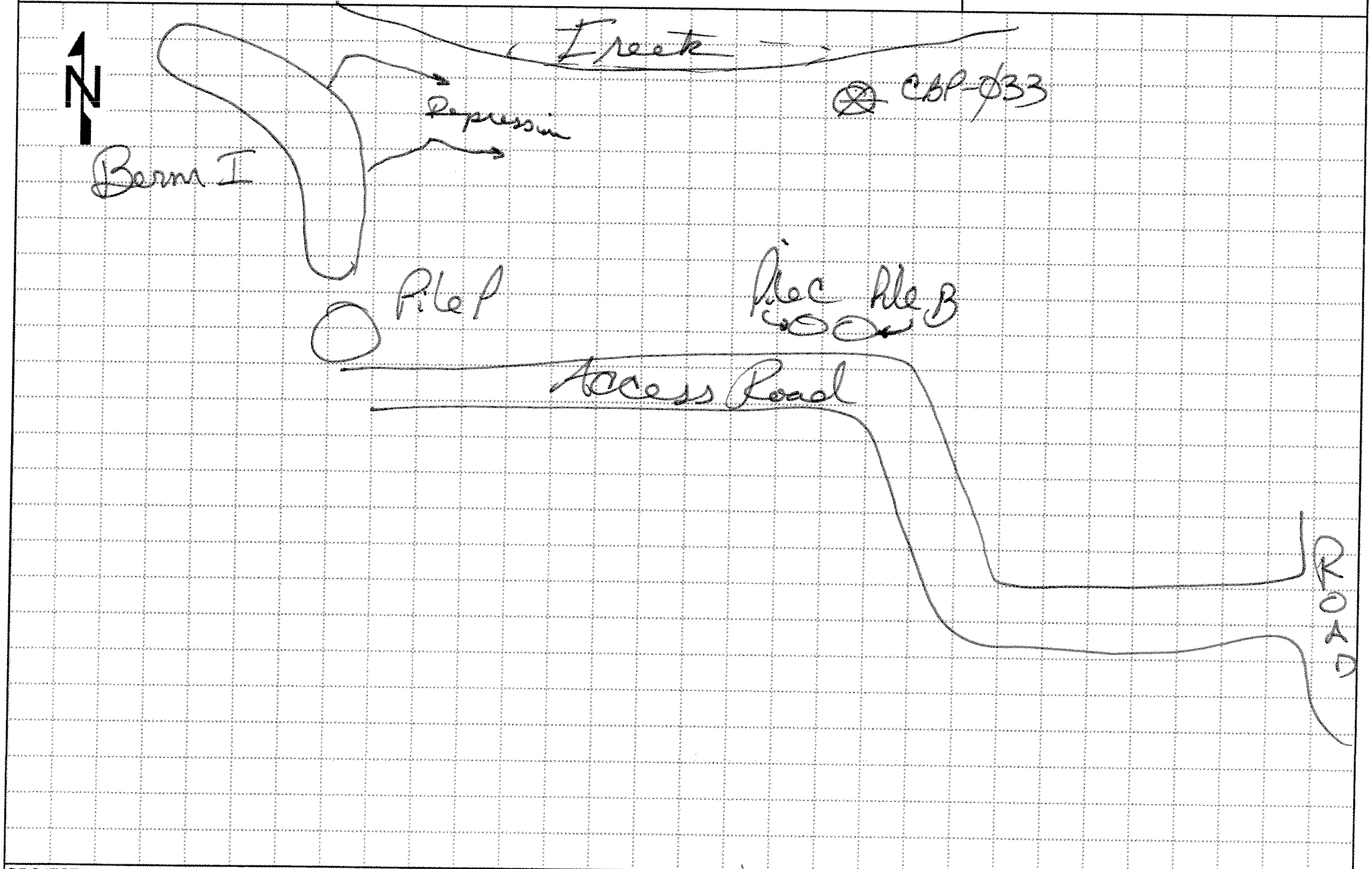
21. TOTAL CORE RECOVERY %: N/A

22. DISPOSITION OF BOREHOLE: DATE STARTED/INSTALLED: 11/17/05 DATE COMPLETED/ABANDONED:

BACKFILL TYPE: ☐ GROUT ☒ BENTONITE ☐ TEMPORARY WELL POINT ☐ MONITORING WELL

LOCATION SKETCH/COMMENTS

SCALE: None



PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: QC by Jed Thomas
B. W 11/17/05

BOREHOLE NUMBER: CBP-033

HTRW DRILLING LOG (continued)

DISTRICT
USACE - Louisville

BOREHOLE NUMBER
CBP-033

1. COMPANY NAME
SAIC

2. DRILL SUBCONTRACTOR
N/A

SHEET 2 OF 2

3. PROJECT Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION RVAAP

5. NAME OF DRILLER SAIC - Jed Thomas

6. DIRECTION OF BOREHOLE ☒ VERTICAL ☐ INCLINED DEGREES

7. NOTES PID MAKE/MODEL: Perkins Elmer Photovac 2020 PID SERIAL#: ED KR 303

ELEVATION	DEPTH (0.1 Feet)	USCS	CLASSIFICATION OF MATERIALS	ANALYTICAL SAMPLE NUMBER	MONITORING (PPM)	REMARKS
		CL	2.5Y 3/2 very dark grayish brown; lean clay with fine sand; moist; ~10% fine angular stones; roots.	CBPss-~~033-0~~ 054- 0124- SO	0.0	BW
	1					
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
	10					

BW 11/18/05

PROJECT
Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE QC by Jed Thomas
B. Will 11/17/05

BOREHOLE NUMBER
CBP-033

HTRW DRILLING LOG

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: ~~CBP~~ BW ss- CBP-035

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: NA

SHEET 1 OF 2

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC - Martha Clough

6. MAKE/MODEL OF DRILL: na

7. SIZES AND TYPES OF SAMPLING EQUIPMENT:
S.S. AUGER (HAND) (3-IN)
S.S. BOWL & SPOON
BW

8. BOREHOLE LOCATION: Central Burn Pits

9. SURFACE ELEVATION/DATUM: N/A

10. DRILL DATE/TIME STARTED: 1410 COMPLETED: 1445

15. DEPTH GROUNDWATER ENCOUNTERED: N/A

16. DEPTH TO WATER/ELAPSED TIME AFTER BOREHOLE COMPLETION: NA

12. OVERBURDEN THICKNESS: N/A

13. DEPTH DRILLED INTO BEDROCK: N/A

14. TOTAL DEPTH OF BOREHOLE: 3FT

17. OTHER WATER LEVEL MEASUREMENTS (INLCLUDE DATE/TIME): NA

18. GEOTECHNICAL SAMPLES: N/A UNDISTURBED: — DISTURBED: —

19. TOTAL NUMBER OF CORE BOXES: N/A

20. CHEMICAL SAMPLES: [✓ METALS] [✓ EXPL] OTHER: —

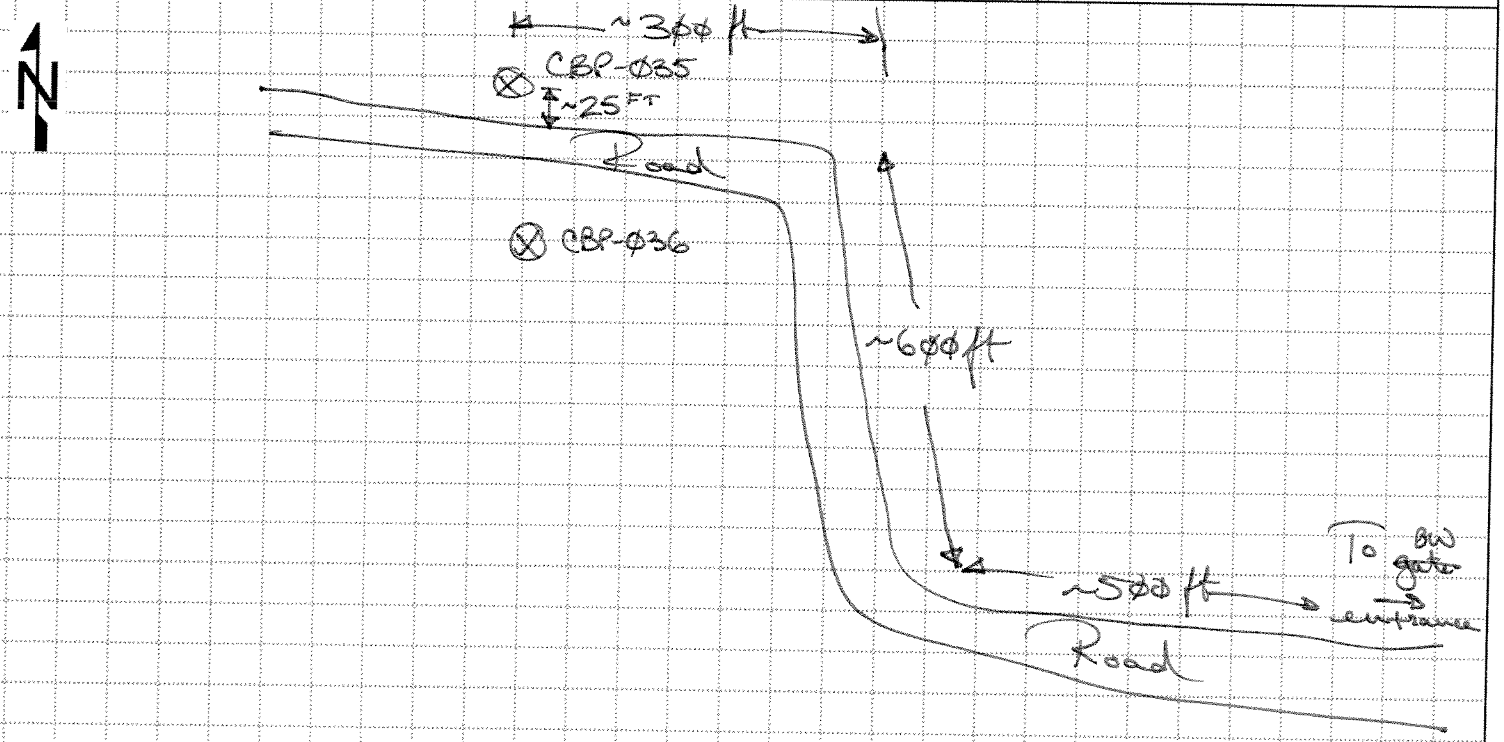
21. TOTAL CORE RECOVERY %: N/A

22. DISPOSITION OF BOREHOLE: DATE STARTED/INSTALLED: 11/14/05 DATE COMPLETED/ABANDONED:

BACKFILL TYPE: ☐ GROUT ☒ BENTONITE ☐ TEMPORARY WELL POINT ☐ MONITORING WELL

LOCATION SKETCH/COMMENTS

SCALE: None



PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: QC by JA Thomas
B. Williams 11/14/05

BOREHOLE NUMBER: CBP-035

HTRW DRILLING LOG (continued)

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-035

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: N/A

SHEET 2 OF 2

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC - Martha Clough

6. DIRECTION OF BOREHOLE: ☒ VERTICAL ☐ INCLINED DEGREES

7. NOTES PID MAKE/MODEL: Perkins Elmer Photovac 2020 PID SERIAL#: ED KR 303

ELEVATION	DEPTH (0.1 Feet)	USCS	CLASSIFICATION OF MATERIALS	ANALYTICAL SAMPLE NUMBER	MONITORING (PPM)	REMARKS
	0.7		2.5Y 3/1 very dark gray silt with sand (medium to course) poorly sorted angular to subangular very fine to course stones.	CBPss-035-0100-SO	0.0	BW
	1.0			1.0 ft		
		CL	5Y 6/1 gray with 10YR 5/8 yellowish brown mottling (20%) lean clay fine to medium sand; damp; medium ~~to~~ BW subangular stones	CBPso-035-0101 SO	0.0	BW
	2.0					
	3.0		3.0 ft			
			Bottom of borehole			
	4					
	5					
	6		BW			
	7		BW ~~11/15~~ 11/14/05			
	8					
	9					
	10					

PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE QC by [illegible] B. Wil 11/14/05

BOREHOLE NUMBER: CBP-035

HTRW DRILLING LOG

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-036

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: NA

SHEET 1 OF 2

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC - Martha Clough

6. MAKE/MODEL OF DRILL: na

7. SIZES AND TYPES OF SAMPLING EQUIPMENT:
SS. Hand Auger (3-in)
SS. Bowl & Spoon
BW

8. BOREHOLE LOCATION: Central Burn Pits

9. SURFACE ELEVATION/DATUM: N/A

10. DRILL DATE/TIME STARTED: 0825 COMPLETED: 0855

15. DEPTH GROUNDWATER ENCOUNTERED: N/A - Surface water at GS.

16. DEPTH TO WATER/ELAPSED TIME AFTER BOREHOLE COMPLETION: NA

12. OVERBURDEN THICKNESS: N/A

13. DEPTH DRILLED INTO BEDROCK: N/A

17. OTHER WATER LEVEL MEASUREMENTS (INLCLUDE DATE/TIME): NA

14. TOTAL DEPTH OF BOREHOLE: 3 ft

18. GEOTECHNICAL SAMPLES: N/A UNDISTURBED: — DISTURBED: —

19. TOTAL NUMBER OF CORE BOXES: N/A

20. CHEMICAL SAMPLES: [✓ METALS] [✓ EXPL] OTHER: —

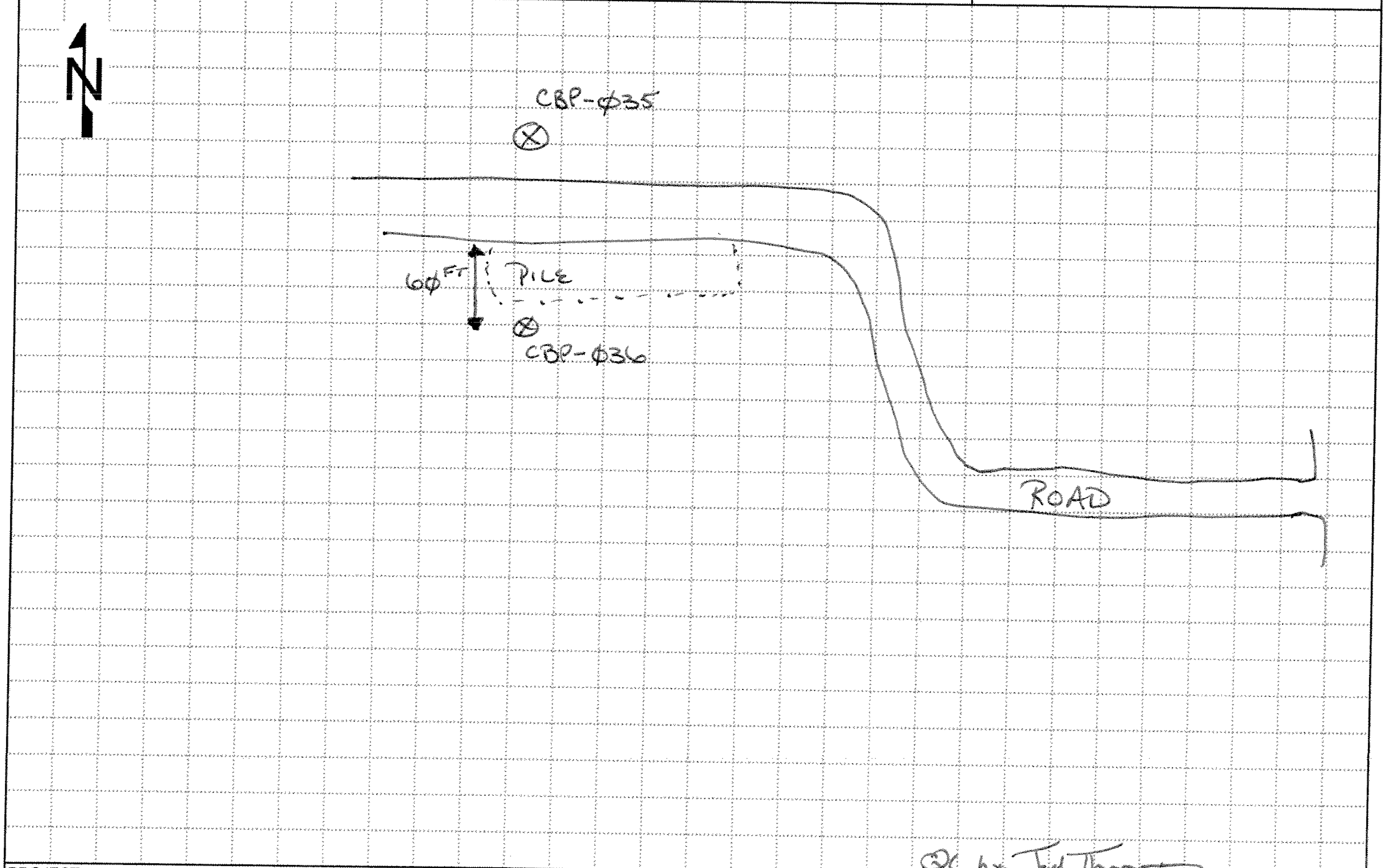
21. TOTAL CORE RECOVERY %: N/A

22. DISPOSITION OF BOREHOLE: DATE STARTED/INSTALLED: 11/16/05 DATE COMPLETED/ABANDONED: 11/16/05

BACKFILL TYPE: ☐ GROUT ☒ BENTONITE ☐ TEMPORARY WELL POINT ☐ MONITORING WELL

LOCATION SKETCH/COMMENTS

SCALE: None



QC by

PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: B. Williams 11/16/05

BOREHOLE NUMBER: CBP-036

HTRW DRILLING LOG (continued)

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-036

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: N/A

SHEET 2 OF 2

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC Martha Clough

6. DIRECTION OF BOREHOLE: ☒ VERTICAL ☐ INCLINED DEGREES

7. NOTES PID MAKE/MODEL: Perkins Elmer Photovac 2020 PID SERIAL#: ED KR 303

ELEVATION	DEPTH (0.1 Feet)	USCS	CLASSIFICATION OF MATERIALS	ANALYTICAL SAMPLE NUMBER	MONITORING (PPM)	REMARKS
	0.2	SM	2.5Y 3/2 very dark grayish brown silt with BW ~~coa~~ medium sand; wet; roots; organic layers	CBPss-036-0102-SO	0.0	Martha Clough
	1.0	CL	2.5Y 5/4 light olive brown BW ~~lead~~ lean clay with fine to medium sand; wet; low to medium ~~plasty~~ BW plasticity.	1.0 ft CBPso-036-0103-SO	0.0	Martha Clough
	2.0		BW			
	3.0		3.0 ft Bottom of borehole			
	4					
	5		BW 11/16/05			
	6					
	7					
	8					
	9					
	10					

QC by [illegible]

PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: B. Willi 11/16/05

BOREHOLE NUMBER: CBP-036

HTRW DRILLING LOG

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-037

SHEET 1 OF 2

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: NA

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC-Martha Clough & Jed Thomas

6. MAKE/MODEL OF DRILL: na

7. SIZES AND TYPES OF SAMPLING EQUIPMENT:
S.S. Hand Auger (3-in)
S.S. Bowl & Spoon
BW

8. BOREHOLE LOCATION: Central Burn Pits

9. SURFACE ELEVATION/DATUM: N/A

10. DRILL DATE/TIME STARTED: 1005 COMPLETED: ~~1030~~ BW 1020

15. DEPTH GROUNDWATER ENCOUNTERED: N/A

16. DEPTH TO WATER/ELAPSED TIME AFTER BOREHOLE COMPLETION: NA

12. OVERBURDEN THICKNESS: N/A

13. DEPTH DRILLED INTO BEDROCK: N/A

14. TOTAL DEPTH OF BOREHOLE: 3 ft.

17. OTHER WATER LEVEL MEASUREMENTS (INLCLUDE DATE/TIME): NA

18. GEOTECHNICAL SAMPLES: N/A UNDISTURBED: —— DISTURBED: ——

19. TOTAL NUMBER OF CORE BOXES: N/A

20. CHEMICAL SAMPLES: [✓ METALS] [✓ EXPL] ~~OTHER:~~

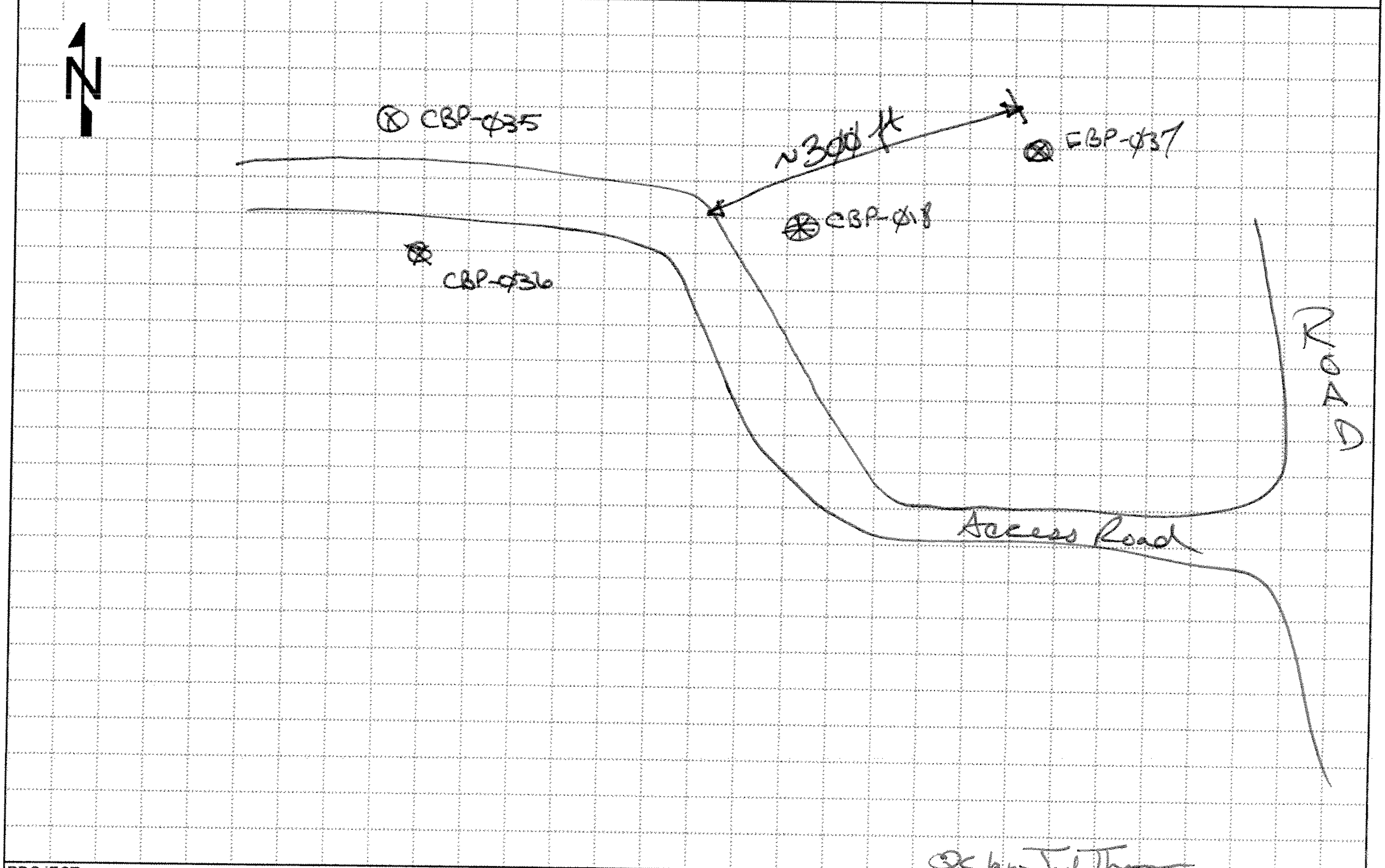
21. TOTAL CORE RECOVERY %: N/A

22. DISPOSITION OF BOREHOLE: DATE STARTED/INSTALLED: 11/16/05 DATE COMPLETED/ABANDONED: 11/16/05

BACKFILL TYPE: ☐ GROUT ☒ BENTONITE ☐ TEMPORARY WELL POINT ☐ MONITORING WELL

LOCATION SKETCH/COMMENTS

SCALE: None



QC by Jed Thomas

PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: B. Williams 11/16/05

BOREHOLE NUMBER: CBP-037

HTRW DRILLING LOG (continued)

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-037

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: N/A

SHEET 2 OF 2

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC - Martha Clough & Jed Thomas

6. DIRECTION OF BOREHOLE: ☒ VERTICAL ☐ INCLINED DEGREES

7. NOTES PID MAKE/MODEL: Perkins Elmer Photovac 2020 PID SERIAL#: ED KR 303

ELEVATION	DEPTH ~~(0.1~~ Feet)	USCS	CLASSIFICATION OF MATERIALS	ANALYTICAL SAMPLE NUMBER	MONITORING (PPM)	REMARKS
	0.4	OL	2.5Y 3/2 very dark grayish brown silt with medium sand; moist; roots; organic layer	CBPss-037-0104-SO 1.0 ft	0.0	BW CBPss-037-~~0127~~-SO Duplicate ~~0129~~ BW 012 CBPso-037-~~0128~~-SO ~~0130~~ BW -012 Split Martha Clough 1.0 ft
	1 1.2	CL	2.5Y 4/4 olive brown, soft BW lean clay 5% fine to medium sand; damp; fine roots; 10YR 5/8 yellowish brown mottling (15%)			Jed Thomas
	2	CL	2.5Y 6/1 gray with 10YR 5/8 yellowish brown mottling (50%) fine sand; 1% course sand 3.0	CBPso-037-0105-SO	0.0	
	3		Bottom of borehole			
	4					
	5		BW 11/16/05			
	6					
	7					
	8					
	9					
	10					

QC by Jed Thomas

PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: B. Williams 11/16/05

BOREHOLE NUMBER: CBP-037

HTRW DRILLING LOG

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-038

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: NA

SHEET 1 OF 2

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC - Martha Clough & Jed Thomas

6. MAKE/MODEL OF DRILL: na

7. SIZES AND TYPES OF SAMPLING EQUIPMENT:
S.S. Hand Auger (3-in)
S.S. Bowl & Spoon

8. BOREHOLE LOCATION: Central Burn Pits

9. SURFACE ELEVATION/DATUM: N/A

10. DRILL DATE/TIME STARTED: 1105 COMPLETED: 1125

15. DEPTH GROUNDWATER ENCOUNTERED: N/A

16. DEPTH TO WATER/ELAPSED TIME AFTER BOREHOLE COMPLETION: NA

12. OVERBURDEN THICKNESS: N/A

13. DEPTH DRILLED INTO BEDROCK: N/A

17. OTHER WATER LEVEL MEASUREMENTS (INLCLUDE DATE/TIME): NA

14. TOTAL DEPTH OF BOREHOLE: 3 ft.

18. GEOTECHNICAL SAMPLES: N/A UNDISTURBED: ——— DISTURBED: ———

19. TOTAL NUMBER OF CORE BOXES: N/A

20. CHEMICAL SAMPLES: GW ~~N/A~~ [✓ METALS] [✓ EXPL] OTHER: ———

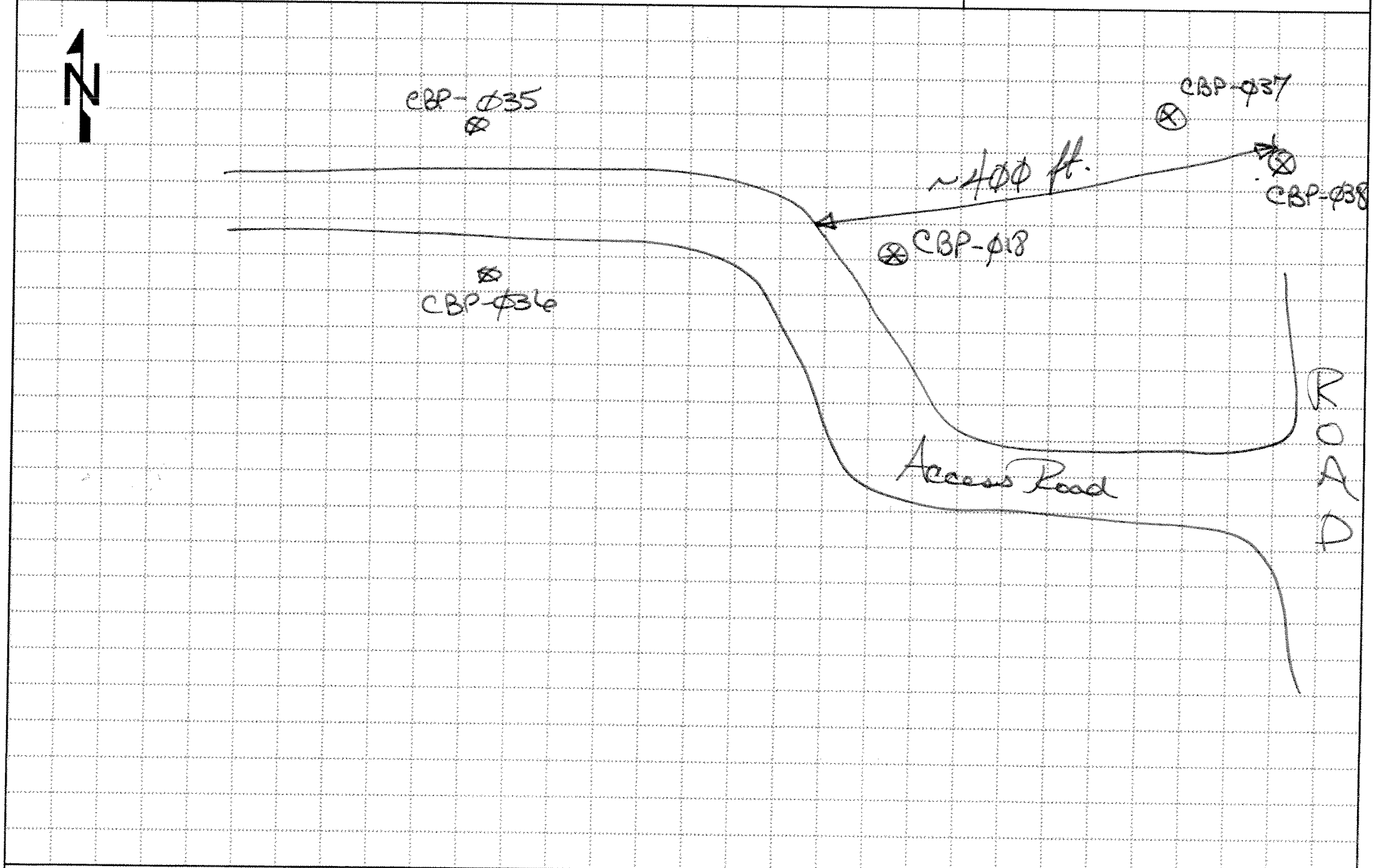
21. TOTAL CORE RECOVERY %: N/A

22. DISPOSITION OF BOREHOLE: DATE STARTED/INSTALLED: 11/16/05 DATE COMPLETED/ABANDONED: 11/16/05

BACKFILL TYPE: ☐ GROUT ☒ BENTONITE ☐ TEMPORARY WELL POINT ☐ MONITORING WELL

LOCATION SKETCH/COMMENTS

SCALE: None



PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: QC by Jed Thomas B. Williams 11/16/05

BOREHOLE NUMBER: CBP-038

HTRW DRILLING LOG (continued)

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-038

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: N/A

SHEET 2 OF 2

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC - Martha Clough & Jed Thomas

6. DIRECTION OF BOREHOLE: ☒ VERTICAL ☐ INCLINED DEGREES

7. NOTES PID MAKE/MODEL: Perkins Elmer Photovac 2020 PID SERIAL#: ED KR 303

ELEVATION	DEPTH ~~(0.1 Feet)~~ BW	USCS	CLASSIFICATION OF MATERIALS	ANALYTICAL SAMPLE NUMBER	MONITORING (PPM)	REMARKS
0.4	0.4	CL	2.5Y 4/2 dark grayish brown with 15% mottling: 7.5YR 4/6 strong brown. Mottling appears to be associated with fine roots; lean clay with fine sand; moist; 3% subangular stones; Roots throughout; organic layer	CBPss-038-0106-SO 1.0 ft	0.0	Martha Clough
CL	1.0	CL		CBPso-038-0107-SO	0.0	Jed Thomas
	1.2 BW					
	2.0	BW	2.5Y 6/1 gray with 50% mottling: 10YR 4/6 dark yellowish brown, clay (lean) with medium to course sand; very fine to fine subangular stones; course flat ~~S~~ BW weathered shale pieces - 1%. 3.0 ft	BW		BW
3.0	3.0					
	4		Bottom of borehole			
	5					
	6		BW 11/16/05			
	7					
	8					
	9					
	10					

PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: QC by Jed Thomas B. Willi 11/16/05

BOREHOLE NUMBER: CBP-038

HTRW DRILLING LOG

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-039

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: NA

SHEET 1 OF 2

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC - Martha Clough & Jed Thomas

6. MAKE/MODEL OF DRILL: na

7. SIZES AND TYPES OF SAMPLING EQUIPMENT:
S.S. Hand Auger (3-in)
S.S. Bowl & Spoon
BW

8. BOREHOLE LOCATION: Central Burn Pits

9. SURFACE ELEVATION/DATUM: N/A

10. DRILL DATE/TIME STARTED: 1105 COMPLETED: 1125

15. DEPTH GROUNDWATER ENCOUNTERED: N/A

16. DEPTH TO WATER/ELAPSED TIME AFTER BOREHOLE COMPLETION: NA

12. OVERBURDEN THICKNESS: N/A

13. DEPTH DRILLED INTO BEDROCK: N/A

14. TOTAL DEPTH OF BOREHOLE: 3 ft.

17. OTHER WATER LEVEL MEASUREMENTS (INLCLUDE DATE/TIME): NA

18. GEOTECHNICAL SAMPLES: N/A UNDISTURBED: — DISTURBED: —

19. TOTAL NUMBER OF CORE BOXES: N/A

20. CHEMICAL SAMPLES: [✓ METALS] [✓ EXPL] OTHER: —

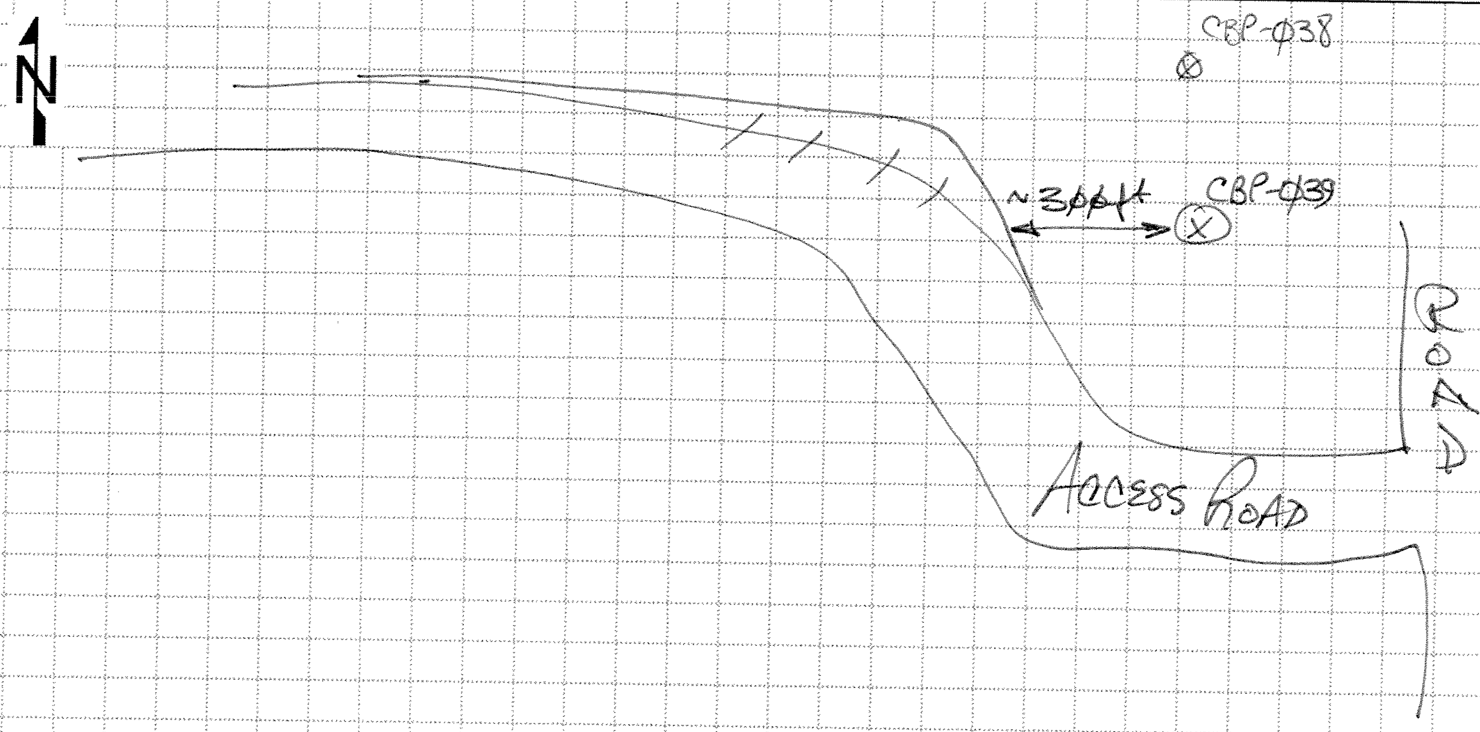
21. TOTAL CORE RECOVERY %: N/A

22. DISPOSITION OF BOREHOLE: DATE STARTED/INSTALLED: 11/16/05 DATE COMPLETED/ABANDONED: 11/16/05

BACKFILL TYPE: ☐ GROUT ☒ BENTONITE ☐ TEMPORARY WELL POINT ☐ MONITORING WELL

LOCATION SKETCH/COMMENTS

SCALE: None



PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: QC by Jed Thomas B. Williams 11/16/05

BOREHOLE NUMBER: CBP-039

HTRW DRILLING LOG (continued)

DISTRICT
USACE - Louisville

BOREHOLE NUMBER
CBP-039

1. COMPANY NAME
SAIC

2. DRILL SUBCONTRACTOR
N/A

SHEET 2 OF 2

3. PROJECT Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION RVAAP

5. NAME OF DRILLER SAIC - Martha Clough; Jed Thomas

6. DIRECTION OF BOREHOLE ☒ VERTICAL ☐ INCLINED DEGREES

7. NOTES PID MAKE/MODEL: Perkins Elmer Photovac 2020 PID SERIAL#: ED KR 303

ELEVATION	DEPTH (0.1 Feet)	USCS	CLASSIFICATION OF MATERIALS	ANALYTICAL SAMPLE NUMBER	MONITORING (PPM)	REMARKS
		CL	2.5Y 4/2 dark grayish brown with 15% mottling: 7.5YR 4/6 strong brown. Mottling appears to be associated with fine roots.; lean clay with fine sand; moist; 3% subangular stones; roots throughout; organic layer	CBPss-039-0108-SO	0.0	Martha Clough
	0.3	CL				
	1.0			CBPso-039-0109-SO	0.1	Jed Thomas
	2	CL	2.5Y 6/1 gray with 50% mottling: 10YR 4/6 dark yellowish brown; lean clay with medium to fine sand (15%); moist.			
	3					
	4		Same as 0.3 - 1.0 ft interval ~~without mottling~~ BW mottling: 10YR 5/6 yellowish brown. 3.0 ft.			
	5		Bottom of borehole			
	6		BW			
	7		11/16/05			
	8					
	9					
	10					

PROJECT
Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE
B. Williams 11/16/05 QC by Jed Thomas

BOREHOLE NUMBER
CBP-039

HTRW DRILLING LOG

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-040

BW ~~Pile~~ Berm A

SHEET 1 OF 2

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: NA

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC - Beau Williams & Martha Clough

6. MAKE/MODEL OF DRILL: BW na

7. SIZES AND TYPES OF SAMPLING EQUIPMENT: S.S. Soil Probe (1in)
S.S. Bowl & Spoon
BW

8. BOREHOLE LOCATIONS: Central Burn Pits

9. SURFACE ELEVATION/DATUM: Berm is ~3ft Above Ground Surface

10. DRILL DATE/TIME STARTED: 0800 COMPLETED: 0930

15. DEPTH GROUNDWATER ENCOUNTERED: N/A

16. DEPTH TO WATER/ELAPSED TIME AFTER BOREHOLE COMPLETION: NA

12. OVERBURDEN THICKNESS: N/A

13. DEPTH DRILLED INTO BEDROCK: N/A

17. OTHER WATER LEVEL MEASUREMENTS (INLCLUDE DATE/TIME): NA

14. TOTAL DEPTH OF BOREHOLE: Range from 0ft to 3ft. (3ft Pile)

18. GEOTECHNICAL SAMPLES: BW N/A UNDISTURBED: N/A DISTURBED: N/A

19. TOTAL NUMBER OF CORE BOXES: N/A

20. CHEMICAL SAMPLES: [✓ METALS] [✓ EXPL] OTHER: Hex. Chrome.

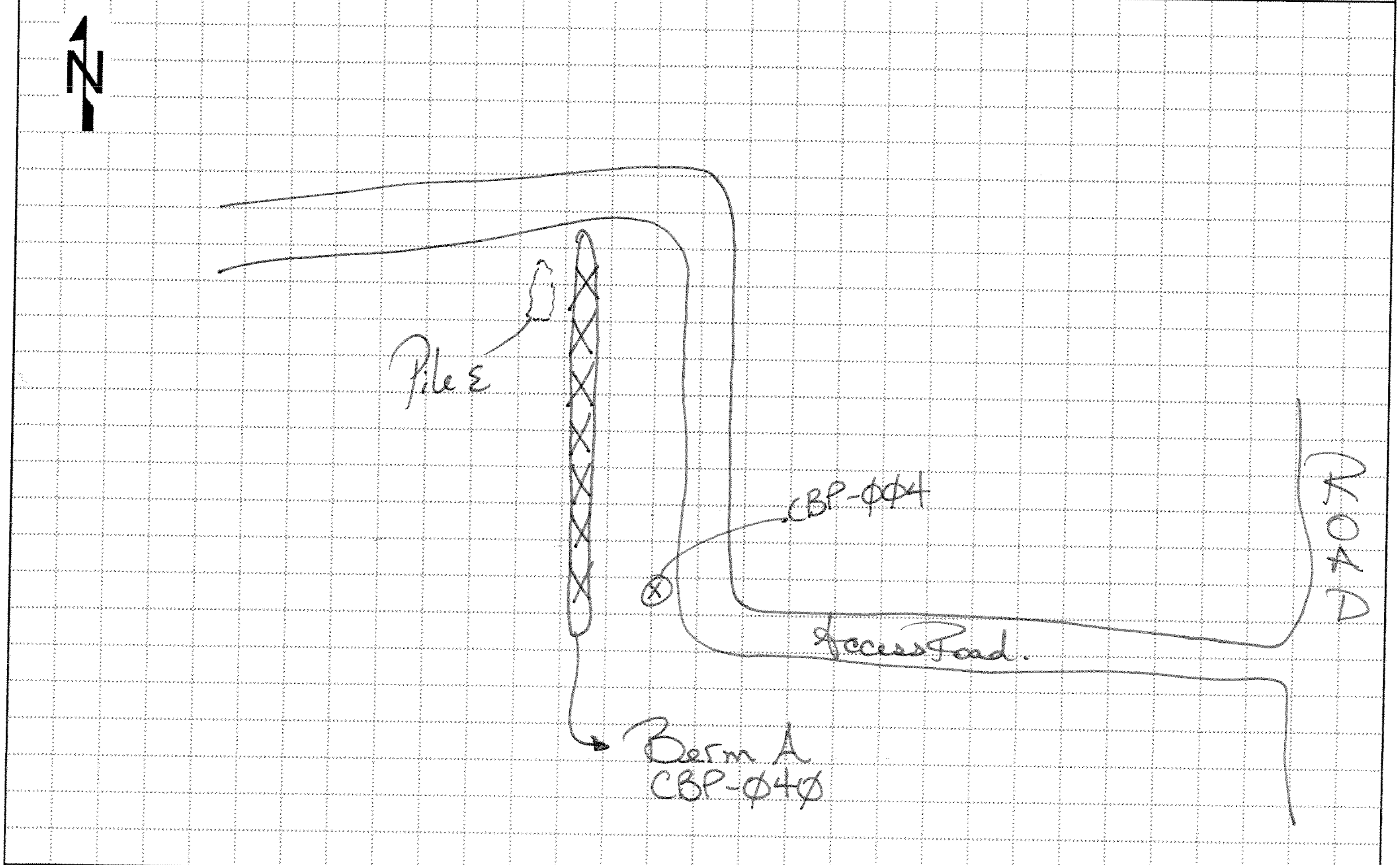
21. TOTAL CORE RECOVERY %: N/A

22. DISPOSITION OF BOREHOLE: DATE STARTED/INSTALLED: 11/17/05 BW DATE COMPLETED/ABANDONED: 11/17/05

BACKFILL TYPE: ~~☐ GROUT ☐ BENTONITE ☐ TEMPORARY WELL POINT ☐ MONITORING WELL~~ No BACKFILL

LOCATION SKETCH/COMMENTS

SCALE: None



PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: QC by Jed Thomas
B. Williams 11/17/05

BOREHOLE NUMBER: CBP-040

HTRW DRILLING LOG (continued)	DISTRICT USACE - Louisville	BOREHOLE NUMBER CBP-040
1. COMPANY NAME SAIC	2. DRILL SUBCONTRACTOR N/A	SHEET 2 OF 2

3. PROJECT Supplemental Phase II at CBP, FBQ, and ODA2
4. LOCATION RVAAP
5. NAME OF DRILLER SAIC-Martha Clough & Beau Williams
6. DIRECTION OF BOREHOLE ☒ VERTICAL ☐ INCLINED DEGREES
7. NOTES PID MAKE/MODEL: Perkins Elmer Photovac 2020 PID SERIAL#: ED ~~PK~~ BW KR 303

ELEVATION	DEPTH (~~0.1~~ Feet) BW	USCS	CLASSIFICATION OF MATERIALS	ANALYTICAL SAMPLE NUMBER	MONITORING (PPM)	REMARKS
	1.0 2.0 3.0	ML & CL	ML - silt with sand 2.5Y 2.5/1 Black with roots & organic layer. CL - lean clay with fine sand, some locations were mottled. (~30% of locations) 2.5Y 5/4 light olive brown. Some locations 20% mottling 10YR 5/8 yellowish brown. Various subround to angular stones (very fine to medium)	CBPss-040-0110M-SO 3.0ft	0.0	- General soil description of 30 boreholes. - Berm is ~3 ft thick. Several holes were advanced 2 times to collect full 3ft interval. - Many locations had refusal due to slag stones or roots.
	4 5 6 7 8 9 10		*MANY 2-3 inch size slag rocks in pile. Some sides were ~~exposed~~ BW primarily slag without vegetation. Slag fragments pulverized during sample collection. (Sample soil probe cut through the rocks). Sulfer odor in soil bowl & associated, in part anyway, to the pulverization of slag stones. Berm has Sycamore and Honey Locust trees growing through it. BW 11/17/05	Bottom of borehole		

PROJECT	INSPECTOR SIGNATURE/DATE	BOREHOLE NUMBER
Supplemental Phase II at CBP, FBQ, and ODA2	QC by Jed [illegible] B. Williams 11/17/05	CBP-040

HTRW DRILLING LOG

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-041

Pile B.

SHEET 1 OF 2

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: NA

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC-Martha Clough & Bean Williams

6. MAKE/MODEL OF DRILL: na

7. SIZES AND TYPES OF SAMPLING EQUIPMENT:
SS. Hand Auger (3-in)
SS Soil Probe (1-in)
SS Bowl & Spoon

8. BOREHOLE LOCATION: Central Burn Pit

9. SURFACE ELEVATION/DATUM: 0-7 ft Above Ground Surface

10. DRILL DATE/TIME STARTED: ~~[illegible]~~ 0945 COMPLETED: 1130

15. DEPTH GROUNDWATER ENCOUNTERED: N/A

16. DEPTH TO WATER/ELAPSED TIME AFTER BOREHOLE COMPLETION: NA

12. OVERBURDEN THICKNESS: N/A

13. DEPTH DRILLED INTO BEDROCK: N/A

0-~~3.0~~ 4 ft (total)

14. TOTAL DEPTH OF BOREHOLE: ~~0-4~~ 0-3 ft. (Sample)

17. OTHER WATER LEVEL MEASUREMENTS (INLCLUDE DATE/TIME): NA

18. GEOTECHNICAL SAMPLES: N/A UNDISTURBED: — DISTURBED: —

19. TOTAL NUMBER OF CORE BOXES: N/A

20. CHEMICAL SAMPLES: [✓ METALS] [✓ EXPL] TCLP OTHER: Cr+6

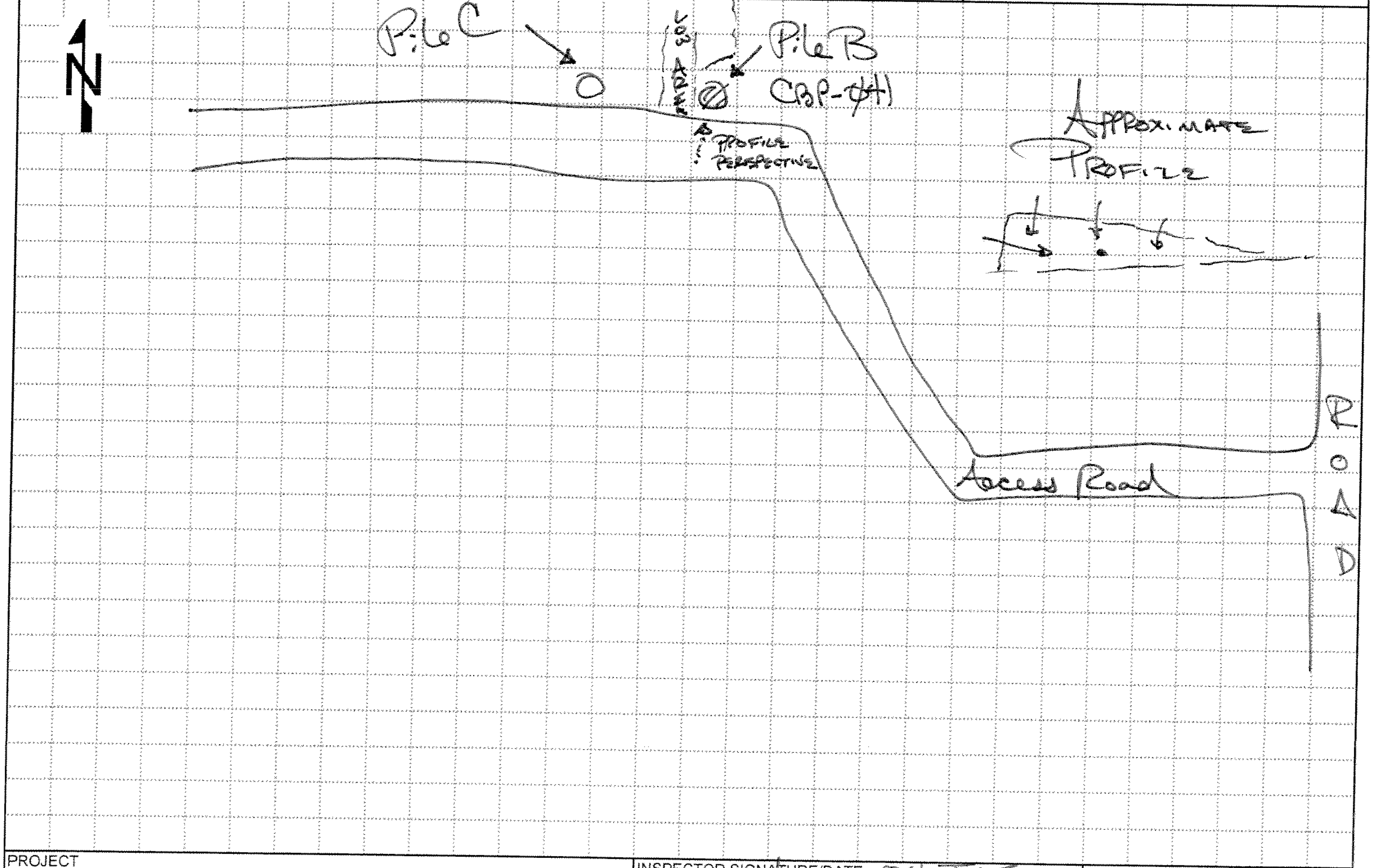
21. TOTAL CORE RECOVERY %: N/A

22. DISPOSITION OF BOREHOLE: DATE STARTED/INSTALLED: 11/17/05 DATE COMPLETED/ABANDONED: 11/17/05

BACKFILL TYPE: ☐ GROUT ☒ BENTONITE IN HAND AUGER HOLES ☐ TEMPORARY WELL POINT ☐ MONITORING WELL

LOCATION SKETCH/COMMENTS

SCALE: None



PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: QC by Jed Thomas
B. Williams 11/17/05

BOREHOLE NUMBER: CBP-041

HTRW DRILLING LOG (continued)

DISTRICT
USACE - Louisville

BOREHOLE NUMBER
CBP-041
Pile B
SHEET 2 OF 2

1. COMPANY NAME
SAIC

2. DRILL SUBCONTRACTOR
N/A

3. PROJECT Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION RVAAP

5. NAME OF DRILLER SAIC - Martha Clough & Bean Williams

6. DIRECTION OF BOREHOLE ☒ VERTICAL ☒ INCLINED ~0-80 DEGREES

7. NOTES PID MAKE/MODEL: Perkins Elmer Photovac 2020 PID SERIAL#: ED KR 2020

ELEVATION	DEPTH (0.1 Feet)	USCS	CLASSIFICATION OF MATERIALS	ANALYTICAL SAMPLE NUMBER	MONITORING (PPM)	REMARKS
	0.5	SM	SW ~~Silt~~ 2.5Y 3/1 very dark gray; Silt with sand; poorly sorted angular to subangular very fine to fine stones. Larger rocks on sides of pile; organic layer.	CBPss-041-0111M-SO	0.0	Slag stones Sandstone, large tree growing through center of pile.
	1			///		
	2	CL	2.5Y 5/6 light olive brown; lean clay with fine sand and fine subangular stones damp.			Some side samples were driven in/collected ~~both~~ horizontally. ie:  0-0.5 layer. generally consistent over top of pile
	3					
	4					
	5					
	6		BW 11/17/05			
	7					
	8					
	9					
	10					

PROJECT
Supplemental Phase II at CBP, FBQ, and ODA2

QC by Ted Thomas

INSPECTOR SIGNATURE/DATE
B. Williams 11/17/05

BOREHOLE NUMBER
CBP-041

HTRW DRILLING LOG

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-042

~~SWBurn~~ Pile C

SHEET 1 OF 2

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: NA

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: Ted Thomas

6. MAKE/MODEL OF DRILL: na

7. SIZES AND TYPES OF SAMPLING EQUIPMENT:
S.S. Hand Auger (3-in)
S.S. Soil Probe (1-in)
S.S. Bowl & Spoon

8. BOREHOLE LOCATION: Central Burn Pits

9. SURFACE ELEVATION/DATUM: ~10 ft Above Ground Surface

10. DRILL DATE/TIME: STARTED: 1020 COMPLETED: 1130

15. DEPTH GROUNDWATER ENCOUNTERED: N/A

16. DEPTH TO WATER/ELAPSED TIME AFTER BOREHOLE COMPLETION: NA

12. OVERBURDEN THICKNESS: N/A

13. DEPTH DRILLED INTO BEDROCK: N/A

17. OTHER WATER LEVEL MEASUREMENTS (INLCLUDE DATE/TIME): NA

14. TOTAL DEPTH OF BOREHOLE: 0-5ft (sample holes)

18. GEOTECHNICAL SAMPLES: N/A UNDISTURBED: N/A DISTURBED: N/A

19. TOTAL NUMBER OF CORE BOXES: N/A

20. CHEMICAL SAMPLES: [✓ METALS] [✓ EXPL] TCLP OTHER: Cr^{+6}

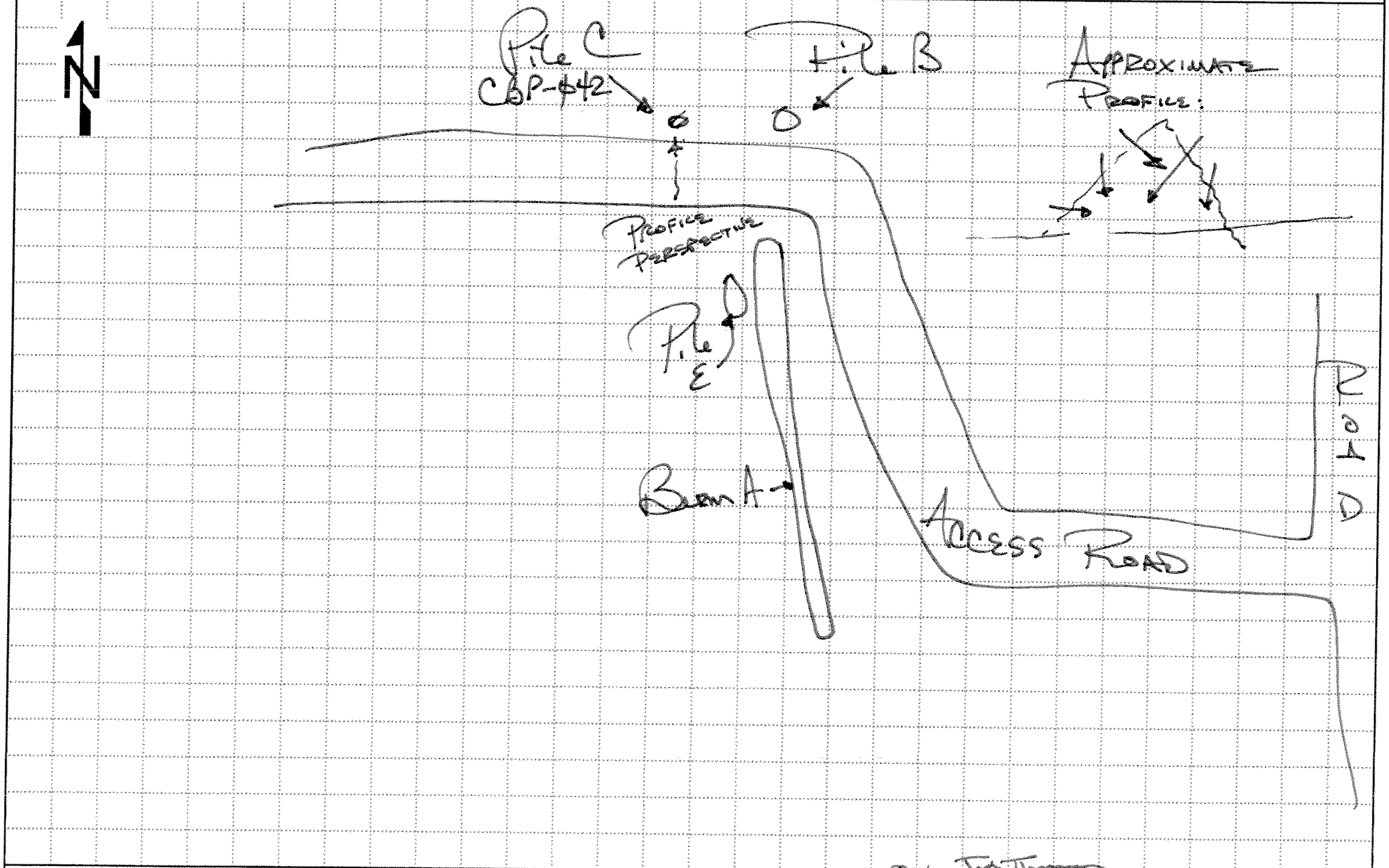
21. TOTAL CORE RECOVERY %: N/A

22. DISPOSITION OF BOREHOLE: DATE STARTED/INSTALLED: 11/17/05 DATE COMPLETED/ABANDONED: 11/17/05

BACKFILL TYPE: ☐ GROUT ☒ BENTONITE in hand auger holes ☐ TEMPORARY WELL POINT ☐ MONITORING WELL

LOCATION SKETCH/COMMENTS

SCALE: None



PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: QC by Ted Thomas B. Williams 11/17/05

BOREHOLE NUMBER: CBP-042

HTRW DRILLING LOG (continued)

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-042 Pile C

SHEET 2 OF 2

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: N/A

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: Jed Thomas

6. DIRECTION OF BOREHOLE: ☒ VERTICAL ☒ INCLINED ~0-80° DEGREES

7. NOTES PID MAKE/MODEL: Perkins Elmer Photovac 2020 PID SERIAL#: ED KR 303

ELEVATION	DEPTH ~~(0.1 Feet)~~ BW	USCS	CLASSIFICATION OF MATERIALS	ANALYTICAL SAMPLE NUMBER	MONITORING (PPM)	REMARKS
		SC & CL	2.5Y 2.5/1 Black BW Sand-clay mixture; medium to course stones 30% BW; angular to subangular; roots; moist; medium to course sands.	CBPss-042-0112M-SO	0.0	- Slag stones; Sand stones; burnt wood; - Some holes were inclined at varying angles ie:  - ~~light~~ BW thin organic layer over top of pile.
	1.0					
	2.0					
	3.0		BW 11/17/05			
	4.0					
	5.0					
	6					
	7		BW 11/17/05			
	8					
	9					
	10					

PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

QC by Jed Thomas

INSPECTOR SIGNATURE/DATE: B. Williams 11/17/05

BOREHOLE NUMBER: CBP-042

HTRW DRILLING LOG

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-043

BERM D & G

SHEET 1 OF 2

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: NA

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC - Jed Thomas

6. MAKE/MODEL OF DRILL: na

7. SIZES AND TYPES OF SAMPLING EQUIPMENT:
S.S. Soil Probe (1-in)
S.S. Bowl & spoons
BW

8. BOREHOLE LOCATION: Central Burn Pits

9. SURFACE ELEVATION/DATUM: ~0-4 ft (highest point)

10. DRILL DATE/TIME STARTED: 1225 COMPLETED: 1345

15. DEPTH GROUNDWATER ENCOUNTERED: N/A

16. DEPTH TO WATER/ELAPSED TIME AFTER BOREHOLE COMPLETION: NA

12. OVERBURDEN THICKNESS: N/A

13. DEPTH DRILLED INTO BEDROCK: N/A BW

17. OTHER WATER LEVEL MEASUREMENTS (INLCLUDE DATE/TIME): NA

14. TOTAL DEPTH OF BOREHOLE: 0-3 ft (samples)

18. GEOTECHNICAL SAMPLES: N/A UNDISTURBED: — DISTURBED: —

19. TOTAL NUMBER OF CORE BOXES: N/A

20. CHEMICAL SAMPLES: [✓ METALS] [✓ EXPL] TCLP OTHER: Cr+6

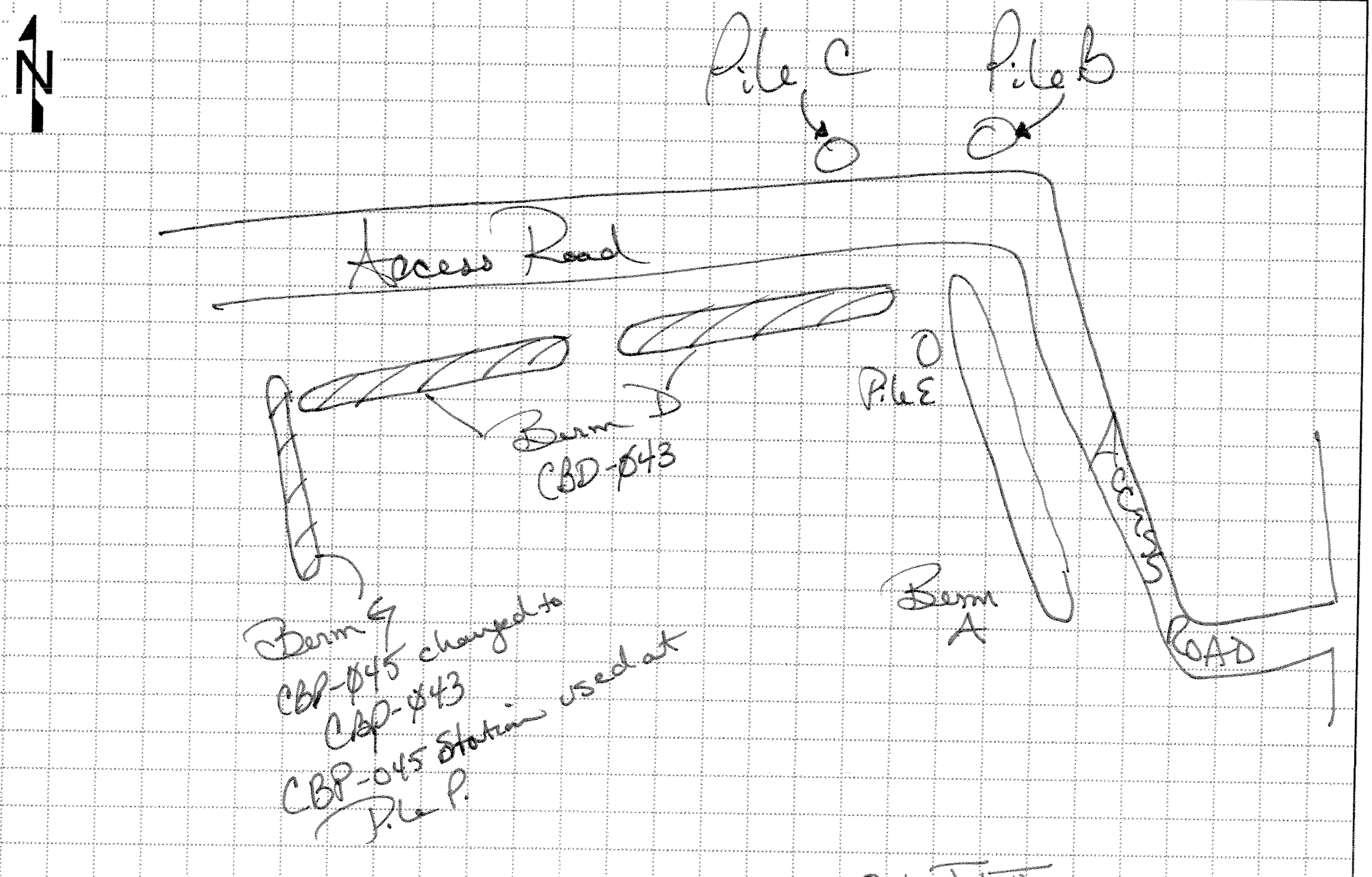
21. TOTAL CORE RECOVERY %: N/A

22. DISPOSITION OF BOREHOLE: DATE STARTED/INSTALLED: 11/17/05 DATE COMPLETED/ABANDONED: 11/17/05

BACKFILL TYPE: ~~☐ GROUT ☐ BENTONITE ☐ TEMPORARY WELL POINT ☐ MONITORING WELL~~ BW N/A

LOCATION SKETCH/COMMENTS

SCALE: None



CBP-045 changed to CBP-043
CBP-045 Station used at Pile P.

QC by Jed Thomas

PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: B. Williams 11/17/05

BOREHOLE NUMBER: CBP-043

HTRW DRILLING LOG (continued)

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-043

Berm Q 1 E2

SHEET 2 OF 2

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: N/A

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC - Jed Thomas

6. DIRECTION OF BOREHOLE: ☒ VERTICAL ☒ INCLINED 0-90% DEGREES

7. NOTES: PID MAKE/MODEL: Perkins Elmer Photovac 2020 PID SERIAL#: ED KR 303

ELEVATION	DEPTH (0.1 Feet)	USCS	CLASSIFICATION OF MATERIALS	ANALYTICAL SAMPLE NUMBER	MONITORING (PPM)	REMARKS
	1 2 3 3.5	SM & CL	Primarily 2.5Y 3/1 very dark gray, silt with medium sand, subangular to subround medium to fine stones; Roots & organic material; damp; ~~BW~~ Some 2.5Y 5/3 light olive brown 50% mottled: 10YR 5/6 ~~BW~~ lean Clay; damp. (BW to yellowish brown)	CBPss-043-0113M-SO	0.0	BW
	4 5 6 7 8 9 10		BW 11/17/05			

QC by Jed Thomas

PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: B. Williams 11/17/05

BOREHOLE NUMBER: CBP-043

SAMPLE LOCATION SKETCH

HOLE NUMBER Pile E (CBP-044)

PROJECT CBP Supplemental PII Soil Sample

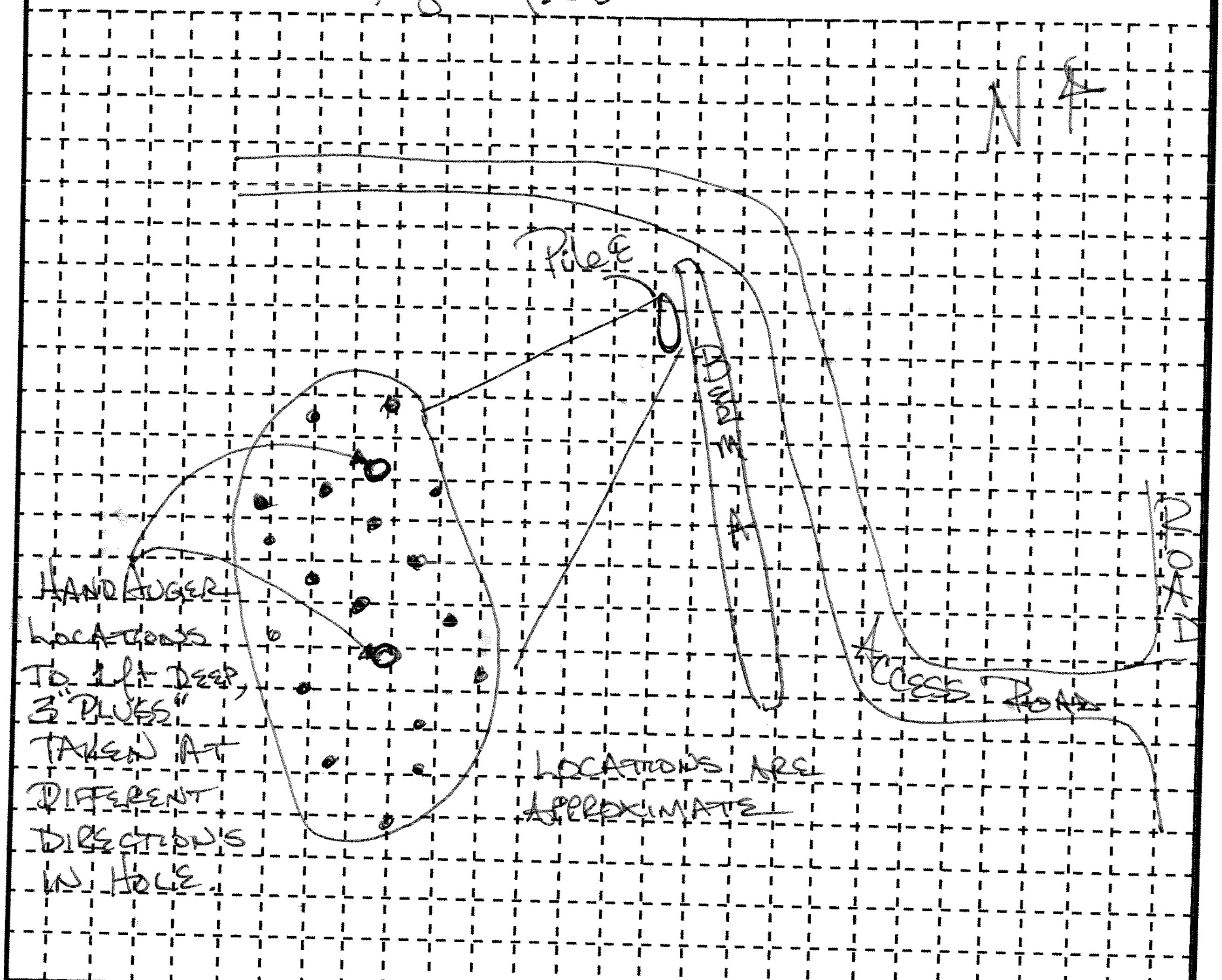
ELEVATION TOP OF HOLE N/A

LOCATION STATION CBP-044

DATUM FOR ELEVATION SHOWN N/A

LOCATION SKETCH Page 1 of 23

SCALE: N/A



HAND AUGER LOCATIONS TO 1 ft DEEP, 3 "PLUGS" TAKEN AT DIFFERENT DIRECTION'S IN HOLE

LOCATIONS ARE APPROXIMATE

COMMENTS

Pile was 30-50% slag stones (2-3 inch size). The sampler was hammered into sample locations, many times it encountered stone & either broke through or pushed it/advanced into soil pile. 3 locations were sampled at two different depths.

SIGNATURE OF INSPECTOR/DATE B. Williams 11/16/05

PROJECT CBP Supplemental PII Soil

HOLE NO. Pile E (CBP-044)

QC by Jack [illegible]

99-011M(P65)/040899

FTP-1215, Revision 0, 4/07/99

SAMPLE LOCATION SKETCH

HOLE NUMBER Pile E (CBP-044)

PROJECT CBP Supplemental PII Soil Sample

ELEVATION TOP OF HOLE N/A

LOCATION STATION CBP-044

DATUM FOR ELEVATION SHOWN N/A

LOCATION SKETCH Page 2 of ~~2~~ 3 BW

SCALE: N/A

BW 11/16/05

COMMENTS

General soil description: Silt with medium to course sand, clay intervals throughout. Silt: 2.5Y 4/2 dark grayish brown; Clay = lean clay 2.5Y 5/4 light olive brown. Slag throughout. Sulfer odor from slag fragments.

SIGNATURE OF INSPECTOR/DATE B. Williams 11/16/05

QC by [illegible]

PROJECT Supplemental PII Sampling at CBP ODA2, FBQ

HOLE NO. CBP-044

SAMPLE LOCATION SKETCH

HOLE NUMBER Pile E (CBP-044)

PROJECT CBP Supplemental PII Soils

ELEVATION TOP OF HOLE N/A

LOCATION STATION CBP-044

DATUM FOR ELEVATION SHOWN N/A

LOCATION SKETCH Page 3 of 3 **SCALE:** N/A

11/16/05

COMMENTS

CBPSS-044-0114M-SO collected between 1430 to 1600.

0.0 PPM throughout sampling Photovac 2020 serial#: EDKR303

Samplers: Bear Williams, Jed Thomas, Dale (UXO)

Photographs taken

SIGNATURE OF INSPECTOR/DATE B. Williams 11/16/05

PROJECT Phase 2 Supplemental Sampling at CBP ODA2 FBQ

HOLE NO. CBP-044

QC by Jed Thomas

HTRW DRILLING LOG

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-045 Pile P

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: NA

SHEET 1 OF 2

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC-Jed Thomas

6. MAKE/MODEL OF DRILL: *na*

7. SIZES AND TYPES OF SAMPLING EQUIPMENT:
S.S. Soil Probe (1-in)
S.S. Hand Auger (3-in.)
S.S. Bowl & Spoon

8. BOREHOLE LOCATION: Central Burn Pits

9. SURFACE ELEVATION/DATUM: ~0-8ft (highest Point)

10. DRILL DATE/TIME STARTED: 1350 COMPLETED: 1450

15. DEPTH GROUNDWATER ENCOUNTERED: N/A

16. DEPTH TO WATER/ELAPSED TIME AFTER BOREHOLE COMPLETION: *NA*

12. OVERBURDEN THICKNESS: N/A

13. DEPTH DRILLED INTO BEDROCK: N/A

17. OTHER WATER LEVEL MEASUREMENTS (INLCLUDE DATE/TIME): NA

14. TOTAL DEPTH OF BOREHOLE: 0-3ft (sampling)

18. GEOTECHNICAL SAMPLES: N/A UNDISTURBED: — DISTURBED: —

19. TOTAL NUMBER OF CORE BOXES: N/A

20. CHEMICAL SAMPLES: [✓ METALS] [✓ EXPL] TCLP OTHER: Cr+6

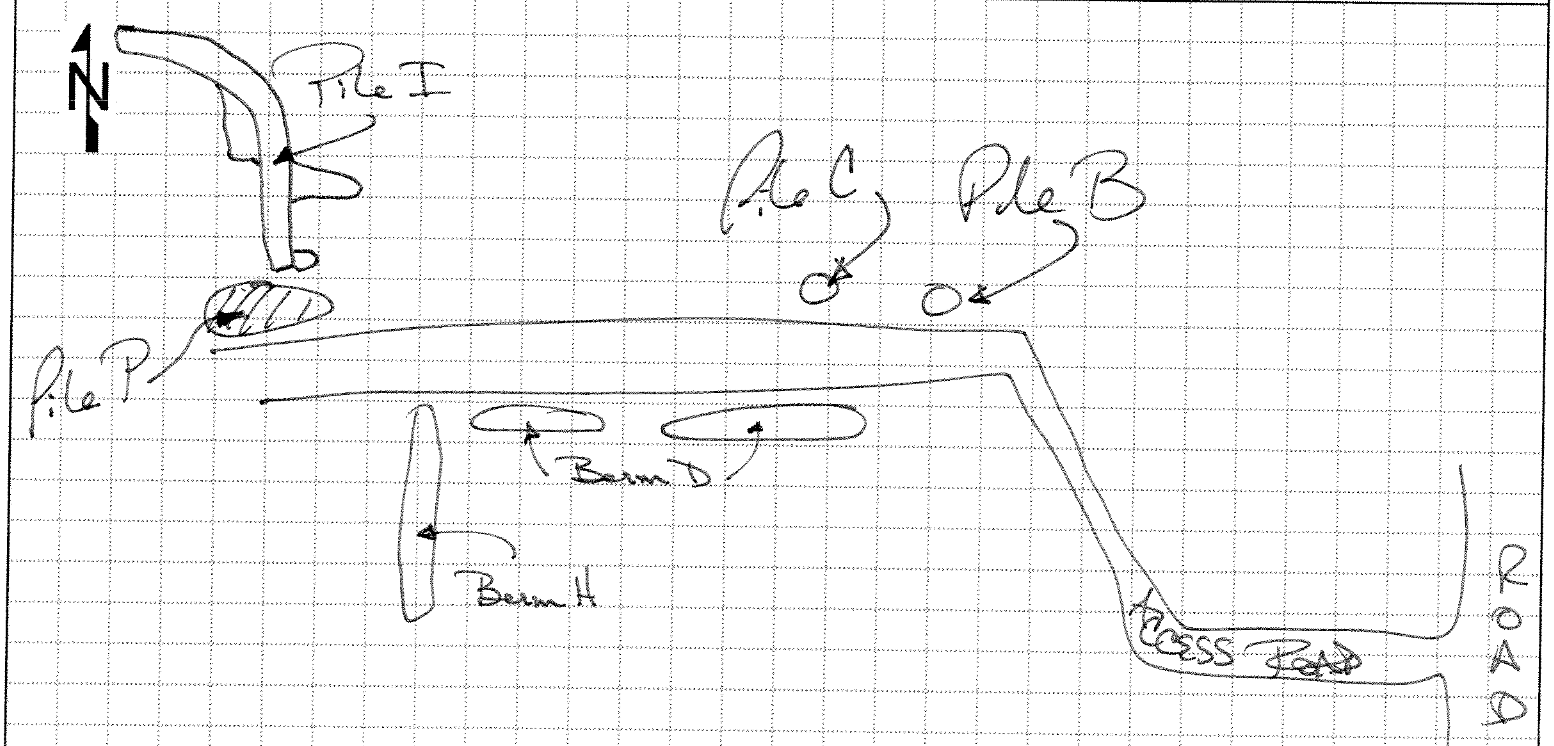
21. TOTAL CORE RECOVERY %: N/A

22. DISPOSITION OF BOREHOLE: DATE STARTED/INSTALLED: 11/17/05 DATE COMPLETED/ABANDONED: 11/17/05

BACKFILL TYPE: ☐ GROUT ☒ BENTONITE in hand auger holes ☐ TEMPORARY WELL POINT ☐ MONITORING WELL

LOCATION SKETCH/COMMENTS

SCALE: None



QC by Jed Thomas

PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: B. Williams 11/17/05

BOREHOLE NUMBER: CBP-045

HTRW DRILLING LOG (continued)

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-045 Pile P.

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: N/A

SHEET 2 OF 2

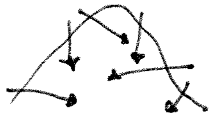
3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC - Jed Thomas

6. DIRECTION OF BOREHOLE: ☒ VERTICAL ☒ INCLINED 0-80% DEGREES

7. NOTES PID MAKE/MODEL: Perkins Elmer Photovac 2020 PID SERIAL#: ED KR 303

ELEVATION	DEPTH (0.1 Feet)	USCS	CLASSIFICATION OF MATERIALS	ANALYTICAL SAMPLE NUMBER	MONITORING (PPM)	REMARKS
	1	SC	2.5Y 3/3 dark olive brown clay and medium to course sand mixture; very fine to 2-3-ft size stone; moist	~~CBBW~~ CBPss-045-0115M-SD	0.0	- 2-3-ft pieces of Sandstone on & likely inside pile - angular probes collected; ie: 
	2		BW 11/17/05	BW 11/17/05	BW 11/17/05	
	3					
	4					
	5					BW 11/17/05
	6		BW 11/17/05			
	7					
	8					
	9					
	10					

QC by Jed Thomas

PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: B. Williams 11/17/05

BOREHOLE NUMBER: CBP-045

HTRW DRILLING LOG

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-046 Berm H

SHEET 1 OF 2

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: NA

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC-Bear Williams & Martha Clough

6. MAKE/MODEL OF DRILL: na

7. SIZES AND TYPES OF SAMPLING EQUIPMENT:
S.S. Soil Probe (1-in)
S.S. Bowl & Spoon
BW

8. BOREHOLE LOCATION: Central Burn Pits

9. SURFACE ELEVATION/DATUM: ~0-3ft (highest point)

10. DRILL DATE/TIME STARTED: 1245 COMPLETED: 1430

15. DEPTH GROUNDWATER ENCOUNTERED: N/A

16. DEPTH TO WATER/ELAPSED TIME AFTER BOREHOLE COMPLETION: NA

12. OVERBURDEN THICKNESS: N/A

13. DEPTH DRILLED INTO BEDROCK: N/A

17. OTHER WATER LEVEL MEASUREMENTS (INLCLUDE DATE/TIME): NA

14. TOTAL DEPTH OF BOREHOLE: 0-2 ft sample

18. GEOTECHNICAL SAMPLES: N/A UNDISTURBED: — DISTURBED: —

19. TOTAL NUMBER OF CORE BOXES: N/A

20. CHEMICAL SAMPLES: [✓ METALS] [✓ EXPL] TCLP OTHER: Cr+6

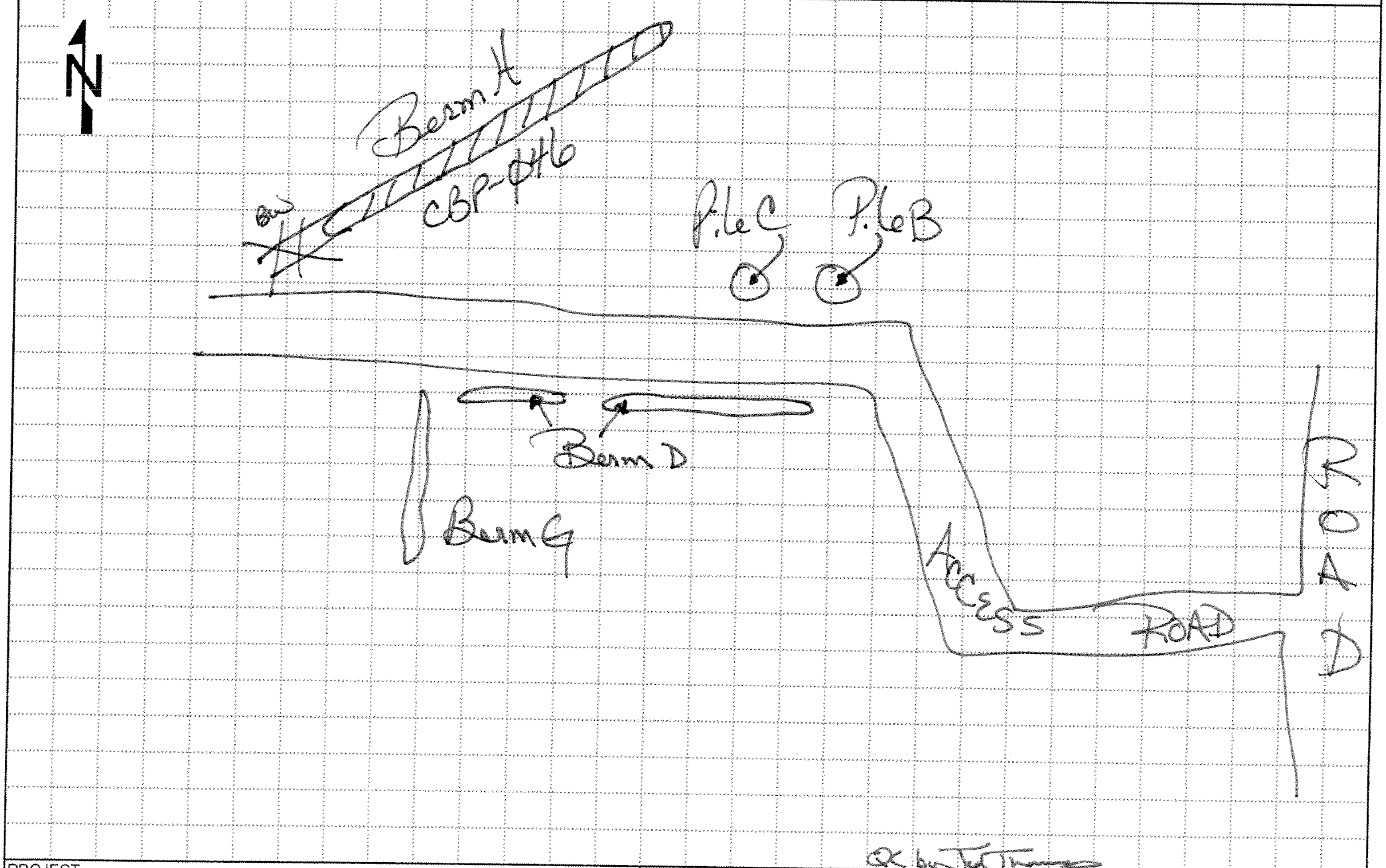
21. TOTAL CORE RECOVERY %: N/A

22. DISPOSITION OF BOREHOLE: DATE STARTED/INSTALLED: 11/17/05 DATE COMPLETED/ABANDONED: 11/17/05

BACKFILL TYPE: ~~☐ GROUT ☐ BENTONITE ☐ TEMPORARY WELL POINT ☐ MONITORING WELL~~ N/A

LOCATION SKETCH/COMMENTS

SCALE: None



PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

QC by Jed Thomas

INSPECTOR SIGNATURE/DATE: B. Williams 11/17/05

BOREHOLE NUMBER: CBP-046

HTRW DRILLING LOG (continued)

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-046 Berm H.

SHEET 2 OF 2

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: N/A

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC - Bean Williams & Martha Cough

6. DIRECTION OF BOREHOLE: ☒ VERTICAL ☒ INCLINED ~0-8% DEGREES

7. NOTES PID MAKE/MODEL: Perkins Elmer Photovac 2020 PID SERIAL#: ED KR 303

ELEVATION	DEPTH (0.1 Feet)	USCS	CLASSIFICATION OF MATERIALS	ANALYTICAL SAMPLE NUMBER	MONITORING (PPM)	REMARKS
	1 2 3	GC	2.5Y 3/2 very dark grayish brown; gravel-sand-clay mixture; well sorted (uniform size & shape) gravel throughout sandy clay. Gravel comprises ~ 80% of ~~pile~~ BW berm's composition. Some organic matter & roots in top ~~la~~ BW 1-in.	CBPss-046-0116M-SO BW	0.0 BW	Appears to be gravel with some sandy BW st clay - uniformity suggests anthropogenic source.
	4 5 6 7 8 9 10		BW 11/17/05			

QC by [illegible]

PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: B. Williams 11/17/05

BOREHOLE NUMBER: CBP-046

HTRW DRILLING LOG

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-047 Pile I

SHEET 1 OF 2

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: NA

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC - Beau Williams

6. MAKE/MODEL OF DRILL: *na*

7. SIZES AND TYPES OF SAMPLING EQUIPMENT: S.S. Soil Probe (1-in) S.S. Bowl & Spoon

8. BOREHOLE LOCATION: Central Burn Pits

9. SURFACE ELEVATION/DATUM: 0-8 ft at highest Point.

10. DRILL DATE/TIME STARTED: 0945 COMPLETED: 1045

12. OVERBURDEN THICKNESS: N/A

13. DEPTH DRILLED INTO BEDROCK: N/A

14. TOTAL DEPTH OF BOREHOLE: 0-4 ft

15. DEPTH GROUNDWATER ENCOUNTERED: N/A

16. DEPTH TO WATER/ELAPSED TIME AFTER BOREHOLE COMPLETION: *NA*

17. OTHER WATER LEVEL MEASUREMENTS (INLCLUDE DATE/TIME): NA

18. GEOTECHNICAL SAMPLES N/A UNDISTURBED: —— DISTURBED: ——

19. TOTAL NUMBER OF CORE BOXES: N/A

20. CHEMICAL SAMPLES [✓ METALS] [✓ EXPL] TCLP OTHER: Cr+6

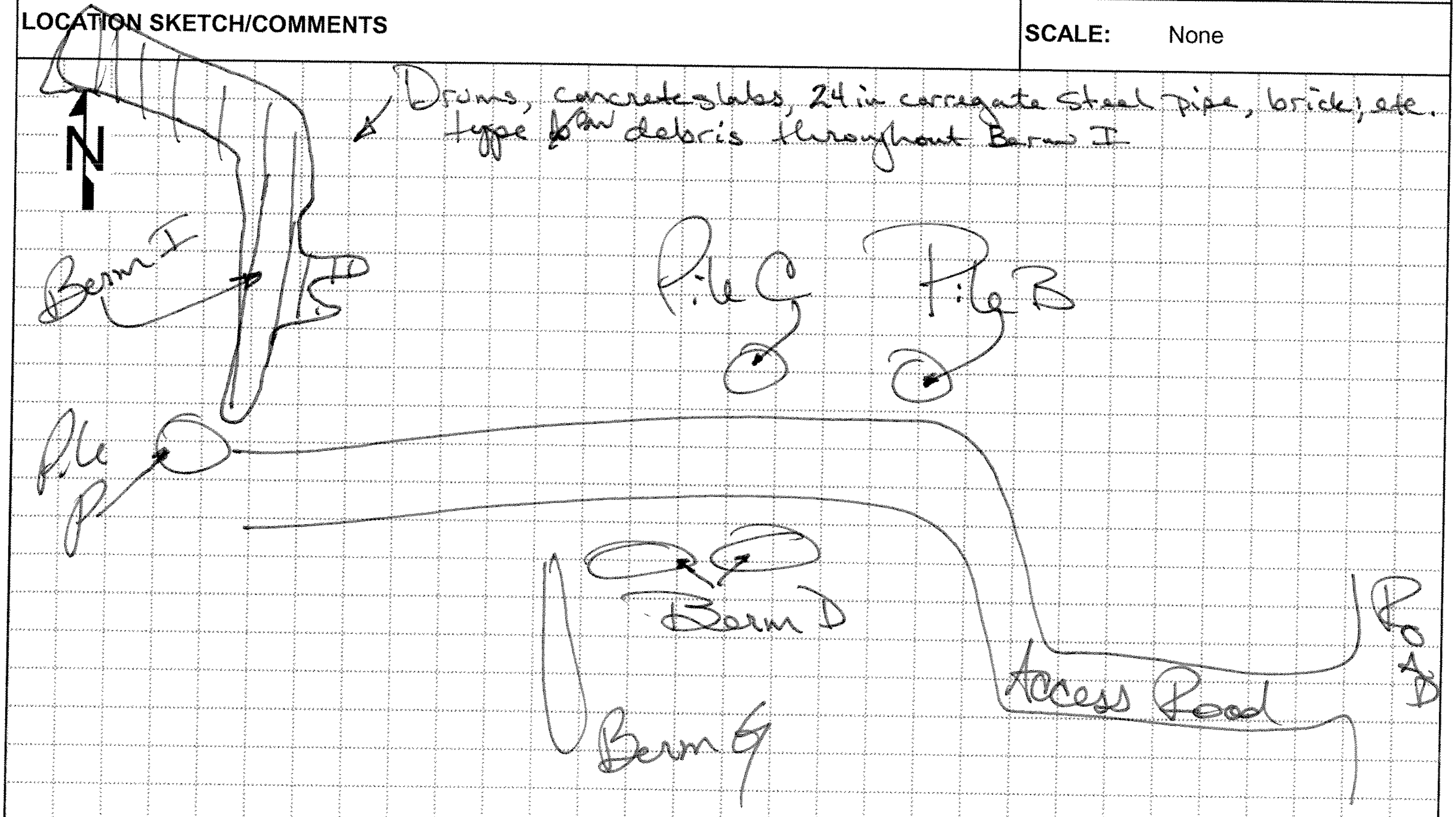
21. TOTAL CORE RECOVERY %: N/A

22. DISPOSITION OF BOREHOLE DATE STARTED/INSTALLED: 11/18/05 DATE COMPLETED/ABANDONED: 11/18/05

BACKFILL TYPE: ~~☐ GROUT ☐ BENTONITE ☐ TEMPORARY WELL POINT ☐ MONITORING WELL~~ N/A

LOCATION SKETCH/COMMENTS

SCALE: None



Drums, concrete slabs, 24 in corrugate steel pipe, brick, etc. type of debris throughout Berm I

PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

QC by Ted [illegible]

INSPECTOR SIGNATURE/DATE: B. Williams 11/18/05

BOREHOLE NUMBER: CBP-047

HTRW DRILLING LOG (continued)

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-047 Pile I

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: N/A

SHEET 2 OF 2

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC - Beav Williams

6. DIRECTION OF BOREHOLE: ☒ VERTICAL ☒ INCLINED 0-8 DEGREES

7. NOTES: PID MAKE/MODEL: Perkins Elmer Photovac 2020 PID SERIAL#: ED KR 303

ELEVATION	DEPTH (0.1 Feet)	USCS	CLASSIFICATION OF MATERIALS	ANALYTICAL SAMPLE NUMBER	MONITORING (PPM)	REMARKS
	1	CL	2.5Y 5/3 light olive brown lean clay with 15% medium sand; damp; top 1-inch generally was a silty organic layer (black); Pieces of brick in sample. BW	CBPss-047-0117M-SO	0.0	- Samples collected from inside of 2 corrugated pipes with soil in bottom. - no samples collected beneath concrete slabs.
	2					
	3		BW			
	4					
	5					
	6		BW 11/18/05			
	7					
	8					
	9					
	10					

QC by Jed Thomas

PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: B. Williams 11/18/05

BOREHOLE NUMBER: CBP-047

HTRW DRILLING LOG

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-048

Berm K

SHEET 1 OF 2

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: NA

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC - Beau Williams

6. MAKE/MODEL OF DRILL: *na*

7. SIZES AND TYPES OF SAMPLING EQUIPMENT:
S.S. Bowl & Spoon
S.S. Soil Probe (1 in)
BW

8. BOREHOLE LOCATION: Central Burn Pits

9. SURFACE ELEVATION/DATUM: ~ 0.3 ft (highest point)

10. DRILL DATE/TIME STARTED: 1530 COMPLETED: 1630

12. OVERBURDEN THICKNESS: N/A

13. DEPTH DRILLED INTO BEDROCK: N/A

14. TOTAL DEPTH OF BOREHOLE: 0-2 ft

15. DEPTH GROUNDWATER ENCOUNTERED: N/A

16. DEPTH TO WATER/ELAPSED TIME AFTER BOREHOLE COMPLETION: *NA*

17. OTHER WATER LEVEL MEASUREMENTS (INLCLUDE DATE/TIME): NA

18. GEOTECHNICAL SAMPLES: N/A UNDISTURBED: — DISTURBED: —

19. TOTAL NUMBER OF CORE BOXES: N/A

20. CHEMICAL SAMPLES: [✓ METALS] [✓ EXPL] TCLP OTHER: Cr+6

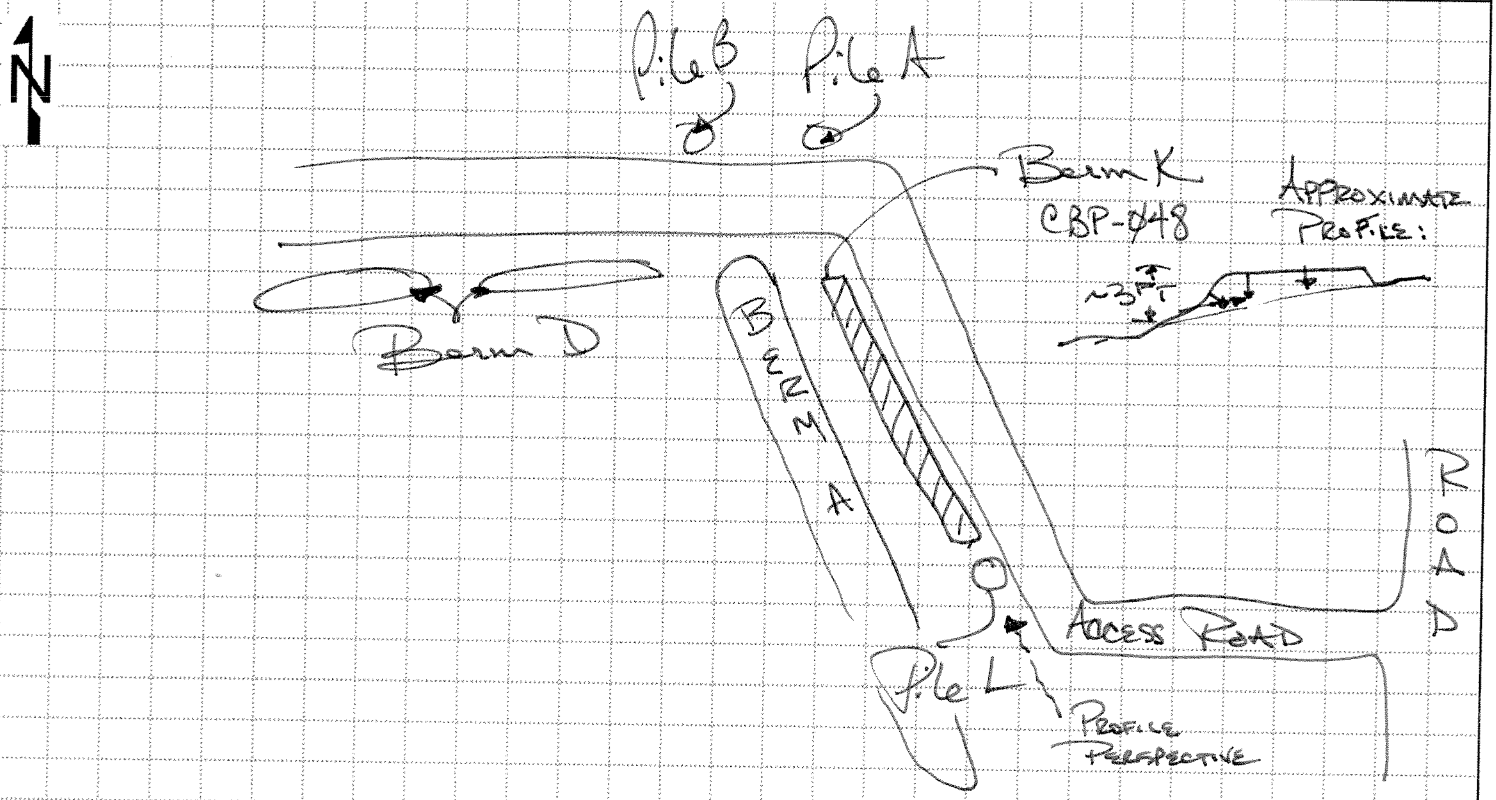
21. TOTAL CORE RECOVERY %: N/A

22. DISPOSITION OF BOREHOLE: DATE STARTED/INSTALLED: 11/17/05 DATE COMPLETED/ABANDONED: 11/17/05

BACKFILL TYPE: ~~☐ GROUT~~ ~~☐ BENTONITE~~ ~~☐ TEMPORARY WELL POINT~~ ~~☐ MONITORING WELL~~ BW

LOCATION SKETCH/COMMENTS

SCALE: None



QC by [illegible]

PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: B. Williams 11/17/05

BOREHOLE NUMBER: CBP-048

HTRW DRILLING LOG (continued)

DISTRICT
USACE - Louisville

BOREHOLE NUMBER
CBP-048
Berm K

1. COMPANY NAME
SAIC

2. DRILL SUBCONTRACTOR
N/A

SHEET 2 OF 2

3. PROJECT Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION RVAAP

5. NAME OF DRILLER SAIC - Beau Williams

6. DIRECTION OF BOREHOLE ☒ VERTICAL ☒ INCLINED ~0-70 BW DEGREES

7. NOTES PID MAKE/MODEL: Perkins Elmer Photovac 2020 PID SERIAL#: ED KR 303

ELEVATION	DEPTH (0.1 Feet)	USCS	CLASSIFICATION OF MATERIALS	ANALYTICAL SAMPLE NUMBER	MONITORING (PPM)	REMARKS
	1 2 3 4	SM & CL	2.5Y 3/3 dark olive brown SM sand-silt mixture; damp; roots; Sand is medium to ~~&~~ BW course; some CL lean clay with same color. 2.5Y 4/2 dark grayish brown with 2% mottling: 10YR 5/6 yellowish brown lean clay (CL) with 5% course sand. This clay was ~20-25% of composite sample.	CBP-048-0118M-SO	0.0	- Sand stone light gray to reddish sands pulled up in samples in layers, ~0.5-0.75 in thick. - Some sand is cut by probe but retained its cohesiveness & could not be crushed with finger pressure
	5					
	6					
	7					
	8					
	9					
	10					

BW 11/17/05

BW 11/17/05

QC by Jed Thomas

PROJECT
Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE
B. Williams 11/17/05

BOREHOLE NUMBER
CBP-048

HTRW DRILLING LOG

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-049

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: NA

Pile L

SHEET 1 OF 2

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC - Beau Williams

6. MAKE/MODEL OF DRILL: na

7. SIZES AND TYPES OF SAMPLING EQUIPMENT:
SS. Soil Probe
SS. Bowl & Spoon
BW

8. BOREHOLE LOCATION: Central Burn Pits

9. SURFACE ELEVATION/DATUM: ~ 0-5 ft (highest point)

10. DRILL DATE/TIME: STARTED: 0800 COMPLETED: 0845

15. DEPTH GROUNDWATER ENCOUNTERED: N/A

16. DEPTH TO WATER/ELAPSED TIME AFTER BOREHOLE COMPLETION: NA

12. OVERBURDEN THICKNESS: N/A

13. DEPTH DRILLED INTO BEDROCK: N/A

17. OTHER WATER LEVEL MEASUREMENTS (INLCLUDE DATE/TIME): NA

14. TOTAL DEPTH OF BOREHOLE: 0-3 ft

18. GEOTECHNICAL SAMPLES: N/A UNDISTURBED: — DISTURBED: —

19. TOTAL NUMBER OF CORE BOXES: N/A

20. CHEMICAL SAMPLES: [✓ METALS] [✓ EXPL] TCLP OTHER: Cr+6

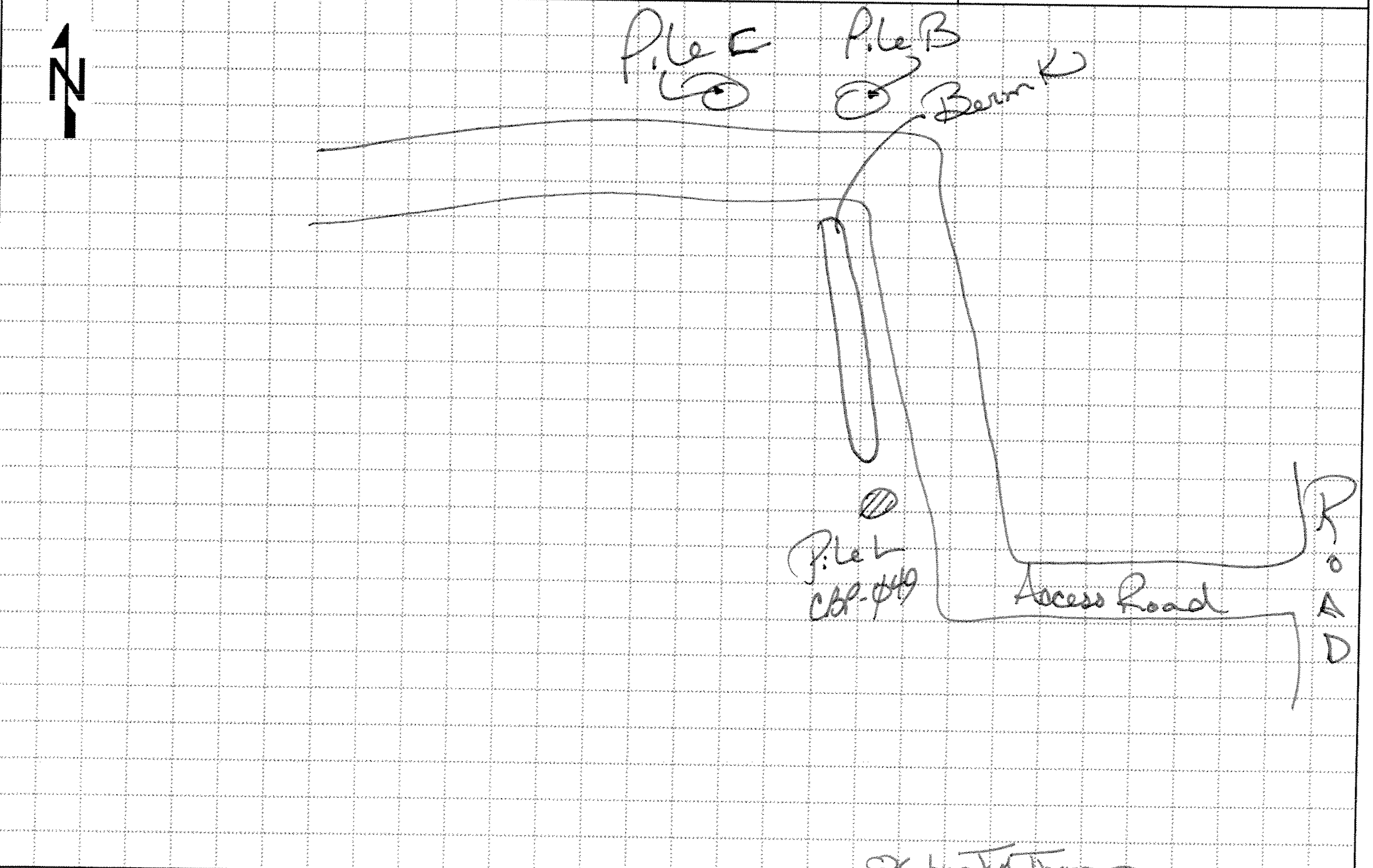
21. TOTAL CORE RECOVERY %: N/A

22. DISPOSITION OF BOREHOLE: DATE STARTED/INSTALLED: 11/18/05 DATE COMPLETED/ABANDONED: 11/18/05

BACKFILL TYPE: ~~☐ GROUT ☐ BENTONITE ☐ TEMPORARY WELL POINT ☐ MONITORING WELL~~ N/A

LOCATION SKETCH/COMMENTS

SCALE: None



QC by [illegible]

PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: B. Williams 11/18/05

BOREHOLE NUMBER: CBP-049

HTRW DRILLING LOG (continued)

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-049 Pile L

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: N/A

SHEET 2 OF 2

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC - Beau Williams

6. DIRECTION OF BOREHOLE: ☒ VERTICAL ☒ INCLINED ~0 - 80 DEGREES

7. NOTES: PID MAKE/MODEL: Perkins Elmer Photovac 2020 PID SERIAL#: ED KR 303

ELEVATION	DEPTH (0.1 Feet)	USCS	CLASSIFICATION OF MATERIALS	ANALYTICAL SAMPLE NUMBER	MONITORING (PPM)	REMARKS
		SM : CL	2.5Y 3/3 dark olive brown Sand-silt mixture; medium to course sand; slag in pile; angular to subangular stones; damp. BW Occasional clay zone - CL lean clay; same color as above with 5% 10YR 5/6 yellowish brown mottling.	CBPss-049-0119M-SO	0.0 BW 11/18/05	~5-6 inch stones through pile; ~3 ft stones on outside of pile. - Slag in pile
	1					
	2					
	3					
	4					
	5					
	6		BW 11/18/05			
	7					
	8					
	9					
	10					

QC by Jed Th

PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: B. Williams 11/18/05

BOREHOLE NUMBER: CBP-049

HTRW DRILLING LOG

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-050 Pile M

SHEET 1 OF 2

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: NA

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC · Martha Clough

6. MAKE/MODEL OF DRILL: na

7. SIZES AND TYPES OF SAMPLING EQUIPMENT:
S.S. Soil Probe
S.S. Bowl & Spoon
BW

8. BOREHOLE LOCATION: Central Burn Pits

9. SURFACE ELEVATION/DATUM: 0-6 ft

10. DRILL DATE/TIME STARTED: 0810 COMPLETED: 0950

15. DEPTH GROUNDWATER ENCOUNTERED: N/A

16. DEPTH TO WATER/ELAPSED TIME AFTER BOREHOLE COMPLETION: NA

17. OTHER WATER LEVEL MEASUREMENTS (INLCLUDE DATE/TIME): NA

12. OVERBURDEN THICKNESS: N/A

13. DEPTH DRILLED INTO BEDROCK: N/A

14. TOTAL DEPTH OF BOREHOLE: bowl ~~0-2.5 ft~~ 0-3 ft

18. GEOTECHNICAL SAMPLES: N/A UNDISTURBED: N/A DISTURBED: N/A

19. TOTAL NUMBER OF CORE BOXES: N/A

20. CHEMICAL SAMPLES: [✓ METALS] [✓ EXPL] TCLP OTHER: Cr+6

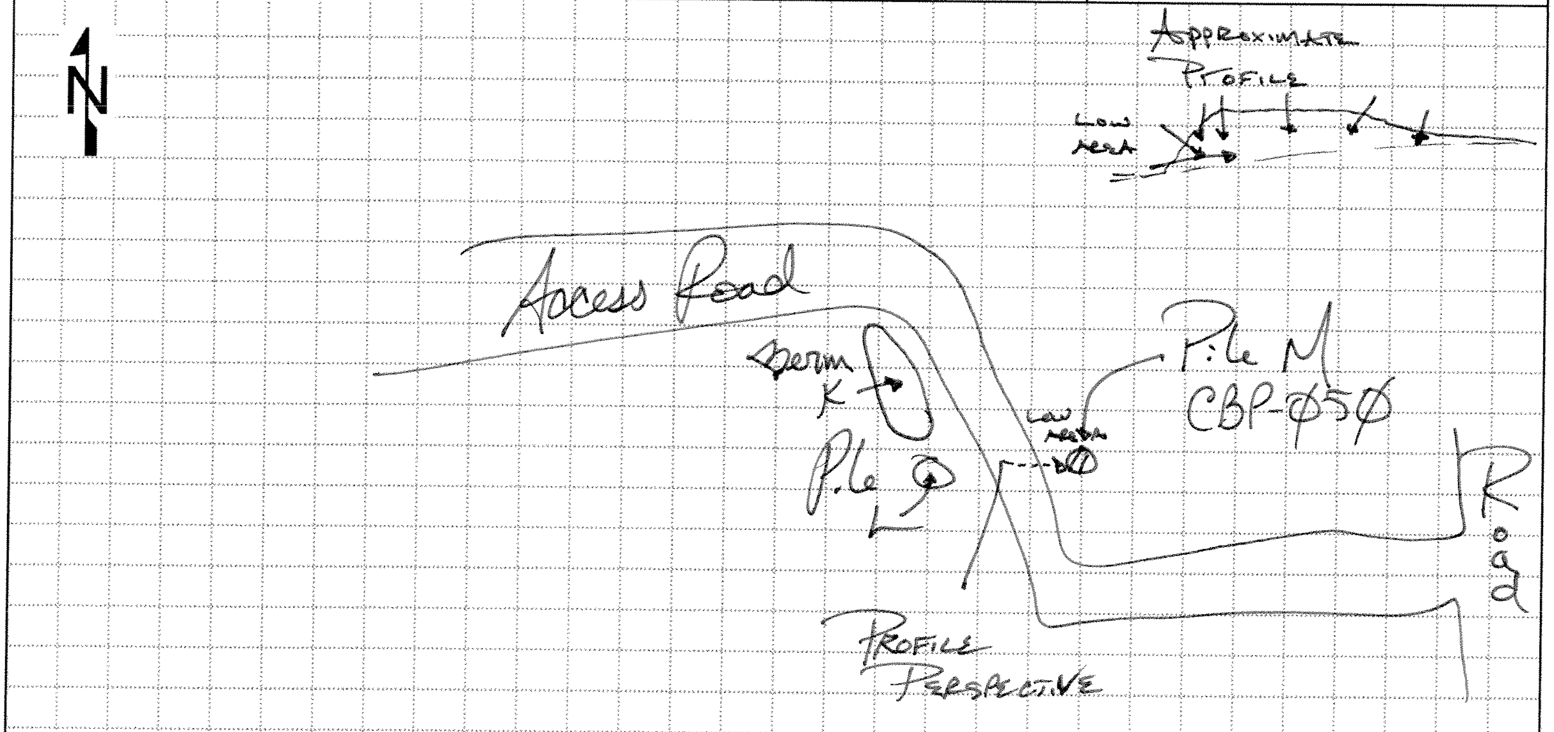
21. TOTAL CORE RECOVERY %: N/A

22. DISPOSITION OF BOREHOLE DATE STARTED/INSTALLED: 11/18/05 DATE COMPLETED/ABANDONED: 11/18/05

BACKFILL TYPE: ~~☐ GROUT ☐ BENTONITE ☐ TEMPORARY WELL POINT ☐ MONITORING WELL~~ N/A

LOCATION SKETCH/COMMENTS

SCALE: None



QC by Ted Thomas

PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: B. Williams 11/8/05

BOREHOLE NUMBER: CBP-050

HTRW DRILLING LOG (continued)

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-050

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: N/A

SHEET 2 OF 2

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC - Martha Clough

6. DIRECTION OF BOREHOLE: ☒ VERTICAL ☒ INCLINED 0-~~90~~ BW DEGREES

7. NOTES: PID MAKE/MODEL: Perkins Elmer · Photovac 2020 PID SERIAL#: ED KR 303

ELEVATION	DEPTH (0.1 Feet)	USCS	CLASSIFICATION OF MATERIALS	ANALYTICAL SAMPLE NUMBER	MONITORING (PPM)	REMARKS
			2.5Y 3/1 very dark gray sand-silt mixture; medium to course sands; very fine to course angular to subangular stones throughout the pile; damp.	CBPss-050-0120M-SO	0.0	BW
	1.0	SM				
	2.0					
BW	~~2.5~~					
	3		3.0 ft sample depths			
	4					
	5					
	6					
	7		BW 11/18/05			
	8					
	9					
	10					

QC by Jed Thomas

PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: B. Williams 11/18/05

BOREHOLE NUMBER: CBP-050

HTRW DRILLING LOG

DISTRICT: USACE - Louisville

BOREHOLE NUMBER: CBP-051

Pile N

SHEET 1 OF 2

1. COMPANY NAME: SAIC

2. DRILL SUBCONTRACTOR: NA

3. PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION: RVAAP

5. NAME OF DRILLER: SAIC - Jed Thomas

6. MAKE/MODEL OF DRILL: *na*

7. SIZES AND TYPES OF SAMPLING EQUIPMENT:
~~S.S. Hand Auger~~ BW
S.S. Soil Probe
S.S. Bowl & Spoon

8. BOREHOLE LOCATION: Central Burn Pits

9. SURFACE ELEVATION/DATUM: ~0-6 ft (highest point)

10. DRILL DATE/TIME STARTED: 0805 COMPLETED: ~~0805~~ BW 0905

15. DEPTH GROUNDWATER ENCOUNTERED: N/A

16. DEPTH TO WATER/ELAPSED TIME AFTER BOREHOLE COMPLETION: *NA*

12. OVERBURDEN THICKNESS: N/A

13. DEPTH DRILLED INTO BEDROCK: N/A

14. TOTAL DEPTH OF BOREHOLE: 0-4 ft.

17. OTHER WATER LEVEL MEASUREMENTS (INLCLUDE DATE/TIME): NA

18. GEOTECHNICAL SAMPLES: BW N/A UNDISTURBED: — DISTURBED: —

19. TOTAL NUMBER OF CORE BOXES: N/A

20. CHEMICAL SAMPLES: [✓ METALS] [✓ EXPL] TCLP OTHER: Cr +6

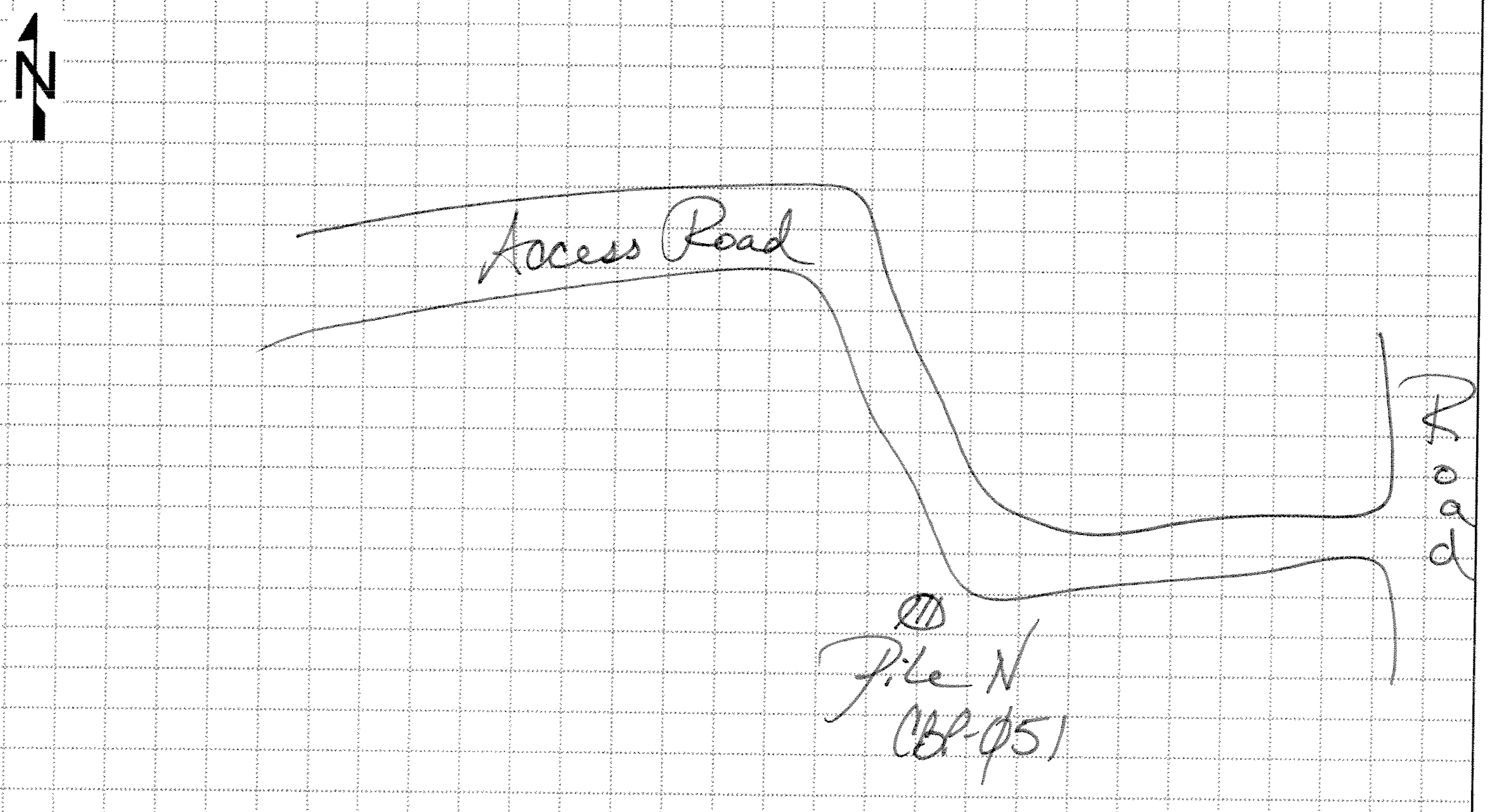
21. TOTAL CORE RECOVERY %: N/A

22. DISPOSITION OF BOREHOLE DATE STARTED/INSTALLED: 11/18/05 DATE COMPLETED/ABANDONED: 11/18/05

BACKFILL TYPE: ~~☐ GROUT~~ ☒ ~~BENTONITE~~ IN HAND AUGER HOLES BW ~~☐ TEMPORARY WELL POINT~~ ~~☐ MONITORING WELL~~ N/A

LOCATION SKETCH/COMMENTS

SCALE: None



QC by Jed Thomas

PROJECT: Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE: B. Williams 11/18/05

BOREHOLE NUMBER: CBP-051

HTRW DRILLING LOG (continued)

DISTRICT
USACE - Louisville

BOREHOLE NUMBER
CBP-051
Pile N

SHEET 2 OF 2

1. COMPANY NAME
SAIC

2. DRILL SUBCONTRACTOR
N/A

3. PROJECT Supplemental Phase II at CBP, FBQ, and ODA2

4. LOCATION RVAAP

5. NAME OF DRILLER SAIC - Jed Thomas

6. DIRECTION OF BOREHOLE ☒ VERTICAL ☒ INCLINED 0-80 DEGREES

7. NOTES PID MAKE/MODEL: Perkins Elmer PhotoVac 2020 PID SERIAL#: ED KR 303

ELEVATION	DEPTH (0.1 Feet)	USCS	CLASSIFICATION OF MATERIALS	ANALYTICAL SAMPLE NUMBER	MONITORING (PPM)	REMARKS
	1	OL→ PT	10YR 4/3 Brown silt-with organics; soft & very loose; fine texture; 10% medium sand; dry	CBPss-051-0121M-SO	0.0	Soil probe was easily pressed into pile, material is soft & loose - has a burnt (slight) odor
	2			BW 11/18/05		
	3					
	4					
	5					
	6					
	7		BW 11/18/05			
	8					
	9					
	10					

QC by Jed Thomas

PROJECT
Supplemental Phase II at CBP, FBQ, and ODA2

INSPECTOR SIGNATURE/DATE
B. Williams 11/18/05

BOREHOLE NUMBER
CBP-051

ATTACHMENT B

IDW LETTER REPORT

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An Employee-Owned Company
Science Applications International Corporation

December 21, 2005

Mr. Paul Zorko
U.S. Army Corps of Engineers, Louisville District
ATTN: CELRL-ED-E
600 Martin Luther King, Jr. Place
P.O. Box 59
Louisville, KY 40202-0059

SUBJECT: **Contract No. GS-10F-0076J Delivery Order W912QR-05-F-0033, Performance-Based Contract for Six Environmental Areas of Concern at Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio**

RE: **DRAFT Investigation Derived Waste (IDW) Characterization and Disposal Report for Soil Cuttings and Decontamination Fluids**

Dear Mr. Zorko:

Investigation activities conducted during November 2005 for the Supplemental Phase II Remedial Investigation (RI) at RVAAP-04 Open Demolition Area #2 (ODA2); RVAAP-16 Fuze and Booster Quarry Landfill/Ponds (FBQ); and RVAAP-49 Central Burn Pits (CBP) at RVAAP resulted in the generation of IDW consisting of soil and decontamination fluids. The purpose of this letter report is to summarize characterization and classification information to assist in determining the proper disposition of IDW consisting of soil cuttings (contained in 2 open-topped 55 gallon drums) and decon fluids from small tool decontamination (contained in 1 close-topped 55 gallon drum).

This letter report includes a summary of IDW generated, its origin (Table 1), as well as classification and recommendations for disposal of the IDW (Table 2). This letter report follows guidance established by the Facility-Wide Sampling and Analysis Plan (SAP) (USACE 2001), the SAP Addendum No. 1 for the Supplemental Phase II RI of ODA2, FBQ, and CBP (November 2005), and Ohio EPA (November 1997) regarding IDW disposition at RVAAP.

Table 1. Summary of Supplemental Phase II RI IDW

CONTAINER NUMBER	CONTAINER TYPE AND SIZE	CONTENTS	GENERATION DATES	SAMPLE ID
DECON-01	55- Gallon Closed Top Drum	Deon Fluids From Small Tool Decon	11/15/2005-11/21/2005	CBP0133
SOIL-01	55-Gallon Open Top Drum	Soil Cuttings	11/15/2005-11/18/2005	CBP0134
SOIL-02	55-Gallon Open Top Drum	Soil Cuttings	11/21/2005	

IDW – WATER:

Per Section 7 of the Facility-Wide SAP, non-indigenous IDW is characterized for disposal on the basis of composite samples collected from waste stream storage containers. A composite waste sample was collected and submitted for laboratory analysis to characterize the waste stream for disposal. One liquid composite sample was collected, CBP0133 (composite of decontamination fluids). Upon receipt of analytical results from the laboratory, the analytical results were reviewed to determine if the waste is potentially hazardous. This review consisted of a comparison of the analytical results against toxicity characteristic leaching procedure (TCLP) criteria presented in Table 7-1, Maximum Concentration of Contaminants for the Toxicity Characteristic (40 CFR 261.24) presented in the Facility-Wide SAP (USACE 2001).

Attachment 1 presents the analytical laboratory data for TCLP analysis for IDW water (CBP0133) generated during the November 2005 sampling event. All analytical results were below quantitation limits (BQL). The waste is considered non-hazardous, contaminated wastewater.

IDW – SOILS:

Per Section 7 of the Facility-Wide SAP, indigenous IDW contained in 55-gallon open-topped drums are characterized for disposal on the basis of composite samples collected and submitted for laboratory analysis of full TCLP. One composite sample was collected from the two 55-gallon drums of soil cuttings generated during this reporting period. Upon receipt of analytical results from the laboratory, the analytical results were reviewed to determine if any potentially hazardous waste exist. This review consisted of a comparison of the analytical results against the TCLP criteria presented in Table 7-1, Maximum Concentration of Contaminants for the Toxicity Characteristic (40 CFR 261.24) presented in the Facility-Wide SAP (USACE 2001).

Attachment 1 presents the analytical laboratory data for TCLP analysis for IDW soil cuttings (CBP0134) generated during the November 2005 sampling event. All analytical results were below quantitation limits (BQL). The waste is considered non-hazardous, contaminated solid waste.

Table 2 presents the disposal option identified as a result of these data. Disposal at a permitted solid waste or water treatment facility is recommended for all IDW wastes generated during the November 2005 sampling activities.

Table 2. Summary of Final Waste Classification and Recommended Disposal Options

NON-HAZARDOUS, CONTAMINATED WASTE			
Container Number	**Medium**	**Waste Criterion**	**Disposal Recommendation**
DECON-01	Water	Inorganics, organics	Permitted Wastewater Treatment Facility or Permitted Solid Waste Facility
SOIL-01	Soils	Inorganics, organics	Permitted Wastewater Treatment Facility or Permitted Solid Waste Facility
SOIL-02	Soils	Inorganics, organics	Permitted Wastewater Treatment Facility or Permitted Solid Waste Facility

Please note the IDW addressed in this letter report has been characterized under provisions of the Facility-Wide SAP and SAP Addendum No. 1 using TCLP analyses and process knowledge. Unless RVAAP has additional information that would result in the IDW meeting, or containing materials that meet, the definition of a listed hazardous waste as defined in 40 CFR Part 261 Subpart D, it is recommended that the IDW, as presently characterized, be disposed as summarized in Table 2.

Since RVAAP, under RCRA, is the generator of this material, SAIC requests concurrence or direction on the waste classification prior to disposal to ensure materials are properly disposed. Following your direction and immediate approval, we will proceed with appropriate waste disposal.

If you have any questions, or require additional information, please do not hesitate to contact me at (330) 405-5804.

Sincerely,

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

Martha Clough
Project IDW Coordinator

cc: Glen Beckham, USACE
Todd Fisher, Ohio EPA DERR
JoAnn Watson, USAEC
Irv Venger, RVAAP
Kevin Jago, SAIC
SAIC Project Files
SAIC CRF

Attachment 1
Analytical IDW Data

Analysis Type	Chemical	Units	Reporting Limit (mg/L)	TCLP Criteria (mg/L)	Results	
					CBP0134 (Soils)	CBP0133 (Water)
Semi-Volatile Organics	1,4-Dichlorobenzene	µg/L	0.05	7.50	BQL	BQL
Semi-Volatile Organics	2,4,5-Trichlorophenol	µg/L	0.05	400.00	BQL	BQL
Semi-Volatile Organics	2,4,6-Trichlorophenol	µg/L	0.05	2.00	BQL	BQL
Semi-Volatile Organics	2,4-Dinitrotoluene	µg/L	0.05	0.13	BQL	BQL
Semi-Volatile Organics	2-methylphenol	µg/L	0.05		BQL	BQL
Semi-Volatile Organics	3 & 4-Methylphenol	µg/L	0.05		BQL	BQL
Semi-Volatile Organics	Hexachlorobenzene	µg/L	0.05	0.13	BQL	BQL
Semi-Volatile Organics	Hexachlorobutadiene	µg/L	0.05	0.50	BQL	BQL
Semi-Volatile Organics	Hexachloroethane	µg/L	0.05	3.00	BQL	BQL
Semi-Volatile Organics	Nitrobenzene	µg/L	0.05	2.00	BQL	BQL
Semi-Volatile Organics	Pentachlorophenol	µg/L	0.1	100.00	BQL	BQL
Semi-Volatile Organics	Pyidine	µg/L	0.05	5.00	BQL	BQL
TCLP Metals	Arsenic	µg/L	0.2	5.00	BQL	BQL
TCLP Metals	Barium	µg/L	1	100.00	BQL	BQL
TCLP Metals	Cadmium	µg/L	0.06	1.00	BQL	BQL
TCLP Metals	Chromium	µg/L	0.05	5.00	BQL	BQL
TCLP Metals	Lead	µg/L	0.1	5.00	BQL	BQL
TCLP Metals	Mercury	µg/L	0.002	0.20	BQL	BQL
TCLP Metals	Selenium	µg/L	0.2	1.00	BQL	BQL
TCLP Metals	Silver	µg/L	0.05	5.00	BQL	BQL
TCLP Herbicides	2,4,5-TP (Silvex)	µg/L	0.005	1.00	BQL	BQL
TCLP Herbicides	2,4-D	µg/L	0.005	10.00	BQL	BQL
TCLP Pesticides and/or PCBs	Chlordane	µg/L	0.005	0.03	BQL	BQL
TCLP Pesticides and/or PCBs	Endrin	µg/L	0.00025	0.02	BQL	BQL
TCLP Pesticides and/or PCBs	Gamma-BHC (Lindane)	µg/L	0.00025	0.40	BQL	BQL
TCLP Pesticides and/or PCBs	Heptachlor	µg/L	0.00025	0.01	BQL	BQL
TCLP Pesticides and/or PCBs	Heptachlor Epoxide	µg/L	0.00025	0.01	BQL	BQL
TCLP Pesticides and/or PCBs	Methoxychlor	µg/L	0.00025	10.00	BQL	BQL
TCLP Pesticides and/or PCBs	Toxaphene	µg/L	0.005	0.50	BQL	BQL
Semi-Volatile Organics	1,1-Dichloroethene	µg/L	0.1		BQL	BQL
Semi-Volatile Organics	1,2-Dichloroethane	µg/L	0.1	0.50	BQL	BQL
Semi-Volatile Organics	1,4-Dichlorobenzene	µg/L	0.1	7.50	BQL	BQL
Semi-Volatile Organics	2-Butanone	µg/L	0.1		BQL	BQL
Semi-Volatile Organics	Benzene	µg/L	0.1	0.50	BQL	BQL
Semi-Volatile Organics	Carbon Tetrachloride	µg/L	0.1	0.50	BQL	BQL
Semi-Volatile Organics	Chlorobenzene	µg/L	0.1	100.00	BQL	BQL
Semi-Volatile Organics	Chloroform	µg/L	0.1	6.00	BQL	BQL
Semi-Volatile Organics	Tetrachloroethylene	µg/L	0.1	0.70	BQL	BQL
Semi-Volatile Organics	Trichloroethene	µg/L	0.1	0.50	BQL	BQL
Semi-Volatile Organics	Vinyl Chloride	µg/L	0.1	0.20	BQL	BQL

BQL - below quantitation limits

TCLP - toxicity characteristic leaching procedure

ONYX

ENVIRONMENTAL SERVICES

Please type or print in block letters. (Form designed for use on elite (12-pitch) typewriter.)

NH040

NON-HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No. OH5210020736 Manifest Document No. 06001

2. Page 1 of 1

A. Non-hazardous Manifest Document Number Z 178520

3. Generator's Name and Mailing Address
RAVENNA ARMY AMMO PLANT
8451 SATE RT 5
RAVENNA, OH 44266

4. Generator's Phone (330) 405-5804

B. State Generator's ID SAME

5. Transporter 1 Company Name HAZMAT ENVIRONMENTAL GROUP INC

6. US EPA ID Number NYD980769947

C. State Trans. ID 1241B7NY

D. Transporter's Phone (716) 827-7200

7. Transporter 2 Company Name

8. US EPA ID Number

E. State Trans. ID

F. Transporter's Phone ( )

9. Designated Facility Name and Site Address
ONYX ENVIRONMENTAL SVCS,L.L.C.
4301 INFIRMARY ROAD
WEST CARROLLTON, OH 45449

10. US EPA ID Number OHD093945293

G. State Facility's ID

H. Facility's Phone (937) 859-6101

	11. US DOT Description (Including Proper Shipping Name, Hazard Class, and ID Number) HM		12. Containers No.	Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste No.
a.		NON RCRA AND DOT NON REGULATED LIQUID, NONE, NONE	004	DM	01600	P	NONE
b.		NON RCRA AND DOT NON REGULATED SOLID, NONE, NONE	002	DM	00800	P	NONE
c.							
d.							

J. Additional Descriptions for Materials Listed Above
a. L/- 236022//NON HAZ WATER
b. S/- 236023//NON HAZ SOIL
c.
d.

K. Handling Codes for Wastes Listed Above
a.
b.
c.
d.

15. Special Handling Instructions and Additional Information
PACKING SLIPS ATTACHED FOR CLARIFICATION - EMERGENCY NUMBER-INFOTRAC: 1-800-535-5053

16. **GENERATOR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.

I hereby certify that the above-named material is not hazardous waste as defined by 40 CFR Part 261 or any applicable state law.

Printed/Typed Name Irv Venger
Signature Irv B Venger
Month Day Year 02 23 06

17. Transporter 1 Acknowledgement of Receipt of Materials
Printed/Typed Name Darrell Ferguson
Signature Darrell Ferguson
Month Day Year 02 23 06

18. Transporter 2 Acknowledgement of Receipt of Materials
Printed/Typed Name
Signature
Month Day Year

19. Discrepancy Indication Space

20. Facility Owner or Operator: Certification of receipt of non-hazardous materials covered by this manifest except as noted in Item 19.
Printed/Typed Name
Signature
Month Day Year

GENERATOR

TRANSPORTER

FACILITY

1-GENERATOR COPY

SIGNATURE AND INFORMATION *MUST* BE LEGIBLE ON ALL COPIES

ATTACHMENT C

PROJECT QUALITY ASSURANCE SUMMARY

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CONTENTS

ACRONYMS

CQC	contractor quality control
EPA	U. S. Environmental Protection Agency
FCO	field change order
GPL	GPL Laboratories, Inc.
M&TE	materials and testing equipment
NCR	Nonconformance Report
QA	quality assurance
QC	quality control
RI	remedial investigation
RVAAP	Ravenna Army Ammunition Plant
SAIC	Science Applications International Corporation
SAP	sampling and analysis plan
SOW	Statement of Work
USACE	U. S. Army Corps of Engineers

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C. PROJECT QUALITY CONTROL SUMMARY REPORT

This attachment presents the actions and methodologies undertaken to meet the quality assurance/quality control (QA/QC) goals for the Supplemental Phase II remedial investigation (RI) at Central Burn Pits (CBP) at the Ravenna Army Ammunition Plant (RVAAP). These goals were established in the *Facility-wide Sampling and Analysis Plan (SAP) for the Ravenna Army Ammunition Plant* (USACE 2001a) and the *Sampling and Analysis Plan Addendum No. 1 for the Supplemental Phase II Remedial Investigation* (USACE 2005). The field investigation was conducted under one mobilization; this attachment addresses QA/QC goals for the entire project. These goals were implemented through project-specific procedures and requirements, the Science Applications International Corporation (SAIC) QA Program, and the U. S. Army Corps of Engineers (USACE), Louisville District QA requirements. A large portion of project QA was focused on field and analytical laboratory activities and project administration.

C.1 FIELD QUALITY ASSURANCE

C.1.1 Readiness Review

Field QA was initiated for the Supplemental Phase II RI in the readiness review held at the SAIC Twinsburg, OH office on November 10, 2005. The purpose of the readiness review was to ensure that

- project documents and procedures were approved, controlled, and properly distributed;
- assigned personnel were trained or a schedule was established to conduct training;
- mobilization and site logistics were established;
- laboratories were ready to accept samples;
- subcontractors were ready to begin work; and
- QA systems were implemented.

All elements of the readiness review were completed prior to initiating field activities and were approved by the SAIC QA/QC Officer. Readiness review and project kickoff checklists provide documentation of this QA element and are maintained in the project file.

C.1.2 Procedures

Standard operating methods for field activities performed during the Supplemental Phase II RI are incorporated into the governing documents for the project. The facility-wide sampling and analysis plan (SAP) (USACE 2001a) describes the overall approach and methodologies to be used for projects at RVAAP, and the *Supplemental Phase II RI SAP Addendum* (USACE 2005) details project-specific requirements for field implementation. These documents were reviewed by USACE, Louisville District and by the Ohio Environmental Protection Agency prior to implementation. Clarifications and/or planned deviations from these methods were documented as field change orders (FCOs), and variances were documented as Nonconformance Reports (NCRs). Copies of the FCOs issued during the Phase I RI are attached to this attachment.

C.1.3 Training

Field team personnel were trained in all procedures applicable to their assigned tasks. Training was accomplished through a combination of classroom lectures, reading assignments, and on-the-job training. Surveillance performed by the project SAIC contractor quality control (CQC) representative provided assessments of worker proficiency and training effectiveness.

Copies of training records and surveillance reports were maintained in the project file. Copies of training records required for Occupational Safety and Health Administration and U. S. Department of Transportation compliance also were maintained in the field.

C.1.4 Equipment Calibration

Various types of measuring and testing equipment (M&TE) were used during the field investigation. All M&TE was categorized, assigned unique identifiers, and listed in an inventory in the M&TE logbook. Last and next calibration recall dates were also recorded. As appropriate, instruments were calibrated daily according to the manufacturer's instructions. Only equipment and standards having verifiable traceability to nationally recognized standards were used for calibration. Daily calibration activities and results were recorded in the M&TE logbook, as well as source information for all calibration standards and reagents.

C.1.5 Quality Control Samples

Field QC samples collected included equipment rinsate blanks, source water, and field duplicates. Field QA splits were collected as specified in the *Supplemental Phase II RI SAP Addendum* (USACE 2005) pertaining to CQC. Implementation of the CQC program in the field was done by the SAIC CQC representative. Attachment D presents an evaluation of data quality and analytical performance with respect to field QC results. Field QC data and analyses of QC samples are presented in Attachment E.

C.1.6 Field Records

Field data, observations, activities, and information were recorded on standardized field sheets and in bound field logbooks. The use of standardized field sheets ensured that all necessary data were entered consistently. Logbook entries were checked for accuracy and completeness by independent reviewers. Other field records, which were collected and likewise maintained, included equipment/material certifications, boring logs, and air-bill forms.

C.2 ANALYTICAL LABORATORY QUALITY ASSURANCE

SAIC subcontracted GPL Laboratories, Inc. (GPL) to perform chemical analysis of samples collected during the Supplemental Phase II RI. The selected laboratory is certified by the USACE, Missouri River Division, Mandatory Center of Expertise in Omaha, Nebraska. In addition, this laboratory was technically audited by SAIC prior to contract award. QA split samples were collected and submitted to an independent USACE QA laboratory, Severn Trent Laboratories, Inc., located in North Canton, Ohio.

C.2.1 Readiness Review

Laboratory QA/QC activities were initiated during the readiness review. The readiness review ensured that (1) governing documents and approved analytical methods were controlled and properly distributed, (2) the laboratory was scheduled and ready to conduct the analysis, (3) logistical coordination was established between the laboratory and the field team, and (4) laboratory QA programs were consistent and compatible with the project requirements.

C.2.2 Procedures

Prior to initiation of analytical support for the Supplemental Phase II RI, GPL and SAIC reviewed and negotiated a contract based on a comprehensive laboratory Statement of Work (SOW). The laboratory

SOW detailed project-specific requirements, including the parameters to be measured, analytical methods, adherence to U. S. Environmental Protection Agency (EPA) SW-846 protocols, project quantitation goals (sensitivity), and data deliverables requirements. All laboratory comments and questions were resolved before analytical work proceeded.

C.2.3 Laboratory Quality Control

To document laboratory data quality and to measure the quality of the analytical process, laboratory QC samples and data verification/validation were employed. The results of laboratory QC are discussed in the project QC Summary Report (Attachment D). Analytical results of laboratory QC samples are included in the project file and form the basis of the data verification and evaluation process (Section C.2.5).

C.2.4 Laboratory Documentation

GPL maintains comprehensive information regarding the entire analytical process. The laboratory delivered summary data packages and electronic deliverables consistent with those identified in the EPA SW-846 protocol to SAIC for validation and verification. Laboratory QC sample analyses were cross-referenced to the appropriate environmental field sample analyses in the laboratory deliverables.

C.2.5 Data Verification/Validation

Analytical data generated during this project were subjected to a rigorous process of data verification by SAIC. For verification of data, criteria were established against which the analytical results were compared and from which a judgment was rendered regarding the acceptability and qualification of the data (Attachment D). Upon receipt of data packages from each laboratory, the information was subjected to a systematic examination following standardized checklists and procedures to ensure content, presentation, administrative validity, and technical validity. Routine data changes were documented through data change forms. Data deficiencies or formal laboratory-related nonconformances were documented through an NCR process, as required.

C.3 QUALITY ASSURANCE DOCUMENTATION

Primary methods for documenting QA during the Supplemental Phase II RI include the completion of FCOs requiring USACE concurrence and NCRs generated in accordance with SAIC QA procedures. Copies of FCOs completed during the investigation are included in this attachment. Copies of NCRs are on record in the SAIC RVAAP project file.

C.3.1 Field Change Control

The FCOs are completed during the RI to request and document the rationale and approval for any departures from protocols specified in the approved Facility-wide SAP and the Supplemental Phase II RI SAP Addendum. Field changes provide clarification to the scope or refinement in the procedural approach to a specific field activity. All FCOs are reviewed and approved by designated technical representatives of USACE, Louisville District prior to implementation. No FCOs were implemented during the Supplemental Phase I RI activities for CBP.

C.3.2 Nonconformance Reports

To identify and correct conditions adverse to quality, as described in the field and laboratory QA plans, NCRs and associated corrective action reports were completed, as necessary. No NCRs were identified throughout the duration of the project.

C.4 REFERENCES

USACE (U. S. Army Corps of Engineers) 2001a. *Facility-wide Sampling and Analysis Plan (SAP) for the Ravenna Army Ammunition Plant, Ravenna, Ohio,* DACA62-00-D-0001, DO CY 02, March.

USACE (U. S. Army Corps of Engineers) 2005. *Sampling and Analysis Plan Addendum No. 1 for Supplemental Phase II Remedial Investigation of ODA2, FBQ, and CBP.* November.

ATTACHMENT D

DATA QUALITY CONTROL SUMMARY REPORT

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CONTENTS

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TABLES

ACRONYMS

AOC	area of concern
DQA	data quality assessment
DQCR	Data Quality Control Report
DQO	data quality objective
EPA	U. S. Environmental Protection Agency
GPL	GPL Laboratories, Inc.
IDW	investigation-derived waste
LCS	laboratory control standard
MDL	method detection level
MPR	monthly progress report
MS	matrix spike
MSD	matrix spike duplicate
PCB	polychlorinated biphenyl
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RI	remedial investigation
RPD	relative percent difference
RQL	Ramsdell Quarry Landfill
RVAAP	Ravenna Army Ammunition Plant
SAIC	Science Applications International Corporation
SAP	sampling and analysis plan
SDG	sample delivery group
SVOC	semivolatile organic compound
USACE	U. S. Army Corps of Engineers
VOC	volatile organic compound

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D1.0 PURPOSE OF THIS REPORT

Environmental data must always be interpreted relative to its known limitations and its intended use. As can be expected in environmental media of this type, there are areas and data points where the user needs to be cautioned relative to the quality of the project information presented. The data verification process and this data quality assessment (DQA) are intended to provide current and future data users assistance throughout the interpretation of these data.

The purpose of this DQA report is (1) to describe the quality control (QC) procedures followed to ensure data generated by Science Applications International Corporation (SAIC) during these investigations at the Ravenna Army Ammunition Plant (RVAAP) would meet project requirements; (2) to describe the quality of the data collected; and (3) to describe problems encountered during the course of the study and their solutions. A separate Chemical Quality Assessment Report will be completed by the U. S. Army Corp of Engineers (USACE) quality assurance (QA) representative and will cover data generated from QA split samples remanded to their custody.

This report provides an assessment of the analytical information gathered during the course of the RVAAP Supplemental Phase II Remedial Investigation (RI) for the Central Burn Pit (CBP), area performed during November 2005. It documents that the quality of the data employed for the RI report and evaluation met their objectives. Evaluation of field and laboratory QC measures will constitute the majority of this assessment; however, references will also be directed toward those QA procedures that establish data credibility. The primary intent of this assessment is to illustrate that data generated for these studies can withstand scientific scrutiny, are appropriate for their intended purpose, are technically defensible, and are of known and acceptable sensitivity, precision, and accuracy.

Multiple activities were performed to achieve the desired data quality for this project. As discussed in the report, decisions were made during the initial scoping of the RI to define the quality and quantity of data required. Data quality objectives (DQOs) were established to guide the implementation of the field sampling and laboratory analysis [refer to the RVAAP Sampling and Analysis Plan (SAP) Addendum August (USACE 2005)]. A QA program was established to standardize procedures and to document activities [refer to the RVAAP Facility-wide Quality Assurance Project Plan (QAPP) March 2001]. This program provided a means to detect and correct any deficiencies in the process. Upon receipt by the project team, data were subjected to verification and validation review to identify and qualify problems related to the analysis. These review steps contributed to this final DQA where data used in the investigation are identified as having met the criteria and are being employed appropriately.

D2.0 QUALITY ASSUARNACE PROGRAM

A Facility-wide QAPP and a Supplemental Phase II RI QAPP Addendum were developed to guide the investigation. These plans are found in Part II of the Facility-wide SAP for RVAAP (USACE 2001) and the Supplemental Phase II RI SAP Addendum No. 1 (USACE 2005). The purpose of these documents was to enumerate the quantity and type of samples to be taken to inspect the area of concern (AOC), and to define the quantity and type of QA/QC samples to be used to evaluate the quality of the data obtained.

The QAPP established requirements for both field and laboratory QC procedures. In general, field QC duplicates and QA split samples were required for each environmental sample matrix collected in the area being investigated; volatile organic compound (VOC) trip blanks were to accompany each cooler containing water samples for VOC determinations; and analytical laboratory QC duplicates, matrix spikes (MSs), laboratory control samples (LCSs), and method blanks were required for every 20 samples or less of each matrix and analyte.

A primary goal of the RVAAP QA Program was to ensure that the quality of results for all environmental measurements were appropriate for their intended use. To this end, the QAPP and standardized field procedures were compiled to guide the investigation. Through the process of readiness review, training, equipment calibration, QC implementation, and detailed documentation, the project has successfully accomplished the goals set for the QA Program. Surveillances were conducted to determine the adequacy of field performance as evaluated against the QA plan and procedures.

D2.1 MONTHLY PROGRESS REPORTS

Monthly Progress Reports (MPRs) were completed by the SAIC Project Manager for the duration of the project. The MPRs contained the following information: work completed, problems encountered, corrective actions/solutions, summary of findings, and upcoming work. These reports were issued to the USACE, Louisville District Project Manager. Access to these reports can be obtained through the USACE, Louisville District Project Manager.

D2.2 DAILY QUALITY CONTROL REPORTS

The Field Team Leader produced all Daily Quality Control Reports (DQCRs). These include information such as, but not limited to, sub-tier contractors on-site, equipment on-site, work performed summaries, QC activities, Health and Safety activities, problems encountered, and corrective actions. The DQCRs were submitted to the USACE, Louisville District Project Manager and may be obtained through his office.

D2.3 LABORATORY “DEFINITIVE” LEVEL DATA REPORTING

The QAPP for this project identified requirements for laboratory data reporting and identified GPL Laboratory (GPL), Gaithersburg, Maryland as the laboratory for the project. During the execution of the project, the GPL facility performed all of the analyses. Environmental Protection Agency (EPA) “definitive” data have been reported, including the following basic information:

a. laboratory case narratives

b. sample results (soils/sediments reported per dry weight)

c. laboratory method blank results

d. LCS results

e. laboratory sample MS recoveries

f. laboratory duplicate results

g. surrogate recoveries [VOCs, semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and explosives]

h. sample extraction dates

i. sample analysis dates

This information from the laboratory, along with field information, provides the basis for subsequent data evaluation relative to sensitivity, precision, accuracy, representativeness, and completeness. These have been presented in Chapter 4.0.

D3.0 DATA VERIFICATION

The objective when evaluating the project data quality is to determine its usability. The evaluation is based on the interpretation of laboratory QC measures, field QC measures, and the project DQOs. This project implemented the Automated Data Review (ADR) electronic review process in combination with technical oversight to facilitate laboratory data review. ADR output was reviewed by the project-designated verification staff and the project laboratory coordinator. The ADR product is retained in the project database and available within that structure.

D3.1 FIELD DATA VERIFICATION

DQCRs were completed by the Field Team Leader. The DQCRs and other field-generated documents such as sampling logs, boring logs, daily health and safety summaries, daily safety inspections, equipment calibration and maintenance logs, and sample management logs were peer reviewed on-site. These logs and all associated field information have been delivered to the USACE, Louisville District Project Manager and can be obtained through his office.

D3.2 LABORATORY DATA VERIFICATION

Analytical data generated for this project have been subjected to a process of data verification and review. The following describes this systematic process and the evaluation activities performed. Several criteria have been established against which the data were compared and from which a judgment was rendered regarding the acceptance and qualification of the data. These and project specific QC criteria are programmed into the database and evaluated using the ADR programming. Because it is beyond the scope of this report to cite those criteria, the reader is directed to the following documents for specific detail:

- SAIC Technical Support Contractor QA Technical Procedure (TP-DM-300-7) Data Verification and Validation;

- EPA – National Functional Guidelines for Inorganic Data Review, EPA 540/R-94/013, February 1994;

- EPA – National Functional Guidelines for Organic Data Review, EPA-540/R-99/008, October 1999; and

- Supplemental Phase II RI at RVAAP, SAP Addendum, USACE, November 2005.

Upon receipt of field and analytical data, verification staff performed a systematic examination of the reports, utilizing the ADR process to ensure the content, presentation, and administrative validity of the data. Discrepancies identified during this process were recorded and documented utilizing the dataset. As part of data verification, standardized laboratory electronic data deliverables were subjected to review. This technical evaluation ensured that all contract-specified requirements had been met, and that electronic information conformed to reported hardcopy data. QA Program Nonconformance Report and Corrective Action systems were implemented as required.

During the verification phase of the review and evaluation process, data were subjected to a systematic technical review by examining all field and analytical QC results and laboratory documentation, following EPA functional guidelines, the ADR process, and SAIC internal procedures for laboratory data review. These data review guidelines define the technical review criteria, methods for evaluation of the criteria, and actions to be taken resulting from the review of these criteria. The primary objective of this phase was to assess and summarize the quality and reliability of the data for the intended use and to document factors that may affect the usability of the data. This process did not include in-depth review of raw data instrument out-put or recalculation of results from the primary instrument out-put. This data verification, validation, and analytical review process included, but was not necessarily limited to, the following parameters:

- data completeness;
- analytical holding times and sample preservation;
- calibration (initial and continuing);
- method blanks;
- sample results verification;
- surrogate recovery;
- LCS analysis;
- internal standard performance;
- MS recovery;
- duplicate analysis comparison;
- reported detection limits;
- compound, element, and isotope quantification;
- reported detection levels; and
- secondary dilutions.

As an end result of this phase of the review, the data were qualified based on the technical assessment of the verification/validation criteria. Qualifiers were applied to each field and analytical result to indicate the usability of the data for its intended purpose.

D3.3 DEFINITION OF DATA QUALIFIERS (FLAGS)

During the data verification process, all laboratory data were assigned appropriate data qualification flags and reason codes. Qualification flags are defined as follows:

“U” Indicates the analyte was analyzed for, but not detected above, the level of the associated value.

“J” Indicates the analyte was positively identified; however, the associated numerical value is an approximate concentration of the analyte in the sample.

“UJ” Indicates the analyte was analyzed for, but not detected above, the associated value; however, the reported value is an estimate and demonstrates a decreased knowledge of its accuracy or precision.

“R” Indicates the analyte value reported is unusable. The integrity of the analyte’s identification, accuracy, precision, or sensitivity has raised significant questions as to the reality of the information presented.

"=" Indicates the analyte has been validated, the analyte has been positively identified, and the associated concentration value is accurate.

D3.4 DATA ACCEPTABILITY

Twenty-nine environmental soil and field QC samples were collected with approximately 1,500 discrete analyses (i.e., analytes) being obtained, reviewed, and integrated into the assessment (these totals do not include field measurements and field descriptions). The project produced acceptable results for 100% of the sample analyses performed and successfully collected investigation samples under the direction of the SAP and the USACE, Louisville District.

Table D-1 presents a summary of the collected investigation samples. It tallies the successful collection of all targeted field QC and QA split samples, while Table D-2 identifies a cross reference for duplicate and QA split sample pair numbers. Table D-3 provides a summary of rejected analyses grouped by media and analyte category. The majority of estimated values were based on values observed between the laboratory method detection levels (MDLs) and the project reporting levels. Values determined in this region have an inherently higher variability and need to be considered estimated at best.

Table D-1. Central Burn Pits Investigation Summary

Area	Media	Environmental Samples	Field Duplicates	Trip Blanks	Equipment Rinsate Blanks	Site Source Water Blanks	USACE Split Samples
CBP	Soils	22	4	-	1	2	4

USACE = U. S. Army Corps of Engineers.

Table D-2. Primary, Duplicate, and Split Sample Correlation Table
Central Burn Pits Investigation

Media	Station #	Sample #	Duplicate #	Laboratory SDG #	Split #
Soil	CBP-037	CBPSS-037-0104-SO	CBPSS-037-0125-SO	511101	CBPSS-037-126-SO
Soil	CBP-041	CBPSS-041-0111M-S0	CBPSS-041-0127M-SO	511115	CBPSS-041-0128M-SO
Soil	CBP-042	CBPSS-042-0112M-SO	CBPSS-042-0136M-SO	511115	CBPSS-042-0137M-SO
Soil	CBP-052	CBPSS-052-0122-SO	CBPSS-052-0129-SO	511101	CBPSS-052-0135-SO

SDG = Sample delivery group.

Table D-3. Central Burn Pits Investigation
Summary of Rejected Analytes (Laboratory)
(grouped by medium and analysis group)

Media	Analysis Group	Rejected/	Total	Percent Rejected
Soil (surface and subsurface	Metals	0/	597	0.0
	Chromium +6	0/	16	0.0
	Explosives	0/	350	0.0
	TCLP parameters	0/	560	0.0
Project Total		0/	1,523	0.0

For this RVAAP study, one field duplicate was analyzed for soil media. Equipment rinsate, site potable water source and DI water source samples were collected in conjunction with the concurrent sampling program at the Central Burn Pits.

D4.0 DATA QUALITY EVALUATION

D4.1 METALS AND HEXAVALENT CHROMIUM, SOILS

Analytical holding times were met for all samples. Initial calibration and continuing calibration criteria were achieved for all elements analyzed. Method blank levels or continuing calibration blank levels did not result in any qualification of data. Antimony concentrations were consistently qualified as estimated “J or UJ” due to low MS results; however, none of the values were rejected. Arsenic, barium, magnesium, chromium, copper, potassium and vanadium were qualified as estimated “J or UJ” due to MS recoveries being above criteria. Other metals exhibited acceptable recoveries and were not qualified. LCS determinations were considered acceptable throughout the data set. Reporting levels are considered to be acceptable relative to the QAPP goals. Laboratory duplicate comparisons were acceptable. Although some analyses were qualified as estimated, the deviations observed should not have a primary influence on the results and the values are considered technically sound and defensible. All hexavalent chromium data was in order and no qualification of the results were necessary. None of the metal soil results were rejected. Complete data summary tables, with associated qualifiers, are provided in Chapter 4.0 of the main text of the report, and can be found in the RVAAP Environmental Information Management System.

D4.2 EXPLOSIVE ANALYSES, SOILS

Analytical holding times were met for all samples. Initial calibration criteria and continuing calibration criteria were met for all compounds. Method blanks exhibited detectable concentrations of nitrobenzene causing similar values observed in samples to be qualified as non-detect. No other explosive compounds were observed in the method blanks. Surrogate compound recoveries were acceptable for all analyses, with the exception of slightly elevated recoveries for samples CBPSS-038-0107-SO, CBPSS-038-0106-SO, CBPSS-039-0108-SO, and CBPSS-044-0114M-SO. Impacted compound results were qualified as estimated “J”. LCS and MS/MSD recoveries were within criteria. Although some analyses were qualified as estimated, the deviations observed should not have a primary influence on the results and the values are considered technically sound and defensible. Complete data summary tables, with associated qualifiers, are provided in Chapter 4.0 of the main text of the report, and can be found in the RVAAP Environmental Information Management System.

D4.3 PRECISION

A field duplicate sample was collected to ascertain the contribution to variability (i.e., precision) due to the combination of environmental media, sampling consistency, and analytical precision. The field duplicate sample was collected from the same spatial and temporal conditions as the primary environmental sample. The sample was collected from the same sampling device, after homogenization.

Field duplicate comparison information in Table D-4 presents the absolute difference or RPD for field duplicate measurements, by analyte. RPD was calculated only when both samples were > 5 times the reporting level. When one or both sample values were between the reporting level and 5 times the reporting level, the absolute difference was evaluated. If both samples were not detected for a given analyte, precision was considered acceptable. To review information, this DQA has implemented general criteria for comparison of absolute difference measurements and RPDs. RPD criteria were set at 50 and absolute difference criteria were set at 3 times the reporting level. All field duplicate comparisons are considered good, with the highest difference being for lead in the soil duplicate pair CBPSS-041-0111M-SO/CBPSS-041-0127M-SO at 45 RPD.

D4.4 SENSITIVITY

Determination of minimum detectable values allows the investigation to assess the relative confidence that can be placed in a value relative to the magnitude or level of analyte concentration observed. The closer a measured value comes to the minimum detectable concentration, the less confidence and more variation the measurement will have. Project sensitivity goals were expressed as quantitation level goals in the QAPP. These levels were achieved or exceeded throughout the analytical process. Actual laboratory MDLs achieved during this investigation achieved project quantitation level goals. Individual analyte reporting levels varied due to matrix differences and contaminant analyte concentrations. Reporting levels were elevated in soils due to inherent moisture content variability and results being reported in the standard dry weight format. Reporting level variations have been considered during data interpretation and statistical applications.

Method blank determinations were performed with each analytical sample batch for each analyte under investigation. These blanks were evaluated during data review to determine their potential impact on individual data points, if any. Review action levels are set at 5 times the reporting level for all analytes, except those designated as common laboratory contaminants (methylene chloride, acetone, toluene, 2-butanone, and phthalate compounds) with action levels set at 10 times reporting levels. During data review, reported sample concentrations are assessed against method blank action levels and the following qualifications are made when reportable quantities of analyte were observed in the associated method blank.

- When the analyte sample concentration is above 5 or 10 times the action level, the data are not qualified and it is considered a positive value.

- When the analyte sample concentration is determined below 5 or 10 times the action level but above the reporting level, the data are considered impacted by the method blank and the value reported is qualified as a non-detect at the analyte value reported. These data are then qualified as “U.

- When the analyte sample concentration is determined below 5 or 10 times the action level and below the reporting level, the data are considered impacted by the method blank and the value reported is qualified as a non-detect at the reporting level. These data are then qualified as “U”.

Table D-4. Field Duplicate Comparison, Central Burn Pit Investigation

Analysis	CBPSS-037-0104-SO/ CBPSS-037-0125-SO Soil RPD	CBPSS-041-0111M-SO/ CBPSS-041-0127M-SO Soil RPD	CBPSS-042-0112M-SO/ CBPSS-042-0136M-SO Soil RPD	CBPSS-052-0122-SO/ CBPSS-052-0129-SO Soil RPD
Metals				
Aluminum	3	3	1	na
Antimony	*	*	*	na
Arsenic	3	3	4	na
Barium	2	9	1	na
Beryllium	*	14	3	na
Cadmium	*	3	2	na
Calcium	0	14	2	na
Chromium	26	*	*	6
Cobalt	14	1	3	na
Copper	0	15	22	na
Iron	0	10	3	na
Lead	2	45	3	na
Magnesium	2	17	5	na
Manganese	10	12	6	na
Mercury	*	*	*	na
Nickel	23	1	5	na
Potassium	4	2	0	na
Selenium	*	*	*	na
Silver	*	*	*	na
Sodium	*	*	*	na
Thallium	*	*	*	na
Vanadium	3	1	3	na
Zinc	1	11	1	na
Chromium+6	na	*	*	*
Explosives				
All compounds	*	*	*	na

= At least one value is < 5 times the reporting level, and duplicate comparison is within 3 times the reporting level.
RPD = Relative percent difference.
na = Not Analyzed
RVAAP = Ravenna Army Ammunition Plant.
UNAC = At least one value is < 5 times the reporting level, and duplicate comparison is NOT within 3 times the reporting level.

Evaluation of overall project sensitivity can be gained through review of field blank information. These actual sample analyses may provide a comprehensive look at the combined sampling and analysis sensitivity attained by the project. Field QC blanks obtained during sampling activities at RVAAP included samples of VOC trip blank waters and site water sources.

Equipment rinsate sample (CBP-QC-130-QC) did not exhibit any concentrations of explosive compounds. Minor levels of chromium, copper, iron, lead, magnesium, manganese, nickel, potassium, and sodium were observed. All rinsates were associated with soil sampling equipment cleaning operations and none of the contaminant levels impacted the sample values being reported.

Field source water blank CBP-QC-132-QC (DI water source) exhibited a few analyte levels similar to those observed in the equipment blanks. Source water blank CBP-QC-131-QC (potable water source) contained normal levels of barium, calcium, copper, iron, lead, magnesium, manganese, potassium, sodium, and zinc for this type of water source. Neither of these sources contained any explosive compound levels. There is no indication that the source waters impacted associated sample levels.

D4.5 REPRESENTATIVENESS AND COMPARABILITY

Representativeness expresses the degree to which data accurately reflect the analyte or parameter of interest for the environmental site and is the qualitative term most concerned with the proper design of the sampling program. Factors that affect the representativeness of analytical data include proper preservation, holding times, use of standard sampling and analytical methods, and determination of matrix or analyte interferences. Samples were delivered to the laboratory by overnight express courier, were received in good condition, and at appropriate temperature. All analyses were performed within the recommended analytical holding times. Sample preservation, analytical methodologies, and soil sampling methodologies were documented to be adequate and consistently applied.

Comparability, like representativeness, is a qualitative term relative to an individual project data set. These RVAAP AOC investigations employed appropriate sampling methodologies, site surveillance, use of standard sampling devices, uniform training, documentation of sampling, standard analytical protocols/procedures, QC checks with standard control limits, and universally accepted data reporting units to ensure comparability to other data sets. Through the proper implementation and documentation of these standard practices, the project has established the confidence that the data will be comparable to other project and programmatic information. Table D-5 presents the standardized parameter groups, analytical methods, sample containers, preservation techniques, and associated holding times.

D4.6 COMPLETENESS

Usable data are defined as those data that pass individual scrutiny during the verification and validation process and are accepted for unrestricted application to the human health risk assessment evaluation or equivalent type applications. It has been determined that estimated data are acceptable for RVAAP project objectives.

Objectives for Central Burn Pit data have been achieved. The project produced usable results for 100% of the sample analyses performed and successfully collected all the samples planned.

D5.0 DATA QUALITY ASSESSMENT SUMMARY

The overall quality of RVAAP Central Burn Pit information meets or exceeds the established project objectives. Through proper implementation of the project data verification and assessment process, project information has been determined to be acceptable for use.

Data, as presented, have been qualified as usable or estimated “J or UJ”. Data that have been estimated provide indications of either accuracy, precision, or sensitivity being less than desired but adequate for interpretation. Qualifiers have been applied to data when necessary.

Data produced for this project demonstrate that they can withstand scientific scrutiny, are appropriate for its intended purpose, are technically defensible, and are of known and acceptable sensitivity, precision, and accuracy. Data integrity has been documented through proper implementation of QA and QC measures. The environmental information presented has an established confidence that allows utilization for the project objectives and provides data for future needs.

Table D-5. Container Requirements for Soil Samples at RVAAP, Ravenna, Ohio

Analyte Group	Container	Minimum Sample Size	Preservative	Holding Time
Explosive Compounds 8330	One 4-oz glass jar with Teflon®-lined cap	60 g	Cool, 4°C	14 day (extraction) 40 day (analysis)
Metals 6010B and 7471	One 4-oz glass jar with Teflon®-lined cap	50 g	Cool, 4°C	180 day; Hg @ 28 day

ATTACHMENT E

LABORATORY ANALYTICAL RESULTS AND COCs

ATTACHMENT E
LABORATORY ANALYTICAL RESULTS

DISCRETE SURFACE AND SUBSURFACE SOIL SAMPLES

Table 1. Discrete Surface Soil Samples - Inorganics

Station		**CBP-035**	**CBP-036**	**CBP-037**
Sample ID		**CBPSS-035-0100-SO**	**CBPSS-036-0102-SO**	**CBPSS-037-0104-SO**
Customer ID		**CBPSS-035-0100-SO**	**CBPSS-036-0102-SO**	**CBPSS-037-0104-SO**
Date		**11/14/2005**	**11/16/2005**	**11/16/2005**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Filtered		**Total**	**Total**	**Total**
Field Type		**Spatial Composite**	**Spatial Composite**	**Spatial Composite**
Analyte (mg/kg)	**Units**			
Aluminum	MG/KG	9470 /=	15500 /=	10800 /=
Antimony	MG/KG	0.47 JN/J	0.28 UN/UJ	0.46 JN/J
Arsenic	MG/KG	13.1 N/J	16.5 /=#	10.5 /=
Barium	MG/KG	82.1 N/J	68.6 N/J	53 N/J
Beryllium	MG/KG	0.6 /=	0.84 /=	0.44 /=
Cadmium	MG/KG	0.34 /=#	0.02 U/U	0.02 U/U
Calcium	MG/KG	10300 /=	2950 /=	476 /=
Chromium	MG/KG	25.8 /=#	22.3 /=#	21.3 /=#
Cobalt	MG/KG	7.8 /=	11.1 /=#	8.9 /=
Copper	MG/KG	12.4 /=	22.2 N/J#	7.6 N/J
Iron	MG/KG	15400 /=	31300 /=#	20900 /=
Lead	MG/KG	30.1 /=#	25.3 /=	23.5 /=
Magnesium	MG/KG	2170 N/J	3690 N/J#	1390 N/J
Manganese	MG/KG	619 /=	227 /=	532 /=
Mercury	MG/KG	0.1 /=#	0.03 J/J	0.05 /=#
Nickel	MG/KG	21 /=	26.4 /=#	12.1 /=
Potassium	MG/KG	1030 N/J#	1250 N/J#	635 N/J
Selenium	MG/KG	0.74 J/J	0.43 U/U	0.5 J/J
Silver	MG/KG	0.05 U/U	0.04 U/U	0.05 U/U
Sodium	MG/KG	100 J/J	99.7 /U	83.3 J/UJ
Thallium	MG/KG	0.33 U/U	0.52 U/U	0.55 U/U
Vanadium	MG/KG	16.6 N/J	24.9 N/=	24.1 N/=
Zinc	MG/KG	103 /=#	98.9 /=#	55.1 /=

Table 1. Discrete Surface Soil Samples – Inorganics (continued)

Station		**CBP-037**	**CBP-038**	**CBP-039**
Sample ID		**CBPSS-037-0125-SO**	**CBPSS-038-0106-SO**	**CBPSS-039-0108-SO**
Customer ID		**CBPSS-037-0125-SO**	**CBPSS-038-0106-SO**	**CBPSS-039-0108-SO**
Date		**11/16/2005**	**11/16/2005**	**11/16/2005**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Filtered		**Total**	**Total**	**Total**
Field Type		**Field Duplicate**	**Spatial Composite**	**Spatial Composite**
Analyte (mg/kg)	**Units**			
Aluminum	MG/KG	11100 /=	11000 /=	13900 /=
Antimony	MG/KG	0.4 JN/J	0.56 JN/J	0.39 JN/J
Arsenic	MG/KG	10.2 /=	10.4 /=	10.5 /=
Barium	MG/KG	54.1 N/J	92.7 N/J#	77.6 N/J
Beryllium	MG/KG	0.43 /=	0.62 /=	0.47 /=
Cadmium	MG/KG	0.02 U/U	0.08 /=#	0.02 U/U
Calcium	MG/KG	475 /=	1830 /=	1390 /=
Chromium	MG/KG	16.4 /=	18.8 /=#	18.3 /=#
Cobalt	MG/KG	7.7 /=	9.9 /=	9.1 /=
Copper	MG/KG	7.6 N/J	10.4 N/J	9.5 N/J
Iron	MG/KG	21000 /=	20600 /=	22800 /=
Lead	MG/KG	23 /=	29.3 /=#	17.9 /=
Magnesium	MG/KG	1420 N/J	1690 N/J	1970 N/J
Manganese	MG/KG	481 /=	1260 D/=	731 /=
Mercury	MG/KG	0.06 /=#	0.05 /=#	0.06 /=#
Nickel	MG/KG	9.6 /=	14.7 /=	11.4 /=
Potassium	MG/KG	662 N/J	771 N/J	716 N/J
Selenium	MG/KG	0.46 U/U	0.41 U/U	0.74 J/J
Silver	MG/KG	0.05 U/U	0.04 U/U	0.05 U/U
Sodium	MG/KG	88.8 J/UJ	94.3 /U	96.4 /U
Thallium	MG/KG	0.55 U/U	0.99 UD/U	0.54 U/U
Vanadium	MG/KG	24.9 N/=	24.3 N/=	29.5 N/=
Zinc	MG/KG	55.4 /=	101 /=#	57.4 /=

Note: Data Qualifiers are presented as Laboratory qualifiers/Validation qualifiers

- value above facility wide background
U - Not detected
E - Result estimated because of the presence of interference.
B - for organics-compound was detected in the blank as well as the sample
B - for inorganics-result was less than the contract required detection limit but greater than the instrument detection limit.
= - analyte present and concentration accurate.
N - Matrix spike recovery outside control limits
P - greater than 25% difference between two GC columns
NA – not analyzed
J - estimated value less than reporting limits.
* - Duplicate analysis outside control limits.

Table 2. Discrete Surface Soil Samples – Hexavalent Chromium

Station		**CBP-052**	**CBP-052**	**CBP-053**	**CBP-054**
Sample ID		**CBPSS-052-0122-SO**	**CBPSS-052-0129-SO**	**CBPSS-053-0123-SO**	**CBPSS-054-0124-SO**
Customer ID		**CBPSS-052-0122-SO**	**CBPSS-052-0129-SO**	**CBPSS-053-0123-SO**	**CBPSS-054-0124-SO**
Date		**11/16/2005**	**11/16/2005**	**11/16/2005**	**11/17/2005**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Filtered		**Total**	**Total**	**Total**	**Total**
Field Type		**Spatial Composite**	**Field Duplicate**	**Spatial Composite**	**Spatial Composite**
Analyte (mg/kg)	**Units**				
MISC					
Chromium, hexavalent	MG/KG	0.51 U/U	0.49 U/U	0.48 U/U	3.6 /=
Inorganics					
Chromium	MG/KG	105 /=#	112 D/=#	35 /=#	32.3 /=#

Note: Data Qualifiers are presented as Laboratory qualifiers/Validation qualifiers

# - value above facility wide background	= - analyte present and concentration accurate.
J - estimated value less than reporting limits.	U - Not detected
N - Matrix spike recovery outside control limits	* - Duplicate analysis outside control limits.
E - Result estimated because of the presence of interference.	P - greater than 25% difference between two GC columns
B - for organics-compound was detected in the blank as well as the sample	NA – not analyzed

B - for inorganics-result was less than the contract required detection limit but greater than the instrument detection limit.

Table 3. Discrete Surface Soil Samples - Explosives

Station		**CBP-035**	**CBP-036**	**CBP-037**
Sample ID		**CBPSS-035-0100-SO**	**CBPSS-036-0102-SO**	**CBPSS-037-0104-SO**
Customer ID		**CBPSS-035-0100-SO**	**CBPSS-036-0102-SO**	**CBPSS-037-0104-SO**
Date		**11/14/2005**	**11/16/2005**	**11/16/2005**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Filtered		**Total**	**Total**	**Total**
Field Type		**Spatial Composite**	**Spatial Composite**	**Spatial Composite**
Analyte (mg/kg)	**Units**			
Explosives				
1,3,5-Trinitrobenzene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U
1,3-Dinitrobenzene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U
2,4,6-Trinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U
2,4-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U
2,6-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U
2-Amino-4,6-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U
2-Nitrotoluene	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U
3-Nitrotoluene	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U
4-Amino-2,6-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U
4-Nitrotoluene	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U
HMX	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U
Nitrobenzene	MG/KG	0.1 JB/UJ	0.05 J/J	0.05 J/J
RDX	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U
Tetryl	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U

Table 3. Discrete Surface Soil Samples – Explosives (continued)

Station		**CBP-037**	**CBP-038**	**CBP-039**
Sample ID		**CBPSS-037-0125-SO**	**CBPSS-038-0106-SO**	**CBPSS-039-0108-SO**
Customer ID		**CBPSS-037-0125-SO**	**CBPSS-038-0106-SO**	**CBPSS-039-0108-SO**
Date		**11/16/2005**	**11/16/2005**	**11/16/2005**
Depth (ft)		**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Filtered		**Total**	**Total**	**Total**
Field Type		**Field Duplicate**	**Spatial Composite**	**Spatial Composite**
Analyte (mg/kg)	**Units**			
Explosives				
1,3,5-Trinitrobenzene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U
1,3-Dinitrobenzene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U
2,4,6-Trinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U
2,4-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U
2,6-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U
2-Amino-4,6-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U
2-Nitrotoluene	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U
3-Nitrotoluene	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U
4-Amino-2,6-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U
4-Nitrotoluene	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U
HMX	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U
Nitrobenzene	MG/KG	0.05 J/J	0.03 J/J	0.04 J/J
RDX	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U
Tetryl	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U

Note: Data Qualifiers are presented as Laboratory qualifiers/Validation qualifiers

# - value above facility wide background	= - analyte present and concentration accurate.
J - estimated value less than reporting limits.	U - Not detected
N - Matrix spike recovery outside control limits	* - Duplicate analysis outside control limits.
E - Result estimated because of the presence of interference.	P - greater than 25% difference between two GC columns
B - for organics-compound was detected in the blank as well as the sample	NA – not analyzed

B - for inorganics-result was less than the contract required detection limit but greater than the instrument detection limit.

Table 4. Discrete Subsurface Soil Samples - Inorganics

Station		**CBP-035**	**CBP-036**	**CBP-037**	**CBP-038**	**CBP-039**
Sample ID		**CBPSO-035-0101-SO**	**CBPSO-036-0103-SO**	**CBPSO-037-0105-SO**	**CBPSO-038-0107-SO**	**CBPSO-039-0109-SO**
Customer ID		**CBPSO-035-0101-SO**	**CBPSO-036-0103-SO**	**CBPSO-037-0105-SO**	**CBPSO-038-0107-SO**	**CBPSO-039-0109-SO**
Date		**11/14/2005**	**11/16/2005**	**11/16/2005**	**11/16/2005**	**11/16/2005**
Depth (ft)		**1.0 - 3.0**	**1.0 - 3.0**	**1.0 - 3.0**	**1.0 - 3.0**	**1.0 - 3.0**
Filtered		**Total**	**Total**	**Total**	**Total**	**Total**
Field Type		**Spatial Composite**	**Spatial Composite**	**Spatial Composite**	**Spatial Composite**	**Spatial Composite**
Analyte	**Units**					
Aluminum	MG/KG	14600 /=	13700 /=	13900 /=	9840 /=	12500 /=
Antimony	MG/KG	0.38 JN/J	0.28 UN/UJ	0.27 UN/UJ	0.27 UN/UJ	0.3 JN/J
Arsenic	MG/KG	14.7 N/J	20.9 /=#	20.2 /=#	12 /=	15 /=
Barium	MG/KG	46.8 N/J	81.8 N/J	94.3 N/J	77.7 N/J	101 N/J
Beryllium	MG/KG	0.62 /=	0.82 /=	1 /=#	0.69 /=	0.82 /=
Cadmium	MG/KG	0.01 U/U	0.02 U/U	0.02 U/U	0.02 U/U	0.02 U/U
Calcium	MG/KG	1320 /=	1800 /=	1220 /=	1170 /=	1800 /=
Chromium	MG/KG	22.8 /=	22.8 /=	20.7 /=	15.5 /=	19.6 /=
Cobalt	MG/KG	7.6 /=	16.8 /=	22.6 /=	13.2 /=	13.5 /=
Copper	MG/KG	18.5 /=	23.9 N/J	24.4 N/J	7.9 N/J	21.9 N/J
Iron	MG/KG	25700 /=	34300 /=	34000 /=	25000 /=	28400 /=
Lead	MG/KG	14.1 /=	16.4 /=	16.4 /=	15.6 /=	13.9 /=
Magnesium	MG/KG	2210 N/J	4700 N/J	3720 N/J	1940 N/J	3560 N/J
Manganese	MG/KG	237 /=	403 /=	465 /=	1410 D/=	477 /=
Mercury	MG/KG	0.03 J/J	0.02 J/J	0.02 J/J	0.03 J/J	0.02 J/J
Nickel	MG/KG	15.9 /=	36.3 /=	34.7 /=	16.3 /=	34.1 /=
Potassium	MG/KG	1390 N/J	1530 N/J	1260 N/J	849 N/J	1070 N/J
Selenium	MG/KG	0.54 J/J	0.42 U/U	0.4 U/U	0.4 U/U	0.4 U/U
Silver	MG/KG	0.04 U/U	0.04 U/U	0.04 U/U	0.04 U/U	0.04 U/U
Sodium	MG/KG	64 J/J	135 /U	113 /U	101 /U	104 /U
Thallium	MG/KG	0.47 J/J	0.51 U/U	0.48 U/U	0.98 UD/U	0.48 U/U
Vanadium	MG/KG	29.1 N/J	22.1 N/=	23.5 N/=	22.8 N/=	22.1 N/=
Zinc	MG/KG	43.5 /=	79.2 /=	74.9 /=	62.7 /=	68.8 /=

Note: Data Qualifiers are presented as Laboratory qualifiers/Validation qualifiers
= - analyte present and concentration accurate.
N - Matrix spike recovery outside control limits
P - greater than 25% difference between two GC columns
B - for inorganics-result was less than the contract required detection limit but greater than the instrument detection limit.
J - estimated value less than reporting limits.
* - Duplicate analysis outside control limits.
B - for organics-compound was detected in the blank as well as the sample
- value above facility wide background
U - Not detected
E - Result estimated because of the presence of interference.
NA – not analyzed

Table 5. Discrete Subsurface Soil Samples - Explosives

Station		**CBP-035**	**CBP-036**	**CBP-037**	**CBP-038**	**CBP-039**
Sample ID		**CBPSO-035-0101-SO**	**CBPSO-036-0103-SO**	**CBPSO-037-0105-SO**	**CBPSO-038-0107-SO**	**CBPSO-039-0109-SO**
Customer ID		**CBPSO-035-0101-SO**	**CBPSO-036-0103-SO**	**CBPSO-037-0105-SO**	**CBPSO-038-0107-SO**	**CBPSO-039-0109-SO**
Date		**11/14/2005**	**11/16/2005**	**11/16/2005**	**11/16/2005**	**11/16/2005**
Depth (ft)		**1.0 - 3.0**	**1.0 - 3.0**	**1.0 - 3.0**	**1.0 - 3.0**	**1.0 - 3.0**
Filtered		**Total**	**Total**	**Total**	**Total**	**Total**
Field Type		**Spatial Composite**	**Spatial Composite**	**Spatial Composite**	**Spatial Composite**	**Spatial Composite**
Analyte (mg/kg)	**Units**					
Explosives						
1,3,5-Trinitrobenzene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
1,3-Dinitrobenzene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
2,4,6-Trinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
2,4-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
2,6-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
2-Amino-4,6-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
2-Nitrotoluene	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
3-Nitrotoluene	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
4-Amino-2,6-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
4-Nitrotoluene	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
HMX	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
Nitrobenzene	MG/KG	0.12 B/UJ	0.04 J/J	0.04 J/J	0.03 J/J	0.04 J/J
RDX	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
Tetryl	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U

Note: Data Qualifiers are presented as Laboratory qualifiers/Validation qualifiers

# - value above facility wide background	= - analyte present and concentration accurate.
J - estimated value less than reporting limits.	U - Not detected
N - Matrix spike recovery outside control limits	* - Duplicate analysis outside control limits.
E - Result estimated because of the presence of interference.	P - greater than 25% difference between two GC columns
B - for organics-compound was detected in the blank as well as the sample	NA – not analyzed

B - for inorganics-result was less than the contract required detection limit but greater than the instrument detection limit.

Table 6. Multi-Increment Soil Samples - Inorganics

Station		**CBP-040**	**CBP-041**	**CBP-041**	**CBP-042**
Sample ID		**CBPSS-040-0110M-SO**	**CBPSS-041-0111M-SO**	**CBPSS-041-0127M-SO**	**CBPSS-042-0112M-SO**
Customer ID		**CBPSS-040-0110M-SO**	**CBPSS-041-0111M-SO**	**CBPSS-041-0127M-SO**	**CBPSS-042-0112M-SO**
Date		**11/17/2005**	**11/17/2005**	**11/17/2005**	**11/17/2005**
Depth (ft)		**0.0 - 3.0**	**0.0 - 7.0**	**0.0 - 7.0**	**0.0 - 10**
Filtered		**Total**	**Total**	**Total**	**Total**
Field Type		**Multi-increment**	**Multi-increment**	**Multi-increment Field Duplicate**	**Multi-increment**
Analyte (mg/kg)	**Units**				
MISC					
Chromium, hexavalent	MG/KG	0.42 U/U	0.47 U/U	0.4 U/U	0.4 U/U
Inorganics					
Aluminum	MG/KG	14500 /=	15900 /=	16400 /=	6960 /=
Antimony	MG/KG	0.47 JN/J	0.88 JN/J	1.2 JN/J#	0.93 JN/J
Arsenic	MG/KG	10 /=	14.6 /=	15 /=	21.3 /=#
Barium	MG/KG	121 N/J#	135 N/J#	148 N/J#	87 N/J
Beryllium	MG/KG	1.1 /=#	1.3 /=#	1.5 /=#	0.67 /=
Cadmium	MG/KG	0.35 /=#	0.68 /=#	0.66 /=#	0.92 /=#
Calcium	MG/KG	26300 /=#	32600 /=#	37600 /=#	12700 /=
Chromium	MG/KG	51.6 ND/J#	27.9 ND/J#	26.6 ND/J#	19.2 ND/J#
Cobalt	MG/KG	7.2 /=	8.8 /=	8.9 /=	8.8 /=
Copper	MG/KG	13.9 /=	28.5 /=#	24.5 /=#	113 /=#
Iron	MG/KG	22200 /=	27900 /=#	30700 /=#	22500 /=
Lead	MG/KG	20.7 D/=	75.1 D/=#	119 D/=#	62.1 D/=#
Magnesium	MG/KG	5030 D/=#	5790 D/=#	6860 D/=#	1690 D/=
Manganese	MG/KG	1540 D/=#	1320 D/=	1490 D/=#	1050 D/=
Mercury	MG/KG	0.04 /=#	0.05 /=#	0.05 /=#	0.06 /=#
Nickel	MG/KG	24.6 /=#	20.6 /=	20.4 /=	19.5 /=
Potassium	MG/KG	928 N/J#	1250 N/J#	1220 N/J#	724 N/J
Selenium	MG/KG	1.8 JD/J#	1.6 D/=#	2.3 JD/J#	1.4 JD/J
Silver	MG/KG	0.21 UD/U	0.08 UD/U	0.19 UD/U	0.11 JD/J#
Sodium	MG/KG	167 /U	227 /U	268 /=#	108 J/UJ
Thallium	MG/KG	1.4 UD/U	0.54 UD/U	1.2 UD/U	0.57 UD/U
Vanadium	MG/KG	20.8 /=	20.3 /=	20.1 /=	14.1 /=
Zinc	MG/KG	58.1 /=	131 /=#	146 /=#	151 /=#

Table 6. Multi-Increment Soil Samples – Inorganics (continued)

Station		**CBP-042**	**CBP-043**	**CBP-044**	**CBP-045**
Sample ID		**CBPSS-042-0136M-SO**	**CBPSS-043-0113M-SO**	**CBPSS-044-0114M-SO**	**CBPSS-045-0115M-SO**
Customer ID		**CBPSS-042-0136M-SO**	**CBPSS-043-0113M-SO**	**CBPSS-044-0114M-SO**	**CBPSS-045-0115M-SO**
Date		**11/17/2005**	**11/17/2005**	**11/16/2005**	**11/17/2005**
Depth (ft)		**0.0 - 10**	**0.0 - 5.0**	**0.0 - 5.0**	**0.0 - 8.0**
Filtered		**Total**	**Total**	**Total**	**Total**
Field Type		**Multi-increment Field Duplicate**	**Multi-increment**	**Multi-increment**	**Multi-increment**
Analyte (mg/kg)	**Units**				
MISC					
Chromium, hexavalent	MG/KG	0.46 U/U	0.48 U/U	0.43 U/U	0.49 U/U
Inorganics					
Aluminum	MG/KG	7000 /=	18100 /=#	12400 /=	6190 /=
Antimony	MG/KG	1.2 JN/J#	0.4 UN/UJ	0.96 JN/J	0.46 JN/J
Arsenic	MG/KG	20.5 /=#	8.8 /=	15.6 /=#	15 /=
Barium	MG/KG	88.1 N/J	329 N/J#	132 N/J#	73.1 N/J
Beryllium	MG/KG	0.69 /=	2.4 /=#	1.2 /=#	0.37 /=
Cadmium	MG/KG	0.9 /=#	0.69 /=#	0.27 /=#	0.43 /=#
Calcium	MG/KG	12900 /=	117000 D/J#	23400 /=#	11300 /=
Chromium	MG/KG	21.7 ND/J#	28.9 ND/=#	28.3 /=#	13.8 N/J
Cobalt	MG/KG	8.5 /=	3.9 /=	8.2 /=	7.3 /=
Copper	MG/KG	90.3 /=#	13.2 /=	38.7 N/J#	9.9 /=
Iron	MG/KG	23200 /=#	14800 /=	26500 /=#	17100 /=
Lead	MG/KG	60 D/=#	57.9 D/=#	85.3 /=#	29.8 /=#
Magnesium	MG/KG	1770 D/=	10900 D/=#	4930 N/J#	1070 /=
Manganese	MG/KG	1110 D/=	2790 D/=#	3130 D/=#	690 /=
Mercury	MG/KG	0.06 /=#	0.04 /=#	0.04 /=#	0.06 /=#
Nickel	MG/KG	18.5 /=	17.1 /=	24.9 /=#	15.4 /=
Potassium	MG/KG	721 N/J	1460 N/J#	1240 N/J#	729 N/J
Selenium	MG/KG	1.5 D/=#	1.6 JD/J#	0.5 J/J	0.91 /=
Silver	MG/KG	0.08 UD/U	0.24 UD/U	0.04 U/U	0.05 U/U
Sodium	MG/KG	129 J/UJ	487 /=#	166 /U	86 J/UJ
Thallium	MG/KG	0.55 UD/U	1.6 UD/U	2.4 UD/U	0.3 U/U
Vanadium	MG/KG	14.5 /=	15.6 /=	17.5 N/=	12.6 /=
Zinc	MG/KG	153 /=#	65.5 /=#	151 /=#	67.2 /=#

Table 6. Multi-Increment Soil Samples – Inorganics (continued)

Station		**CBP-046**	**CBP-047**	**CBP-048**	**CBP-049**
Sample ID		**CBPSS-046-0116M-SO**	**CBPSS-047-0117M-SO**	**CBPSS-048-0118M-SO**	**CBPSS-049-0119M-SO**
Customer ID		**CBPSS-046-0116M-SO**	**CBPSS-047-0117M-SO**	**CBPSS-048-0118M-SO**	**CBPSS-049-0119M-SO**
Date		**11/17/2005**	**11/18/2005**	**11/17/2005**	**11/18/2005**
Depth (ft)		**0.0 - 3.0**	**0.0 - 8.0**	**0.0 - 3.0**	**0.0 - 5.0**
Filtered		**Total**	**Total**	**Total**	**Total**
Field Type		**Multi-increment**	**Multi-increment**	**Multi-increment**	**Multi-increment**
Analyte (mg/kg)	**Units**				
MISC					
Chromium, hexavalent	MG/KG	0.53 U/U	0.42 U/U	0.49 U/U	1.2 /=
Inorganics					
Aluminum	MG/KG	16900 /=	12500 /=	32600 /=#	22300 /=#
Antimony	MG/KG	0.69 JN/J	0.34 U/U	0.37 UN/UJ	0.51 J/J
Arsenic	MG/KG	9.9 /=	11.3 /=	5.4 /=	10.8 /=
Barium	MG/KG	222 N/J#	76.8 /=	465 N/J#	264 /=#
Beryllium	MG/KG	2.1 /=#	0.6 /=	3.6 /=#	2.2 /=#
Cadmium	MG/KG	0.79 /=#	0.36 /=#	0.38 /=#	0.27 /=#
Calcium	MG/KG	135000 D/=#	2710 /=	187000 D/=#	91900 D/=#
Chromium	MG/KG	20.5 ND/J#	18.8 /=#	40.8 ND/J#	27.8 D/=#
Cobalt	MG/KG	5.7 /=	9.5 /=	5.4 /=	5.8 /=
Copper	MG/KG	16.4 /=	15.7 /=	14.8 /=	18 /=#
Iron	MG/KG	16800 /=	22900 N/J	10100 /=	19900 N/J
Lead	MG/KG	56.1 D/=#	37.3 /=#	15.4 D/=	21.6 D/=
Magnesium	MG/KG	8620 D/=#	2400 /=	25500 D/=#	12900 D/=#
Manganese	MG/KG	1880 D/=#	733 /=	5290 D/=#	2630 D/=#
Mercury	MG/KG	0.06 /=#	0.06 /=#	0.04 /=#	0.13 /=#
Nickel	MG/KG	18.1 /=	16.5 /=	9 /=	13.9 /=
Potassium	MG/KG	1400 N/J#	1030 /=#	1400 N/J#	1430 /=#
Selenium	MG/KG	1 JD/J	0.73 /=	3.6 JD/J#	2.3 JD/J#
Silver	MG/KG	0.22 UD/U	0.04 U/U	0.9 JD/J#	0.2 UD/U
Sodium	MG/KG	411 /=#	62.4 J/J	848 /=#	451 /=#
Thallium	MG/KG	1.5 UD/U	0.27 U/U	2.9 UD/U	1.3 UD/U
Vanadium	MG/KG	16.7 /=	21 /=	14.3 /=	17 /=
Zinc	MG/KG	75.1 /=#	127 /=#	34.3 /=	72.9 /=#

Table 6. Multi-Increment Soil Samples – Inorganics (continued)

Station		**CBP-051**
Sample ID		**CBPSS-051-0121M-SO**
Customer ID		**CBPSS-051-0121M-SO**
Date		**11/18/2005**
Depth (ft)		**0.0 - 6.0**
Filtered		**Total**
Field Type		**Multi-increment**
Analyte (mg/kg)	**Units**	
MISC		
Chromium, hexavalent	MG/KG	25 /=
Inorganics		
Aluminum	MG/KG	10200 /=
Antimony	MG/KG	6.5 /=#
Arsenic	MG/KG	40.1 /=#
Barium	MG/KG	317 /=#
Beryllium	MG/KG	1.1 /=#
Cadmium	MG/KG	6.2 /=#
Calcium	MG/KG	12900 /=
Chromium	MG/KG	105 /=#
Cobalt	MG/KG	7.7 /=
Copper	MG/KG	380 /=#
Iron	MG/KG	29500 N/J#
Lead	MG/KG	348 /=#
Magnesium	MG/KG	3180 /=#
Manganese	MG/KG	745 /=
Mercury	MG/KG	28 D/=#
Nickel	MG/KG	30.7 /=#
Potassium	MG/KG	1020 /=#
Selenium	MG/KG	2.7 /=#
Silver	MG/KG	98.2 D/=#
Sodium	MG/KG	123 J/J
Thallium	MG/KG	0.41 J/J#
Vanadium	MG/KG	15.4 /=
Zinc	MG/KG	490 /=#

Note: Data Qualifiers are presented as Laboratory qualifiers/Validation qualifiers

- value above facility wide background
J - estimated value less than reporting limits.
N - Matrix spike recovery outside control limits
E - Result estimated because of the presence of interference.
B - for organics-compound was detected in the blank as well as the sample
B - for inorganics-result was less than the contract required detection limit but greater than the instrument detection limit.

= - analyte present and concentration accurate.
U - Not detected
* - Duplicate analysis outside control limits.
P - greater than 25% difference between two GC columns
NA – not analyzed

Table 7. Multi-Increment Soil Samples – Explosives

Station		**CBP-040**	**CBP-041**	**CBP-041**	**CBP-042**
Sample ID		**CBPSS-040-0110M-SO**	**CBPSS-041-0111M-SO**	**CBPSS-041-0127M-SO**	**CBPSS-042-0112M-SO**
Customer ID		**CBPSS-040-0110M-SO**	**CBPSS-041-0111M-SO**	**CBPSS-041-0127M-SO**	**CBPSS-042-0112M-SO**
Date		**11/17/2005**	**11/17/2005**	**11/17/2005**	**11/17/2005**
Depth (ft)		**0.0 - 3.0**	**0.0 - 7.0**	**0.0 - 7.0**	**0.0 - 10**
Field Type		**Multi-increment**	**Multi-increment**	**Multi-increment Field Duplicate**	**Multi-increment**
Analyte (mg/kg)	**Units**				
Explosives					
1,3,5-Trinitrobenzene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
1,3-Dinitrobenzene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
2,4,6-Trinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
2,4-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
2,6-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.08 J/J
2-Amino-4,6-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
2-Nitrotoluene	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
3-Nitrotoluene	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
4-Amino-2,6-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
4-Nitrotoluene	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
HMX	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
Nitrobenzene	MG/KG	0.02 J/J	0.03 J/J	0.03 J/J	0.1 U/U
RDX	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
Tetryl	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U

Table 7. Multi-Increment Soil Samples – Explosives (continued)

Station		**CBP-042**	**CBP-043**	**CBP-044**	**CBP-045**
Sample ID		**CBPSS-042-0136M-SO**	**CBPSS-043-0113M-SO**	**CBPSS-044-0114M-SO**	**CBPSS-045-0115M-SO**
Customer ID		**CBPSS-042-0136M-SO**	**CBPSS-043-0113M-SO**	**CBPSS-044-0114M-SO**	**CBPSS-045-0115M-SO**
Date		**11/17/2005**	**11/17/2005**	**11/16/2005**	**11/17/2005**
Depth (ft)		**0.0 - 10**	**0.0 - 5.0**	**0.0 - 5.0**	**0.0 - 8.0**
Field Type		**Multi-increment Field Duplicate**	**Multi-increment**	**Multi-increment**	**Multi-increment**
Analyte (mg/kg)	**Units**				
Explosives					
1,3,5-Trinitrobenzene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
1,3-Dinitrobenzene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
2,4,6-Trinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
2,4-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
2,6-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
2-Amino-4,6-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
2-Nitrotoluene	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
3-Nitrotoluene	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
4-Amino-2,6-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
4-Nitrotoluene	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
HMX	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
Nitrobenzene	MG/KG	0.1 U/U	0.1 U/U	0.03 J/J	0.1 U/U
RDX	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
Tetryl	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U

Table 7. Multi-Increment Soil Samples – Explosives (continued)

Station		**CBP-046**	**CBP-047**	**CBP-048**	**CBP-049**
Sample ID		**CBPSS-046-0116M-SO**	**CBPSS-047-0117M-SO**	**CBPSS-048-0118M-SO**	**CBPSS-049-0119M-SO**
Customer ID		**CBPSS-046-0116M-SO**	**CBPSS-047-0117M-SO**	**CBPSS-048-0118M-SO**	**CBPSS-049-0119M-SO**
Date		**11/17/2005**	**11/18/2005**	**11/17/2005**	**11/18/2005**
Depth (ft)		**0.0 - 3.0**	**0.0 - 8.0**	**0.0 - 3.0**	**0.0 - 5.0**
Field Type		**Multi-increment**	**Multi-increment**	**Multi-increment**	**Multi-increment**
Analyte (mg/kg)	**Units**				
Explosives					
1,3,5-Trinitrobenzene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
1,3-Dinitrobenzene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
2,4,6-Trinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
2,4-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
2,6-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
2-Amino-4,6-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
2-Nitrotoluene	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
3-Nitrotoluene	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
4-Amino-2,6-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
4-Nitrotoluene	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
HMX	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
Nitrobenzene	MG/KG	0.05 J/J	0.1 U/U	0.04 J/J	0.1 U/U
RDX	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
Tetryl	MG/KG	0.2 U/U	0.2 U/U	0.2 U/U	0.02 J/J

Table 7. Multi-Increment Soil Samples – Explosives (continued)

Station		**CBP-050**	**CBP-051**
Sample ID		**CBPSS-050-0120M-SO**	**CBPSS-051-0121M-SO**
Customer ID		**CBPSS-050-0120M-SO**	**CBPSS-051-0121M-SO**
Date		**11/18/2005**	**11/18/2005**
Depth (ft)		**0.0 - 6.0**	**0.0 - 6.0**
Field Type		**Multi-increment**	**Multi-increment**
Analyte (mg/kg)	**Units**		
Explosives			
1,3,5-Trinitrobenzene	MG/KG	0.1 U/U	0.1 U/U
1,3-Dinitrobenzene	MG/KG	0.1 U/U	0.1 U/U
2,4,6-Trinitrotoluene	MG/KG	0.1 U/U	0.1 U/U
2,4-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U
2,6-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U
2-Amino-4,6-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U
2-Nitrotoluene	MG/KG	0.2 U/U	0.2 U/U
3-Nitrotoluene	MG/KG	0.2 U/U	0.2 U/U
4-Amino-2,6-Dinitrotoluene	MG/KG	0.1 U/U	0.1 U/U
4-Nitrotoluene	MG/KG	0.2 U/U	0.2 U/U
HMX	MG/KG	0.2 U/U	0.2 U/U
Nitrobenzene	MG/KG	0.1 U/U	0.1 JB/UJ
RDX	MG/KG	0.2 U/U	0.2 U/U
Tetryl	MG/KG	0.06 J/J	0.03 J/J

Note: Data Qualifiers are presented as Laboratory qualifiers/Validation qualifiers

# - value above facility wide background	= - analyte present and concentration accurate.
J - estimated value less than reporting limits.	U - Not detected
N - Matrix spike recovery outside control limits	* - Duplicate analysis outside control limits.
E - Result estimated because of the presence of interference.	P - greater than 25% difference between two GC columns
B - for organics-compound was detected in the blank as well as the sample	NA – not analyzed

B - for inorganics-result was less than the contract required detection limit but greater than the instrument detection limit.

Table 8. Multi-Increment Soil Samples – TCLP

Station		**CBP-040**	**CBP-041**	**CBP-042**	**CBP-043**
Sample ID		**CBPSS-040-0110M-SO**	**CBPSS-041-0111M-SO**	**CBPSS-042-0112M-SO**	**CBPSS-043-0113M-SO**
Customer ID		**CBPSS-040-0110M-SO**	**CBPSS-041-0111M-SO**	**CBPSS-042-0112M-SO**	**CBPSS-043-0113M-SO**
Date		**11/17/2005**	**11/17/2005**	**11/17/2005**	**11/17/2005**
Depth (ft)		**0.0 - 3.0**	**0.0 - 7.0**	**0.0 - 10**	**0.0 - 5.0**
Field Type		**Multi-increment**	**Multi-increment**	**Multi-increment**	**Multi-increment**
Analyte (mg/kg)	**Units**				
TCLPHB					
2,4-D TCLP	MG/L	0.005 U/U	0.005 U/U	0.005 U/U	0.005 U/U
Silvex TCLP	MG/L	0.005 U/U	0.0019 JP/J	0.005 U/U	0.005 U/U
TCLPIN					
Arsenic TCLP	MG/L	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
Barium TCLP	MG/L	1 U/U	1 U/U	1 U/U	1 U/U
Cadmium TCLP	MG/L	0.06 U/U	0.06 U/U	0.06 U/U	0.06 U/U
Chromium TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
Lead TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
Mercury TCLP	MG/L	0.002 U/U	0.002 U/U	0.002 U/U	0.002 U/U
Selenium TCLP	MG/L	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
Silver TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
TCLPPP					
Chlordane TCLP	MG/L	0.005 U/U	0.005 U/U	0.005 U/U	0.005 U/U
Endrin TCLP	MG/L	0.00025 U/U	0.00025 U/U	0.00025 U/U	0.00025 U/U
Heptachlor TCLP	MG/L	0.00025 U/U	0.00025 U/U	0.00025 U/U	0.00025 U/U
Heptachlor epoxide TCLP	MG/L	0.00025 U/U	0.00025 U/U	0.00025 U/U	0.00025 U/U
Lindane TCLP	MG/L	0.00025 U/U	0.00025 U/U	0.00025 U/U	0.00025 U/U
Methoxychlor TCLP	MG/L	0.00025 U/U	0.00025 U/U	0.00025 U/U	0.00025 U/U
Toxaphene TCLP	MG/L	0.005 U/U	0.005 U/U	0.005 U/U	0.005 U/U
TCLPSV					
1,4-Dichlorobenzene TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
2,4,5-Trichlorophenol TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
2,4,6-Trichlorophenol TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
2,4-Dinitrotoluene TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
2-Methylphenol TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
4-Methylphenol TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U

Table 8. Multi-Increment Soil Samples – TCLP (continued)

Station		**CBP-040**	**CBP-041**	**CBP-042**	**CBP-043**
Sample ID		**CBPSS-040-0110M-SO**	**CBPSS-041-0111M-SO**	**CBPSS-042-0112M-SO**	**CBPSS-043-0113M-SO**
Customer ID		**CBPSS-040-0110M-SO**	**CBPSS-041-0111M-SO**	**CBPSS-042-0112M-SO**	**CBPSS-043-0113M-SO**
Date		**11/17/2005**	**11/17/2005**	**11/17/2005**	**11/17/2005**
Depth (ft)		**0.0 - 3.0**	**0.0 - 7.0**	**0.0 - 10**	**0.0 - 5.0**
Field Type		**Multi-increment**	**Multi-increment**	**Multi-increment**	**Multi-increment**
Analyte (mg/kg)	**Units**				
Hexachlorobenzene TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
Hexachlorobutadiene TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
Hexachloroethane TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
Nitrobenzene TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
Pentachlorophenol TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
Pyridine TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
TCLPVO					
1,1-Dichloroethene TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
1,2-Dichloroethane TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
1,4-Dichlorobenzene TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
2-Butanone TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
Benzene TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
Carbon tetrachloride TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
Chlorobenzene TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
Chloroform TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
Tetrachloroethene TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
Trichloroethene TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
Vinyl chloride TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U

Table 8. Multi-Increment Soil Samples – TCLP (continued)

Station		**CBP-044**	**CBP-045**	**CBP-046**	**CBP-047**
Sample ID		**CBPSS-044-0114M-SO**	**CBPSS-045-0115M-SO**	**CBPSS-046-0116M-SO**	**CBPSS-047-0117M-SO**
Customer ID		**CBPSS-044-0114M-SO**	**CBPSS-045-0115M-SO**	**CBPSS-046-0116M-SO**	**CBPSS-047-0117M-SO**
Date		**11/16/2005**	**11/17/2005**	**11/17/2005**	**11/18/2005**
Depth (ft)		**0.0 - 5.0**	**0.0 - 8.0**	**0.0 - 3.0**	**0.0 - 8.0**
Field Type		**Multi-increment**	**Multi-increment**	**Multi-increment**	**Multi-increment**
Analyte (mg/kg)	**Units**				
TCLPHB					
2,4-D TCLP	MG/L	0.005 U/U	0.005 U/U	0.005 U/U	0.005 U/U
Silvex TCLP	MG/L	0.005 U/U	0.005 U/U	0.005 U/U	0.005 U/U
TCLPIN					
Arsenic TCLP	MG/L	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
Barium TCLP	MG/L	1 U/U	1 U/U	1 U/U	1 U/U
Cadmium TCLP	MG/L	0.06 U/U	0.06 U/U	0.06 U/U	0.06 U/U
Chromium TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
Lead TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
Mercury TCLP	MG/L	0.002 U/U	0.002 U/U	0.002 U/U	0.002 U/U
Selenium TCLP	MG/L	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
Silver TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
TCLPPP					
Chlordane TCLP	MG/L	0.005 U/U	0.005 U/U	0.005 U/U	0.005 U/U
Endrin TCLP	MG/L	0.00025 U/U	0.00025 U/U	0.00025 U/U	0.00025 U/U
Heptachlor TCLP	MG/L	0.00025 U/U	0.00005 J/J	0.0001 J/J	0.00025 U/U
Heptachlor epoxide TCLP	MG/L	0.00025 U/U	0.00025 U/U	0.00025 U/U	0.00025 U/U
Lindane TCLP	MG/L	0.00025 U/U	0.00025 U/U	0.00025 U/U	0.00025 U/U
Methoxychlor TCLP	MG/L	0.00025 U/U	0.00025 U/U	0.00025 U/U	0.00025 U/U
Toxaphene TCLP	MG/L	0.005 U/U	0.005 U/U	0.005 U/U	0.005 U/U
TCLPSV					
1,4-Dichlorobenzene TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
2,4,5-Trichlorophenol TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
2,4,6-Trichlorophenol TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
2,4-Dinitrotoluene TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U

Table 8. Multi-Increment Soil Samples – TCLP (continued)

Station		**CBP-044**	**CBP-045**	**CBP-046**	**CBP-047**
Sample ID		**CBPSS-044-0114M-SO**	**CBPSS-045-0115M-SO**	**CBPSS-046-0116M-SO**	**CBPSS-047-0117M-SO**
Customer ID		**CBPSS-044-0114M-SO**	**CBPSS-045-0115M-SO**	**CBPSS-046-0116M-SO**	**CBPSS-047-0117M-SO**
Date		**11/16/2005**	**11/17/2005**	**11/17/2005**	**11/18/2005**
Depth (ft)		**0.0 - 5.0**	**0.0 - 8.0**	**0.0 - 3.0**	**0.0 - 8.0**
Field Type		**Multi-increment**	**Multi-increment**	**Multi-increment**	**Multi-increment**
Analyte (mg/kg)	**Units**				
2-Methylphenol TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
4-Methylphenol TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
Hexachlorobenzene TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/UJ
Hexachlorobutadiene TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
Hexachloroethane TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
Nitrobenzene TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
Pentachlorophenol TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
Pyridine TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
TCLPVO					
1,1-Dichloroethene TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
1,2-Dichloroethane TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
1,4-Dichlorobenzene TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
2-Butanone TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
Benzene TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
Carbon tetrachloride TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
Chlorobenzene TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
Chloroform TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
Tetrachloroethene TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
Trichloroethene TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
Vinyl chloride TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/UJ

Table 8. Multi-Increment Soil Samples – TCLP (continued)

Station		**CBP-048**	**CBP-049**	**CBP-050**	**CBP-051**
Sample ID		**CBPSS-048-0118M-SO**	**CBPSS-049-0119M-SO**	**CBPSS-050-0120M-SO**	**CBPSS-051-0121M-SO**
Customer ID		**CBPSS-048-0118M-SO**	**CBPSS-049-0119M-SO**	**CBPSS-050-0120M-SO**	**CBPSS-051-0121M-SO**
Date		**11/17/2005**	**11/18/2005**	**11/18/2005**	**11/18/2005**
Depth (ft)		**0.0 - 3.0**	**0.0 - 5.0**	**0.0 - 6.0**	**0.0 - 6.0**
Field Type		**Multi-increment**	**Multi-increment**	**Multi-increment**	**Multi-increment**
Analyte (mg/kg)	**Units**				
TCLPHB					
2,4-D TCLP	MG/L	0.005 U/U	0.005 U/U	0.005 U/U	0.005 U/U
Silvex TCLP	MG/L	0.005 U/U	0.005 U/U	0.005 U/U	0.005 U/U
TCLPIN					
Arsenic TCLP	MG/L	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
Barium TCLP	MG/L	1 U/U	1 U/U	3.58 /=	1 U/U
Cadmium TCLP	MG/L	0.06 U/U	0.06 U/U	0.143 /=	0.06 U/U
Chromium TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
Lead TCLP	MG/L	0.1 U/U	0.1 U/U	15.4 /=	0.1 U/U
Mercury TCLP	MG/L	0.002 U/U	0.002 U/U	0.002 U/U	0.002 U/U
Selenium TCLP	MG/L	0.2 U/U	0.2 U/U	0.2 U/U	0.2 U/U
Silver TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
TCLPPP					
Chlordane TCLP	MG/L	0.005 U/U	0.005 U/U	0.005 U/U	0.005 U/U
Endrin TCLP	MG/L	0.00025 U/U	0.00025 U/U	0.00025 U/U	0.00025 U/U
Heptachlor TCLP	MG/L	0.00005 JP/J	0.00025 U/U	0.00025 U/U	0.00025 U/U
Heptachlor epoxide TCLP	MG/L	0.00025 U/U	0.00025 U/U	0.00025 U/U	0.00025 U/U
Lindane TCLP	MG/L	0.00025 U/U	0.00025 U/U	0.00025 U/U	0.00025 U/U
Methoxychlor TCLP	MG/L	0.00025 U/U	0.00025 U/U	0.00025 U/U	0.00025 U/U
Toxaphene TCLP	MG/L	0.005 U/U	0.005 U/U	0.005 U/U	0.005 U/U
TCLPSV					
1,4-Dichlorobenzene TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
2,4,5-Trichlorophenol TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
2,4,6-Trichlorophenol TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
2,4-Dinitrotoluene TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
2-Methylphenol TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U

Table 8. Multi-Increment Soil Samples – TCLP (continued)

Station		**CBP-048**	**CBP-049**	**CBP-050**	**CBP-051**
Sample ID		**CBPSS-048-0118M-SO**	**CBPSS-049-0119M-SO**	**CBPSS-050-0120M-SO**	**CBPSS-051-0121M-SO**
Customer ID		**CBPSS-048-0118M-SO**	**CBPSS-049-0119M-SO**	**CBPSS-050-0120M-SO**	**CBPSS-051-0121M-SO**
Date		**11/17/2005**	**11/18/2005**	**11/18/2005**	**11/18/2005**
Depth (ft)		**0.0 - 3.0**	**0.0 - 5.0**	**0.0 - 6.0**	**0.0 - 6.0**
Field Type		**Multi-increment**	**Multi-increment**	**Multi-increment**	**Multi-increment**
Analyte (mg/kg)	**Units**				
4-Methylphenol TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
Hexachlorobenzene TCLP	MG/L	0.05 U/U	0.05 U/UJ	0.05 U/UJ	0.05 U/UJ
Hexachlorobutadiene TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
Hexachloroethane TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
Nitrobenzene TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
Pentachlorophenol TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/U	0.1 U/U
Pyridine TCLP	MG/L	0.05 U/U	0.05 U/U	0.05 U/U	0.05 U/U
TCLPVO					
1,1-Dichloroethene TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/UJ	0.1 U/UJ
1,2-Dichloroethane TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/UJ	0.1 U/UJ
1,4-Dichlorobenzene TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/UJ	0.1 U/UJ
2-Butanone TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/UJ	0.1 U/UJ
Benzene TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/UJ	0.1 U/UJ
Carbon tetrachloride TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/UJ	0.1 U/UJ
Chlorobenzene TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/UJ	0.1 U/UJ
Chloroform TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/UJ	0.1 U/UJ
Tetrachloroethene TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/UJ	0.1 U/UJ
Trichloroethene TCLP	MG/L	0.1 U/U	0.1 U/U	0.1 U/UJ	0.1 U/UJ
Vinyl chloride TCLP	MG/L	0.1 U/U	0.1 U/UJ	0.1 U/UJ	0.1 U/UJ

Note: Data Qualifiers are presented as Laboratory qualifiers/Validation qualifiers

# - value above facility wide background	= - analyte present and concentration accurate.
J - estimated value less than reporting limits.	U - Not detected
N - Matrix spike recovery outside control limits	* - Duplicate analysis outside control limits.
E - Result estimated because of the presence of interference.	P - greater than 25% difference between two GC columns
B - for organics-compound was detected in the blank as well as the sample	NA – not analyzed

B - for inorganics-result was less than the contract required detection limit but greater than the instrument detection limit.

Chain of Custody Record

SAIC Science Applications International Corporation
An Employee Owned Company

COC No.: **RVAAP-GPL-001**
Page 1 of 2
Date: 11/16/2005

Name: Science Applications International Corporation
Address: 151 Layfayette Drive Oak Ridge, TN 37831
Phone Number: (865) 481-4600
Project Manager: Kevin Jago
Project Name: RVAAP Six High Priority AOCs
Job/P.O. #: 01 1700 04 3265 505

Sampler (Signature) Martha Clough (Printed Name) Martha Clough

Laboratory Name:
GPL Laboratories, LLLP
Address: 7210A Corporate CT
Frederick, MD 21703
Phone: 301.694.5310
Contact: Virginia Zusman

						Requested Parameters															
Station	Sample ID	Depth	Date	Time	Matrix	S Explosives (A)	S Metals, TAL (A)	S Chromium +6 (A)	S TCLP- VOC, SVOC, PEST, HERB, MET (A)	S Chromium +6 and Total Chromium					W Explosives (A)	W Metals (C)	W Chromium +6 (A)			No. of Containers	OBSERVATIONS, COMMENTS SPECIAL INSTRUCTIONS
FBQ-193	FBQSS-193-500-SO	0-1	11/15/2005	0825	SO	1	1													2	
FBQ-193	FBQSO-193-0501-SO	1-3	11/15/2005	0835	SO	1	1													2	
FBQ-194	FBQSS-194-0502-SO	0-1	11/15/2005	0810	SO	1	1													2	
FBQ-194	FBQSO-194-0503-SO	1-2.3	11/15/2005	0820	SO	1	1													2	
FBQ-195	FBQSS-195-0504-SO	0-1	11/15/2005	0835	SO	1	1													2	
FBQ-195	FBQSO-195-0505-SO	1-2.3	11/15/2005	0850	SO	1	1													2	
FBQ-196	FBQSS-196-0506-SO	0-1	11/15/2005	0930	SO	1	1													2	
FBQ-196	FBQSS-196-0507-SO	1-2.8	11/15/2005	0945	SO	1	1													2	
FBQ-196	FBQSS-196-0512-SO	0-1	11/15/2005	0930	SO	1	1													2	
FBQ-197	FBQSS-197-0508-SO	0-1	11/14/2005	1400	SO	1	1													2	
FBQ-197	FBQSO-197-0509-SO	1-2.9	11/14/2005	1415	SO	1	1													2	
FBQ-198	FBQSS-198-0510-SO	0-1	11/14/2005	1445	SO	1	1													2	
FBQ-198	FBQSO-198-0511-SO	1-3	11/14/2005	1505	SO	1	1													2	

Subtotal Number of Containers: 26

Relinquished by	Date	Received by	Date
Signature: Martha Clough	11/16/05	Signature: Chino	9/17/05
Printed Name: Martha Clough	Time: 1700	Printed Name: Chino	Time: 9:30
Company:		Company: GPL	
Relinquished by	Date	Received by	Date
Signature:		Signature:	
Printed Name:	Time	Printed Name:	Time
Company:		Company:	

Notes:
A. Cool 4°C
B. HCl to pH<2, Cool 4°C
C. HNO3 to pH<2, Cool 4°C
D. H2SO4 to pH<2, Cool 4°C
E. NaOH + Zn, Cool 4°C
F. $Na_2S_2O_3$ + Cool 4°C

COOLER IDs: GPL-01 AND GPL-02

S=soils
W=water

511091

Shipment Method:
FEDEX

Airbill No.:
853098769614
853098769603

Field Contact: Martha Clough
330-405-5804 (work)
216-287-0450 (cell)

Science Applications International Corporation

Chain of Custody Record

Science Applications International Corporation
An Employee Owned Company

Page 2 of 2

COC No.: RVAAP-GPL-001
Date: 11/16/2005

Name: Science Applications International Corporation
Address: 151 Layfayette Drive Oak Ridge, TN 37831
Phone Number: (865) 481-4600
Project Manager: Kevin Jago
Project Name: RVAAP Six High Priority AOCs
Job/P.O. #: 01 1700 04 3265 505

Sampler (Signature) Martha Clough (Printed Name) Martha Clough

Laboratory Name:
GPL Laboratories, LLLP
Address: 7210A Corporate CT
Frederick, MD 21703
Phone: 301.694.5310
Contact: Virginia Zusman

						Requested Parameters															
Station	Sample ID	Depth	Date	Time	Matrix	S Explosives (A)	S Metals, TAL (A)	S Chromium +6 (A)	S TCLP- VOC, SVOC, PEST, HERB, MET (A)	S Chromium +6 and Total Chromium					W Explosives (A)	W Metals (C)	W Chromium +6 (A)			No. of Containers	OBSERVATIONS, COMMENTS SPECIAL INSTRUCTIONS
DA2-125	DA2SS-125-0900-SO	0-1	11/15/2005	1315	SO	1	1													2	
DA2-125	DA2SO-125-0901-SO	1-3	11/15/2005	1330	SO	1	1													2	
DA2-127	DA2SO-127-0905-SO	1-3	11/15/2005	1425	SO	1	1													2	
DA2-128	DA2SS-128-0906-SO	0-1	11/15/2005	1440	SO	1	1													2	
DA2-128	DA2SO-128-0907-SO	1-3	11/15/2005	1455	SO	1	1													2	
DA2-129	DA2SO-129-0909-SO	1-3	11/15/2005	1215	SO	1	1													2	
DA2-129	DA2SO-129-0914-SO	1-3	11/15/2005	1215	SO	1	1													2	
DA2-130	DA2SS-130-0910-SO	0-1	11/15/2005	1230	SO	1	1													2	
DA2-130	DA2SO-130-0911-SO	0-1.9	11/15/2005	1250	SO	1	1													2	
CBP-035	CBPSS-035-0100-SO	0-1	11/14/2005	1410	SO	1	1													2	
CBP-035	CBPSO-035-0101-SO	1-3	11/14/2005	1425	SO	1	1													2	
CBP-QC	CBP-QC-0131-QC	na	11/16/2005	1530	WA										2	1	1			4	
CBP-QC	CBP-QC-0132-QC	NA	11/16/2005	1550	WA										2	1	1			4	

Relinquished by	Date	Received by	Date
Signature: Martha Clough	11/16/05	Signature:	11/17/05
Printed Name: Martha Clough	Time: 1700	Printed Name: Chino	Time: 9:30
Company: SAIC		Company: GPL	

Relinquished by	Date	Received by	Date
Signature:		Signature:	
Printed Name:	Time:	Printed Name:	Time:
Company:		Company:	

Subtotal Number of Containers: 30

Notes: TOTAL NUMBER OF CONTAINERS 56
A. Cool 4°C
B. HCl to pH<2, Cool 4°C
C. HNO3 to pH<2, Cool 4°C
D. H2SO4 to pH<2, Cool 4°C
E. NaOH + Zn, Cool 4°C
F. $Na_2S_2O_3$ + Cool 4°C

COOLER IDs: GPL-01 AND GPL-02

S=soils
W=water

511093

Shipment Method:
FEDEX

Airbill No.:
853098769614
853098769603

Field Contact: Martha Clough
330-405-5804 (work)
216-287-0450 (cell)

Science Applications International Corporation

Chain of Custody Record

SAIC Science Applications International Corporation
An Employee Owned Company

COC No.: RVAAP-GPL-002
Page 1 of 2 Date: 11/17/2005

Name: Science Applications International Corporation
Address: 151 Layfayette Drive Oak Ridge, TN 37831
Phone Number: (865) 481-4600
Project Manager: Kevin Jago
Project Name: RVAAP Six High Priority AOCs
Job/P.O. #: 01 1700 04 3265 505

Sampler (Signature) Martha Clough (Printed Name) Martha Clough

Laboratory Name:
GPL Laboratories, LLLP
Address: 7210A Corporate CT
Frederick, MD 21703
Phone: 301.694.5310
Contact: Virginia Zusman

Requested Parameters

Station	Sample ID	Depth	Date	Time	Matrix	S Explosives (A)	S Metals, TAL (A)	S Chromium +6 (A)	S TCLP- VOC, SVOC, PEST, HERB, MET (A)	S Chromium +6 and Total Chromium	S Metals, TAL and Chromium +6				W Explosives (A)	W Metals (C)	W Chromium +6 (A)			No. of Containers	OBSERVATIONS, COMMENTS SPECIAL INSTRUCTIONS
DA2-126	DA2SS-126-0902-SO	0-1	11/15/2005	1515	SO	1	1													2	14-21 day Turn Around Time Requested
DA2-126	DA2SO-126-0903-SO	1-3	11/15/2005	1525	SO	1	1													2	14-21 day Turn Around Time Requested
DA2-127	DA2SS-127-0904-SO	0-1	11/15/2005	1405	SO	1	1													2	14-21 day Turn Around Time Requested
DA2-129	DA2SS-129-0908-SO	0-1	11/15/2005	1155	SO	1	1													2	14-21 day Turn Around Time Requested
DA2-129	DASS-129-0912-SO	0-1	11/15/2005	1155	SO	1	1													2	14-21 day Turn Around Time Requested
CBP-037	CBPSO-037-0105-SO	1-3	11/16/2005	1015	SO	1	1													2	14-21 day Turn Around Time Requested
CBP-037	CBPSS-037-0104-SO	0-1	11/16/2005	1005	SO	1	1													2	14-21 day Turn Around Time Requested
CBP-037	CBPSS-037-0125-SO	0-1	11/16/2005	1005	SO	1	1													2	14-21 day Turn Around Time Requested
CBP-038	CBPSS-038-0106-SO	0-1	11/16/2005	1030	SO	1	1													2	14-21 day Turn Around Time Requested
CBP-038	CBPSO-038-0107-SO	1-3	11/16/2005	1040	SO	1	1													2	14-21 day Turn Around Time Requested
CBP-052	CBPSS-052-0122-SO	0-1	11/16/2005	0920	SO					1										1	14-21 day Turn Around Time Requested
CBP-052	CBPSS-052-0129-SO	0-1	11/16/2005	0920	SO					1										1	14-21 day Turn Around Time Requested
CBP-044	CBPSS-044-0114M-SO	0-5	11/16/2005	1430	SO	1			1		1									3	7-14 day Turn Around Time Requested

Subtotal Number of Containers: 25

Relinquished by	Date	Received by	Date
Martha Clough (Signature)	11/17/05	(Signature)	11/18/05
Martha Clough (Printed Name)	Time 1700	Chiao (Printed Name)	Time 9:20
SAIC (Company)		GPL (Company)	

Relinquished by	Date	Received by	Date
Signature		Signature	
Printed Name	Time	Printed Name	Time
Company		Company	

Notes:
A. Cool 4°C
B. HCl to pH<2, Cool 4°C
C. HNO3 to pH<2, Cool 4°C
D. H2SO4 to pH<2, Cool 4°C
E. NaOH + Zn, Cool 4°C
F. $Na_2S_2O_3$ + Cool 4°C

COOLER IDs: GPL-03

S=soils
W=water

511101

Shipment Method:
FEDEX

Airbill No.:
853098769669

Field Contact: Martha Clough
330-405-5804 (work)
216-287-0450 (cell)

Science Applications International Corporation

Chain of Custody Record

SAIC Science Applications International Corporation
An Employee Owned Company

Page 2 of 2

COC No.: RVAAP-GPL-002
Date: 11/17/2005

Name: Science Applications International Corporation
Address: 151 Layfayette Drive Oak Ridge, TN 37831
Phone Number: (865) 481-4600
Project Manager: Kevin Jago
Project Name: RVAAP Six High Priority AOCs
Job/P.O. #: 01 1700 04 3265 505

Sampler (Signature) Martha Clough (Printed Name) Martha Clough

Laboratory Name:
GPL Laboratories, LLLP
Address: 7210A Corporate CT
Frederick, MD 21703
Phone: 301.694.5310
Contact: Virginia Zusman

						Requested Parameters															
Station	Sample ID	Depth	Date	Time	Matrix	S Explosives (A)	S Metals, TAL (A)	S Chromium +6 (A)	S TCLP- VOC, SVOC, PEST, HERB, MET (A)	S Chromium +6 and Total Chromium	S Metals, TAL and Chromium +6				W Explosives (A)	W Metals (C)	W Chromium +6 (A)			No. of Containers	OBSERVATIONS, COMMENTS SPECIAL INSTRUCTIONS
CBP-QC	CBP-QC-0130-QC	NA	11/17/2005	1615	WA										2	1	1			4	
CBP-053	CBPSS-053-0123-SO	0-1	11/16/2005	0915	SO					1										1	14-21 day Turn Around Time Requested
CBP-036	CBPSS-036-0102-SO	0-1	11/16/2005	0825	SO	1	1													2	14-21 day Turn Around Time Requested
CBP-036	CBPSO-036-0103-SO	1-3	11/16/2005	0845	SO	1	1													2	14-21 day Turn Around Time Requested
CBP-039	CBPSS-039-0108-SO	0-1	11/16/2005	1105	SO	1	1													2	14-21 day Turn Around Time Requested
CBP-039	CBPS0-039-0109-SO	1-3	11/16/2005	1115	SO	1	1													2	14-21 day Turn Around Time Requested

Subtotal Number of Containers: 13

Relinquished by	Date	Received by	Date
Signature: Martha Clough	11/17/05	Signature: Chen	11/18/05
Printed Name: Martha Clough	Time: 1700	Printed Name: Chino	Time: 9:20
Company: SAIC		Company: GPL	

Relinquished by	Date	Received by	Date
Signature		Signature	
Printed Name	Time	Printed Name	Time
Company		Company	

Notes: TOTAL NUMBER OF CONTAINERS 38

A. Cool 4°C
B. HCl to pH<2, Cool 4°C
C. HNO3 to pH<2, Cool 4°C
D. H2SO4 to pH<2, Cool 4°C
E. NaOH + Zn, Cool 4°C
F. $Na_2S_2O_3$ + Cool 4°C

COOLER IDs: GPL-03

S=soils
W=water

511101

Shipment Method:
FEDEX

Airbill No.:
853098769669

Field Contact: Martha Clough
330-405-5804 (work)
216-287-0450 (cell)

Science Applications International Corporation

Chain of Custody Record

SAIC Science Applications International Corporation
An Employee Owned Company

COC No.: RVAAP-GPL-003
Page 1 of 1
Date: 11/18/2005

Name: Science Applications International Corporation
Address: 151 Layfayette Drive Oak Ridge, TN 37831
Phone Number: (865) 481-4600
Project Manager: Kevin Jago
Project Name: RVAAP Six High Priority AOCs
Job/P.O. #: 01 1700 04 3265 505

Sampler (Signature)
(Printed Name) Martha Clough

Laboratory Name:
GPL Laboratories, LLLP
Address: 7210A Corporate CT
Frederick, MD 21703
Phone: 301.694.5310
Contact: Virginia Zusman

Requested Parameters

Station	Sample ID	Depth	Date	Time	Matrix	S Explosives (A)	S Metals, TAL (A)	S Chromium +6 (A)	S TCLP- VOC, SVOC, PEST, HERB, MET (A)	S Chromium +6 and Total Chromium	S Metals, TAL and Chromium +6				W Explosives (A)	W Metals (C)	W Chromium +6 (A)			No. of Containers	OBSERVATIONS, COMMENTS SPECIAL INSTRUCTIONS
CBP-040	CBPSS-040-0110M-SO	0-3	11/17/2005	0800	SO	1			1		1									3	7-14 day Turn Around Time Requested
CBP-041	CBPSS-041-0111M-SO	0-7	11/17/2005	0945	SO	1			1		1									3	7-14 day Turn Around Time Requested
CBP-041	CBPSS-041-0127M-SO	0-7	11/17/2005	0945	SO	1					1									2	7-14 day Turn Around Time Requested
CBP-042	CBPSS-042-0112M-SO	0-10	11/17/2005	1020	SO	1			1		1									3	7-14 day Turn Around Time Requested
CBP-042	CBPSS-042-0136M-SO	0-10	11/17/2005	1020	SO	1					1									2	7-14 day Turn Around Time Requested
CBP-043	CBPSS-043-0113M-SO	0-5	11/17/2005	1225	SO	1			1		1									3	7-14 day Turn Around Time Requested
CBP-045	CBPSS-045-0115M-SO	0-8	11/17/2005	1350	SO	1			1		1									3	7-14 day Turn Around Time Requested
CBP-046	CBPSS-046-0116M-SO	0-3	11/17/2005	1245	SO	1			1		1									3	7-14 day Turn Around Time Requested
CBP-048	CBPSS-048-0118M-SO	0-3	11/17/2005	1530	SO	1			1		1									3	7-14 day Turn Around Time Requested

Subtotal Number of Containers: 25

Relinquished by
Signature
Printed Name: Martha Clough
Company: SAIC
Date: 11/18/2005
Time: 1700

Received by: Isaac
Signature: Isaac C
Printed Name
Company: GPL
Date: 11/19/05
Time: 10:15

Notes: TOTAL NUMBER OF CONTAINERS 25
A. Cool 4°C
C. HNO3 to pH<2, Cool 4°C
B. HCl to pH<2, Cool 4°C
D. H2SO4 to pH<2, Cool 4°C
E. NaOH + Zn, Cool 4°C
F. $Na_2S_2O_3$ + Cool 4°C

COOLER IDs: GPL-04

Shipment Method:
FEDEX

Airbill No.:
853098769636

Relinquished by
Signature
Printed Name
Company
Date
Time

Received by
Signature
Printed Name
Company
Date
Time

Field Contact: Martha Clough
330-405-5804 (work)
216-287-0450 (cell)

S=soils
W=water

511115

Science Applications International Corporation

Chain of Custody Record

Science Applications International Corporation
An Employee Owned Company

COC No.: **RVAAP-GPL-004**
Page 1 of 1
Date: 11/21/2005

Name: Science Applications International Corporation
Address: 151 Layfayette Drive Oak Ridge, TN 37831
Phone Number: (865) 481-4600
Project Manager: Kevin Jago
Project Name: RVAAP Six High Priority AOCs
Job/P.O. #: 01 1700 04 3265 505
Sampler (Signature) Martha Clough (Printed Name) Martha Clough

Laboratory Name: GPL Laboratories, LLLP
Address: 7210A Corporate CT
Frederick, MD 21703
Phone: 301.694.5310
Contact: Virginia Zusman

Requested Parameters

Station	Sample ID	Depth	Date	Time	Matrix	S Explosives (1A)	S Metals, TAL and Chromium +6 (A)	S Total Chromium and Chromium +6 (A)	S TCLP - VOC, SVOC, PEST, HERB, MET (A)					W VOC - TCLP (4A)	W SVOCs - TCLP (5A)	W Metals - TCLP (6A)	W Pesticides - TCLP	W Herbicides - TCLP		No. of Containers	OBSERVATIONS, COMMENTS SPECIAL INSTRUCTIONS
CBP-054	CBPSS-054-0124-SO	0-1	11/17/2005	0950	SO			1												1	14-21 DAY TURN AROUND
CBP-049	CBPSS-049-0119M-SO	0-5	11/18/2005	0800	SO	1	1		1											3	7-14 DAY TURN AROUND
CBP-047	CBPSS-047-0117M-SO	0-8	11/18/2005	0945	SO	1	1		1											3	7-14 DAY TURN AROUND
CBP-050	CBPSS-050-0120M-SO	0-6	11/18/2005	0810	SO	1	1		1											3	7-14 DAY TURN AROUND
CBP-051	CBPSS-051-0121M-SO	0-6	11/18/2005	0805	SO	1	1		1											3	7-14 DAY TURN AROUND
CBP-IDW	CBP-IDW-0134-SO	NA	11/21/2005	1130	SO				1											1	
CBP-IDW	CBP-IDW-0133-DW	NA	11/21/2005	1230	WA									2	2	1	2	2		9	

Subtotal Number of Containers: 23

Relinquished by	Date	Received by	Date
Martha Clough (Signature)	11/21/05	Chino (Signature)	11/22/05
Martha Clough (Printed Name)	Time 1600	Chino (Printed Name)	Time 9:45
SAIC (Company)		GPL (Company)	

Relinquished by	Date	Received by	Date
Signature		Signature	
Printed Name	Time	Printed Name	Time
Company		Company	

Notes:
A. Cool 4°C
B. HCl to pH<2, Cool 4°C
C. HNO3 to pH<2, Cool 4°C
D. H2SO4 to pH<2, Cool 4°C
E. NaOH + Zn, Cool 4°C
F. $Na_2S_2O_3$ + Cool 4°C

S=soils
W=water

511120

Shipment Method:
FEDEX

Airbill No.:
7924 4374 0739

Field Contact: Martha Clough
330-405-5804 (work)
216-287-0450 (cell)

Science Applications International Corporation

ATTACHMENT F

TOPOGRAPHIC SURVEY DATA

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Sample ID	Easting	Northing	Elevation	Notes
CBP-035	2366541.11	562150.53	970.62	None
CBP-036	2366582.99	562063.67	971.22	None
CBP-037	2367195.5	562176.02	963.84	None
CBP-038	2367301.23	562185.82	965.54	None
CBP-039	2367310.33	561986.96	966.59	None
SS-004	2367067.59	561726.46	974.55	this was a re-sampled location from original RI
SS-018	2366967.99	562089.13	968.92	this was a re-sampled location from original RI
CBP-040	2366878.691	561931.696	971.1525	Location of approximate center of Berm A
CBP-041	2366701.358	562213.461	978.965	Location of approximate center of Pile B
CBP-042	2366637.363	562187.247	980.296	Location of approximate center of Pile C
CBP-043	2366407.451	562026.189	977.023	Location of approximate center of Berm D
CBP-044	2366750.691	562116.029	976.9515	Location of approximate center of Pile E
CBP-046	2366284.37	562116.291	985.4275	Location of approximate center of Berm H
CBP-047	2365958.915	562036.588	974.712	Location of approximate center of Pile I
CBP-048	2366867.819	562118.898	970.964	Location of approximate center of Berm K
CBP-049	2366920.67	561994.876	969.33	Location of approximate center of Pile L
CBP-050	2367052.957	561956.152	978.098	Location of approximate center of Pile M
CBP-051	2367102.796	561689.679	975.401	Location of approximate center of Pile N
CBP-045	2366174.16	561953.711	978.263	Location of approximate center of Pile P

- coordinate system is Ohio State Plan 1983 Ohio North 3401 NAD 1983 Feet

ATTACHMENT G

MUNITIONS AND EXPLOSIVES OF CONCERN AVOIDANCE SURVEY REPORT

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USA Environmental, Inc.

4 January 2006

Science Applications International Corporation
Attn: Martha L. Clough
8866 Commons Blvd., Suite 201
Twinsburg, OH 44087

RE: After Action Report (AAR) for the MEC Avoidance Support at the Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio.

Dear Martha Clough,

USA Environmental, Inc. (USAE) completed the Munitions and Explosives of Concern (MEC) Avoidance Support at the Ravenna Army Ammunition Plant located in Ravenna, Ohio, from 13-19 November 2005. All operations were completed safely, on time, within budgeted funding, and in accordance with the project technical scope of work.

Throughout the project operations, USAE encountered two munitions debris, which were identified as possible fragments from a 3.5-Inch Rocket. Other than the two munitions debris found, USAE did not encounter any unexploded ordnance (UXO)/MEC items at any of the RVAAP areas of concern (AOCs): the Open Demolition Area 2 (RVAAP-04), the Fuze and Booster Quarry Landfill/Ponds (RVAAP-16), and the Central Burn Pits (RVAAP-49).

Upon receipt of the approval of the work plan and a notice to proceed from Science Applications International Corporation (SAIC), USAE mobilized one UXO qualified personnel, Mr. Dale Miller, and the project support equipment to the RVAAP project site. Mr. Miller has completed the U.S. Naval Explosive Ordnance Disposal training, which details procedures for evaluation and disposal of MEC. Prior to beginning work on site, Mr. Miller also completed a health and safety training program, which complies with Occupational Safety and Health Administration (OSHA) Regulations 29 CFR 1910.120e(9). All USAE employees who work on hazardous sites receive training, which includes an equivalent of 40 hours of training off-site and actual field experience under the direct supervision of a trained, experienced Supervisor. Management and Supervisors receive an additional 8 hours of training on program supervision. Each employee receives 8 hours of OSHA refresher training annually.

Mr. Miller arrived on site at Building 1036 at 0830 on 14 November 2005. Mr. Miller coordinated with Ms. Martha Clough (SAIC Site Manager) for site safety and pre-operation orientation. Upon completion of the orientation and prior to beginning the field operations, Mr. Miller performed a tailgate safety briefing for all field personnel. Mr. Miller commenced the marking sample location operations at areas RVAAP 16 and RVAAP-04. During MEC avoidance support of areas RVAAP-16 and RVAAP-04, Mr. Miller did not encounter any MEC/UXO related items.

On 15 November 2005, prior to beginning the field operations, Mr. Miller provided the daily and tailgate safety briefings and then commenced the soil sample collection operations at the RVAAP-16 and RVAAP-04. During the surface sweep of area RVAAP-16, Mr. Miller did not encounter any MEC/UXO related items. However, during the surface sweep of area RVAAP-04, Mr. Miller encountered two pieces of munitions debris located at sample location #130. Mr. Miller identified these items as potential fragments from a 3.5-Inch Rocket. The two munitions debris encountered were reported to SAIC and avoided. Mr. Miller successfully completed the soil sample collection of both areas at RVAAP-16 and RVAAP-04 with no incidents or accidents.

On 16 November 2005, prior to beginning the field operations, Mr. Miller provided the daily and tailgate safety briefings and then commenced the soil sample collection operations at the Central Burn Pits (RVAAP-49). The soil sample collection activities of this sample area continued for the remaining duration of the project. During the surface sweep of area RVAAP-49, Mr. Miller did not encounter any MEC/UXO related items. Mr. Miller successfully completed the soil sample collection of area RVAAP-49 on 18 November 2005 and demobilized on 19 November 2005.

USAE completed all field operations at the RVAAP in accordance with the approved Work Plan and contract requirements. All site operations were completed safely, efficiently, and in accordance with the Technical Scope of Work.

Sincerely,

Manok N. Synakorn
Project Manager

Encl: Attachment 1, Daily Site Summaries and Daily Safety Briefings

Attachment 1

Daily Site Summaries and Daily Safety Briefings.

USA Environmental, Inc.

Tailgate Safety Briefing

Date: 11 / 18 / 05 **Location:** Ravenna AAP

Time: 7:50 [✓ AM] PM **Team #:**

1. Reason for Briefing:

✓	Daily Safety Briefing		New Site Procedure
	Initial Safety Briefing		New Site Information
	New Task Briefing		Review of Site Information
	Periodic Safety Meeting		Other: (Specify)

2. Personnel Attending:

Name	Signature	Position
Martha Clough	M. Clough	FM/SSHO
Beau Williams	B. Williams	Tech.
Jed Thomas	Jed Thomas	Tech

Briefing Given By:

Name	Signature	Position
Dale E. Miller	Dale E. Miller	T-3

3. Topics: (Check All That Apply)

	Site Safety Personnel		Decontamination Procedures
	Site/Work Area Description	✓	Emergency Response/Equipment
✓	Physical Hazards		On-Site Injuries/Illnesses
	Chemical/Biological Hazards		Reporting Procedures
✓	Heat/Cold Stress		Directions to Medical Facility
	Work/Support Zones		Drug and Alcohol Policies
✓	PPE		Medical Monitoring
✓	Safe Work Practices	✓	Evacuation/Egress Procedures
	Air Monitoring		Communications
	Task Training		Confined Spaces
✓	MEC Precautions		Other:

4. Remarks:

USA Environmental, Inc.

Tailgate Safety Briefing

Date: 11 / 17 / 05　　**Location:** Ravenna AAP

Time: 7:55 [✓ AM] PM　　**Team #:**

1. Reason for Briefing:

✓	Daily Safety Briefing		New Site Procedure
	Initial Safety Briefing		New Site Information
	New Task Briefing		Review of Site Information
	Periodic Safety Meeting		Other: (Specify)

2. Personnel Attending:

Name	Signature	Position
Martha Clough	Martha Clough	FM/SSHO
Brian Williams	B. Williams	Tech
Jed Thomas	Jed Thomas	Tech

Briefing Given By:

Name	Signature	Position
Dale E. Miller	Dale E. Miller	T-3

3. Topics: (Check All That Apply)

	Site Safety Personnel		Decontamination Procedures
	Site/Work Area Description	✓	Emergency Response/Equipment
✓	Physical Hazards		On-Site Injuries/Illnesses
	Chemical/Biological Hazards		Reporting Procedures
✓	Heat/Cold Stress		Directions to Medical Facility
	Work/Support Zones		Drug and Alcohol Policies
✓	PPE		Medical Monitoring
✓	Safe Work Practices	✓	Evacuation/Egress Procedures
	Air Monitoring		Communications
	Task Training		Confined Spaces
✓	MEC Precautions		Other:

4. Remarks:

USA Environmental, Inc.

Tailgate Safety Briefing

Date: 11 / 16 / 05

Location: Ravenna AAP

Time: 7:10 [✓ AM] PM

Team #:

1. Reason for Briefing:

✓	Daily Safety Briefing		New Site Procedure
	Initial Safety Briefing		New Site Information
	New Task Briefing		Review of Site Information
	Periodic Safety Meeting		Other: (Specify)

2. Personnel Attending:

Name	Signature	Position
Martha Clough	Martha Clough	FM SHSO
Jed Thomas	Jed Th	Field Crew
Beau Williams		Field Crew

Briefing Given By:

Name	Signature	Position
Dale E. Miller	Dale E. Miller	T-3

3. Topics: (Check All That Apply)

	Site Safety Personnel		Decontamination Procedures
	Site/Work Area Description	✓	Emergency Response/Equipment
✓	Physical Hazards		On-Site Injuries/Illnesses
	Chemical/Biological Hazards		Reporting Procedures
✓	Heat/Cold Stress		Directions to Medical Facility
	Work/Support Zones		Drug and Alcohol Policies
✓	PPE		Medical Monitoring
✓	Safe Work Practices	✓	Evacuation/Egress Procedures
	Air Monitoring		Communications
	Task Training		Confined Spaces
✓	MEC Precautions		Other:

4. Remarks:

USA Environmental, Inc.

Tailgate Safety Briefing

Date: 11 / 15 / 05

Location: Ravenna AAP

Time: 7:20 [✓ AM] PM

Team #: ______

1. Reason for Briefing:

✓	Daily Safety Briefing		New Site Procedure
	Initial Safety Briefing		New Site Information
	New Task Briefing		Review of Site Information
	Periodic Safety Meeting		Other: (Specify)

2. Personnel Attending:

Name	Signature	Position
Martha Clough	Martha Clough	FM SHSO
Jed Thomas	Jed Thomas	Field Crew
Beau Williams	Beau Williams	Field Crew

Briefing Given By:

Name	Signature	Position
Dale E. Miller	Dale E. Miller	T-3

3. Topics: (Check All That Apply)

	Site Safety Personnel		Decontamination Procedures
	Site/Work Area Description	✓	Emergency Response/Equipment
✓	Physical Hazards		On-Site Injuries/Illnesses
	Chemical/Biological Hazards		Reporting Procedures
✓	Heat/Cold Stress		Directions to Medical Facility
	Work/Support Zones		Drug and Alcohol Policies
✓	PPE		Medical Monitoring
✓	Safe Work Practices	✓	Evacuation/Egress Procedures
	Air Monitoring		Communications
	Task Training		Confined Spaces
✓	MEC Precautions		Other:

4. Remarks:

USA Environmental, Inc.

Tailgate Safety Briefing

Date: 11 / 14 / 05 **Location:** Ravenna AAP

Time: 9:15 [✓ AM] PM **Team #:**

1. Reason for Briefing:

✓	Daily Safety Briefing		New Site Procedure
	Initial Safety Briefing		New Site Information
	New Task Briefing		Review of Site Information
	Periodic Safety Meeting		Other: (Specify)

2. Personnel Attending:

Name	Signature	Position
Martha Clough	Martha Clough	FM, SHSO
Jed Thomas	Jed Thomas	Field Crew
Beau Williams	Beau Williams	Field Crew

Briefing Given By:

Name	Signature	Position
Dale E. Miller	Dale E. Miller	T-3

3. Topics: (Check All That Apply)

	Site Safety Personnel		Decontamination Procedures
	Site/Work Area Description	✓	Emergency Response/Equipment
✓	Physical Hazards		On-Site Injuries/Illnesses
	Chemical/Biological Hazards		Reporting Procedures
✓	Heat/Cold Stress		Directions to Medical Facility
	Work/Support Zones		Drug and Alcohol Policies
✓	PPE		Medical Monitoring
✓	Safe Work Practices	✓	Evacuation/Egress Procedures
	Air Monitoring		Communications
	Task Training		Confined Spaces
✓	MEC Precautions		Other:

4. Remarks:

DAILY OPERATIONS SUMMARY

DATE: 11/13/05 thru 11/19/05

PAGE 1 OF 5 PAGES

SITE / LOCATION: Ravenna Army Ammunition Plant

1. WORK SUMMARY

a. Work Accomplished:

	Number Completed	Total Remaining
(1) Survey		
(2) Preparation		
(3) Mag & Flag		
(4) Geophysical		
(5) Intrusive		
(6) Quality Control		
(7) Quality Assurance		

b. Discrepancies:

c. Inspection Results:

	Pass	Fail
(1) Quality Control		
(2) Quality Assurance		
(3) Safety		

2. INSTRUCTIONS RECEIVED FROM CUSTOMER REPRESENTATIVE:

Escort SAIC personnel while collecting soil samples to ensure ordnance avoidance in all phases of the project.

Daily Operations Summary Con't.

PAGE 2 OF 5 PAGES

3. UXO SUMMARY

a. UXO Located: None

Type:	Quantity:	Live/Prac.:	Remarks:

Daily Operations Summary Con't.

PAGE 3 of 5 PAGES

b. Demolition Supplies Expended: None

Type:	Quantity:	Remarks:

c. Scrap Generation / Deposition: None

Type:	Quantity:	Weight:	Remarks:

Daily Operations Summary Con't.

PAGE 4 of 5 PAGES

4. Utilization

a. Daily Man-hours:

Labor Category:	Task #:	M/H Used this ~~Today:~~ Week!	M/H Remaining:	% M/H Remaining:	Remarks:
Project Manager					
SUXO					
UXO Tech. III		44			
UXO Tech. II					
UXO Tech. I					
Laborer					
UXOSO					
UXOQCS					
Admin Personnel					
Visitor					
Sub-Contractor Personnel (List by Category)					

Daily Operations Summary Con't.

PAGE 5 of 5 PAGES

b. Daily Equipment:

Description:	Task:	Hours Used:	Hours Remaining:	% Hours Remaining:	Remarks:
Schonstedt		44			
Geophysical					
Truck (Heavy)					
Truck (Light)		44			
Radio, Base					
Radio, Handheld					
Backhoe					
Front-end Loader					
Rental Car					
GPS					
Weedeater					
Chainsaw					
Chipper					

5. Operational Remarks:

6. Signature / Date:

Dale E. Miller
SUXO / Project Manager

Date: 11/19/05

11/13/05

Dale E. Miller, Tech III mobilized from Aberdeen, OH to Ravenna Army Ammunition plant.

1935 Arrived at Hampton Inn, Brimfield, OH

Received 4 packages shipped from USA Environmental.

1	Schoenstadt
1	MK 26 Forrester
1	First Aid Kit
1	Water Jug (5 gal)
2	Radios with chargers
1	Hard Hat
4pr	Safety glasses
2pr	Gloves
1	Safety Vest
1	roll engineers tape
1	roll package tape
10pr	ear plugs
1pkg	9V batteries

Dale E. Miller

11/13/05

11/14/05

0830 Arrived at Ravenna Army Ammunition Plant and met SAIC personnel. Martha Clough, site manager, Jed Thomas and Beau Williams.

0900 Morning safety briefing by Martha Clough.

0920 Departed Bldg 1036 for the field.

0935 Tailgate safety brief.

0945 Comenced marking sample sites in Fuse, Booster Quarry area.

1115 Completed marking sample sites in FBQ area. Moved to Open Demolition Area 2.

1200 Lunch break.

1245 Lunch break over, back to ODA2.

1405 Completed marking sample sites in ODA2. Moving back to FBQ area to begin taking soil samples.

1645 Completed taking samples from two sample sites. Returning to bldg 1036.

1700 Secured for the day. No MEC or residue encountered today.

Dale E. Muller
11/14/05

11/15/05

0700 Morning safety brief.

0720 Tailgate safety brief.

0725 Departed Bldg 1036 to collect soil samples.

0755 Arrived at the FBQ area to collect samples.

1115 Finished collection of samples in the FBQ area. Will break for lunch.

1145 Lunch break complete. Moving to the Open Detonation Area #2 to collect soil samples.

1320 Encountered two pieces of frag from 3.5" rockets at sample site #130. Items moved to facilitate sampling work. No explosive residue associated with these two items.

1615 Finished collection of samples from ODA2, returning to Bldg 1036.

1657 Secured for the day. No MEC items encountered today.

Dale E. Miller
11/15/05

11/16/05

0700 Morning Safety Brief

0710 Tail gate safety brief.

0715 Departed Bldg 1036 to collect soil samples from the central burn pits area.

0740 Arrived at the central burn pits area, started collecting samples.

1210 Returned to Bldg 1036 to turn in collected samples.

1215 Taking lunch break

1245 Lunch break over. Returning to central burn pits area to continue collecting samples.

1625 Returned to Bldg 1036 with soil samples.
No MEC or related residue encountered today.

1640 Secured for the day.

Dale E. Miller
11/16/05

11/17/05

0703 Morning safety brief.

0745 Departed Bldg 1036 to collect soil samples from the central burn area.

0755 Tailgate safety brief.

0800 Started collection of soil samples.

1145 Lunch break.

1220 Lunch break over, returned to collecting soil samples.

1650 Returned to Bldg 1036 with collected samples.

1705 Secured for the day.

Dale E. Miller
11/17/05

11/18/05

0600 Gave Mk 26 to desk clerk at Motel, Hampton Inn, who stated that he would call FedEx for pick up, MK 26 is being shipped to James Hannan in Abingdon, MD.

0700 Morning safety brief.

0735 Departed Bldg 1036 to resume collecting soil samples from the central barn area.

0750 Tailgate safety brief!

0800 Resumed collecting soil samples.

1115 Completed collection of all soil samples, returning to Bldg 1036.

1145 Completed packaging of all USHE equipment for shipment back to Tampa, FL.

1200 Departed Ravenna AAP to drop equipment for shipping.

1230 Equipment dropped for shipping.

1400 Completed paperwork for project. On site work complete.

1600 Call Manok Synakorn to report that all documentation will be sent to him via Fedex on Monday.

Dale E. Miller
11/18/05

11/19/05

0515 Demolized from Brimfield, Ohio to ~~At~~ Aberdeen, OH.

1230 Washed truck after project use.

1300 Arrived at home of record.

Dale E. Miller
11/19/05

Appendix 7A
Detailed Cost Estimate

Feasibility Study for Six High Priority AOCs
Central Burn Pits - Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio
Summary of Alternatives

Central Burn Pits Alternatives		Land Use	Duration	Non Discounted Cost		
				Soils and Sediment		
				Capital Cost	O&M Cost	Total
1	No Action		0	$0	$0	$0
2	Excavation of Waste Piles, Treatment, and Offsite Disposal	Unrestricted	<1 mo	$124,269	$0	$124,269

Central Burn Pits Alternatives		Land Use	Duration	Discounted Cost (3.1%)		
				Soils and Sediment		
				Capital Cost	O&M Cost	Total
1	No Action		0	$0	$0	$0
2	Excavation of Waste Piles, Treatment, and Offsite Disposal	Unrestricted	<1 mo	$124,269	$0	$124,269

Notes:

1. The base year of comparison and cost data will be CY2005. The "real" discounted rates used to calculate present values will be based on OMB Circular No. A-94 memorandum dated January 31, 2005.

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.

Feasibility Study for Six High Priority AOCs
Central Burn Pits - Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio
Summary of AOC Areas and Volumes

		In situ		*In situ with Constructability* [a]		*Ex situ* [a,b]	
SITE/SCENARIO	**Surface Area (sq ft)**	**Volume (cubic ft)**	**Volume (cubic yards)**	**Volume (cubic ft)**	**Volume (cubic yards)**	**Volume (cubic ft)**	**Volume (cubic yards)**
Central Burn Pits Unrestricted Soil							
Pile M[c]	1,134	1,700	63	2,125	79	2,550	95
Pile N[d]	314	710	26	888	33	1,065	39
Total Unrestricted	1,448	2,410	89	3,013	111	3,615	134

[a] Includes 25% constructability factor

[b] Includes 20% swell factor

[c] Includes a 19-ft radius pile with a 3-ft height. Pile shaped as paraboloid.

[d] Includes a 10-ft radius pile with a 4.5-ft height. Pile shaped as paraboloid.

Central Burn Pits Soil Piles
Alternative 2 - Excavation of Waste Piles, Treatment, and Offsite Disposal
Key Parameters and Assumptions

Key Parameters and Assumptions:

Item	Unit	Value	Notes
Capital Cost			
Additional Site Characterization			Piles have been characterized. Assume existing data is adequate for the disposal facility waste acceptance profile forms. Assume no additional characterization is required.
Site Work			
Site Area	sf	1,448	
Civil Survey	day	0.5	Survey AOC for as-built drawings. RSMeans 01107 700 1200.
Civil Survey	$/day	885	
As Built Drawings	hours	4	Develop as-built drawings.
As Built Drawings	$/hr	60	
Clearing	acre	0.00	Assume trees/brush cleared, chipped, and left onsite.
Clearing	$/acre	4,025	RSMeans 022302000200. Clear and chip medium trees to 12" dia.
Soil Excavation			Includes excavation of AOC areas based on the areas and heights presented in the summary table. Ex situ volumes include a 25% constructability factor and 20% swell factor.
Soil Excavation Volume (In situ)	cy	89	
Soil Excavation Volume (Ex situ)	cy	134	Includes soil to be treated and backfilled on site.
Soil Excavation Mass	tons	120	Includes soil mass to be treated and backfilled on site.
Soil Excavation Surface Area	sf	1,448	
Volume to Weight Conversion	tons/cy	1.35	Insitu soil conversion.
Treatability Study			Includes mobilization, treatment of 3 ea. 1 cy batches, analytical testing, and on-site disposal.
Treatability Study	$/lot	15,000	
Ex situ Treatment			Treatment cost are based on the RACER 2005 Solidification cost model. Assume 100% of the waste is solidified and disposed offsite.
Ex situ Treatment	cy	134	
Mobilization/Demobilization	ls	5,000	Includes mob/demob of treatment equipment and preparing submittals.
Loading and Transport	hrs	16	Includes 1.25 cy loader and dump truck. ECHOS 17030220 and 17030285.
Loading and Transport	$/hr	240	
Holding Tanks	mo	1	Includes one 550 gal. tank and one 21,000 gal tank. ECHOS 19040401 and 19040401.
Holding Tanks	$/mo	1,900	
Chemical Fixation & Stabilization	tons	28	Chemical Fixation & Stabilization, cement based processes, fixation agents, cement, type 1, bulk shipment. ECHOS 33150405.
Chemical Fixation & Stabilization	$/ton	10	
Urrichem Proprietary Additive	tons	2	
Urrichem Proprietary Additive	$/ton	1,500	ECHOS 33150408.
Operational Labor	hrs	32	Operational labor to operate process equipment. ECHOS 33150420.
Operational Labor	$/hr	67	
Waste Mixer	mo	1	Mixer, 15 cy. ECHOS 33150434.
Waste Mixer	$/mo	7,200	
Solidification Ancillary Equipment	ea	1	ECHOS 33150435.
Solidification Ancillary Equipment	$/ea	11,500	
Maintenance of Solidification Unit	yr	0.10	ECHOS 33150437.
Maintenance of Solidification Unit	$/yr	10,300	
Transport and Offsite Disposal	tons	160	Includes 33% increase in mass after treatment.
Nonhazardous Waste Disposal	$/ton	34.80	Based on escalated 2004 vendor pricing.

Central Burn Pits Soil Piles
Alternative 2 - Excavation of Waste Piles, Treatment, and Offsite Disposal
Key Parameters and Assumptions

Key Parameters and Assumptions:

Item	Unit	Value	Notes
Confirmational Sampling & Analysis			
Confirmation Samples	ea	8	Assume 1 metal sample and 1 full TCLP sample per pile footprint. Assume one full TCLP test on treated waste from each pile. Includes 1 duplicate and 1 rinsate for metals.
Sampling Labor	hrs	30	Includes confirmation sampling. Assumes 1 sampling technician at 10 hours/day for 3 days. Includes travel.
Sampling Labor	$/hr	60	
Per Diem	$/event	345	(1 person x $115/day)
Truck Rental / Gas	$/event	370	1 truck x $90/day. Add $50 for gas.
Confirmation Sample Materials	ea	8	Reference ECHOS 33 02 0401/0402 for disposable sampling and decontamination materials.
Confirmation Sample Materials	$/ea	21	
Sample Analysis	$/ea	3,200	Analyze samples for metals (4 @ $100) and full TCLP (4 @ $700). Includes 1 duplicate and 1 rinsate for metals.
Data Management	hrs	8	Data validation
Data Management	$/hr	60	
Restoration			Includes native soil backfill. Assume productivity has been reduced by 25% to account for security and safety requirements. Add 20% premium for small job.
Native Soil Backfill	cy	134	ECHOS 17030422, Unclassified Fill, 6" Lifts, Onsite Source, Includes Delivery, Spreading, and Compaction.
Native Soil Backfill	$/cy	10.76	
Seeding, Vegetative Cover	MSF	11	RSMeans 029203200200. Seeding with mulch and fertilizer. Assume 0.25 acre is revegetated for excavation areas and equipment damage.
Seeding, Vegetative Cover	$/MSF	69.75	
Plans and Reports			
Corrective Action Completion Report	hrs	120	Includes Construction QC data and preparing report.
Technical Labor	$/hr	70	

Central Burn Pits Soil Piles
Alternative 2 - Excavation of Waste Piles, Treatment, and Offsite Disposal
Cost Estimate

CAPITAL COST **$124,269**

Activity (unit)	Quantity	Unit Cost	Total
Site Work			
Civil Survey (day)	0.5	$885.00	$443
As Built Drawings (hrs)	4	$60.00	$240
Clearing (acre)	0.0	$4,025.00	$0
Treatability Study			
Treatability Study (lot)	1	$15,000.00	$15,000
Ex situ Treatment			
Mobilization/Demobilization (ls)	1	$5,000.00	$5,000
Loading and Transport (hr)	16	$240.00	$3,840
Holding Tanks (mo)	1	$1,900.00	$1,900
Chemical Fixation & Stabilization (tons)	28	$10.00	$280
Urrichem Proprietary Additive (tons)	2	$1,500.00	$3,000
Operational Labor (hr)	32	$67.00	$2,144
Waste Mixer (mo)	1	$7,200.00	$7,200
Solidification Ancillary Equipment (ea)	1	$11,500.00	$11,500
Maintenance of Solidification Unit (yr)	0.1	$10,300.00	$1,030
Nonhazardous Waste Disposal (tons)	160	$34.80	$5,568
Confirmational Sampling & Analysis			
Sampling Labor (hrs)	30	$60.00	$1,800
Per Diem (event)	1	$345.00	$345
Truck Rental / Gas (event)	1	$370.00	$370
Confirmation Sample Materials (ea)	8	$21.00	$168
Sample Analysis	1	$3,200.00	$3,200
Data Management (hrs)	8	$60.00	$480
Restoration			
Native Soil Backfill (cy)	134	$10.76	$1,436
Seeding, Vegetative Cover (MSF)	11	$69.75	$767
Plans and Reports			
Corrective Action Completion Report (ea)	120	$70.00	$8,400
Subtotal			$74,111
Design		8%	$5,929
Office Overhead		5%	$3,706
Field Overhead		15%	$11,117
Subtotal			$94,861
Profit		6%	$5,692
Contingency		25%	$23,715
Total			$124,269