REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
11-02-2010	Final	October 2009 - February 2010

4. TITLE AND SUBTITLE

Final Sampling and Analysis Plan Addendum No. 1 for Environmental Services at RVAAP-34 Sand Creek Disposal Road Landfill, RVAAP-03 Open Demolition Area #1, and RVAAP-28 Mustard Agent Burial Site

5a. CONTRACT NUMBER
W912QR-08-D-0013

5b. GRANT NUMBER
N/A

5c. PROGRAM ELEMENT NUMBER
N/A

6. AUTHOR(S)
Andrea Steele
David Crispo, PE

5d. PROJECT NUMBER
133616

5e. TASK NUMBER
01001304

5f. WORK UNIT NUMBER
N/A

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Shaw Environmental & Infrastructure, Inc.
100 Technology Center Drive
Stoughton, MA 02072

8. PERFORMING ORGANIZATION REPORT NUMBER
N/A

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U.S. Army Corps of Engineers - Louisville District
600 Martin Luther King, Jr. Place
Louisville, KY 40202

10. SPONSOR/MONITOR'S ACRONYM(S)
CELRL-ED-EE

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
N/A

12. DISTRIBUTION/AVAILABILITY STATEMENT

Reference distribution page.

13. SUPPLEMENTARY NOTES

None.

14. ABSTRACT

This Sampling and Analysis Plan Addendum supplements the Facility-Wide Sampling and Analysis Plan for area of concern (AOC) specific environmental investigations at RVAAP-34 Sand Creek Disposal Road Landfill (the 'Sand Creek' site), RVAAP-03 Open Demolition Area #1 (ODA1), and RVAAP-28 Mustard Agent Burial Site. The primary objectives of the addendum are to 1) perform geophysical surveys at the three AOCs to identify suspected remaining anomalies and potential munitions and explosives of concern (MEC) as part of MEC avoidance procedures; 2) conduct surface soil, subsurface soil, and dry sediment sampling at ODA1 and the Sand Creek site to define the nature and extent of contamination for each AOC and complete a Remedial Investigation (RI)/Feasibility Study (FS) for each AOC as applicable; 3) to collect data to support a Record of Decision (ROD) at each AOC.

15. SUBJECT TERMS

Sampling and Analysis Plan, SAP, Field Sampling Plan, FSP, Quality Assurance Project Plan, QAPP, Sand Creek Disposal Road Landfill, RVAAP-34, Open Demolition Area #1, RVAAP-03, Mustard Agent Burial Site, RVAAP-28

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			David Crispo
Unclassified	Unclassified	Unclassified	UL	150	19b. TELEPHONE NUMBER *(Include area code)* 617-589-8146

Reset

INSTRUCTIONS FOR COMPLETING SF 298

1. REPORT DATE. Full publication date, including day, month, if available. Must cite at least the year and be Year 2000 compliant, e.g. 30-06-1998; xx-06-1998; xx-xx-1998.

2. REPORT TYPE. State the type of report, such as final, technical, interim, memorandum, master's thesis, progress, quarterly, research, special, group study, etc.

3. DATES COVERED. Indicate the time during which the work was performed and the report was written, e.g., Jun 1997 - Jun 1998; 1-10 Jun 1996; May - Nov 1998; Nov 1998.

4. TITLE. Enter title and subtitle with volume number and part number, if applicable. On classified documents, enter the title classification in parentheses.

5a. CONTRACT NUMBER. Enter all contract numbers as they appear in the report, e.g. F33615-86-C-5169.

5b. GRANT NUMBER. Enter all grant numbers as they appear in the report, e.g. AFOSR-82-1234.

5c. PROGRAM ELEMENT NUMBER. Enter all program element numbers as they appear in the report, e.g. 61101A.

5d. PROJECT NUMBER. Enter all project numbers as they appear in the report, e.g. 1F665702D1257; ILIR.

5e. TASK NUMBER. Enter all task numbers as they appear in the report, e.g. 05; RF0330201; T4112.

5f. WORK UNIT NUMBER. Enter all work unit numbers as they appear in the report, e.g. 001; AFAPL30480105.

6. AUTHOR(S). Enter name(s) of person(s) responsible for writing the report, performing the research, or credited with the content of the report. The form of entry is the last name, first name, middle initial, and additional qualifiers separated by commas, e.g. Smith, Richard, J, Jr.

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES). Self-explanatory.

8. PERFORMING ORGANIZATION REPORT NUMBER. Enter all unique alphanumeric report numbers assigned by the performing organization, e.g. BRL-1234; AFWL-TR-85-4017-Vol-21-PT-2.

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES). Enter the name and address of the organization(s) financially responsible for and monitoring the work.

10. SPONSOR/MONITOR'S ACRONYM(S). Enter, if available, e.g. BRL, ARDEC, NADC.

11. SPONSOR/MONITOR'S REPORT NUMBER(S). Enter report number as assigned by the sponsoring/ monitoring agency, if available, e.g. BRL-TR-829; -215.

12. DISTRIBUTION/AVAILABILITY STATEMENT. Use agency-mandated availability statements to indicate the public availability or distribution limitations of the report. If additional limitations/ restrictions or special markings are indicated, follow agency authorization procedures, e.g. RD/FRD, PROPIN, ITAR, etc. Include copyright information.

13. SUPPLEMENTARY NOTES. Enter information not included elsewhere such as: prepared in cooperation with; translation of; report supersedes; old edition number, etc.

14. ABSTRACT. A brief (approximately 200 words) factual summary of the most significant information.

15. SUBJECT TERMS. Key words or phrases identifying major concepts in the report.

16. SECURITY CLASSIFICATION. Enter security classification in accordance with security classification regulations, e.g. U, C, S, etc. If this form contains classified information, stamp classification level on the top and bottom of this page.

17. LIMITATION OF ABSTRACT. This block must be completed to assign a distribution limitation to the abstract. Enter UU (Unclassified Unlimited) or SAR (Same as Report). An entry in this block is necessary if the abstract is to be limited.

Final Sampling and Analysis Plan Addendum No. 1 for Environmental Services at RVAAP-34 Sand Creek Disposal Road Landfill, RVAAP-03 Open Demolition Area #1, and RVAAP-28 Mustard Agent Burial Site

Version 1.0

Ravenna Army Ammunition Plant
Ravenna, Ohio

Contract No. W912QR-08-D-0013
Delivery Order 0002

Prepared for:

US Army Corps of Engineers ®
Louisville District

600 Martin Luther King, Jr. Place
Louisville, Kentucky 40202

Prepared by:

Shaw Environmental & Infrastructure, Inc.
100 Technology Center Drive
Stoughton, MA 02072

February 11, 2010

DOCUMENT DISTRIBUTION

Name/Organization	Number of Printed Copies	Number of Electronic Copies
BRACO Program Manager	1	1
NGB Program Manager	0	1
Ohio EPA Facility Manager	2	2
OHARNG – Camp Ravenna	1	1
RVAAP Facility Manager	2	2
USAEC Program Manager	0	1
USACE – Huntsville District	1	1
USACE – Louisville District	3	3
Shaw Project Manager	2	2

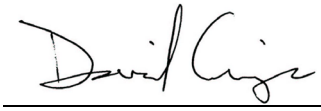
BRACO – Base Realignment and Closure Office
NGB – National Guard Bureau
Ohio EPA – Ohio Environmental Protection Agency
OHARNG – Ohio Army National Guard
RVAAP – Ravenna Army Ammunition Plant
Shaw – Shaw Environmental & Infrastructure, Inc.
USACE – U.S. Army Corps of Engineers
USAEC – U.S. Army Environmental Command

CONTRACTOR'S STATEMENT OF INDEPENDENT TECHNICAL REVIEW

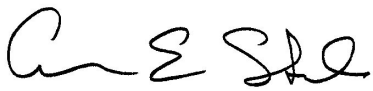
Shaw Environmental & Infrastructure, Inc. has completed the *Final Sampling and Analysis Plan Addendum No. 1 for Environmental Services at RVAAP-34 Sand Creek Disposal Road Landfill, RVAAP-03 Open Demolition Area 1, and RVAAP-28 Mustard Agent Burial Site* at the Ravenna Army Ammunition Plant, Ravenna, Ohio. Notice is hereby given that Shaw has conducted an independent technical review that is appropriate to the level of risk and complexity inherent in the project. During the independent technical review, compliance with established policy, principles, and procedures, utilizing justified and valid assumptions, was verified. This included review of data quality objectives; technical assumptions; methods, procedures, and materials to be used; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets customer's needs consistent with law and existing USACE policy.

Reviewed/Approved by:  Date: 2/11/2010

David Cobb
Project/Program Manager

Reviewed/Approved by:  Date: 2/11/2010

David Crispo, P.E.
Technical/Regulatory Lead

Prepared by:  Date: 2/11/2010

Andrea E. Steele
Environmental Scientist

Contents

Part 1: Field Sampling Plan

Part 2: Quality Assurance Project Plan

Part 3: Sampling and Analysis Plan Addendum No. 1 Attachments

Final Field Sampling Plan Addendum No. 1 for Environmental Services at RVAAP-34 Sand Creek Disposal Road Landfill, RVAAP-03 Open Demolition Area #1, and RVAAP –28 Mustard Agent Burial Site

Version 1.0

Ravenna Army Ammunition Plant
Ravenna, Ohio

Contract No. W912QR-08-D-0013
Delivery Order 0002

Prepared for:

US Army Corps of Engineers ®
Louisville District
600 Martin Luther King, Jr. Place
Louisville, Kentucky 40202

Prepared by:

Shaw Environmental & Infrastructure, Inc.
100 Technology Center Drive
Stoughton, MA 02072

February 11, 2010

Table of Contents

List of Figures

List of Tables

List of Appendices

Acronyms and Abbreviations

A/E	Architectural/Engineering
AOC	Area of Concern
ARPA	Archeological Resources Protection Act
ASTM	American Society for Testing and Materials
bgs	below ground surface
BRAC	Base Realignment and Closure
Camp Ravenna	Camp Ravenna Joint Military Training Center
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CRM	Cultural Resource Manager
COCs	chemicals of concern
COPCs	chemicals of potential concern
CUG	Cleanup Goal
DFFO	Director's Final Findings and Orders
DO	Delivery Order
DoD	U.S. Department of Defense
DQO	Data Quality Objective
EPA	U.S. Environmental Protection Agency
EPC	Exposure Point Concentration
FS	Feasibility Study
FSA	field staging area
FSAP	Facility-Wide Sampling and Analysis Plan
FSP	Field Sampling Plan
ft	foot/feet
GPS	Global Positioning System
GPO	Geophysical Prove Out
HAZWOPER	Hazardous Waste Operations
HHRAM	Human Health Risk Assessor Manual
HQ	Hazard Quotient
IDW	Investigation-derived waste
IRP	Installation Restoration Program
km	kilometer
MABS	Mustard Agent Burial Site, RVAAP-28
MEC	munitions and explosives of concern
MI	multi-increment
mm	millimeter
mph	miles per hour
MS/MSD	Matrix spike / matrix spike duplicate
NAGPRA	Native American Graves Protection and Repatriation Act
ODA1	Open Demolition Area 1, RVAAP-03
OHARNG	Ohio Army National Guard
Ohio EPA	Ohio Environmental Protection Agency
OHPO	Ohio Historic Preservation Office

OSHA	Occupational Safety and Health Administration
PCBs	polychlorinated biphenyls
PE	Professional Engineer
PID	photoionization detector
PIGS	steel shipping cylinders
PPE	personal protective equipment
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
REIMS	Ravenna Environmental Information Management System
RI	Remedial Investigation
ROD	Record of Decision
RSLs	Regional Screening Levels
RVAAP	Ravenna Army Ammunition Plant
SAIC	Science Applications International Corporation
SAP	Sampling and Analysis Plan
SDZ	Safety Danger Zone
Shaw	Shaw Environmental & Infrastructure, Inc.
SHERP	Safety, Health and Emergency Response Plan
SVOC	semivolatile organic compound
TAL	Target Analyte List
UCL	Upper Confidence Limit
USACE	U.S. Army Corps of Engineers
USCS	Unified Soil Classification System
UXO	unexploded ordnance
VOC	volatile organic compound

1.0 Project Description

1.1 Introduction

Shaw Environmental & Infrastructure, Inc. (Shaw) prepared this *Sampling and Analysis Plan (SAP) Addendum No.1* (hereafter referred to as "*Addendum*") under Delivery Order (DO) 0002 for Architectural/Engineering (A/E) Environmental Services at the Ravenna Army Ammunition Plant (RVAAP) under the Indefinite Delivery/Indefinite Quantity Contract No. W912QR-08-D-0013. The DO was issued by the U.S. Army Corps of Engineers, Louisville District (USACE) on September 22, 2008. This *Addendum* was prepared in two parts including a Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP).

This *Addendum* supplements the *Facility-Wide Sampling and Analysis Plan* (*FSAP*) *for Environmental Investigations at the RVAAP* (SAIC, 2001a). The *FSAP* provides the base documentation (i.e., technical and investigative protocols) for conducting a Remedial Investigation (RI) under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) at RVAAP. This *Addendum* includes the Area of Concern (AOC)-specific planned field and sampling and analysis activities and criteria that will be followed to conduct supplemental investigation activities at the RVAAP-03 Open Demolition Area #1 (ODA1), RVAAP-28 Mustard Agent Burial Site (MABS), and RVAAP-34 Sand Creek Disposal Road Landfill (Sand Creek). When appropriate, this *Addendum* references the *FSAP* for basic procedures and protocols.

Shaw prepared data quality objective (DQO) reports (Shaw, 2009a, 2009b, and 2009c) for each of the AOCs based upon historical information and analytical results from previous investigations, assessments, and/or evaluations. The DQOs for each of the three sites were developed in accordance with the facility-wide DQOs presented in the *FSAP* (SAIC, 2001a), the Data Collection and Evaluation Process presented in the *RVAAP's Facility-Wide Human Health Risk Assessor Manual* (*HHRAM*) (USACE, 2005), and the revised *Scope of Work*, dated August 26, 2008, included as an attachment to this DO contract. The geophysical locations for each of the three sites and the surface soil, subsurface soil, and dry sediment sampling locations presented in this *Addendum* for ODA1 and Sand Creek were coordinated with USACE and were reviewed/approved by the Ohio Environmental Protection Agency (Ohio EPA) based on the DQOs prior to the preparation of this *Addendum*.

The primary objectives of this *Addendum* are as follows:

1. Perform geophysical surveys at the three AOCs to identify suspected remaining anomalies and potential munitions and explosives of concern (MEC) as part of MEC avoidance procedures;

2. To conduct surface and subsurface soil and dry sediment sampling at two of the three AOCs (ODA1 and Sand Creek) to define the nature and extent of contamination for each AOC and complete a RI/Feasibility Study (FS) for each AOC as applicable.
3. To collect data to support a Record of Decision (ROD) at each AOC.

The media addressed in this *Addendum* include surface soil, subsurface soil, and dry sediment.

1.2 Facility Description and History

The RVAAP is located in northeastern Ohio within Portage and Trumbull counties, approximately 1.6 kilometer (km; 1 mile) northwest of the city of Newton Falls and 4.8 km (3 miles) east-northeast of the city of Ravenna (Figure 1-1). The facility is a parcel of property approximately 17.7 km (11 miles) long and 5.6 km (3.5 miles) wide bounded by State Route 5, the Michael J. Kirwan Reservoir, and the CSX System Railroad on the south; Garret, McCormick, and Berry roads on the west; the Norfolk Southern Railroad on the north; and State Route 534 on the east (Figure 1-2).

As of February 2006, administrative control of 20,403 acres of the former 21,683-acre RVAAP have been transferred to the U.S. Property and Fiscal Officer for Ohio and subsequently licensed to the Ohio Army National Guard (OHARNG) for use as a training site. Currently, RVAAP consists of 1,280 acres in several distinct parcels scattered throughout the confines of the Camp Ravenna Joint Military Training Center (Camp Ravenna). These 1,280 acres consist of former industrial facilities that are being remediated and managed by the Base Realignment and Closure (BRAC) Division that has, among other responsibilities, the task of overseeing inactive status installations.

During the operational years, prior to Camp Ravenna, the entire 21,683- acre property was a government-owned, contractor-operated industrial facility. The RVAAP Installation Restoration Program (IRP) encompasses investigation and cleanup of past activities over the entire 21,683 acres of the former RVAAP; therefore, references to the RVAAP in this document are considered to be inclusive of the historical extent of the RVAAP, which is inclusive of the combined acreages of the current Camp Ravenna and RVAAP, unless otherwise specifically stated.

The Ohio EPA is the lead regulatory agency for the investigation and remediation conducted by USACE under the U.S. Department of Defense (DoD) IRP. It is important to note that RVAAP is bound to the Director's Final Findings and Orders (DFFO) issued June 10, 2004 by the Ohio EPA pursuant to the authority vested under Chapters 3734, 3745, and 6111 of the Ohio Revised Code. The objective of the DFFO is to ensure that the public health, safety, and welfare, as well as the environment, is protected from the disposal, discharge, or release of contaminants.

A brief description of each AOC included in this *Addendum*, a brief summary of past investigation results, and AOC-specific characterization activities are included in the following appendices:

- Appendix A: RVAAP-03 Open Demolition Area 1
- Appendix B: RVAAP-28 Mustard Agent Burial Site
- Appendix C: RVAAP-34 Sand Creek Disposal Road Landfill

Figure 1-1
Location Map

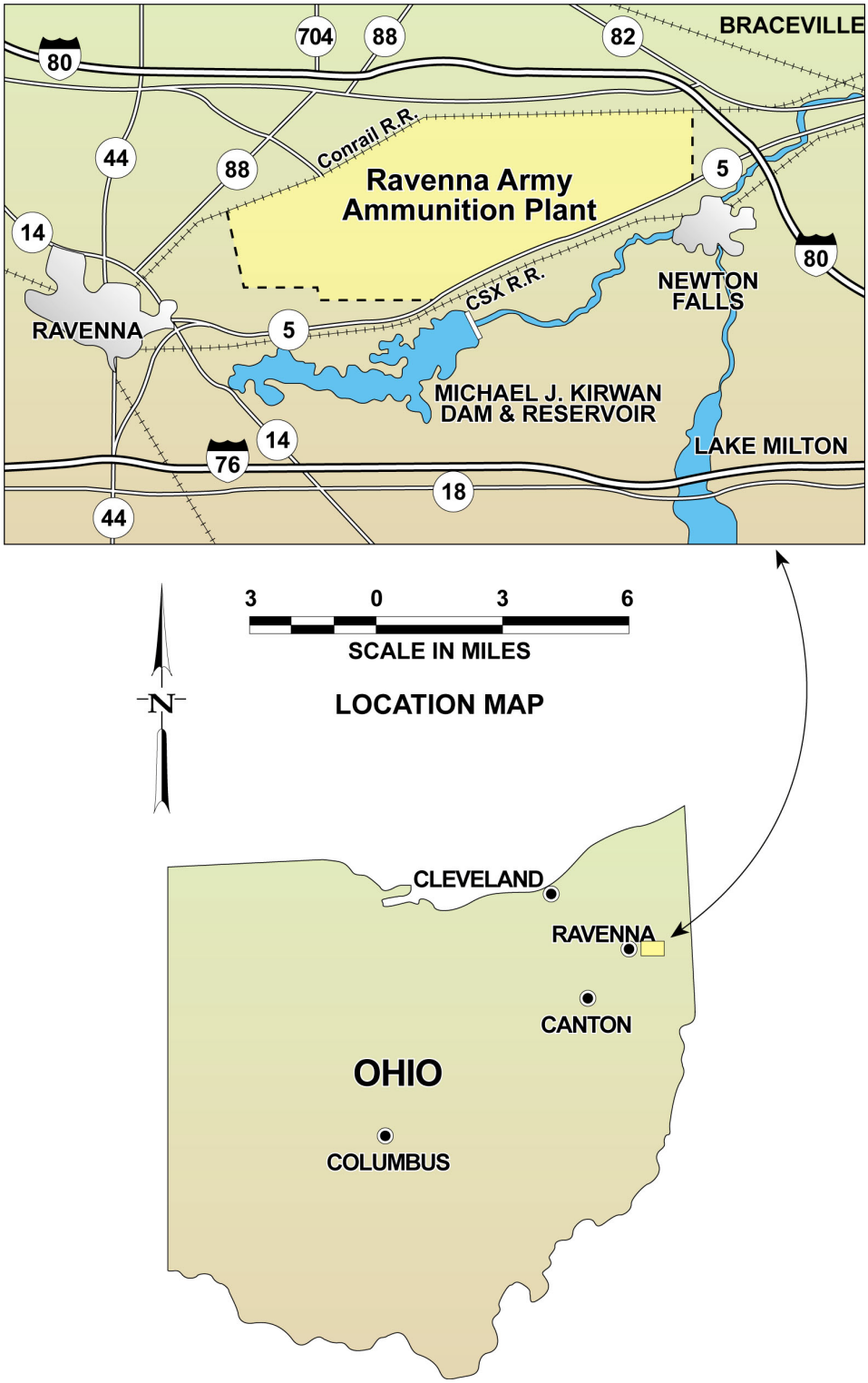
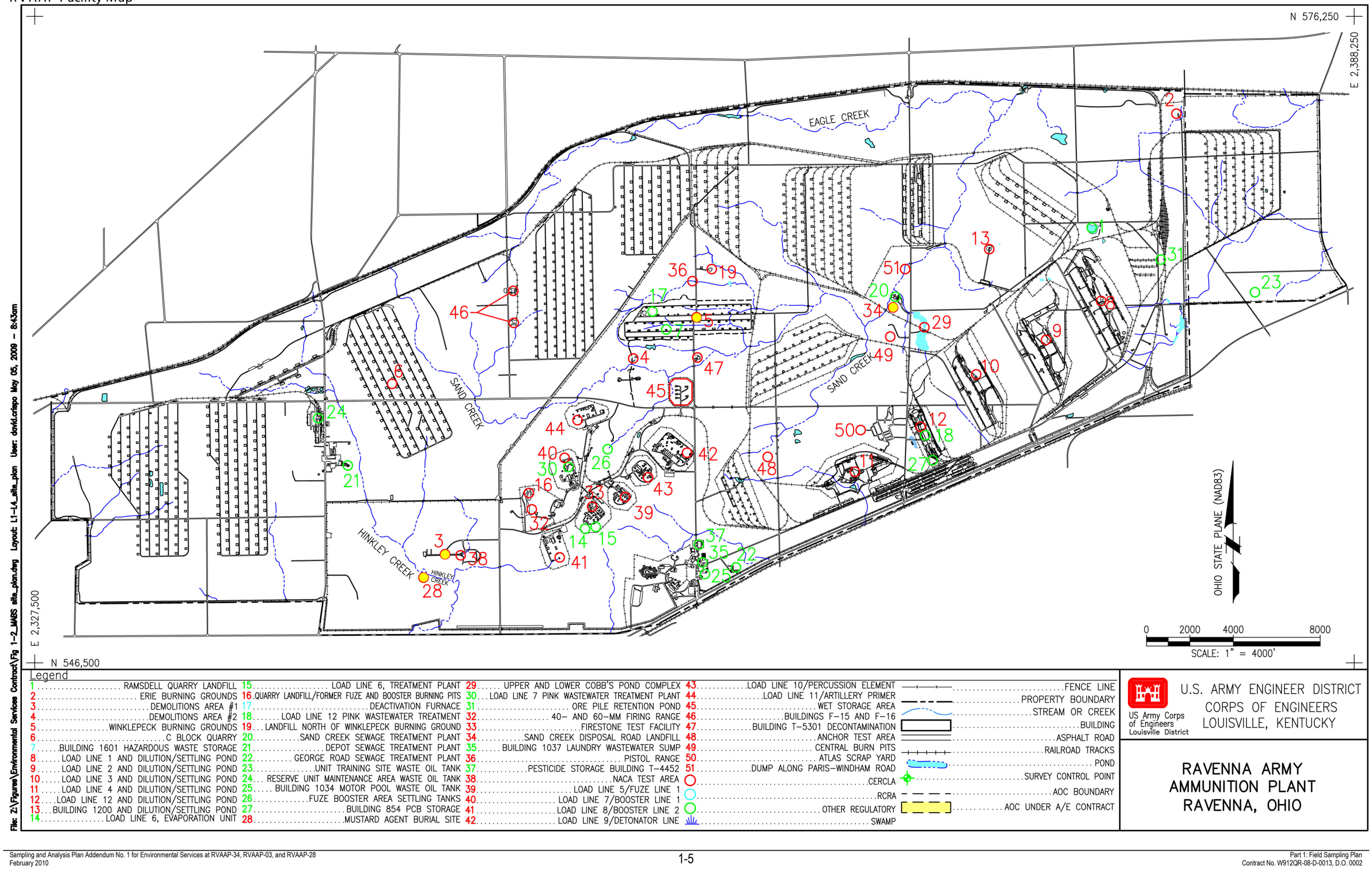


Figure 1-2
RVAAP Facility Map



US Army Corps of Engineers Louisville District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

File: Z:\Figures\Environmental Services Contract\Fig 1-2_MABS site_plan.dwg Layout: L1-L4_site_plan User: dowld.crispo May 05, 2009 – 8:43am

This page intentionally left blank.

2.0 Project Organization and Responsibilities

The organization of key personnel for the implementation of this *Addendum* is as shown in Figure 2-1 of the *FSAP* (SAIC, 2001a). Key personnel and subcontractors implementing this *Addendum* and their responsibilities including reporting structure are listed in Table 2-1. The key personnel will be identified in the final version of this *Addendum*. The functional responsibilities of these key personnel are described in greater detail in Section 2.0 of the *FSAP* (SAIC, 2001a).

Table 2-1
Key Personnel and Responsibilities for SAP Addendum

Role	Responsibilities
David Cobb Shaw Program/Project Manager	As per FSAP Sections 2.1 and 2.2: • Ensures overall management and quality of project. • Ensures project goals and objectives are met in a high-quality and timely manner. • Direct responsibility for implementing project. • Serves as principal point of contact with USACE and RVAAP.
Dave Crispo, PE Shaw Technical/Regulatory Lead	As per FSAP Sections 2.2: • Serves as technical and regulatory lead and supports Program Manager in USACE and RVAAP communications. • Coordinates staff to maintain a coordinated and timely flow of project activities. • Reports to Program Manager. And • Responsible for overall preparation and submittal of deliverables. • Ensures operations are conducted in compliance with approved plans and regulatory requirements.
James Joice, CIH Shaw Health & Safety Officer	As per FSAP Section 2.4: • Ensures that health and safety procedures are maintained throughout field activities. • Authority to stop work. • Reports to Program Manager
Maqsud Rahman, PhD Shaw Project Chemist/Laboratory Coordinator	As per FSAP Section 2.6: • Coordinates sample collection and subsequent laboratory analysis. • Resolves questions with laboratory on QAPP requirements and prepares necessary quality assessment reports. • Reports to Program Manager.

Table 2-1 (continued)
Key Personnel and Responsibilities for SAP Addendum

Role	Responsibilities
Mark Kick Shaw Geophysical Lead	• Assists in the preparation of geophysical work plans, technical reports, and other geophysical project deliverables. • Provides technical scientific support on field geophysical activities. • Reports to Field Operations Manager and Technical Lead.
Greg Norden Shaw Waste Disposal Coordinator	• Coordinates handling and management of IDW. • Reports to Field Operations Manager and Technical Lead.
TBD Shaw Field Operations Manager	As per FSAP Section 2.7: • Implements field activities in accordance with approved plans. • Ensures technical performance of field activities. • Coordinates with field subcontractors. • Reports to Program Manager and QA/QC Officer.
TBD Shaw Field Personnel	As per FSAP Section 2.8: • Perform field activities in accordance with approved plans. • Report to Field Operations Manager.
TBD Shaw QA/QC Officer	As per FSAP Section 2.3: • Responsible for the project QA/QC in accordance with the requirements of the Facility-Wide and project-specific QAPPs. • Reports to Program Manager.
TBD Analytical Laboratory Services	Includes responsibilities identified in FSAP Section 2.5.

CIH = Certified Industrial Hygienist
IDW = Investigation-derived waste
PE = Professional Engineer
QA/QC = Quality Assurance/Quality Control
TBD = To Be Determined prior to field activities

3.0 Scope and Objectives

3.1 Scope of Work and Project Objectives

The primary objectives of this *Addendum* are as follows:

1. Perform geophysical surveys at the three AOCs to identify suspected remaining anomalies and potential MEC as part of MEC avoidance procedures;
2. To conduct surface soil/dry sediment and subsurface soil at two of the three AOCs (ODA1 and Sand Creek) to define the nature and extent of contamination for each AOC and complete a RI/ FS for each AOC as applicable; and
3. To collect data to support a ROD at each AOC.

The scope of this *Addendum* includes activities to fully characterize and define the nature and extent of contamination in surface soil (0 to 1 foot below ground surface [ft bgs] for the Adult Residential Farmer and Child Residential Farmer and 0 to 4 ft bgs for the National Guard user exposure scenarios) and subsurface soil at ODA1 and Sand Creek. The maximum depth of subsurface soils is defined as 1 to 13 ft bgs which is the range of soil depth to which a potential receptor (Residential Farmer Adult and Child) may be exposed; however, for the purposes of this task order, subsurface samples will be collected to a maximum depth of 20 ft at Sand Creek as required per the *Scope of Work*. For Sand Creek, dry sediment samples will be collected in the floodplains between the creek and the AOC.

Geophysical activities to be conducted under this *Addendum* include investigation activities at all three AOCs to geophysically map each AOC and determine the horizontal extent of potential MEC contamination without conducting intrusive investigations for MEC. The geophysical survey at MABS will also further investigate the potential for buried containers of mustard agent. No intrusive sampling activities will be conducted at MABS due to the potential for encountering buried mustard agent. The project scope and objectives for geophysical activities at the three AOCs are presented in the *Final Geophysical Investigation Plan for the RVAAP-34 Sand Creek Disposal Road Landfill, RVAAP-03 Open Demolition Area #1, and RVAAP-28 Mustard Agent Burial* Site (Shaw, 2009d).

3.2 Data Quality Objectives

Previous actions have been performed at each of the AOCs as summarized in Appendices A through C. In general, the actions consisted of investigative sampling at ODA1 to identify the nature and extent of contamination. Removal actions were conducted at ODA1 and Sand Creek followed by confirmatory sampling to identify if residual contamination remained in

environmental media at the sites. Geophysical surveys were conducted at MABS to characterize subsurface conditions and the potential for buried mustard agent containers.

Shaw prepared AOC-specific DQO reports utilizing the investigative facility-wide DQO approach presented in the *FSAP* to evaluate the data results (analytical and geophysical) collected during previous actions conducted at each of the AOCs. The DQO process is a tool to guide investigations at CERLCA sites and was implemented for each of the three AOCs to identify chemicals of potential concern (COPCs) where intrusive activities were conducted (ODA1 and Sand Creek) and data gaps. The systematic approach used for evaluating data requirements to support the decision making process associated with possible future actions, COPCs and the identified data gaps at each of the AOCs are presented in each of the AOC-specific DQO reports:

- *Final Data Quality Objectives Report for the RVAAP-28 Mustard Agent Burial Site*, Shaw, May 11, 2009.
- *Final Data Quality Objectives Report for the RVAAP-34 Sand Creek Disposal Road Landfill*, Shaw, July 16, 2009.
- *Final Data Quality Objectives Report for the RVAAP-03 Open Demolition Area 1*, Shaw, October 9, 2009.

The AOC-specific summary of results, COPCs identified during the DQO evaluation process for existing data (ODA1 and Sand Creek), and associated data gaps are presented in Appendices A through C.

3.2.1 Sampling and Analysis Plan Addendum Decision Rules

Each of the three AOCs will proceed through the CERCLA process (RI/FS and Proposed Plan) individually until a ROD is attained based on the AOC-specific sample designs identified during the aforementioned DQO evaluations and presented in Appendices A through C. Intrusive sampling activities will be conducted at ODA1 and Sand Creek only, whereas only geophysical investigation activities will be conducted at MABS. Therefore, the general decision rules as identified in the *USACE RVAAP Position Paper for the Application and Use of Facility-Wide Human Health Cleanup Goals* (USACE, 2009a); hereafter, referred to as the *Position Paper*, and discussed further in this section, will be applied to the data collected for ODA1 and Sand Creek as part of the requirements of this *Addendum*.

3.2.1.1 Determination of the Chemicals of Potential Concern

The evaluation of previous sample data at ODA1 and Sand Creek identified COPCs and the need for additional sampling. Therefore, additional data will be collected under this *Addendum* and evaluated to determine the presence or absence of contamination, nature and extent of

contamination, characterization of contamination, and need for additional sample locations (if any). This data will be evaluated in accordance with the initial evaluation step presented in the *Position Paper* to further establish COPCs and characterize areas of contamination. This evaluation process consists of the following guidance:

1. The concentrations of inorganics shall be compared to the soil background values in the RVAAP report titled *Phase II Remedial Investigation Report for the Winklepeck Burning Ground at RVAAP, OH* (SAIC, 2001b). Exceedance of an inorganic above its respective background value will require it to be retained as a COPC for further evaluation.

2. Chemicals identified as essential nutrients (e.g., calcium, chloride, iodine, iron, magnesium, potassium, phosphorus, and sodium) will be screened out as long as they are: 1) present at low concentrations (i.e., only slightly elevated above naturally occurring levels), and 2) toxic at very high doses (i.e., much higher than those that could be associated with contact at an AOC.

3. Chemicals meeting the less than 5% detected rule (i.e. frequency of detection) may be screened out; however, in order for this to occur, the chemical must have a statistically valid data set with a sample size of at least 20. The frequency of detection screening does not apply to site-related contaminants such as propellants and explosives which will be retained as COPCs through the evaluation process.

4. To establish COPCs, all chemicals that have not been eliminated to this point will be evaluated using the following process:

   - The Facility-wide cleanup goals (FWCUGs) developed for the Residential Farmer Adult and Child and the National Guard Trainee human health receptors for each chemical will be used. If there are no FWCUGs developed for a particular chemical, then the U.S. Environmental Protection Agency (EPA) Regional Screening Levels (RSLs) for the Residential Receptor will be used. If neither the FWCUG nor the RSL is available, then a CUG will be developed or another approach will be developed in concurrence with USACE and the Ohio EPA. The FWCUGs are currently presented in the *Draft Facility-Wide Human Health Cleanup Goals for the RVAAP, Ravenna, Ohio* (SAIC, 2008) and are hereafter referred to as the Draft FWCUGs.

   - The Draft FWCUGs at the $1x10^{-6}$ cancer risk level and non-carcinogenic risk Hazard Quotient (HQ) using the 0.1 risk value for each of the receptors will be selected.

   - All carcinogenic and non-carcinogenic risk values for each chemical for each receptor will be reported.

   - A comparison of the selected Draft FWCUG to the Exposure Point Concentration (EPC) will be completed. The EPC will be either the 95% Upper Confidence Limit (UCL) of the mean for each chemical concentration or the maximum value

detected, depending upon whichever value is the lowest. In comparisons where the 95% UCL cannot be determined, the maximum concentration of the chemical will be compared to the appropriate Draft FWCUGs.

- The chemical will be retained as a COPC if the EPC exceeds the most stringent risk value for the Residential Farmer Adult and Child and/or the National Guard Trainee for either one of the $1x10^{-6}$ carcinogenic value and the non-carcinogenic HQ using the 0.1 risk value.

3.2.1.2 Determination of the Chemicals of Concern

Once the COPCs have been thoroughly evaluated in accordance with Section 3.2.1.1 and all sampling has been completed so that the nature and extent of contamination is known, the second step as identified in the *Position Paper* will be implemented to determine which COPCs are chemicals of concern (COCs). It is expected that the determination of COCs will occur during the FS stage and will consist of screening of the chemical concentrations to specific Draft FWCUGs similar as for COPCs; however, the COCs are determined by comparing the chemical concentration to different risk levels and for the actual intended National Guard human health receptors in addition to the Residential Farmer Adult and Child. The planned future reuse of ODA1 by OHARNG is Multi-purpose Training – Dismounted and Mounted Training. The intended future use receptor at ODA1 is expected to be the National Guard Trainee. The planned future reuse for Sand Creek by OHARNG is as a Safety Danger Zone (SDZ) within a proposed Small Arms Range Complex that will receive occasional foot traffic. The intended future use receptors at Sand Creek are expected to be the National Guard Trainee and the Range Maintenance Soldier.

The determination of COCs for ODA1 and Sand Creek will proceed as follows:

1. The Draft FWCUG for the Residential Farmer Adult and Child receptors and the receptor for the planned future land use by the OHARNG will be selected using the $1x10^{-5}$ carcinogenic value and non-carcinogenic risk value termed HQ using the 1.0 risk value.

2. All carcinogenic and non-carcinogenic risk values for all receptors and all critical effect and target organ for each of the non-carcinogenic risk values will be reported.

3. A comparison of the Draft FWCUG to the EPC will be completed similarly as discussed for COPC evaluation in Section 3.2.1.1.

4. For carcinogens and non-carcinogens, the chemical-specific concentrations will be compared to the target risk Draft FWCUG using the Sum or Ratios method presented in the *Position Paper*.

5. The chemical will be retained as a COC if: 1) the EPC exceeds the most stringent risk value for either the Adult Residential Farmer, Child Residential Farmer, and/or the

OHARNG planned future use receptor, for either one of the $1x10^{-5}$ carcinogenic value and the non-carcinogenic risk value termed HQ using the 1.0 risk value, and/or 2) the Sum of Ratios for all carcinogens and all non-carcinogens that may affect the same organ are greater than 1 and the chemical contributes at least 10% to the sum.

The Draft FWCUGs for each of the COCs identified through the aforementioned process are the actual remediation levels unless there are additive effects. In some instances, there may be a risk management analysis such as a "Weight of Evidence" approach that may allow for a COC to be reassessed; however, any re-evaluation of a COC and the proposed approach will require concurrence from the Army and Ohio EPA. The use of the Sum of Ratios approach is intended to account for additive effects from exposure to multiple chemicals that can cause the same effect (e.g., cancer) or affect the same target organ. The Sum of Ratios approach compares the chemical concentration (e.g., mean concentration or concentration in confirmation samples, the EPC) of the COC to the individual Draft FWCUG to determine a ratio of acceptable risk (USACE, 2009a).

3.2.2 AOC-Specific Data Quality Objectives and Investigation Activities

For ODA1 and Sand Creek, where intrusive sampling activities will occur, the AOC-specific summary of results, COPCs identified during the DQO evaluation process for existing data and associated data gaps, and proposed characterization activities going forward are presented in Appendices A and C, respectively. The proposed characterization activities detail the numbers, types, and locations of samples to be collected to accomplish the project objectives. Geophysical data gaps identified for MABS during the DQO evaluation process and the proposed geophysical investigation activities at that AOC are presented in Appendix B.

This page intentionally left blank.

4.0 Project Activities

Prior to mobilizing to the field, Shaw will conduct a kick-off meeting with project personnel, which includes both key personnel identified in Section 2.0 and laborers. This kick-off meeting will familiarize the field team with the project's activities and safety requirements. All personnel will be trained and have all the necessary certifications in accordance with the Shaw site-specific *Safety, Health and Emergency Response Plan* (*SHERP*) (Shaw, 2009d). Any person required to work at an AOC will be required at a minimum to provide adequate training documentation including 40-Hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations (HAZWOPER) Training and current 8-Hour Annual OSHA HAZWOPER Refresher Training. Personnel performing MEC avoidance work shall meet the applicable minimum qualification standards for UXO Technicians as defined in Department of Defense Explosives Safety Board technical pamphlet TP-18. This section details the tasks that will be performed including the following:

- Pre-Sampling Activities
- Surface Soil Sampling
- Dry Sediment Sampling
- Subsurface Soil Sampling
- Sample Collection for Field and Laboratory Analysis
- Field Quality Control (QC) Sampling Procedures
- Decontamination Procedures
- Site Survey
- Archeological Surveys

All field activities and sampling procedures will be accomplished in accordance with Section 4.0 of the *FSAP*. Changes to the execution of specific tasks from those identified in the *FSAP* or unique elements of performing specific tasks are provided in this section. The AOC-specific rationale for sample types, quantities, and locations is provided in Appendices A through C.

4.1 Pre-Sampling Activities

Before the sampling crews are mobilized, activities that will ensure a quick, efficient mobilization and orderly execution of the project will be completed. These activities include the following:

- Conduct MEC clearance for sampling locations using MEC avoidance procedures
- Conduct geophysical surveys
- Clear vegetation from AOCs as needed for sample location access
- Verify that no utilities are present

- Stake sampling locations
- Inspect and transport sampling equipment to the field
- Coordinate site security with Post 1
- Establish work zones and decontamination facilities for sampling equipment

4.1.1 MEC Avoidance

Prior to entry at any of the AOCs by Shaw field personnel, Shaw will conduct MEC avoidance procedures as presented in Section 4.1.5 of the *SHERP* (Shaw, 2009e). Shaw will provide an Unexploded Ordnance (UXO) Technician III or higher for performing initial ground clearance of potential MEC with a Schonstedt Model GA-52Cx magnetometer (or equivalent). If MEC is encountered, the UXO Technician will immediately stop work, document the location of the MEC, and evacuate the work area; Shaw will immediately notify the RVAAP, OHARNG, and Ohio EPA. The MEC shall not be probed, touched, or handled by unauthorized personnel under any circumstances.

The UXO Technician will remain on-site for the duration of all activities to implement the MEC avoidance procedures in the event that unanticipated MEC is encountered. In addition to initial surface clearance, the UXO Technician will screen multi-increment (MI) surface and subsurface sampling locations using the Schonstedt. Soil boreholes will be screened using the Schonstedt as a downhole sensor until the field geologist has determined that the boring has reached undisturbed soil.

4.1.2 Vegetation Clearing

The vegetation at Sand Creek and the north and south boundaries of ODA1 are thickly wooded with considerable canopy. The remainder of ODA1 and the MABS sites are open with vegetation coverage consisting of primarily of grass. Depending on the time of year, more extensive vegetation removal, to include small trees (less than 3 inches in diameter), scrub brush and hanging vegetation (less than 6 feet above ground surface) along the banks of Sand Creek and the north and south ODA1 boundaries, may be required to allow for the performance of the geophysical survey and sampling activities. Clearing activities at these locations will be minimized to the extent possible to allow for the execution of work. Shaw will coordinate with the OHARNG/Camp Ravenna environmental office prior to performing work and any vegetation disturbance at Camp Ravenna property. Ground level vegetation will be mowed as necessary so personnel and equipment can safely access the designated sampling locations. Shaw will only clear vegetation that impedes or interferes with the safe and effective implementation of the project. All cleared vegetation will be removed and will be placed in piles at locations designated by OHARNG/Camp Ravenna.

4.1.3 Geophysical Prove-Out

The Geophysical Prove-Out (GPO) was conducted by Shaw in October 2009 to determine which geophysical system will be most effective in meeting the detection requirements and to demonstrate that the project DQOs will be met during the subsurface investigations. Shaw coordinated an adequate test plot location with RVAAP at which the GPO was performed. The proposed test plot area is approximately 100 square ft and is situated at an area at Load Line #7 considered to be representative of existing conditions at the AOCs. Shaw planted the 'seed items' within the test plot that were simulants intended to represent the following items that may be encountered during the proposed sampling activities: 75 millimeter (mm), 90mm, 105mm, and 155mm casings and steel shipping cylinders (PIGS). The seed items were placed at various depths ranging from just below ground surface to a maximum expected detection depth of six feet. The procedures used for conducting the GPO are presented in the *Final Geophysical Investigation Plan for the RVAAP-34 Sand Creek Disposal Road Landfill, RVAAP-03 Open Demolition Area #1, and RVAAP-28 Mustard Agent Burial Site* (Shaw, 2009d). The results of the GPO will be presented in a GPO report prior to commencing field sampling activities.

4.1.4 Geophysical Survey

The geophysical investigations will include evaluation of geophysical data to characterize in terms of anomaly density in the area of Sand Creek, ODA1 and MABS by documenting the locations of detected anomalies using Geometrics G858G cesium vapor magnetometer (G858G) or Geonics EM61 MK2 instruments. This information will also be used for utility verification, if any. As discussed in Section 4.1.1, for MEC avoidance purposes, a UXO Technician will sweep the area in front of the geophysics crew prior to the survey being performed. Areas identified with detected anomalies will be marked with pin flags and avoided as part of the subsurface sampling activities. The location where an anomaly is identified will be located using Global Positioning System (GPS) instrumentation as discussed in Section 4.2.7. The flags will remain in place at least for the duration of sampling. The procedures for conducting geophysical surveys are presented in the *Final Geophysical Investigation Plan for the RVAAP-34 Sand Creek Disposal Road Landfill, RVAAP-03 Open Demolition Area #1, and RVAAP-28 Mustard Agent Burial Site* (Shaw, 2009d).

4.1.5 Utility Clearance

Prior to intrusive subsurface activities, the designated on-site personnel will review available subsurface geophysics details and facility plans and mark out and identify any subsurface utilities for clearance. All infrastructure organizations or utility related agencies, including the Ohio Utilities Protection Services, which may potentially have utilities in the vicinity of each area, will also be contacted.

4.1.6 Staking Sample Locations

Wooden stakes will be placed at the approximate subsurface soil sampling locations and at the four corners of each MI sample collection area. The staked areas will be surveyed following sampling activities as discussed in Section 4.2.7 of this *Addendum*.

4.1.7 Site Security

Once mobilization begins, site security will be established and coordinated with the RVAAP security at Post 1. Site security is intended for the protection of the general public and site workers, as well as for the security of site equipment and materials.

Shaw will submit a roster of all personnel and subcontractors who will be working at the RVAAP. All personnel approved to enter the RVAAP must provide government issued identification (e.g., driver's license, passport) in order to enter and sign the arrival/departure roster. Any person required to work at an AOC will be required to provide adequate training documentation including 40-Hour OSHA HAZWOPER Training and current 8-Hour Annual OSHA HAZWOPER Refresher Training.

RVAAP security must be notified 24-hours in advance for deliveries to the RVAAP. Trucks are subject to search by RVAAP security at any time. Personnel are expected to observe posted speed limits at the RVAAP or a default of 35 miles per hour (mph) during daylight hours and 25 mph at night.

Shaw shall coordinate with RVAAP security to ensure that contact with Post 1 is maintained at all times. This means of communication could include cellular telephone, two-way radios, hard-line telephones or other acceptable means. The cellular phone may not be relied upon as the sole means of communication and must be backed up by a two-way radio or other acceptable means to enable contact with Post 1 and other Shaw personnel in areas of limited or no cell phone coverage.

4.1.8 Establish Work Zones and Decontamination Area

Shaw will establish work zones in accordance with the procedures presented in the SHERP (Shaw, 2009e). Due to the relatively short duration of this project, services such as water, telephone, sanitary, and gas will not be installed at the AOCs. Water for the decontamination of personnel and equipment will be stored in portable containers. Water for on-site use may be brought on-site daily or stored in a designated temporary location to be determined by the Shaw Field Operations Manager in coordination with the RVAAP Facility Manager.

A temporary decontamination area will be constructed to facilitate decontamination of the drill rigs and other associated equipment and personnel. The Shaw Field Operations Manager, in

coordination with the RVAAP Facility Manager, will determine the location and layout. Decontamination procedures are further discussed in Section 4.2.6.

4.2 Sampling Activities

Shaw will collect MI surface soil samples, MI dry sediment samples, and modified MI subsurface samples as part of the proposed investigation activities at ODA1 and Sand Creek. No intrusive sampling activities will be conducted at MABS. The characterization field activities will be performed in a well defined and consistent manner to ensure that the resulting data are comparable between sampling locations and can be validated against all applicable quality control (QC) requirements. This section defines the field methods and procedures that Shaw will implement. Sections of the *FSAP* are referenced when relevant that describe the methods and procedures that are applicable to the following activities:

- MI surface soil sampling (0 to 1 ft bgs)
- MI dry sediment sampling (0 to 0.5 ft bgs)
- Modified MI subsurface soil sampling (varies, see AOC-specific Appendices)
- Decontamination Procedures

All sampling activities will be conducted in accordance with Section 4.0 of the *FSAP*. Table 1-1 in the *QAPP Addendum* (Part II of this *Addendum*) summarizes the sampling and analysis requirements. The following sections discuss the field protocols and procedures to be used for the sampling activities to be conducted for this *Addendum*.

4.2.1 Multi-Increment Surface Soil and Dry Sediment Sampling

Surface soil and dry sediment samples will be collected using the MI sample approach. The purpose of collecting, preparing, and analyzing an MI sample is to provide a repeatable and accurate measure of the average concentrations of constituents of interest within a sample area. Sufficient amount of sample material must be collected from the sample area to account for compositional heterogeneity and additionally, a sufficient number of sub samples utilizing a stratified random methodology must be taken to account for distributional heterogeneity. Typical uses of accurate, average values are as, (i) exposure point concentration within human health or ecological risk assessments, (ii) delineation of nature and extent of contamination, (iii) characterization sampling of a potential waste material, and (iv) closure sampling of a remediated area to provide legally defensible, scientifically based evidence that satisfactory remediation has been accomplished.

Each MI surface soil sample will consist of 30 random samples collected from each designated area across the entire 1-ft interval between 0 and 1 ft bgs. Each MI dry sediment sample will consist of 30 random samples collected from each designated area across the entire 6-inch interval between 0 and 0.5 ft bgs. Sub-sample locations within the designated MI sampling area

will be selected on a systematic-random basis at ODA1 and on a stratified-random basis at Sand Creek. The systematic-random approach may be more reproducible; however, uneven terrain and heavy vegetation, such as at Sand Creek, may require more flexibility in selecting sub-sample locations. The stratification assures coverage over the entire sample area and the randomness provides repeatability and accuracy. The key steps for collection of a systematic random sample as depicted in Figure 4-1 are: 1) sub-divide the MI sampling area into a uniform grid (e.g., pace out the area and divide into at least 30 grids for a 30-aliquot sample), 2) randomly select a single sub-sample location in the first grid, and 3) collect sub-samples from the same relative location within each of the other grids (USACE, 2009b). In stratified random sampling as depicted in Figure 4-2, the MI sampling area is sub-divided into a uniform grid and one sub-sample is collected from a location chosen randomly in each grid (USACE, 2009b).

Figure 4-1
Systematic Random Sampling

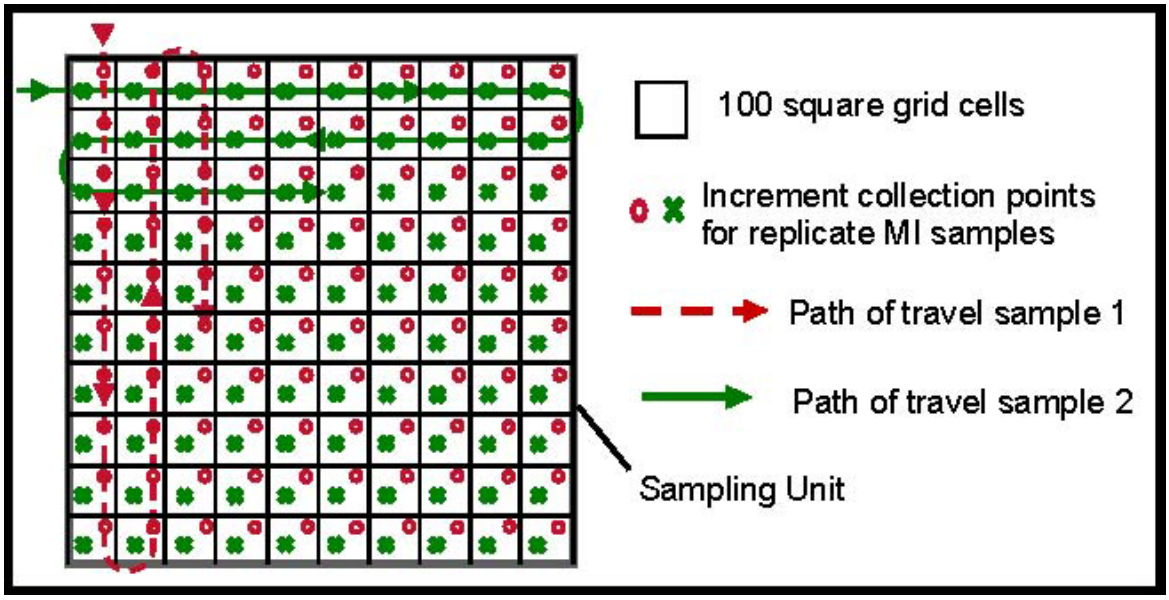
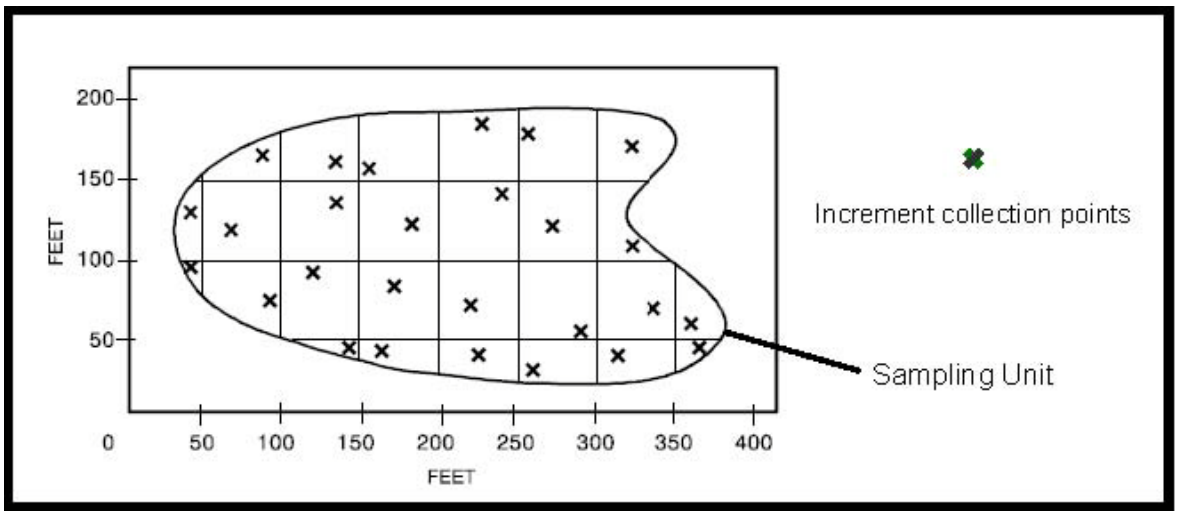


Figure 4-2
Stratified Random Sampling



MI samples will be collected from the pre-determined number of sub-sample locations using a $^{7}/_{8}$-inch stainless steel step probe (or approved equal) sample collection device. The sub-samples shall be placed into a plastic lined bucket and combined to make a single sample. If feasible, disposable tools may be utilized; otherwise, decontamination will be performed on tools between samples areas, but not during collection of the sub-samples within a sample area. The sub-samples collected from a sample area should be placed together in a container, such as a large baggie that is large enough to transport them back to the sample processing location.

Approximately 1 kilogram of soil or dry sediment will be collected for each MI sample and submitted to the laboratory for processing and analysis. Processing consists of drying out the sample and the sieving the sample through a #10 sieve. Any material larger than the #10 sieve is discarded. The remaining air-dried, sieved material should then be ground to better homogenize the sample. Shaw has successfully used off-site laboratories for MI sample processing and analysis in the past for work conducted at the RVAAP and intends to do the same for this program.

Field duplicate samples will be collected from the MI sample areas at the frequency listed in Section 4.2.5 of this *Addendum*. The collection of the field duplicate samples requires two similar portions of soil or dry sediment. Therefore, at an MI sample location where a field duplicate is to be collected, two MI samples will be collected from within the same MI sample area consisting of at least 30 sub-sample aliquots each. The two samples will be labeled with different sample numbers and submitted to the laboratory for processing as a blind field duplicate.

The MI sampling method will not be utilized for volatile organic compound (VOC) analysis. If a sample is designated for VOC analysis, one discrete sample will be collected from within the MI area using the bucket hand auger method identified in Section 4.5.2.1.1 of the *FSAP*. The specific location of the discrete sample will be biased toward the area most likely to contain volatile compounds, or if no such area is observed, the location will be randomly chosen. Soil and dry sediment portions designated for VOC analysis will be placed directly in the sample container and will not be composited or further processed in the field. A photoionization detector (PID) will be used to screen for VOC headspace following placement of the soil or dry sediment portion into the sealed sample container in accordance with Section 4.4.2.3 of the *FSAP*.

4.2.2 Subsurface Soil Sampling

Subsurface soil will be collected by means of hydraulic direct-push samplers (e.g., Geoprobe®) to a maximum sampling depth of 16 ft bgs at ODA1 and 20 ft bgs at Sand Creek. In the event that the sample location cannot be accessed with the Geoprobe® rig, as may be the case for areas of steep slopes at Sand Creek, subsurface soil will be collected using a bucket hand auger to a maximum sampling depth of 5 ft bgs. The procedures for hydraulic direct-push and bucket hand auger sampling are discussed in Sections 4.4.2.1.5 and 4.4.2.1.4 of the *FSAP*, respectively.

Subsurface samples will be collected at a maximum of 4-ft intervals using the modified MI sampling approach. In general, 30 increments of soil will be collected from the soil column for each 4-ft interval to generate an modified MI sample. Modified MI subsurface soil samples will be collected at ODA1 and Sand Creek. The subsurface soil sample intervals for ODA1 begin between 1 and 5 ft bgs depending on the location relative to prior sampling and removal activities as described in Appendix A. The subsurface soil sample intervals for Sand Creek will begin at 1 ft bgs as described in Appendix C.

Duplicate QC samples will be collected at the frequency listed in Section 4.2.5 of this *Addendum*. Borehole logs, including estimates of Unified Soil Classification System (USCS) classification, will be prepared at the time of sampling in accordance with Section 4.3.2.4.1.1 of the *FSAP*. Organic vapor screening using a PID will be conducted on soil cores and results will be noted on the borehole logs. Soil sample organic vapor headspace readings will not be obtained.

4.2.3 Chromium Speciation

Previous samples at each AOC have been analyzed for total chromium only. In this *Addendum* and the referenced DQO Reports, the total chromium Draft FWCUG, as presented in the *Draft Facility-Wide Human Health Remediation Goals, Ravenna Army Ammunition Plant* (SAIC, 2008), was used for screening both total and hexavalent chromium results. Although, a Draft FWCUG is provided for hexavalent chromium for each of the receptors, it is the same as the Draft FWCUG for total chromium. The use of the total chromium Draft FWCUG for both

chromium states is based on the assumption that chromium exists predominantly in the trivalent state, rather than the more toxic hexavalent state. In order to confirm this assumption and determine an appropriate risk, chromium speciation samples will be collected at the AOCs to develop AOC-specific ratios of hexavalent chromium to trivalent chromium.

Chromium speciation measures the concentration of chromium present in both the hexavalent and trivalent forms. Based on these measurements, a sample specific ratio of hexavalent chromium to trivalent chromium can be calculated. When done for several samples at a site, a site-specific ratio can be determined. This ratio can then be applied to the larger total chromium data set as part of the development of site-specific risks. For the AOCs included in this *Addendum*, this ratio will be calculated by collecting and analyzing up to 5 samples for each surface and subsurface soils and dry sediment per AOC for both hexavalent chromium and total chromium. The number of samples for each AOC is identified in Appendices A through C. Efforts will be made to collect samples both from areas previously identified as having elevated total chromium concentrations and areas identified as having chromium concentrations near background levels, if possible. Should analytical data indicate the ratio of hexavalent chromium to trivalent chromium is 1:6 (i.e., 14 percent) in environmental samples at an AOC, the Draft FWCUG for total chromium will be used for risk calculations as part of the human health risk and ecological screening assessments required for the RI/FS. This process has been approved and was documented in the *Remedial Investigation Report Addendum No. 1 for the RVAAP-49 Central Burn Pits* (USACE, 2008). However, if the ratio varies from the standard 1:6 ratio, the draft FWCUG will be adjusted to a lower or higher value using the toxicity values for the two valence states of chromium and the AOC-specific hexavalent to trivalent chromium ratio.

4.2.4 Sample Collection for Laboratory Chemical Analyses

The following chemical analyses will be conducted for soil and dry sediment samples:

- All samples will be analyzed for Target Analyte List (TAL) metals and explosives. Parameters are detailed for each AOC in Appendices A and C.
- A minimum of 10 percent of the MI samples at each AOC will be analyzed for the full suite of parameters (Table 1-1 of the *QAPP Addendum*) including VOCs (discrete samples only), semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), cyanide and propellants (nitroglycerine, nitrocellulose and nitroguanidine).
- MI samples will not be analyzed for VOCs; instead, a discrete sample will be specially handled for VOC analysis at designated MI sample areas.
- Up to 5 samples per media per AOC will be analyzed for hexavalent chromium.

Sample container and preservation technique requirements will follow those identified in Table 4-1 of the *QAPP Addendum*.

4.2.5 Field QC Sampling Procedures

Soil and dry sediment QA/QC samples will be collected during the implementation of this *Addendum* for the various AOCs. QC duplicate samples will be collected at a frequency of 10 percent (1 per 10 environmental samples) for each medium (e.g., soil, dry sediment). Matrix spike/matrix spike duplicate (MS/MSD) samples will be collected at a rate of 5 percent (1 per 20) of the total samples per medium. For QA of MI samples, designated samples will be processed and split by the primary laboratory. The QA split sample will be submitted to the USACE-contracted QA Laboratory for analysis. Duplicate and split samples will be derived from the same sampling station (or MI area for MI samples), selected on a random basis, and submitted for the same analyses as the environmental samples. If disposable sampling equipment is not used, then 1 rinsate blank will be collected for each surface soil and dry sediment re-usable sampling equipment per field cycle.

One source blank will be collected from the portable water source, which will be used for all potable wash and rinse water for equipment decontamination during the implementation of this *Addendum*. One source blank will also be collected from the deionized/distilled (American Society for Testing and Materials [ASTM] Type I) water source used. The source blanks will be analyzed for a full suite of analyses.

Section 3.0 of the *QAPP Addendum* summarizes QA/QC sampling requirements. Quantities of QA/QC samples are presented in Table 1-1 of the *QAPP Addendum*.

4.2.6 Decontamination Procedures

The decontamination procedure for surface and subsurface soil and dry sediment sampling activities is presented in Section 4.4.2.8 of the *FSAP*. This procedure will be followed with the exception of using isopropanol in place of the methanol rinse. Sampling equipment that is not dedicated will be decontaminated after completion of sampling activities at each borehole for subsurface soil and each sampling location for surface soil and dry sediment. A final decontamination inspection of any equipment leaving RVAAP at the end of field activities will be conducted to ensure proper decontamination.

4.2.7 Site Survey

Following sampling activities, the horizontal coordinates of all sampling locations and the corners of MI sample areas will be determined. Surveys will be performed utilizing a Trimble ProXRS (or approved equal) GPS with submeter or better accuracy; however, a professional surveyor's services may be required if vegetation cover limits the capabilities of the GPS. All locations will be conveyed in Ohio State Plane Coordinates (NAD83). The coordinates will be

recorded on a field log sheet and/or boring logs. Electronic results will be provided to USACE and RVAAP in ASCII format.

4.3 Cultural Resources

This area has not been previously surveyed for cultural or archaeological resources. In the event that cultural materials, artifacts, or human remains are encountered in or near the AOC, either by the contractor, his subcontractors, or by other personnel observing the AOC during this scope of work, the following OHARNG procedures for inadvertent discoveries should be followed:

- Report any observations or discoveries or artifacts or human remains immediately to the OHARNG Cultural Resource Manager (CRM)/Environmental Office. If the CRM is not available, report the discovery to Range Control. Report incident to RVAAP, USACE, and Ohio EPA.
- The CRM or Range Control will secure any artifacts or remains identified in the AOC area for analysis or curation, as appropriate. Human remains are not to be disturbed or removed from the AOC.
- The CRM will examine the area to determine whether an archaeological deposit or human burial has been exposed within the area and will take measures to protect the location from further disturbance.
- If human remains are known or suspected to be present, the CRM or Range Control will also promptly notify the State police or Federal Bureau of Investigation, as appropriate.
- The CRM will promptly notify the Ohio Historic Preservation Office (OHPO) of the discovery. The CRM will follow the Native American Graves Protection and Repatriation Act (NAGPRA) and the Archeological Resources Protection Act (ARPA) procedures to contact Native American tribes and any other stakeholders as appropriate.
- If a site area or burial is identified as the source of the materials found in the AOC, the CRM will make arrangements for the site recordation and stabilization, in consultation with the OHPO and any interested Native American tribes.

All archaeological surveys and cultural activities will be performed with OHARNG oversight and approval.

This page intentionally left blank.

5.0 Sample Chain-of-Custody Documentation

5.1 Field Logbook

All information pertinent to soil boring and sampling activities, including field instrument calibration data, will be recorded in field logbooks. All field logbook information will follow structures identified in Section 5.1 of the *FSAP*.

5.2 Photographs

Information regarding documentation of photographs taken during AOC-specific investigations is presented in Section 4.3.2.4.3 of the *FSAP*. Representative photographs will be taken of the investigative measures during the fieldwork and any significant observations that are made during the field effort. Photographs will be suitable for presentation in a public forum, as well as for documenting scientific information. Attempts will be made when taking photographs to document sampling points to include two or more permanent reference points to facilitate relocating.

5.3 Sample Numbering System

The sample numbering system that will be used to identify samples collected during the implementation of this *Addendum* is outlined in Section 5.3 and Figure 5-1 of the *FSAP*. Sample numbers for each AOC presented in Appendices A and C were coordinated with Science Applications International Corporation (SAIC), the current Ravenna Environmental Information Management System (REIMS) Manager, in order to provide a continuous and accurate documentation of samples collected at each AOC and to avoid duplication of sample numbers within the data base. Specific sample identifying information that will be used to implement the sampling scheme is presented in Figure 5-1. Samples will be identified sequentially using the identification number system consistent with previous investigations.

5.4 Sample Documentation

All sample label and chain-of-custody information will follow the procedures identified in Section 5.4 of the *FSAP*.

5.5 Documentation Procedures

Documentation and tracking of samples and field information will follow the series of steps identified in Section 5.5 of the *FSAP*.

5.6 Corrections to Documentation

Any correction to documentation will follow guidance established in Section 5.6 of the *FSAP*.

Figure 5-1
Sample Identification System

Sample Identification: XXXmm-NNN(n)-####-tt	
XXX = Area Designator	DA1 = Open Demolition Area 1 (RVAAP-03) MAB = Mustard Agent Burial Site (RVAAP-28) SC = Sand Creek Disposal Road Landfill (RVAAP-34)
mm = Sample Location Type	SB = Soil Boring/Subsurface Soil Location SS = Surface Soil Location SD = Sediment Sample Location
NNN = Sequential Sample Location Number	Unique, sequential number for each sample location beginning with the number following from the last number used from previous investigation stations and extending into any subsequent investigative phases (i.e., 001-999)
(n) = Special Identifier	Optional use (as needed) to identify special sample matrices or sample location characteristics (e.g., m=multi-increment sample, d=discrete sample)
#### = Sequential Sample Number	Unique, sequential number for each sample beginning with last sampling locations, specific to each AOC, and extending into any subsequent investigative phases (i.e., 0001-9999)
tt = Sample Type	SO = Soil Sample SD = sediment sample FB = Field Blank ER = Equipment Rinsate

5.7 Monthly Reports

Shaw will identify the status of *Addendum* activities in the contract-required monthly progress reports. These reports are submitted to the USACE Project Manager by the 10th of each month. The reports contain the following information: 1) site identification and activities; 2) status; 3) percent complete; 4) data collected to date (not including analytical results which are provided in site-specific documents); 5) difficulties encountered; 6) corrective actions; and 7) planned activities.

6.0 Sample Packaging and Shipping Requirements

Sample packaging and shipping will be performed in accordance with the procedures identified in Section 6.0 of the *FSAP*.

This page intentionally left blank.

7.0 Investigation-Derived Waste

All investigation-derived waste (IDW), including consolidated MI surface soil and dry sediment sampling spoils, drilling spoils, personal protective equipment (PPE), disposable sampling equipment, and decontamination fluids, will be properly handled, labeled, characterized, and managed in accordance with Section 7.0 of the *FSAP*. At the conclusion of field activities for the project, a letter report will be submitted to the USACE, Ohio EPA, and the RVAAP Facility Manager documenting the characterization and classification of the wastes. Upon approval of the IDW classification report, all solid and liquid IDW will be removed from the site and disposed of by a licensed waste disposal contractor. All shipments of IDW off site will be coordinated through the RVAAP Facility Manager.

7.1 IDW Collection and Containerization

The following types of IDW are anticipated to be generated during the proposed field activities:

- Environmental Media (soil and dry sediment) derived from the surface soil, subsurface soil and dry sediment sampling activities.
- Solid Waste (decontamination fluids) derived from decontamination of sampling equipment and drilling equipment.
- Solid Waste (expendable waste debris) including PPE and disposable sampling equipment.

Environmental media and solid waste will be contained separately. For the environmental media, unsaturated soils will be segregated from saturated soils. For solid waste, decontamination fluids will be containerized separately from expendable solid waste debris. Characterization and classification of the different types of IDW will be based on the specific protocols described below.

- **Soils and Dry Sediment:** Drilling spoils and excess surface soils and dry sediment will be placed in 55-gallon steel drums, plastic lined and sealed with gasketed ring-topped lids. Disposition of the drummed soil will be based on analytical results from the environmental samples or from direct results of composite IDW samples. For estimating purposes, approximately ten 55-gallon drums will be used to contain environmental media waste generated during sampling activities.
- **Decontamination Fluids:** Decontamination fluids will be placed in steel or polyethylene drums. Disposition of decontamination liquid will be based on the analytical results of composite grab samples from the containers. For estimating purposes, approximately two 55-gallon drums of decontamination fluids (one for each of the AOCs to be sampled) will be generated.

- **Expendable Waste Debris:** Expendable waste debris will be segregated as non-contaminated and potentially contaminated material based on visual inspection, use of the waste material and field screening using field screening instruments. Expendable waste debris considered to be non-contaminated will be placed in trash bags and stored in 55-gallon drums or sanitary waste containers whereas potentially contaminated expendable waste will be containerized in 55-gallon steel drums, plastic lined and sealed with gasketed ring-topped lids. Disposition of expendable waste debris will be based on correlative results of the environmental samples submitted for laboratory analyses.

7.2 Waste Container Labeling

All containerized waste will be labeled as specified in Section 7.2 of the *FSAP*. Label information on each container will be written in indelible ink and will include at a minimum; container number, contents, source of the waste, source location, project name and site identification, physical characteristics of the waste, and generation dates. Each label will be placed on the side of each container at a location that will be protected from damage or degradation.

7.3 IDW Field Staging

Shaw will coordinate a central field staging area (FSA) with the RVAAP Facility Manager, OHARNG/Camp Ravenna environmental office and Ohio EPA prior to generating waste. All waste shall remain on the FSA until it has been characterized for disposal. The FSA will be visibly identified with signage and the drums/containers will be covered with poly sheeting if the FSA is in an open location. Drummed soil will be transported to the FSA where it will be staged on wooden pallets. Decontamination fluids will also be staged at the identification location within secondary containment structures. To avoid potential drum rupture due to freezing conditions, drums containing liquid IDW will be filled only to 75 percent capacity.

7.4 IDW Disposal

Disposal of IDW will be conducted in accordance with Section 7.5 of the *FSAP*. All waste determined to be ‘non-hazardous, contaminated’ or ‘hazardous, contaminated’ will be disposed off-site at a permitted waste facility. Non-contaminated expendable waste debris will be disposed as sanitary trash. Potentially contaminated expendable waste debris will be disposed similar to the associated waste under which it was generated. Any on-site disposal of the generated waste (soils and dry sediments) that have been identified with concentrations below the RVAAP acceptable criteria and background concentrations will require approval from the RVAAP Facility Manager, OHARNG/Camp Ravenna environmental office, and the Ohio EPA prior to on-site disposal.

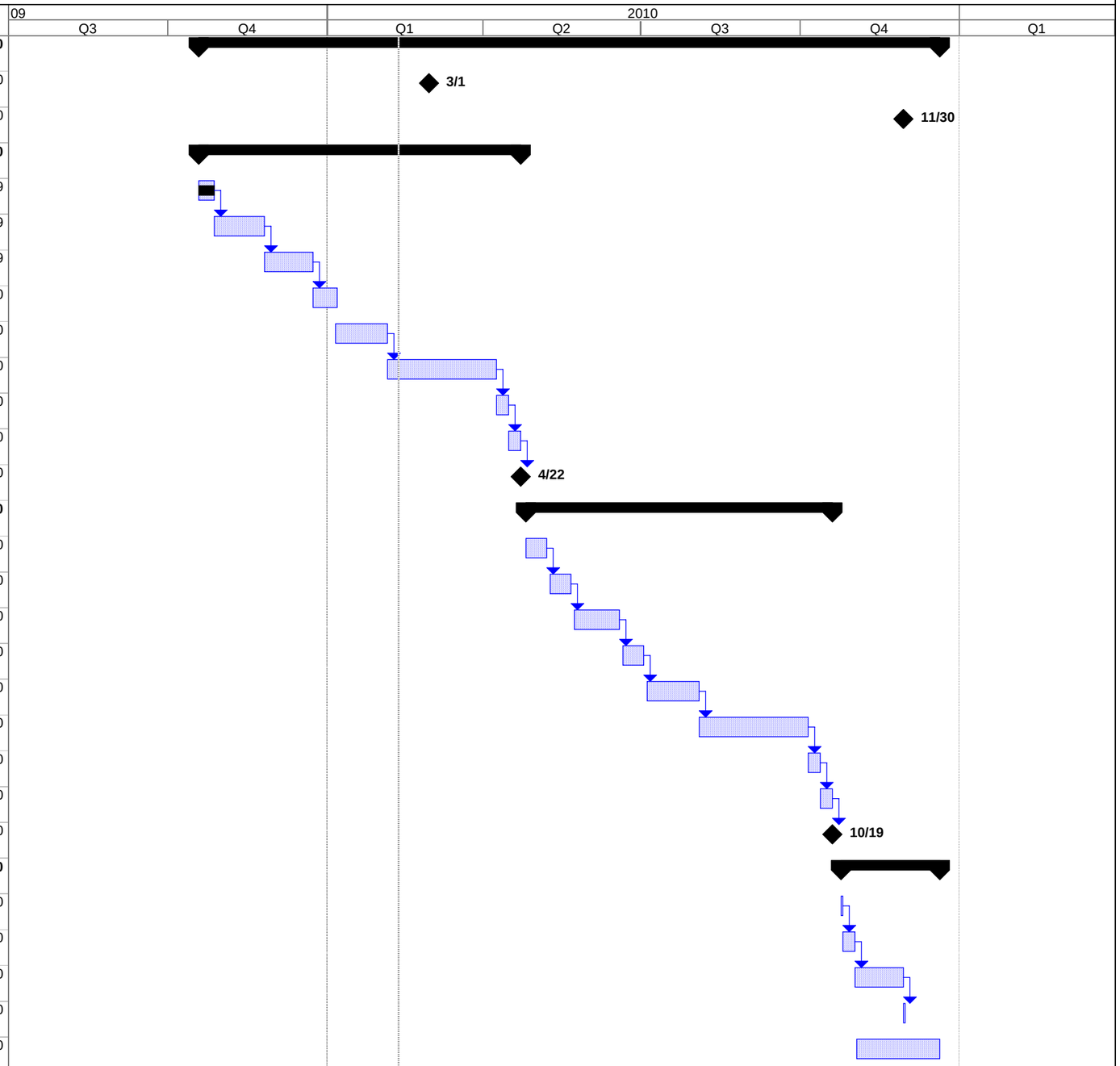
8.0 Project Schedule

The schedule for this scope of work is dependent upon completion of the *Final Addendum* and USACE and Ohio EPA approval thereof. Following approval of this *Addendum* and the *Geophysical Prove-Out Report* that is being reviewed concurrently with this *Addendum*, Shaw anticipates mobilizing to the field to conduct geophysical mapping of the three AOCs in April 2010. Following review and approval of the geophysical survey report, field sampling would commence in October 2010. It is expected that field sampling activities will be completed in December 2010. A detailed breakdown of the schedule of the proposed activities included in this addendum is shown in **Figure 8-1**.

This page intentionally left blank.

Figure 8-1
Field Sampling and Analysis Plan Addendum No. 1 Schedule

ID	Task Name	Duration	Start	Finish
1	**Project Work Plan Activities**	**306 days**	**10/19/09**	**12/20/10**
2	Final Work Plan Approved	0 days	3/1/10	3/1/10
3	Field Sampling Activities Completed	0 days	11/30/10	11/30/10
4	**Geophysical Prove-Out (GPO)**	**134 days**	**10/19/09**	**4/22/10**
5	Conduct onsite GPO	7 days	10/19/09	10/27/09
6	Prepare Preliminary Draft GPO Report	21 days	10/28/09	11/25/09
7	Army Review of Preliminary Draft GPO Report	20 days	11/26/09	12/23/09
8	Respond to Army Preliminary Draft Review Comments	10 days	12/24/09	1/6/10
9	Prepare Draft GPO Report	22 days	1/6/10	2/4/10
10	Ohio EPA Review of Draft GPO Report	45 days	2/5/10	4/8/10
11	Respond to Ohio EPA Draft Review Comments	5 days	4/9/10	4/15/10
12	Prepare Final GPO Report	5 days	4/16/10	4/22/10
13	Final GPO Approved	0 days	4/22/10	4/22/10
14	**Geophysical Mapping of 3 Areas of Concern (AOCs)**	**127 days**	**4/26/10**	**10/19/10**
15	Conduct Field Geophysical Mapping at 3 AOCs	10 days	4/26/10	5/7/10
16	Prepare Preliminary Draft Geophysical Survey Report	10 days	5/10/10	5/21/10
17	Army Review of Preliminary Draft Geophysical Survey Report	20 days	5/24/10	6/18/10
18	Respond to Army Preliminary Draft Review Comments	10 days	6/21/10	7/2/10
19	Prepare Draft Geophyiscal Survey Report	22 days	7/5/10	8/3/10
20	Ohio EPA Review of Draft Geophysical Survey Report	45 days	8/4/10	10/5/10
21	Respond to Ohio EPA Draft Review Comments	5 days	10/6/10	10/12/10
22	Prepare Final Geophysical Survey Report	5 days	10/13/10	10/19/10
23	Final Geophysical Survey Report Approved	0 days	10/19/10	10/19/10
24	**Environmental Sampling at ODA1 and Sand Creek**	**41 days**	**10/25/10**	**12/20/10**
25	Mobilize Personnel and Equipment	1 day	10/25/10	10/25/10
26	Perform vegegation clearance	5 days	10/26/10	11/1/10
27	Field Sampling	20 days	11/2/10	11/29/10
28	Demobilize Personnel and Equipment	1 day	11/30/10	11/30/10
29	Laboratory analysis (15 Day TAT)	34 days	11/3/10	12/20/10



Project: Schedule
Date: 2/11/10

Task | Milestone | Rolled Up Task | Rolled Up Progress | External Tasks | Group By Summary
Progress | Summary | Rolled Up Milestone | Split | Project Summary | Deadline

This page intentionally left blank.

9.0 References

Science Applications International Corporation (SAIC), 2001a. *Final Facility-Wide Sampling and Analysis Plan for Environmental Investigations at the Ravenna Army Ammunition Plant, Ravenna, Ohio*. March 2001.

SAIC, 2001b. *Final Phase II Remedial Investigation Report for the Winklepeck Burning Grounds at the Ravenna Army Ammunition Plant, Ohio*. April 2001.

SAIC, 2008. *Draft Facility-Wide Human Health Cleanup Goals, Ravenna Army Ammunition Plant, Ravenna, Ohio*. September 2008.

Shaw Environmental & Infrastructure, Inc. (Shaw), 2009a. *Final Data Quality Objectives Report for the RVAAP-28 Mustard Agent Burial Site*. May 11, 2009.

Shaw, 2009b. *Final Data Quality Objectives Report for the RVAAP-34 Sand Creek Disposal Road Landfill*. July 16, 2009.

Shaw, 2009c. *Final Data Quality Objectives Report for the RVAAP-03 Open Demolition Area 1*. October 9, 2009.

Shaw, 2009d. *Final Geophysical Investigation Plan for the RVAAP-34 Sand Creek Disposal Road Landfill, RVAAP-03 Open Demolition Area #1, and RVAAP-28 Mustard Agent Burial Site*. July 16, 2009.

Shaw, 2009e. *Preliminary Draft Safety, Health, and Emergency Response Plan for Environmental Services at Sand Creek Disposal Road Landfill (RVAAP034), Open Demolition Area #1 (RVAAP-03), Mustard Agent Burial Site (RVAAP-28) and Winklepeck Burning Grounds (RVAAP-05)*. September 2, 2009.

USACE, 2005. *RVAAP's Facility-Wide Human Health Risk Assessor Manual, Amendment 1*. December 1, 2005.

USACE, 2008. *Remedial Investigation Report Addendum No. 1 for the RVAAP-49 Central Burn Pits at Ravenna Army Ammunition Plant, Ravenna, Ohio, GS-10F-0076J, DO W912QR-05-F-0033*. Final. June 2008.

USACE, 2009a. *Ravenna Army Ammunition Plant (RVAAP) Position Paper for the Application and Use of Facility-Wide Human Health Cleanup Goals*. June 2009.

USACE, 2009b. *Interim Guidance 09-02, Implementation of Incremental Sampling (IS) of Soil for the Military Munitions Response Program*. July 20, 2009.

This page intentionally left blank.

APPENDIX A
OPEN DEMOLITION AREA 1 (RVAAP-03)

This page intentionally left blank.

A.0 *Open Demolition Area 1 (RVAAP-03)*

A description of the Open Demolition Area #1 (ODA1; RVAAP-03), previous investigations at this Area of Concern (AOC), and the rationale for additional characterization activities are presented in the *Final Data Quality Objectives (DQO) Report for the RVAAP-03 Open Demolition Area 1* (Shaw, 2009) and summarized in this section. This section further describes the proposed characterization activities based on the results of the *DQO Report*.

A.1 AOC Description

The ODA1 AOC is approximately 6 acres and was formerly used during the 1940s primarily for the open burning and open detonation (OB/OD) of munitions, explosives and associated materials. ODA1 is located within the National Advisory Committee for Aeronautics (NACA) Test Area (NTA; RVAAP-38). The OB/OD area within ODA1 was surrounded by an oval shaped earthen berm and is located adjacent to areas where aircraft used at NTA were staged. Recent visual inspections of the site indicate that OB/OD activities associated with the ODA1 may have also been conducted in small areas within the NTA plane storage area adjacent to ODA1. Burning areas at ODA1 may have been cleared by pushing debris and scrap to the periphery of ODA1 using heavy equipment. ODA1 is currently covered with grass and the berms around the OB/OD area essentially removed. ODA1 has been unused since the cessation of OB/OD activities although dismounted troop training by the Ohio Army National Guard (OHARNG) has been ongoing at the surrounding NTA site since 1969. Seibert stakes have been installed to define the current boundary of the ODA1 site.

Topography across the ODA1 AOC is relatively flat with little change in elevation. The AOC is slightly elevated as compared to its immediate surroundings and surface drainage is to the east, west and south. Drainage from within the bermed OB/OD area is south via a culvert towards a shallow ditch which ultimately discharges at ground surface within the Hinkley Creek drainage area. Depth to groundwater at the site and the adjacent NTA site has been observed to be 15 to 16 feet below ground surface (ft bgs).

A.2 Previous Investigations

Beginning in 1996, the United States Army Center for Health Promotion and Preventive Medicine (USACHPPM) collected surface soil samples as part of a Relative Risk Site Evaluation (RRSE). Other investigations conducted at ODA1 include:

- A Phase I Remedial Investigation (RI) was conducted by Science Application International Corporation (SAIC) in 1999 to further evaluate the occurrence and

distribution of contamination within the AOC in soils, sediment, surface water, and groundwater which included collection of the following samples:

- Forty-two (42) discrete surface soil samples (0 to 1 feet below ground surface [ft bgs])
- Seventy-seven (77) discrete subsurface soil samples (1 to 3, 3 to 5, and 6 to 8 ft bgs)
- Four discrete sediment samples (0 to 0.5 ft bgs)
- Three surface water samples
- One groundwater screening sample

- An interim removal action (IRA) was performed by MKM Engineers, Inc. (MKM) in 2000-2001 to address impacted soils identified in the Phase I RI and remove residual munitions and explosives of concern (MEC) debris. The following samples were collected during this event:
  - Twenty-three (23) discrete subsurface soil samples (intervals vary from 2 to 8 ft bgs)

Shaw prepared the *DQO Report* based on the results of those investigations and evaluated the data using the systematic approach presented in the *RVAAP's Facility-Wide Human Health Risk Assessor Manual, Amendment 1* (*HHRAM*; USACE, 2005) to identify data gaps where additional investigation may be warranted. The *DQO Report* identified chemicals of potential concern (COPCs) and chemicals of concern (COCs) that consisted of elevated concentrations of primarily inorganics above the Ravenna Army Ammunitions Plant (RVAAP) background and draft facility-wide cleanup goals (Draft FWCUG) screening criteria for the unrestricted Residential Farmer (adult and child) and OHARNG land use scenarios presented in the *Draft Facility-Wide Human Health Remediation Goals, Ravenna Army Ammunition Plant* (SAIC, 2008). In order to identify COPCs, investigation data (i.e., Phase I RI surface and subsurface soil data) was screened to the 10^{-6} cancer risk level and hazard quotient equal to 0.1 and evaluated to determine COPCs. The COCs were identified by screening the confirmation data collected during the remedial action (i.e., IRA subsurface soil data) to the 10^{-5} cancer risk level and hazard quotient equal to 1. The *DQO Report* recommended that additional surface and subsurface soil sampling be performed to address identified data gaps. Any additional surface water, sediment, or groundwater investigations would be performed under activities associated with the NTA site investigation or the RVAAP facility-wide programs. A summary of COPCs in surface soil and COCs in subsurface soil identified in the *DQO Report* to require further investigation is presented in **Table A-1** below. The table identifies the COPCs or COCs based on the evaluation presented in the DQO Report, their frequency of detection, the number of detections where the

concentrations was greater than both the background value and the Draft FWCUGs, and the maximum concentration detected for each medium (e.g., surface soil or subsurface soil).

Table A-1
Summary of COPCs and COCs for ODA1

Medium	Analyte	Frequency of Detection	# Detects > Background and Draft FWCUGs	Maximum Detect (mg/kg)
Surface Soil (COPCs)	Arsenic	23 / 23	1	15.6
	Beryllium	7 / 23	1	0.94
	Chromium (total)	23 / 23	5	22.7
	Cobalt	23 / 23	3	15.4
Subsurface Soil (COPCs)	Aluminum	42 / 42	1	28,600
	Arsenic	41 / 41	2	21.1
	Chromium (total)	42 / 42	1	34.7
	Lead	42 / 42	1	19.4
Subsurface Soil (COCs)	Aluminum	23 / 23	1	252,000
	Arsenic	22 / 23	6	29.3
	Beryllium	22 / 23	NA	1.0
	Chromium (total)	23 / 23	1	249
	Copper	23 / 23	1	74,200
	Lead	23 / 23	NA	2,370
	Nitrocellulose	3 / 3	NA	1.0
	Benzene	1 / 4	NA	0.066
	Ethylbenzene	1 / 4	NA	0.130
	Toluene	2 / 4	NA	0.180
	Xylene (total)	1 / 4	NA	0.610
	Naphthalene	1 / 4	NA	0.120

***Notes**:*
COCs = Chemicals of Concern, screened to Draft FWCUGs at 10^{-5} cancer risk and hazard quotient equal to 1.
COPCs = Chemicals of Potential Concern, screened to Draft FWCUGs at 10^{-6} cancer risk and hazard quotient equal to 0.1
FWCUGs = facility-wide cleanup goals
NA = not applicable
mg/kg = milligrams per kilogram

A.3 Proposed SAP Characterization Activities

The *DQO Report* concluded that environmental sampling is necessary to determine the extent of COPCs in surface soil and COCs in subsurface soil that remained after the IRA was completed in 2001. Proposed sampling includes the collection of 3 surface soil samples and the performance of 18 subsurface soil borings (82 subsurface soil samples). The media to be sampled and the rationale for the sampling strategy are discussed in the following sections and summarized in **Table A-2**. The coordinates and sample-specific rationale for the proposed sampling locations are presented in **Table A-3**. The proposed sampling locations are shown in **Figure A-1**.

Prior to performing any intrusive sampling and/or removal activities, a geophysical investigation will be performed. At present, it is uncertain if the geophysical survey will indicate any additional potential source areas outside of the current AOC boundaries at ODA1. The need for

additional environmental media sampling beyond the areas originally identified in the *DQO Report* will be evaluated after completion of the geophysical survey. In the event the geophysical survey confirms the presence of additional potential source areas, it will be necessary to implement a revised sampling program to assess the environmental media. Shaw will submit any changes to the sampling program in a Field Change Order notification to be approved by the Army and Ohio EPA and details of the changes will be included in the remedial investigation report.

In accordance with the sample numbering system identified in Figure 5-1 of the *FSP Addendum*, surface soil samples at ODA1 will be identified using the formula DA1ss-NNN-####-SO and subsurface soil samples will be identified using the formula DA1sb-NNN-####-SO. Based on existing datasets for ODA1 and in coordination with the Ravenna Environmental Information Management System (REIMS) contractor for the RVAAP, sample numbering will be assigned sequentially beginning with sample location number (NNN) '050' and sample number (####) '0200.' The proposed sample locations are identified in **Table A-2** with the coordinates in Ohio State Plane (NAD 83). For surface soil samples, the coordinates are provided for the four corners of the MI sample area. The sample numbers, beginning at 0200, will be assigned in the field as each sample is collected.

Table A-2
Summary of Proposed Sampling at ODA1

Medium	Sample Type	Depth (ft bgs)[1]	No. of Samples[2]	Rationale
Surface Soil	MI	0-1	3	A minimum of 3 MI surface soil samples will be collected to address data gaps along the southwest, southern, and southeast perimeters of the site and to further characterize the areas where COPCs consisting of inorganics were identified during the Phase 1 RI. As the purpose of the perimeter surface soil sampling is to confirm the significance of previous discrete surface soil sample results, the MI sample areas include those previous sampling locations. The size and shape of the sampling areas were identified to avoid resampling locations where COPCs were not previously identified. Surface soil samples will be submitted for TAL metals, hexavalent chromium, and explosives analysis. A minimum of 10% will be analyzed for the RVAAP full suite to also include TCL VOCs, SVOCs, pesticides, PCBs, cyanide and propellants.
Subsurface Soil	Modified MI	1-16	40	A minimum of 82 modified MI subsurface soil samples will be collected from 18 soil borings using a Geoprobe rig to address data gaps throughout the site to further characterize the areas where COPCs and COCs were identified during the Phase 1 RI and IRA activities. The intervals and depth of previous subsurface soil sample collection has varied at ODA1. In order to be consistent with the excavation confirmation sampling and potential future use of the data in risk assessments, subsurface soil samples will be collected at intervals that begin/end at 4 ft bgs. Subsurface soil sample collection in areas not previously excavated will begin at 1 ft bgs such that the first interval is 1 to 4 ft bgs and then 4-ft intervals thereafter (1-4, 4-8, 8-12, and 12-16 ft bgs). Sample collection in areas previously excavated will begin at the bottom of the excavation (i.e., 2, 4, or 5 ft bgs) and will proceed in 4 ft intervals. The first sample interval for samples beginning at 2 ft bgs will end at 4 ft bgs and continue in 4-ft intervals thereafter (2-4, 4-8, 8-12, and 12-16 ft bgs). The sample intervals for the one boring beginning at 5 ft bgs will be 5-8, 8-12, and 12-16 ft bgs. Subsurface soil samples will be submitted for TAL metals and explosives analysis. Five samples will be submitted for hexavalent chromium analysis. A minimum of 10% will be analyzed for the RVAAP full suite to also include TCL VOCs, SVOCs, pesticides, PCBs, cyanide and propellants.
		2-16	10	
		4-16	28	
		5-16	4	

Notes:

[1]Depth intervals provided below depict the entire soil column from which the subsurface soils will be collected; however, the actual samples will be collected at maximum intervals of four feet as discussed in the rationale.

[2] Number of samples does not include duplicates or other quality assurance/quality control (QA/QC) samples.

COCs = chemicals of concern
COPCs = chemicals of potential concern
ft bgs = feet below ground surface
IRA = Interim Removal Action
MI = multi-increment
PCBs = polychlorinated biphenyls
RI = Remedial Investigation
SVOCs = semivolatile organic compounds
TAL = Target Analyte List
TCL = Target Compound List
VOCs = volatile organic compounds

Table A-3
Coordinates for Proposed Sampling Locations at ODA1

Sample Location ID	Sample Type	Easting	Northing	Sample ID	Sample Depth (ft bgs)	Number of Samples								
						TAL Metals	Explosives	Hexavalent Chromium	VOCs	Propellants	SVOCs	Pesticides	PCBs	Cyanide
DA1ss-050	MI Surface Soil	2346296.80	551240.02	DA1ss-050m-02##-SO	0-1	1	1	1						
		2346296.80	551332.11											
		2346400.70	551332.08											
		2346400.70	551240.22											
DA1ss-051	MI Surface Soil	2346141.25	551217.11	DA1ss-051m-02##-SO	0-1	1	1	1						
		2346296.79	551217.11											
		2346296.79	551167.11											
		2346141.25	551167.11											
		within	MI area	DA1ss-080m-02##-SO	0-1	1	1	1						
		extra	volume	DA1ss-051m-02##-MS	0-1	1	1	1						
		extra	volume	DA1ss-051m-02##-MD	0-1	1	1	1						
DA1ss-052	MI Surface Soil	2345933.86	551378.26	DA1ss-052m-02##-SO	0-1	1	1	1		1	1	1	1	1
		2346037.55	551378.26											
		2346037.55	551286.17											
		2345933.86	551286.17											
	Discrete Surface Soil	within	MI area	DA1ss-052d-02##-SO	0-1				1					
	MI Surface Soil – QA	split	at lab	DA1ss-052m-02##-SO	0-1	1	1	1		1	1	1	1	1
	Discrete Surface Soil - QA	within	MI area	DA1ss-052d-02##-SO	0-1				1					
DA1sb-055	Geoprobe Subsurface Soil	2346167.80	551516.50	DA1sb-055m-02##-SO	4-8	1	1							
				DA1sb-055m-02##-SO	8-12	1	1							
				DA1sb-055m-02##-SO	12-16	1	1							
DA1sb-056	Geoprobe Subsurface Soil	2346167.30	551562.31	DA1sb-056m-02##-SO	1-4	1	1							
				DA1sb-056m-02##-SO	4-8	1	1							
				DA1sb-056m-02##-SO	8-12	1	1							
				DA1sb-056m-02##-SO	12-16	1	1							
DA1sb-057	Geoprobe Subsurface Soil	2346116.30	551516.13	DA1sb-057m-02##-SO	1-4	1	1							
				DA1sb-057m-02##-SO	4-8	1	1							
				DA1sb-057m-02##-SO	8-12	1	1							
				DA1sb-057m-02##-SO	12-16	1	1							

Table A-3 (Continued)
Coordinates for Proposed Sampling Locations at ODA1

Sample Location ID	Sample Type	Easting	Northing	Sample ID	Sample Depth (ft bgs)	Number of Samples								
						TAL Metals	Explosives	Hexavalent Chromium	VOCs	Propellants	SVOCs	Pesticides	PCBs	Cyanide
DA1sb-058	Geoprobe Subsurface Soil	2346245.00	551516.31	DA1sb-058m-02##-SO	4-8	1	1							
				DA1sb-058m-02##-SO	8-12	1	1							
				DA1sb-058m-02##-SO	12-16	1	1							
DA1sb-059	Geoprobe Subsurface Soil	2345972.00	551459.75	DA1sb-059m-02##-SO	5-8	1	1	1		1	1	1	1	1
				DA1sb-059d-02##-SO	5-8				1					
				DA1sb-059m-02##-SO	8-12	1	1							
				DA1sb-059m-02##-SO	12-16	1	1							
				DA1sb-081m-02##-SO	12-16	1	1							
				DA1sb-059m-02##-SO	12-16	1	1							
DA1sb-060	Geoprobe Subsurface Soil	2345985.80	551493.50	DA1sb-060m-02##-SO	1-4	1	1							
				DA1sb-060m-02##-SO	4-8	1	1							
				DA1sb-060m-02##-SO	8-12	1	1							
				DA1sb-060m-02##-SO	12-16	1	1							
DA1sb-061	Geoprobe Subsurface Soil	2345934.00	551472.69	DA1sb-061m-02##-SO	1-4	1	1							
				DA1sb-061m-02##-SO	4-8	1	1							
				DA1sb-061m-02##-SO	8-12	1	1							
				DA1sb-061m-02##-SO	12-16	1	1							
DA1sb-062	Geoprobe Subsurface Soil	2345955.50	551424.25	DA1sb-062m-02##-SO	1-4	1	1							
				DA1sb-062m-02##-SO	4-8	1	1							
				DA1sb-062m-02##-SO	4-8	1	1							
				DA1sb-062m-02##-SO	8-12	1	1							
				DA1sb-062m-02##-SO	12-16	1	1							
DA1sb-063	Geoprobe Subsurface Soil	2346037.80	551470.38	DA1sb-063m-02##-SO	4-8	1	1			1				
				DA1sb-063m-02##-MS	4-8	1	1			1				
				DA1sb-063m-02##-MD	4-8	1	1			1				
				DA1sb-063m-02##-SO	8-12	1	1			1				
				DA1sb-063m-02##-SO	8-12	1	1			1				
				DA1sb-063m-02##-SO	12-16	1	1			1				
DA1sb-064	Geoprobe Subsurface Soil	2346037.80	551423.88	DA1sb-064m-02##-SO	4-8	1	1	1		1	1	1	1	1
				DA1sb-064d-02##-SO	4-8				1					
				DA1sb-064m-02##-SO	8-12	1	1			1				

Table A-3 (Continued)
Coordinates for Proposed Sampling Locations at ODA1

Sample Location ID	Sample Type	Easting	Northing	Sample ID	Sample Depth (ft bgs)	Number of Samples								
						TAL Metals	Explosives	Hexavalent Chromium	VOCs	Propellants	SVOCs	Pesticides	PCBs	Cyanide
				DA1sb-064m-02##-SO	12-16	1	1			1				
DA1sb-065	Geoprobe Subsurface Soil	2346089.50	551378.25	DA1sb-065m-02##-SO	4-8	1	1							
				DA1sb-065m-02##-SO	8-12	1	1							
				DA1sb-083m-02##-SO	8-12	1	1							
				DA1sb-065m-02##-SO	8-12	1	1							
				DA1sb-065m-02##-SO	12-16	1	1							
DA1sb-066	Geoprobe Subsurface Soil	2346037.50	551377.50	DA1sb-066m-02##-SO	1-4	1	1			1				
				DA1sb-066m-02##-SO	4-8	1	1			1				
				DA1sb-066m-02##-SO	8-12	1	1			1				
				DA1sb-066m-02##-SO	12-16	1	1			1				
DA1sb-067	Geoprobe Subsurface Soil	2346141.30	551332.19	DA1sb-067m-02##-SO	2-4	1	1							
				DA1sb-067d-02##-SO	2-4				1					
				DA1sb-067m-02##-SO	4-8	1	1	1						
				DA1sb-067d-02##-SO	4-8				1					
				DA1sb-067m-02##-SO	8-12	1	1							
				DA1sb-067d-02##-SO	8-12				1					
				DA1sb-067m-02##-SO	12-16	1	1							
				DA1sb-067d-02##-SO	12-16				1					
DA1sb-068	Geoprobe Subsurface Soil	2346167.30	551263.13	DA1sb-068m-02##-SO	1-4	1	1			1	1	1	1	1
				DA1sb-068d-02##-SO	1-4				1					
				DA1sb-084m-02##-SO	1-4	1	1			1	1	1	1	1
				DA1sb-084d-02##-SO	1-4				1					
				DA1sb-068m-02##-SO	1-4	1	1			1				
				DA1sb-068d-02##-SO	1-4				1					
				DA1sb-068m-02##-SO	4-8	1	1			1				
				DA1sb-068d-02##-SO	4-8				1					
				DA1sb-068m-02##-SO	8-12	1	1			1				
				DA1sb-068d-02##-SO	8-12				1					
				DA1sb-068m-02##-SO	12-16	1	1			1				
				DA1sb-068d-02##-SO	12-16				1					

Table A-3 (Continued)
Coordinates for Proposed Sampling Locations at ODA1

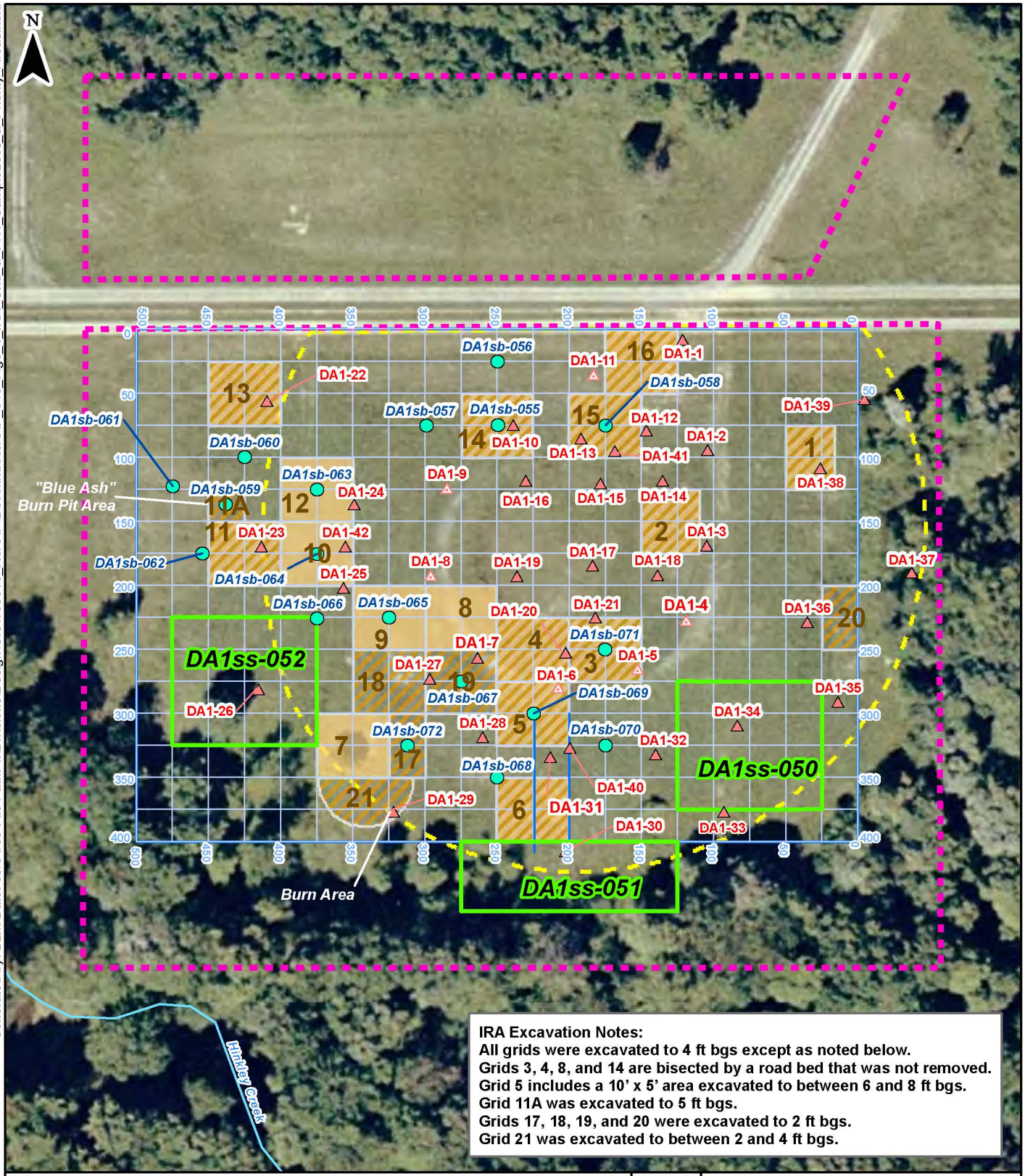
Sample Location ID	Sample Type	Easting	Northing	Sample ID	Sample Depth (ft bgs)	Number of Samples								
						TAL Metals	Explosives	Hexavalent Chromium	VOCs	Propellants	SVOCs	Pesticides	PCBs	Cyanide
DA1sb-069	Geoprobe Subsurface Soil	2346193.30	551309.31	DA1sb-069m-02##-SO	4-8	1	1			1	1	1	1	1
				DA1sb-069d-02##-SO	4-8				1					
				DA1sb-069m-02##-SO	8-12	1	1			1				
				DA1sb-069d-02##-SO	8-12				1					
				DA1sb-069m-02##-SO	12-16	1	1			1				
				DA1sb-069d-02##-SO	12-16				1					
DA1sb-070	Geoprobe Subsurface Soil	2346245.00	551286.19	DA1sb-070m-02##-SO	1-4	1	1			1				
				DA1sb-070d-02##-SO	1-4				1					
				DA1sb-070m-02##-MS	1-4	1	1			1				
				DA1sb-070m-02##-MD	1-4	1	1			1				
				DA1sb-070d-02##-MS	1-4				1					
				DA1sb-070d-02##-MD	1-4				1					
				DA1sb-070m-02##-SO	4-8	1	1			1				
				DA1sb-070d-02##-SO	4-8				1					
				DA1sb-070m-02##-SO	8-12	1	1			1	1	1	1	1
				DA1sb-070d-02##-SO	8-12				1					
				DA1sb-070m-02##-SO	12-16	1	1			1				
				DA1sb-070d-02##-SO	12-16				1					
				DA1sb-085m-02##-SO	12-16	1	1			1				
				DA1sb-085d-02##-SO	12-16				1					
				DA1sb-070m-02##-SO	12-16	1	1			1				
DA1sb-071	Geoprobe Subsurface Soil	2346244.80	551355.38	DA1sb-071m-02##-SO	4-8	1	1	1		1	1	1	1	1
				DA1sb-071d-02##-SO	4-8				1					
				DA1sb-071m-02##-SO	8-12	1	1							
				DA1sb-071m-02##-SO	12-16	1	1							
DA1sb-072	Geoprobe Subsurface Soil	2346102.80	551286.25	DA1sb-072m-02##-SO	2-4	1	1	1						
				DA1sb-072m-02##-SO	4-8	1	1							
				DA1sb-072m-02##-SO	8-12	1	1							
				DA1sb-072m-02##-SO	12-16	1	1							
				DA1sb-086m-02##-SO	12-16	1	1							
				DA1sb-072m-02##-SO	12-16	1	1							

Table A-3 (Continued)
Coordinates for Proposed Sampling Locations at ODA1

Sample Location ID	Sample Type	Easting	Northing	Sample ID	Sample Depth (ft bgs)	Number of Samples								
						TAL Metals	Explosives	Hexavalent Chromium	VOCs	Propellants	SVOCs	Pesticides	PCBs	Cyanide
					Primary MI Samples	67	67	8	0	24	7	7	7	7
					Primary Discrete Samples	0	0	0	19	0	0	0	0	0
					Field (Blind) Duplicate Samples	7	7	1	2	3	1	1	1	1
					QA Samples	7	7	1	2	3	1	1	1	1
					MS/MSD and MS/MD Sample Pairs	3	3	1	1	2	0	0	0	0

Notes:

Coordinates are provided in Ohio State Plane (NAD 83).
= sequential sample number
d = discrete sample
DA = Open Demolition Area
ft bgs = feet below ground surface
QA = quality assurance
m = multi-increment sample
MI = multi-increment
sb= soil boring
ss = surface soil
MD = matrix duplicate
MS = matrix spike
MSD = matrix spike duplicate
PCBs = polychlorinated biphenyls
SO = soil
SVOCs = semivolatile organic compounds
TAL = target analyte list
VOCs = volatile organic compounds



IRA Excavation Notes:
All grids were excavated to 4 ft bgs except as noted below.
Grids 3, 4, 8, and 14 are bisected by a road bed that was not removed.
Grid 5 includes a 10' x 5' area excavated to between 6 and 8 ft bgs.
Grid 11A was excavated to 5 ft bgs.
Grids 17, 18, 19, and 20 were excavated to 2 ft bgs.
Grid 21 was excavated to between 2 and 4 ft bgs.

- Proposed MI Surface Soil Sampling Areas
- Proposed Subsurface Soil Sampling Location
- Phase 1 RI Surface Soil Sample (0-1 ft)
- Phase 1 RI Surface and Subsurface Soil Sample
- Current Area of Concern Boundary
- New Proposed Geophysical Investigation Area

IRA Excavation Grid Removed For:
- Metals
- Explosives and Metals
- OE and OES

0 50 100 Feet

Note:
Please note that the overlay of the IRA excavation grid and Phase 1 RI sample locations are approximate and based on visual alignment of site features as no control points were available in the IRA report.

U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT

RAVENNA ARMY AMMUNITION PLANT, RAVENNA, OHIO

FIGURE NUMBER
A - 1

RVAAP-03
OPEN DEMOLITION AREA 1
PROPOSED SOIL SAMPLING LOCATIONS

Shaw Environmental, Inc.

Generated by: BLM Date: 09/04/09 File Path: T:\Divisions\Design\GIS\133616_RVAAP\Doc\Mxd\RVAAP_018_Fig3_1_IRA_Grid_&_PH1_SampleLocs_&_Priority_Areas.mxd

Project Number: 133616

This page intentionally left blank.

APPENDIX B
MUSTARD AGENT BURIAL SITE (RVAAP-28)

This page intentionally left blank.

B.0 *Mustard Agent Burial Site (RVAAP-28)*

A description of the Mustard Agent Burial Site (MABS; RVAAP-03), previous investigations at this Area of Concern (AOC), and rationale for additional characterization activities are presented in the *Final Data Quality Objectives (DQO) Report for the RVAAP-03 Mustard Agent Burial Site* (Shaw, 2009) and summarized in this section. This section describes the proposed characterization activities based on the results of the *DQO Report*.

B.1 AOC Description

The MABS AOC is a location where Chemical Agent Identification Sets (CAIS), believed to consist of sulfur mustard agent, are suspected to have been buried. The mustard agent CAIS were developed by the Department of the Army from the 1930s through the 1960s. The mustard agent was reportedly buried at Ravenna Army Ammunition Plant (RVAAP) in the 1950s. The depth at which the CAIS may have been buried is not known. Of the various types of CAIS glass containers that have been identified as potentially containing mustard agent, all are believed to have been packed in metal, either metal paint/coffee-type cans, 55-gallon drums, or steel shipping cylinders called PIGs.

In 1969, the U.S. Army excavated a possible mustard agent burial site west of the National Advisory Committee for Aeronautics (NACA) Test Area. One 50-gallon drum and seven small rusted cans were discovered. All recovered items were empty and no contamination was discovered according to reports. An unidentified and undocumented source reported that the first site excavated was incorrectly identified, and that the mustard agent was buried nearby. The second proposed site for the mustard agent burial is located in the wooded area approximately 500 feet (ft) south of Hinckley Creek along an abandoned power line right-of-way. The suspected site was marked and fenced; however, only remnants of the fence still exist. The area is currently marked with Seibert stakes. A third area was identified by a former employee to be adjacent to the concrete pad at the west end of the NACA crash strip. This location is near the 1969 excavation area and is non-forested and flat.

B.2 Previous Investigations

As early as 1996, the United States Army Center for Health Promotion and Preventive Medicine (USACHPPM) collected surface soil samples as part of a Hazardous and Medical Waste Study. Other investigations conducted at MABS include:

- A geophysical survey was conducted in 1998 by Science Applications International Corporation (SAIC).
- A groundwater investigation was conducted by SpecPro, Inc. in 2004-2005.

- Geophysical surveys were conducted in 2006 by Environmental Quality and Management, Inc. (EQM).

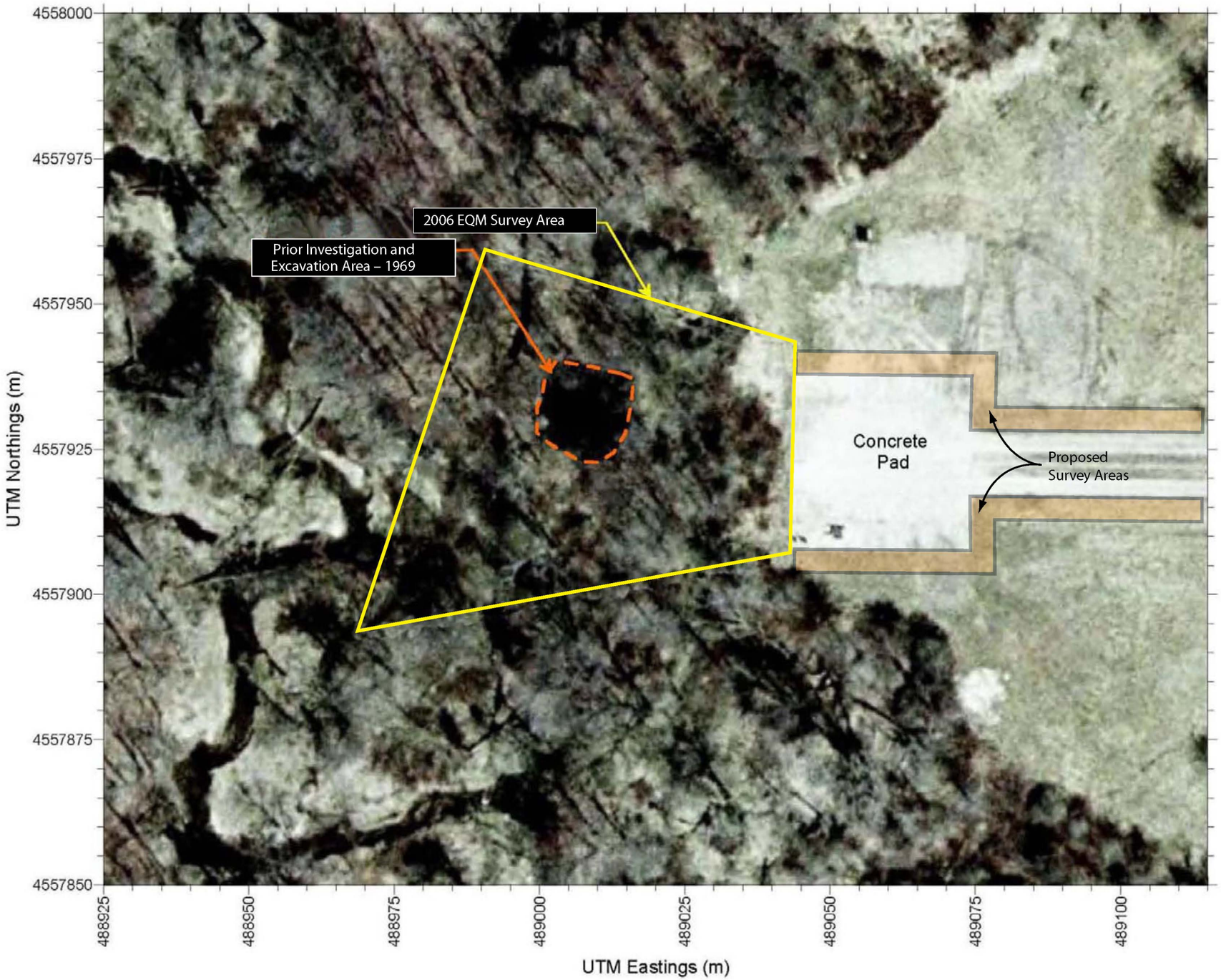
The SAIC and SpecPro investigations were performed in the more heavily wooded area approximately 1,000 feet west of the NACA Test Area. The EQM investigation was conducted adjacent to the west of the concrete pad at the west end of the NACA crash strip.

B.3 Proposed SAP Characterization Activities

An interview conducted with a former employee indicated that the concrete pad on the west end of the NACA crash strip may actually cover part of the burial site. As previous investigations focused to the west of the concrete pad, an additional geophysical investigation will be performed in the areas north, south, and east of the concrete pad to further delineate the extent of the anomalies previously detected to the west of the concrete pad. In addition to the survey areas adjacent to the north and south of the concrete pad (115'x13'), the survey area extends an additional 115 ft to the east along the NACA crash strip. The width of the survey areas on both sides of the crash strip and to the north and south of the concrete pad is approximately 4 meters (13 ft). This equates to approximately four passes with the geophysical instrumentation at approximately 1 meter width per pass. The total survey area is approximately 6,000 square ft to an approximate survey depth of 5 ft below ground surface (bgs), the likely depth of a substantial portion of metallic debris buried at MABS, as identified in the EQM report.

The Geophysical Prove-Out (GPO) will be used to assess and document the performance of the geophysical instrumentation, navigation system, and field deployment form-factor. The GPO will also be used to assess the most optimal data processing techniques and anomaly selection criteria given the local soil, site conditions, and targets of interest at RVAAP. Although the final decision will be based on the results of the GPO, it is likely that a Geonics EM61-MK2 metal detector will be the instrument deployed at the MABS. The EM61-MK2 will be deployed along with a Real-Time Kinematic global positioning system in open areas, which is ideal for the MABS. The EM61-MK2 may detect buried metal beyond 4 ft depending on the size of the target and the contrast between the native soils/geology and the target. Additionally, the EM61-MK2 response is focused directly beneath the coils so the response from nearby structures is minimal compared to other sensors such as the magnetometer.

No environmental or intrusive sampling will be conducted at MABS due to the possibility of the presence of mustard agent.



N

Scale in Feet
0 20 40 60 80 100

Scale in Meters
0 10 20 30 40 50

U.S. ARMY
CORPS OF ENGINEERS
LOUISVILLE DISTRICT

FIGURE NUMBER B-1

PROPOSED GEOPHYSICAL SURVEY LOCATIONS
SUSPECTED MUSTARD AGENT BURIAL SITE
RAVENNA ARMY AMMUNITION PLANT

Shaw Shaw Environmental, Inc.

This page intentionally left blank.

APPENDIX C
SAND CREEK DISPOSAL ROAD LANDFILL (RVAAP-34)

This page intentionally left blank.

C.0 *Sand Creek Disposal Road Landfill (RVAAP-34)*

A description of the Sand Creek Disposal Road Landfill (RVAAP-34), previous investigations at this Area of Concern (AOC), and the rationale for additional characterization activities are presented in the *Final Data Quality Objectives (DQO) Report for the RVAAP-34 Sand Creek Disposal Road Landfill* (Shaw, 2009) and summarized in this section. This section further describes the proposed characterization activities based on the results of the *DQO report*.

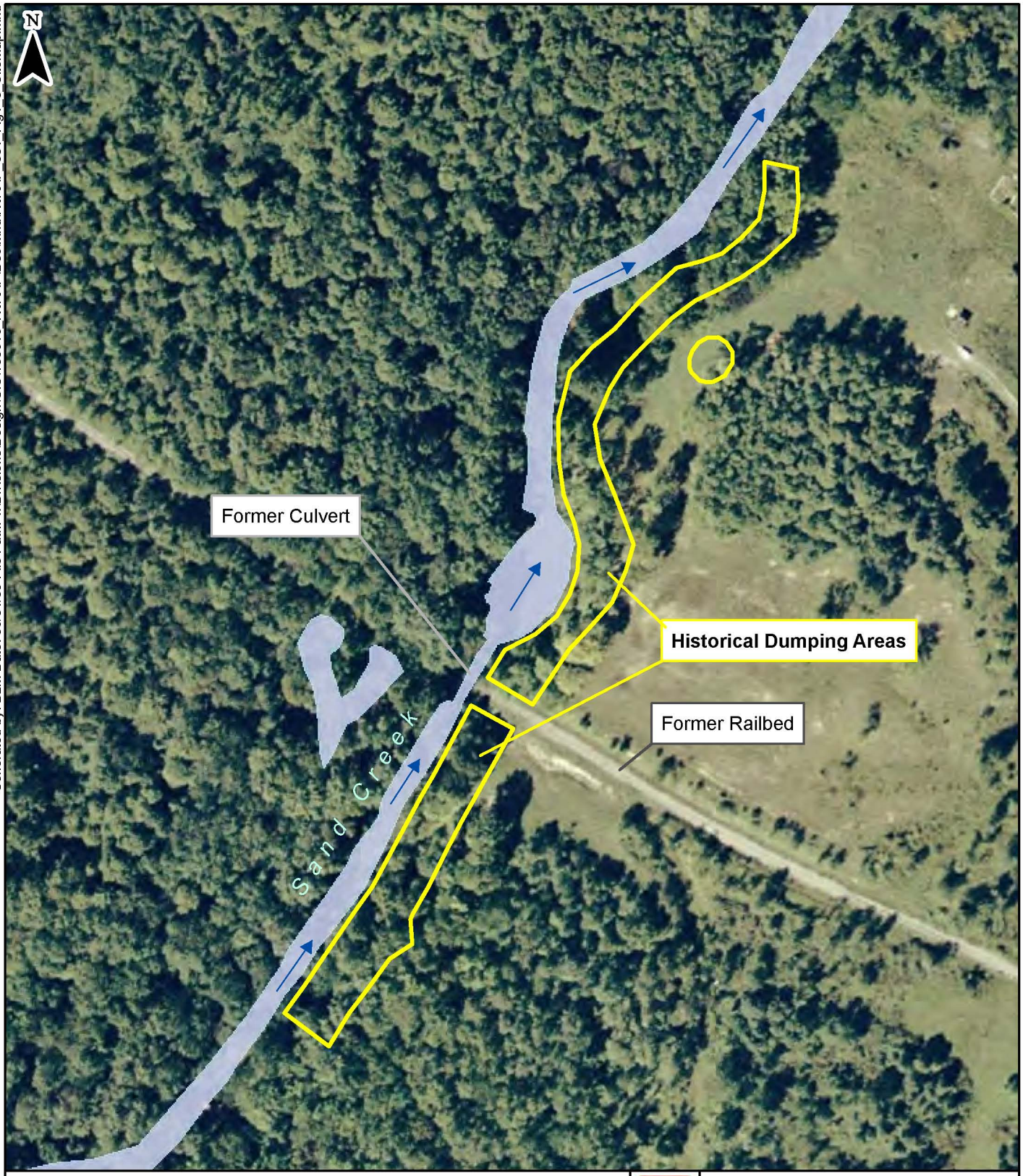
C.1 AOC Description

The Sand Creek Disposal Road Landfill is a former open dump area at the RVAAP. Construction and demolition (C&D) type material were delivered to the site and dumped over an embankment located immediately adjacent to Sand Creek. The dump site extended along the embankment for approximately 1,200 feet (ft) and varied in width from 20 to 40 ft from the top of the bank to the bottom. The bank slopes from east to west towards Sand Creek at 40 to 60 degrees from the horizontal. There are no records indicating the quantities or materials dumped at the site and the dates of operation for the landfill are unknown. Several buildings associated with the former Sand Creek Sewage Treatment Plant are located northeast of the site. Surface water runoff follows the topography of the site and flows in a westerly direction where it enters Sand Creek. A very narrow floodplain occupies the land between the bottom of the embankment and Sand Creek. An inactive railroad bed bisects the AOC. Site features are depicted in **Figure C-1**.

During preliminary site assessments, the site was found to be very overgrown with mature trees and ground level vegetation. The entire site was littered with C&D materials with large piles of debris concentrated mostly in the southern portion of the site. Some of the types of C&D materials identified during the preliminary site assessment included:

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

Recent walkovers at the site have revealed that the corrugated iron culvert beneath the former railroad bed that crossed over Sand Creek has collapsed. The culvert and associated railroad ballast are now lying in Sand Creek adjacent to the site. A removal action (RA) at the Sand



Direction of Flow

RVAAP-34 Site Boundary

Stream

0 100 200 Feet

U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT

FIGURE NUMBER
C-1

RVAAP-34
SAND CREEK DISPOSAL ROAD LANDFILL
SITE MAP

Shaw Shaw Environmental, Inc.

Generated by: BLM Date: 06/01/09 File Path: T:\Divisions\Design\GIS\133616_RVAAP\Doc\Mxd\RVAAP_001_Fig1_3_SiteMap.mxd

Project Number: 133616

Creek Disposal Road Landfill was conducted by MKM Engineers, Inc. (MKM) between August and September 2003 and included the removal of the majority of the surface C&D materials.

C.2 Previous Investigations

The RA at the Sand Creek Disposal Road Landfill was conducted by MKM between August and September 2003. Confirmatory soil, surface water and sediment samples were collected in and around the site by MKM following the removal efforts to evaluate the success of the RA and characterize potential impact to Sand Creek and the neighboring floodplain. The sampling locations are shown in **Figure C-2**. Samples included the following:

- Thirty (30) discrete surface soil samples (0 to 1 ft below ground surface [bgs]);
- Six (6) discrete sediment samples within the Sand Creek stream channel;
- Six (6) discrete sediment samples in the flood plain between Sand Creek and the AOC; and
- Three (3) surface water samples from Sand Creek.

Shaw prepared the *DQO Report* based on the confirmatory surface soils, sediment and surface water results collected during the RA and evaluated the data the systematic approach presented in the *RVAAP's Facility-Wide Human Health Risk Assessor Manual, Amendment 1* (*HHRAM*; USACE, 2005) to identify data gaps where additional investigation may be warranted. The *DQO Report* identified elevated concentrations of primarily inorganics and semivolatile organic compounds (SVOCs) above the RVAAP background values and draft facility-wide cleanup goals (Draft FWCUGs) screening criteria for the unrestricted land use scenarios in surface soil and persistent arsenic and chromium levels in sediment along the banks of the site. The background values and Draft FWCUGs were provided in the *Draft Facility-Wide Human Health Remediation Goals, Ravenna Army Ammunition Plant* (SAIC, 2008). The *DQO Report* recommended that additional sampling be performed to address surface soils, subsurface soils and sediment. No additional sampling of surface water is required. A summary of chemicals of potential concern (COPCs) identified in the *DQO Report* to require further investigation is presented in **Table C-1**. COPCs were screened to Draft FWCUGs at 10^{-6} cancer risk level and hazard quotient equal to 0.1. A summary of accumulation areas with COPCs greater than the Draft FWCUGs is presented in **Table C-2**. **Figure C-1** presents the historical sample location at the site.

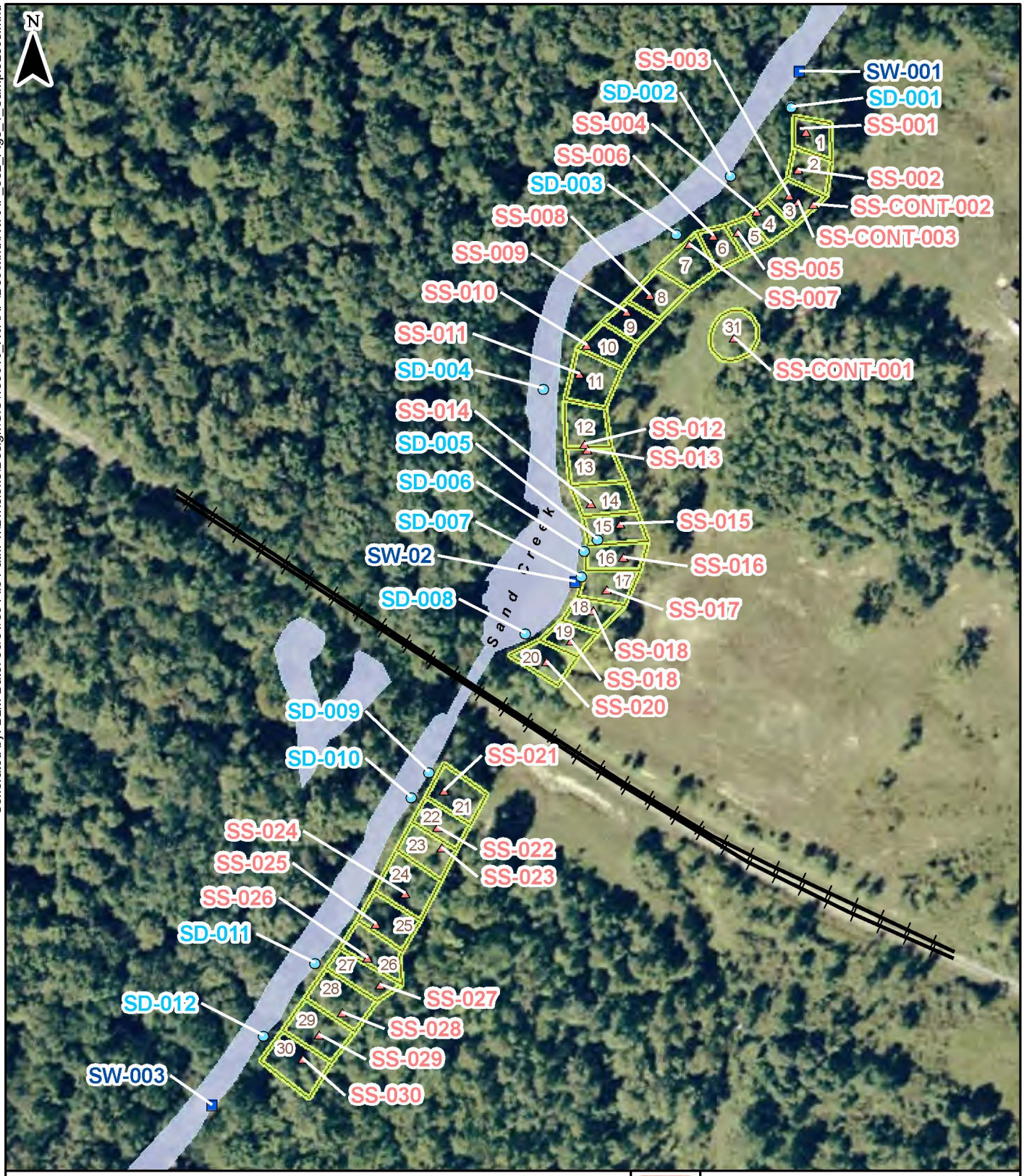

N
SS-003
SW-001
SD-002
SD-001
SS-004
SS-001
SS-006
SS-002
SD-003
SS-CONT-002
SS-008
SS-CONT-003
SS-009
SS-005
SS-010
SS-007
SS-011
SS-CONT-001
SD-004
SS-014
SS-012
SD-005
SS-013
SD-006
SD-007
SS-015
SW-02
SS-016
SD-008
SS-017
SS-018
SS-018
SS-020
SD-009
SD-010
SS-021
SS-024
SS-022
SS-025
SS-023
SS-026
SD-011
SD-012
SS-027
SS-028
SS-029
SW-003
SS-030
Sand Creek
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
Sediment Sample Locations
Shallow Soil Confirmation Sample Locations
Surface Water Sample Locations
Sand Creek Dump-Limits & Sample Grids
Stream
80
0
100
200
Feet
U.S. ARMY
CORPS OF ENGINEERS
LOUISVILLE DISTRICT
FIGURE NUMBER
C-2
RVAAP-34
SAND CREEK DISPOSAL ROAD LANDFILL
REMOVAL ACTION SAMPLE LOCATIONS
Shaw
Shaw Environmental, Inc.
Generated by: BLM Date: 06/01/09 File Path: T:\Divisions\Design\GIS\133616_RVAAP\Doc\Mxd\RVAAP_002_Fig3_1_SampleLocs.mxd
Project Number: 133616

Table C-1
Summary of COPCs for Sand Creek Disposal Road Landfill

Medium	Analyte	Frequency of Detection	Units	Maximum Detect
Surface Soil	Arsenic	30/30	mg/kg	100
	Lead	30/30	mg/kg	1,600
	Barium	30/30	mg/kg	1,600
	Beryllium	30/30	mg/kg	1.2
	[a]Chromium (total and Cr^{+6})	30/30	mg/kg	230
	Cobalt	30/30	mg/kg	26
	Manganese	30/30	mg/kg	5,100
	Selenium	8/30	mg/kg	3.2
	Nitrocellulose	2/3	mg/kg	5
	Chloroethane	1/3	mg/kg	0.091
	Phenanthrene	1/3	mg/kg	0.089
	Bis(2-Ethylhexyl)phthalate	2/3	mg/kg	0.09
	Benzo(a)pyrene	2/3	mg/kg	0.29
	Dibenzo(a,h)anthracene	1/3	mg/kg	0.69
	Benzo(g,h,i)perylene	1/3	mg/kg	0.13
Subsurface Soil	Not sampled	---	---	---
Sediment	2,6-Dinitrotoluene	1/2	mg/kg	0.110
	Lead	12/12	mg/kg	40
	Beryllium	12/12	mg/kg	0.67
	[a]Chromium (total and Cr^{+6})	12/12	mg/kg	19
	Cobalt	12/12	mg/kg	13
	Nitroguanidine	1/2	mg/kg	0.5
	Nitrocellulose	2/2	mg/kg	0.98
	Acetone	1/2	mg/kg	0.011
Surface Water	[b]Nitrocellulose	1/3	µg/L	500

***Notes**:*
[a]Cr^{+6} (hexavalent chromium) was not analyzed during the RA sampling; however, the draft cleanup goals presented in the Draft Human Health Remediation Goals at the RVAAP *(SAIC, 2008) provide a comparison of total chromium results to Cr^{+6} if Cr^{+6} results are not available.*
[b]Although identified as a COPC in surface water, this analyte was removed from further consideration for investigation in the DQO Report.
--- = not applicable
mg/kg = milligrams per kilogram
µg/L = micrograms per liter

This page intentionally left blank.

Table C-2
Distribution of COPCs Greater Than Draft Cleanup Goal Criteria (Cancer Risk =10^{-6} and HQ=0.1)

Sample Locations	Exposure Scenarios									
	Residential Farmer				National Guard					
	Adult		Child		Dust/Fire Control Worker		Range Maintenance Soldier		Trainee	
	CR=10^{-6}	HQ=0.1	CR=10^{-6}	HQ=0.1	CR=10^{-6}	HQ=0.1	CR=10^{-6}	HQ=0.1	CR=10^{-6}	HQ=0.1
Surface Soil Discrete Samples										
SCSS-001-0001-SO				Cr, Co, Ag					Cr, Co	Cr
SCSS-003-0001-SO									Cr, Co	Cr
SCSS-004-0001-SO	Hg			Hg, Cd, Cr, Ag					Cd, Cr, Ag	Cr
SCSS-005-0001-SO	As, Cr	Sb, As, Cd, Ag	As	Sb, As, Hg, Ba, Cd, Cr, Cu, Ag			As		As, Cd, Cr, Co	Ba, Cr
SCSS-006-0001-SO	As	As, Mn, Ag	As	As, Cd, Cr, Mn, Ag	As		As		As, Cr	Ba, Cr, Mn
SCSS-007-0001-SO	As	Sb, As, Cr, Ag	As	An, As, Cd, Cr, Ag	As		As		As, Cd, Cr	Ba, Cr
SCSS-008-0001-SO	As	As	As	As, Cr, Ag	As		As	As	As, Cr	Cr
SCSS-011-0001-SO		Cr		Cr, Cu					Cr	Cr
SCSS-012-0001-SO	As	As	As	As			As		As, Co	
SCSS-013-0001-SO									Cr, Co	Cr, Co
SCSS-016-0001-SO									Co	
SCSS-017-0001-SO	B(a)A, B(b)F, B(a)P, D(a,h)A	Mn		Mn, D(a,h)A			B(a)P, D(a,h)A		D(a.h)A	Mn
SCSS-018-0001-SO									Cr, Co	Cr
SCSS-019-0001-SO	As	As	As	As			As		As, Cr, Co	Cr
SCSS-022-0001-SO									Co	
SCSS-023-0001-SO	As	As	As	As, Cr			As		As, Cr, Co	Cr
SCSS-024-0001-SO									Co	
SCSS-025-0001-SO									Co	
SCSS-026-0001-SO									Co	
SCSS-028-0001-SO									Co	
SCSS-029-0001-SO									Co	
SCSS-030-0001-SO									Co	
SCSS-CONT1-0001-SO	As	As	As	As, Cr			As		As, Cr	Cr
Sediment Discrete Samples										
SCSD-001-0001-SD				Ag						
SCSD-008-0001-SD							Cr	Cr		
Surface Water Samples										
No COPCs were identified >Draft FWCUGs at any surface water sample locations										

Notes:
Ag = silver
As = arsenic
B(a)A = benzo(a)anthracene
B(a)P = benzo(a)pyrene
B(b)F = benzo(b)fluoranthene
Ba = barium
Cr = chromium
CR = cancer risk
Co = cobalt
COPC = chemical of potential concern
D(a,h)A = dibenzo(a,h)anthracene
Hg = mercury
HQ = hazard quotient (non-cancer risk)
Mn = manganese
Sb = antimony

This page intentionally left blank.

C.3 Proposed SAP Characterization Activities

The objective of the *FSP Addendum* is to define the nature and extent of contamination at concentrations exceeding the Draft FWCUG screening criteria in surface and subsurface soils and dry sediment at the Sand Creek Disposal Road Landfill. In order to achieve the objective, further sampling and analysis for metals, SVOCs, volatile organic compounds (VOCs), explosives and propellants will be required. **Table C-3** summarizes the media to be sampled and the rationale for the sample strategy. **Table C-4** presents the coordinates for the proposed sampling locations for this AOC. **Figure C-3** shows the proposed sample locations.

Prior to performing any intrusive sampling and/or removal activities, a geophysical investigation will be performed over the entire boundary of the Sand Creek Disposal Road Landfill site. The purposes of the geophysical investigation are to: 1) identify remaining buried anomalies, and 2) identify if any of the buried anomalies are suspect munitions and explosives of concern (MEC) as part of MEC avoidance procedures. Suspected and identified source areas of debris will represent specific focus areas for additional surface and subsurface sampling.

Additional samples of the environmental media (surface and subsurface soils and dry sediment), otherwise referred to as contingency samples, may be necessary following approval of this work plan based on the results of the geophysical investigation, visible contamination (i.e., stained soils, distressed vegetation or areas of dumping). If additional samples are required, Shaw will submit any changes to the sampling program in a Field Change Order notification to be approved by the Army and Ohio EPA and details of the changes will be included in the remedial investigation report.

In accordance with the sample numbering system identified in Figure 5-1 of the *FSP Addendum*, surface soil samples will be identified using the formula SCss-NNN-####-SO, subsurface soil samples will be identified using the formula SCsb-NNN-####-SO, and dry sediment samples will be identified using the formula SCsd-NNN-####-SD. Based on existing datasets for the Sand Creek Disposal Road Landfill and in coordination with the current Ravenna Environmental Information Management System (REIMS) contractor for the RVAAP, sample numbering will be assigned sequentially beginning with sample location number (NNN) '035' and sample number (####) '0010.' The proposed sample locations are identified in **Table C-4** with the coordinates in Ohio State Plane (NAD 83). For surface soil and dry sediment samples, the coordinates are provided for the four corners of the MI sample area. The sample numbers, beginning at 0010, will be assigned in the field as each sample is collected.

Table C-3
Summary of Proposed Sampling at Sand Creek Disposal Road Landfill

Medium	Sample Type	Depth (ft bgs)[1]	No. of Samples[2]	Rationale
Surface Soil	MI	0-1	13	A minimum of 13 MI surface soil samples will be collected to further characterize the areas where COPCs consisting of inorganics, SVOCs, one propellant and one VOC were identified during the RA. Additional sampling of surface soils will further illustrate the potential for contamination migration via leaching or erosional processes from surface soils to media such as sediment. Surface soil samples will be submitted for TAL metals, SVOCs and explosives. Five samples will be submitted for hexavalent chromium. A minimum of 10% will be analyzed for the RVAAP full suite to also include TCL VOCs, pesticides, PCBs, cyanide and propellants.
Subsurface Soil	Modified MI	1-5	13	A minimum of 13 modified MI subsurface soil samples will be collected from 13 soil borings using hand augers based on the distribution of COPCs identified in surface soil. The hand auger samples will be advance at locations where site conditions consisting of steep slopes, saturated conditions and/or overgrown vegetation may prevent the advancement of Geoprobe samples. The modified MI sample will be collected from the interval of 1 to 5 ft bgs.
		1-20	45	A minimum of 45 modified MI subsurface soil samples will be collected from 9 soil borings using the Geoprobe rig based on the distribution of COPCs identified in surface soil. Each Geoprobe sample will be advanced within 5 feet adjacent to the top of slope since site conditions may limit the ability of the Geoprobe to collect samples. The modified MI samples will be collected from 4 ft intervals at 1-5, 5-9, 9-13, 13-17, and 17-20 ft bgs. Subsurface soil samples will be submitted for TAL metals, SVOCs and explosives. Five samples will be submitted for hexavalent chromium. A minimum of 10% will be analyzed for the RVAAP full suite to also include TCL VOCs, pesticides, PCBs, cyanide and propellants.
Dry Sediment	MI	0-0.5	2	A minimum of 2 MI dry sediment samples will be collected in the floodplain between the creek and the AOC to evaluate the true average concentration of COPCs detected in sediment during the RA.. Dry sediment samples will be analyzed for the full RVAAP suite to include TAL metals, hexavalent chromium, SVOCs, explosives, TCL VOCs, pesticides, PCBs, cyanide and propellants

***Notes**:*
[1]Depth intervals provided below depict the entire soil column from which the subsurface soils will be collected; however, the actual samples will be collected at maximum intervals of four feet as discussed in the rationale.
[2]Number of samples does not include duplicates or other QA/QC samples.

COPC = chemical of potential concern
ft bgs = feet below ground surface
MI = multi increment
PCB = polychlorinated biphenyl
RA = Remedial Action
SVOCs = semivolatile organic compounds
TAL = Target Analyte List
TCL = Target Compound List
VOCs = volatile organic compounds

Table C-4
Coordinates for Proposed Sampling Locations at Sand Creek Disposal Road Landfill

Sample Location ID	Sample Type	Easting	Northing	Sample ID	Sample Depth (ft bgs)	Number of Samples								
						TAL Metals	Explosives	SVOCs	Hexavalent Chromium	VOCs	Pesticides	PCBs	Cyanide	Propellants
SCsb-035	Geoprobe Subsurface Soil	2366957.00	563479.56	SCsb-035m-00##-SO	1-5	1	1	1						
				SCsb-035m-00##-SO	5-9	1	1	1						
				SCsb-035m-00##-SO	9-13	1	1	1						
				SCsb-035m-00##-SO	13-17	1	1	1						
				SCsb-035m-00##-SO	17-20	1	1	1						
SCsb-036	Geoprobe Subsurface Soil	2366868.80	563378.19	SCsb-036m-00##-SO	1-5	1	1	1	1					
				SCsb-036m-00##-SO	5-9	1	1	1						
				SCsb-036m-00##-SO	9-13	1	1	1						
				SCsb-036m-00##-SO	13-17	1	1	1						
				SCsb-036m-00##-SO	17-20	1	1	1						
SCsb-037	Geoprobe Subsurface Soil	2366807.30	563336.69	SCsb-037m-00##-SO	1-5	1	1	1			1	1	1	1
				SCsb-037d-00##-SO	1-5					1				
				SCsb-080m-00##-SO	1-5	1	1	1						
				SCsb-037m-00##-SO	1-5	1	1	1						
				SCsb-037m-00##-SO	5-9	1	1	1						
				SCsb-037m-00##-SO	9-13	1	1	1						
				SCsb-037m-00##-SO	13-17	1	1	1						
				SCsb-037m-00##-SO	17-20	1	1	1						
SCsb-038	Geoprobe Subsurface Soil	2366847.50	563295.19	SCsb-038m-00##-SO	1-5	1	1	1						
				SCsb-038m-00##-MS	1-5	1	1	1						
				SCsb-038m-00##-MD	1-5	1	1	1						
				SCsb-038m-00##-SO	5-9	1	1	1						
				SCsb-038m-00##-SO	9-13	1	1	1						
				SCsb-038m-00##-SO	13-17	1	1	1						
				SCsb-038m-00##-SO	17-20	1	1	1			1	1	1	1
				SCsb-038d-00##-SO	17-20					1				
				SCsb-081m-00##-SO	17-20	1	1	1						
				SCsb-038m-00##-SO	17-20	1	1	1						
SCsb-039	Geoprobe Subsurface Soil	2366729.00	563253.88	SCsb-039m-00##-SO	1-5	1	1	1						
				SCsb-039m-00##-SO	5-9	1	1	1						
				SCsb-039m-00##-SO	9-13	1	1	1						
				SCsb-039m-00##-SO	13-17	1	1	1						
				SCsb-039m-00##-SO	17-20	1	1	1						

Table C-4 (Continued)
Coordinates for Proposed Sampling Locations at Sand Creek Disposal Road Landfill

Sample Location ID	Sample Type	Easting	Northing	Sample ID	Sample Depth (ft bgs)	Number of Samples								
						TAL Metals	Explosives	SVOCs	Hexavalent Chromium	VOCs	Pesticides	PCBs	Cyanide	Propellants
SCsb-040	Geoprobe Subsurface Soil	2366731.00	563144.69	SCsb-040m-00##-SO	1-5	1	1	1						
				SCsb-040m-00##-SO	5-9	1	1	1			1	1	1	1
				SCsb-040d-00##-SO	5-9					1				
				SCsb-082m-00##-SO	5-9	1	1	1						
				SCsb-040m-00##-SO	5-9	1	1	1						
				SCsb-040m-00##-SO	9-13	1	1	1						
				SCsb-040m-00##-SO	13-17	1	1	1						
				SCsb-040m-00##-SO	17-20	1	1	1						
SCsb-041	Geoprobe Subsurface Soil	2366747.80	563030.06	SCsb-041m-00##-SO	1-5	1	1	1						
				SCsb-041m-00##-SO	5-9	1	1	1						
				SCsb-041m-00##-MS	5-9	1	1	1						
				SCsb-041m-00##-MD	5-9	1	1	1						
				SCsb-041m-00##-SO	9-13	1	1	1						
				SCsb-041m-00##-SO	13-17	1	1	1						
				SCsb-041m-00##-SO	17-20	1	1	1						
SCsb-042	Geoprobe Subsurface Soil	2366668.80	562920.44	SCsb-042m-00##-SO	1-5	1	1	1						
				SCsb-042m-00##-SO	5-9	1	1	1						
				SCsb-042m-00##-SO	9-13	1	1	1			1	1	1	1
				SCsb-042d-00##-SO	9-13					1				
				SCsb-083m-00##-SO	9-13	1	1	1						
				SCsb-042m-00##-SO	9-13	1	1	1						
				SCsb-042m-00##-SO	13-17	1	1	1						
				SCsb-042m-00##-SO	17-20	1	1	1						
SCsb-043	Geoprobe Subsurface Soil	2366551.80	562739.13	SCsb-043m-00##-SO	1-5	1	1	1						
				SCsb-043m-00##-SO	5-9	1	1	1						
				SCsb-043m-00##-SO	9-13	1	1	1						
				SCsb-043m-00##-SO	13-17	1	1	1						
				SCsb-043m-00##-SO	17-20	1	1	1						
SCsb-044	Hand-Auger Subsurface Soil	2366922.80	563467.63	SCsb-044m-00##-SO	1-5	1	1	1						
SCsb-045	Hand-Auger Subsurface Soil	2366880.50	563415.00	SCsb-045m-00##-SO	1-5	1	1	1						

Table C-4 (Continued)
Coordinates for Proposed Sampling Locations at Sand Creek Disposal Road Landfill

Sample Location ID	Sample Type	Easting	Northing	Sample ID	Sample Depth (ft bgs)	Number of Samples								
						TAL Metals	Explosives	SVOCs	Hexavalent Chromium	VOCs	Pesticides	PCBs	Cyanide	Propellants
SCsb-046	Hand-Auger Subsurface Soil	2366853.80	563400.50	SCsb-046m-00##-SO	1-5	1	1	1	1					
SCsb-047	Hand-Auger Subsurface Soil	2366824.00	563387.00	SCsb-047m-00##-SO	1-5	1	1	1						
SCsb-048	Hand-Auger Subsurface Soil	2366792.30	563369.06	SCsb-048m-00##-SO	1-5	1	1	1	1		1	1	1	1
				SCsb-048d-00##-SO	1-5					1				
				SCsb-084m-00##-SO	1-5	1	1	1	1		1	1	1	1
				SCsb-048m-00##-SO	1-5	1	1	1	1		1	1	1	1
SCsb-049	Hand-Auger Subsurface Soil	2366762.50	563337.75	SCsb-049m-00##-SO	1-5	1	1	1						
SCsb-050	Hand-Auger Subsurface Soil	2366718.30	563295.50	SCsb-050m-00##-SO	1-5	1	1	1						
SCsb-051	Hand-Auger Subsurface Soil	2366682.80	563226.81	SCsb-051m-00##-SO	1-5	1	1	1	1					
				SCsb-051m-00##-MS	1-5	1	1	1						
				SCsb-051m-00##-MD	1-5	1	1	1						
SCsb-052	Hand-Auger Subsurface Soil	2366702.80	563108.69	SCsb-052m-00##-SO	1-5	1	1	1						
SCsb-053	Hand-Auger Subsurface Soil	2366705.30	563024.63	SCsb-053m-00##-SO	1-5	1	1	1						
SCsb-054	Hand-Auger Subsurface Soil	2366663.80	562966.38	SCsb-054m-00##-SO	1-5	1	1	1						
SCsb-055	Hand-Auger Subsurface Soil	2366509.80	562738.25	SCsb-055m-00##-SO	1-5	1	1	1	1					
SCsb-056	Hand-Auger Subsurface Soil	2366415.80	562576.00	SCsb-056m-00##-SO	1-5	1	1	1						

Table C-4 (Continued)
Coordinates for Proposed Sampling Locations at Sand Creek Disposal Road Landfill

Sample Location ID	Sample Type	Easting	Northing	Sample ID	Sample Depth (ft bgs)	Number of Samples								
						TAL Metals	Explosives	SVOCs	Hexavalent Chromium	VOCs	Pesticides	PCBs	Cyanide	Propellants
SCss-057	MI Surface Soil	2366940.60	563444.14	SCss-057m-00##-SO	0-1	1	1	1	1	1	1	1	1	1
		2366899.14	563463.34											
		2366905.85	563531.32											
		2366944.87	563523.09											
	Discrete Surface Soil	within	MI area	SCss-057d-00##-SO	0-1					1				
	MI Surface Soil	extra	volume	SCss-057m-00##-MS	0-1	1	1	1			1	1	1	1
	MI Surface Soil	extra	volume	SCss-057m-00##-MD	0-1	1	1	1			1	1	1	1
	Discrete Surface Soil	extra	volume	SCss-057d-00##d-MS	0-1					1				
	Discrete Surface Soil	extra	volume	SCss-057d-00##d-MD	0-1					1				
SCss-058	MI Surface Soil	2366905.85	563411.83	SCss-058m-00##-SO	0-1	1	1	1						
		2366877.80	563440.18											
		2366899.14	563463.34											
		2366940.60	563444.14											
		within	MI area	SCss-085m-00##-SO	0-1	1	1	1						
		split	at lab	SCss-058m-00##-SO	0-1	1	1	1						
SCss-059	MI Surface Soil	2366878.41	563392.93	SCss-059m-00##-SO	0-1	1	1	1						
		2366854.64	563421.28											
		2366877.80	563440.18											
		2366905.85	563411.83											
SCss-060	MI Surface Soil	2366851.28	563378.90	SCss-060m-00##-SO	0-1	1	1	1	1					
		2366830.86	563412.44											
		2366854.64	563421.28											
		2366878.41	563392.93											
SCss-061	MI Surface Soil	2366822.63	563364.58	SCss-061m-00##-SO	0-1	1	1	1						
		2366800.38	563404.51											
		2366830.86	563412.44											
		2366851.28	563378.90											

Table C-4 (Continued)
Coordinates for Proposed Sampling Locations at Sand Creek Disposal Road Landfill

Sample Location ID	Sample Type	Easting	Northing	Sample ID	Sample Depth (ft bgs)	Number of Samples								
						TAL Metals	Explosives	SVOCs	Hexavalent Chromium	VOCs	Pesticides	PCBs	Cyanide	Propellants
SCss-062	MI Surface Soil	2366793.97	563343.85	SCss-062m-00##-SO	0-1	1	1	1	1					
		2366756.78	563365.49											
		2366800.38	563404.51											
		2366822.63	563364.58											
SCss-063	MI Surface Soil	2366719.90	563258.49	SCss-063m-00##-SO	0-1	1	1	1						
		2366672.34	563280.14											
		2366756.78	563365.49											
		2366793.97	563343.85											
SCss-064	MI Surface Soil	2366672.34	563280.14	SCss-064m-00##-SO	0-1	1	1	1	1					
		2366719.90	563258.49											
		2366748.55	563072.54											
		2366683.01	563067.36											
SCss-065	MI Surface Soil	2366683.01	563067.36	SCss-065m-00##-SO	0-1	1	1	1						
		2366748.55	563072.54											
		2366650.70	562915.86											
		2366598.57	562948.17											
SCss-066	MI Surface Soil	2366527.85	562831.72	SCss-066m-00##-SO	0-1	1	1	1	1					
		2366575.10	562799.41											
		2366476.33	562738.14											
		2366524.80	562706.43											
SCss-067	MI Surface Soil	2366476.33	562738.14	SCss-067m-00##-SO	0-1	1	1	1						
		2366524.80	562706.43											
		2366483.04	562593.34											
		2366414.76	562632.97											

Table C-4 (Continued)
Coordinates for Proposed Sampling Locations at Sand Creek Disposal Road Landfill

Sample Location ID	Sample Type	Easting	Northing	Sample ID	Sample Depth (ft bgs)	Number of Samples								
						TAL Metals	Explosives	SVOCs	Hexavalent Chromium	VOCs	Pesticides	PCBs	Cyanide	Propellants
SCss-068	MI Surface Soil	2366414.76	562632.97	SCss-068m-00##-SO	0-1	1	1	1			1	1	1	1
		2366483.04	562593.34											
		2366329.71	562510.42											
		2366383.05	562470.18											
		within	MI area	SCss-068d-00##-SO	0-1					1				
		within	MI area	SCss-086m-00##-SO	0-1	1	1	1						
		within	MI area	SCss-086d-00##-SO	0-1					1				
		split	at lab	SCss-068m-00##-SO	0-1	1	1	1						
		within	MI area	SCss-068d-00##-SO	0-1					1				
SCss-069	MI Surface Soil	Center 2366841.30	Center 563294.09	SCss-069m-00##-SO	0-1	1	1	1						
		2366850.44	563321.02											
		2366867.22	563290.55											
		2366815.88	563295.86											
		2366827.54	563269.07											
SCsd-070	MI Dry Sediment	2366905.85	563531.32	SCsd-070m-00##-SD	0-0.5	1	1	1	1		1	1	1	1
		2366944.87	563523.09											
		2366650.70	562915.86											
		2366598.57	562948.17											
		within	MI area	SCsd-070d-00##-SD	0-0.5					1				
SCsd-071	MI Dry Sediment	2366527.85	562831.72	SCsd-071m-00##-SD	0-0.5	1	1	1	1		1	1	1	1
		2366575.10	562799.41											
		2366329.71	562510.42											
		2366383.05	562470.18											
		within	MI area	SCsd-071d-00##-SD	0-0.5					1				

Table C-4 (Continued)
Coordinates for Proposed Sampling Locations at Sand Creek Disposal Road Landfill

Sample Location ID	Sample Type	Easting	Northing	Sample ID	Sample Depth (ft bgs)	Number of Samples								
						TAL Metals	Explosives	SVOCs	Hexavalent Chromium	VOCs	Pesticides	PCBs	Cyanide	Propellants
				Primary MI Samples		73	73	73	12	0	9	9	9	9
				Primary Discrete Samples		0	0	0	0	9	0	0	0	0
				Field (Blind) Duplicate Samples		7	7	7	1	1	1	1	1	1
				QA Samples		7	7	7	1	1	1	1	1	1
				MS/MSD and MS/MD Sample Pairs		4	4	4	0	1	1	1	1	1

Notes:

Coordinates are provided in Ohio State Plane (NAD 83).

= sequential sample number
d = discrete sample
ft bgs = feet below ground surface
QA = quality assurance
m = multi-increment sample
MI = multi-increment
sb = soil boring
sd = sediment
ss = surface soil
MD = matrix duplicate
MS = matrix spike
MSD = matrix spike duplicate
PCBs = polychlorinated biphenyls
SD = sediment
SO = soil
SVOCs = semivolatile organic compounds
TAL = target analyte list
VOCs = volatile organic compound

Geoprobe Sample Location (9)

Hand-Auger Sample Location (13)

Multi-Increment Sediment Sample Area (2)

Multi-Increment Soil Sample Area (12)

Sand Creek Dump-Limits & Sample Grids

0 100 200 Feet

U.S. ARMY
CORPS OF ENGINEERS
LOUISVILLE DISTRICT

FIGURE NUMBER
C-3

RVAAP-34
SAND CREEK DISPOSAL ROAD LANDFILL
PROPOSED ADDITIONAL INVESTIGATION
SAMPLE LOCATIONS

Shaw Shaw Environmental, Inc.

Generated by: BLM Date: 06/01/09 File Path: T:\Divisions\Design\GIS\133616_RVAAP\Doc\Mxd\RVAAP_003_FigC_2_PropAddlSampleLoc.mxd

Project Number: 133616

Final Quality Assurance Project Plan Addendum No. 1 for Environmental Services at RVAAP-34 Sand Creek Disposal Road Landfill, RVAAP-03 Open Demolition Area #1, and RVAAP –28 Mustard Agent Burial Site

Version 1.0

Ravenna Army Ammunition Plant
Ravenna, Ohio

Contract No. W912QR-08-D-0013
Delivery Order 0002

Prepared for:

US Army Corps of Engineers ®
Louisville District
600 Martin Luther King, Jr. Place
Louisville, Kentucky 40202

Prepared by:

Shaw Environmental & Infrastructure, Inc.
100 Technology Center Drive
Stoughton, MA 02072

February 11, 2010

Table of Contents

List of Tables

Acronyms and Abbreviations

ADR	Automated Data Review
AOC	Area of Concern
ASTM	American Society of Testing Materials
CX	Center of Expertise
DoD	Department of Defense
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
EPA	U.S. Environmental Protection Agency
FSAP	Facility-Wide Sampling and Analysis Plan
FSP	Field Sampling Plan
HTRW	Hazardous, Toxic, and Radioactive Waste
kg	kilogram
LCG	Louisville Chemistry Guideline
LCS	laboratory control sample
LOR	letters of receipt
MABS	Mustard Agent Burial Site (RVAAP-28)
MI	Multi-increment (sample)
MS/MD	matrix spike/matrix duplicate
MS/MSD	matrix spike/matrix spike duplicate
ODA1	Open Demolition Area (RVAAP-03)
Ohio EPA	Ohio Environmental Protection Agency
OVM	organic vapor meter
PCBs	polychlorinated biphenyls
PID	photoionization detector
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
RVAAP	Ravenna Army Ammunition Plant
SAIC	Science Applications International Corporation
Shaw	Shaw Environmental & Infrastructure, Inc.
SOPs	standard operating procedures
SVOCs	semivolatile organic compounds
TAL	Target Analyte List
TBD	to be determined
USACE	U.S. Army Corps of Engineers
VOCs	volatile organic compounds

This page intentionally left blank.

1.0 Project Description

This *Quality Assurance Project Plan (QAPP) Addendum No. 1*; hereafter, referred to as the *QAPP Addendum*, has been prepared by Shaw Environmental & Infrastructure, Inc. (Shaw) in accordance with the *Scope of Work for Environmental Services at and RVAAP-34 Sand Creek Disposal Road Landfill, RVAAP-03 Open Demolition Area 1 (ODA1), and RVAAP-28 Mustard Agent Burial Site (MABS)* and addresses supplemental project-specific information in relation to the final *Facility-Wide QAPP* for the Ravenna Army Ammunition Plant (RVAAP) (SAIC, 2001). The supplemental project-specific information provided in this *QAPP Addendum* is applicable for environmental investigation activities to be conducted at ODA1 and the Sand Creek Disposal Road Landfill. No intrusive sampling and laboratory analyses activities are proposed for MABS. Each section in this *QAPP Addendum* is presented documenting adherence to the *Facility-Wide QAPP* or stipulating project-specific requirements.

Primary analytical direction for these projects will be obtained from the identified U.S. Environmental Protection Agency (EPA) publication SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA, 2007); the Department of Defense's *DoD Quality Systems Manual for Environmental Laboratories* (*QSM*), Version 4.1 (DoD, 2009); and the *Louisville Chemistry Guideline* (*LCG*), Version 5 (USACE, 2002).

1.1 Site History / Background Information

This information is contained in Section 1.0 of the *Field Sampling Plan (FSP) Addendum*. Area of concern (AOC)-specific background and history information for ODA1 and Sand Creek Disposal Road Landfill is included in Appendices A and C, respectively, of the *FSP Addendum*.

1.2 Past Data Collection Activity / Current Status

This information is provided for ODA1 and Sand Creek Disposal Road Landfill in Appendices A and C, respectively, of the *FSP Addendum*.

1.3 Project Objectives and Scope

This information is contained in Section 1.0 of the *FSP Addendum*.

1.4 Sample Network Design and Rationale

General information regarding the sample network design and rationale is provided in Section 3.0 of the *FSP Addendum*, with information specific to ODA1 and Sand Creek Disposal Road Landfill presented in Appendices A and C, respectively.

1.5 Parameters to be Tested and Frequency

Sample matrix types, analytical parameters, and analytical methods are discussed in Section 4.0 and in Appendices A and C (for specific AOCs) of the *FSP Addendum*. These sampling and analysis requirements are summarized in **Table 1-1** of this *QAPP Addendum*, in conjunction with anticipated sample numbers, quality assurance (QA) sample frequencies, and field quality control (QC) sample frequencies.

1.6 Project Schedule

The project schedule is discussed in Section 8.0 of the *FSP Addendum*.

Table 1-1
Sampling and Analytical Requirements

Parameter	Methods	Field Samples [a]			MS/MSD and MS/MD Pairs	Field Duplicate Samples [b]	Site Source Water [c]	Sampler Rinsates [d]	Total Samples	USACE QA Split Samples [e]
		Discrete	MI	Total						
Soil and Dry Sediment – Chemical Analysis										
Metals (TAL)	SW-846, 6010B/6020A/7471B	NA	140	140	7	14	2	20	183	14
Hexavalent Chromium	SW-846, 7196A	NA	20	20	1	2	2	20	45	2
SVOCs	SW-846, 8270C/3540C/3541	NA	80	80	4	8	2	20	114	8
Explosives	SW-846, 8330B	NA	140	140	7	14	2	20	183	14
VOCs	SW-846, 8260B/5035B	28	NA	28	2	3	2	20	55	3
Pesticides	SW-846, 8081A/3550B	NA	16	16	1	2	2	20	41	2
PCBs	SW-846, 8082A/3540C	NA	16	16	1	2	2	20	41	2
Cyanide	SW-846, 9011/9012	NA	16	16	1	2	2	20	41	2
Nitroguanidine	SW-846, 8330A Mod./8332 Mod.	NA	33	33	2	4	2	20	61	4
Nitrocellulose	SW-846, 9056A Mod./EPA 353.2 Mod.	NA	33	33	2	4	2	20	61	4
Nitroglycerin	SW-846, 8332/8330 Mod.	NA	33	33	2	4	2	20	61	4

Notes:

[a] Matrix spike/matrix spike duplicate (MS/MSD) and matrix spike/matrix duplicate (MS/MD; for metals) samples will be collected at a rate of 5% (1 per 20) of total samples per media. Full suite samples will be collected at a frequency of 10% according to the FSP Addendum.

[b] Duplicate samples are collected at a frequency of 10% per AOC; therefore, the total number of duplicate samples is greater than 10% of the total samples.

[c] Source waters will be collected from the potable water source and from the ASTM (de-ionized) water supply lot for the project.

[d] One rinsate sample will be collected per field cycle for soil samples. The number of rinsate samples included in this table is an estimate only and is subject to change.

[e] QA Split Samples will be collected at a rate of 10% and analyzed by USACE and the Ohio EPA in coordination with Shaw.

[f] EPA 353.2 is a previously accepted method for nitrocellulose, but it is not listed in the Facility-Wide QAPP. The method meets the project quantitation levels in Table 3-7 of the Facility-Wide QAPP. Nitrocellulose does not have a facility-wide draft cleanup goal (SAIC, 2008) due to the absence of toxicity data; therefore, there are no levels to consider other than the project quantitation levels.

AOC = Area of Concern

ASTM = American Society of Testing Materials

FSP = Field Sampling Plan

MI = Multi-Increment (sample)

MS/MD = matrix spike/matrix duplicate

MS/MSD = matrix spike/matrix spike duplicate

NA = not applicable

Ohio EPA = Ohio Environmental Protection Agency

PCBs = polychlorinated biphenyls

QA = Quality Assurance

QAPP = Quality Assurance Project Plan

SVOCs = Semivolatile Organic Compounds

TAL = Target Analyte List

TBD = To Be Determined

USACE = U.S. Army Corps of Engineers

VOCs = Volatile Organic Compounds

2.0 Project Organization and Responsibility

The functional project organization and responsibilities are described in Section 2.0 of the *Final Facility-Wide Sampling and Analysis Plan for Environmental Investigations at the Ravenna Army Ammunition Plant, Ravenna, Ohio* (*FSAP*) (SAIC, 2001). Project organization for the implementation of this *QAPP Addendum* is identified in Section 2.0 of the *FSP Addendum*.

Analytical support for this work has not yet been assigned. Information on the selected laboratory and the contract laboratory QAPP will be forwarded to USACE and Ohio EPA once the laboratory is selected.

This page intentionally left blank.

3.0 Quality Assurance Objectives for Measurement

3.1 Data Quality Objectives

Data Quality Objectives (DQO) for this investigation will follow Table 3-1 in the *Facility-Wide QAPP*. All QC parameters stated in the specific EPA SW-846 methods will be adhered to for each chemical listed. The SW-846 methods referenced in the *Facility-Wide QAPP* have been revised to the *Final Update IV* methods (EPA, 2008). Laboratories are required to comply with all methods as written; recommendations are considered requirements. Concurrence with the *QSM* (DoD, 2009), and the *LCG* (USACE, 2002) is expected.

The contract laboratory will deliver an electronic data deliverable (EDD) that is automated data review (ADR) compatible. The contract laboratory must identify variances to the established library prior to any analysis being performed. No variances to the *QSM* and the *LCG* are anticipated. EDDs with errors will not be accepted.

3.2 Level of Quality Control Effort

QC efforts will follow Section 3.2 of the *Facility-Wide QAPP*. Field QC measurements will include field source water blanks, duplicates, and equipment rinsate blanks. Laboratory QC measurements will include method blanks, laboratory control samples (LCSs), laboratory duplicates, and matrix spike/matrix spike duplicate (MS/MSD) samples or matrix spike/matrix duplicate (MS/MD) samples for metals.

3.3 Accuracy, Precision, and Sensitivity of Analysis

Accuracy, precision, and sensitivity goals identified in Section 3.3 and Tables 3-1 through 3-9 of the *Facility-Wide QAPP* will be imposed for this investigation. As stated above, some of the analytical method numbers have been updated (refer to **Table 1-1** of this *QAPP Addendum*). Quality objectives related to individual method QC protocol will also follow requirements given in the *QSM* and the *LCG*.

Laboratories will make all reasonable attempts to meet the program and project reporting levels in Tables 3-1 through 3-9 of the *Facility-Wide QAPP* for each individual sample analysis. When samples require dilution, both the minimum dilution and quantified dilution must be reported. If there are matrix interferences, non-target analyte, or high target analyte concentrations that preclude analysis of an undiluted sample, the laboratory project manager will contact Shaw and U.S. Army Corps of Engineers, Louisville District (USACE), forward analytical and chromatographic information from diluted runs, and obtain direction on how to proceed.

3.4 Completeness, Representativeness, and Comparability

Completeness, representativeness, and comparability goals identified in Section 3.4 and Table 3-1 of the *Facility-Wide QAPP* will be imposed for this investigation.

4.0 Sampling Procedures

Sampling procedures are described in Section 4.0 of the *FSAP* and referenced in Section 4.0 of the *FSP Addendum*.

Each multi-increment (MI) sample weighing 1 kilogram (kg) or more will be submitted to the laboratory in a sealed 1-gallon plastic bag for processing. **Table 4-1** summarizes sample container, preservation, and holding time requirements for the soil and dry sediment media for this investigation. The number of containers required will be estimated in this table after the laboratory has been selected.

As noted in the *Facility-Wide QAPP*, additional sample volumes will be provided, when necessary, for the express purpose of performing associated laboratory QC (MS/MSD or MS/MD). These laboratory QC samples will be designated by the field and identified for the laboratory on respective chain-of-custody documentation.

Table 4-1
Container Requirements for Soil and Dry Sediment Samples

Analyte Group	[a]Container	Minimum Sample Size	Preservative	Holding Time
Metals (TAL)	4 oz glass jar (or include in SVOC container for full-suite samples)	25 g	Cool, 4°C	180 days; Hg 28 days
Hexavalent Chromium	4 oz glass jar	25 g	Cool, 4°C	30 days
SVOCs	16 oz glass jar with Teflon-lined cap	60 g	Cool, 4°C	14 days (extraction) 40 days (analysis)
Explosives	4 oz glass jar with Teflon-lined cap	60 g	Cool, 4°C	14 days (extraction) 40 days (analysis)
VOCs	2 x 2 oz glass jar with septum cap (no headspace)	20 g	Cool, 4°C	14 days
Pesticides	Include in SVOC container	60 g	Cool, 4°C	14 days (extraction) 40 days (analysis)
PCBs	Include in SVOC container	60 g	Cool, 4°C	14 days (extraction) 40 days (analysis)
Cyanide	Include in SVOC container	25 g	Cool, 4°C	14 days
Propellants (nitroguanidine, nitrocellulose, nitroglycerin)	4 oz glass jar with Teflon-lined cap	60 g	Cool, 4°C	14 days (extraction) 40 days (analysis)

Notes:
[a]Soil and sediment samples collected using multi-increment (MI) or modified MI (for subsurface soils only) methods will be shipped in sealed one-gallon plastic bags to the contracted laboratory for MI processing with the exception of samples collected for VOC analysis.

°C - degrees Celcius
g - gram
oz - ounce
PCBs - polychlorinated biphenyls
SVOCs - semivolatile organic compounds
TAL - Target Analyte List
VOCs - volatile organic compounds

This page intentionally left blank.

5.0 Sample Custody

Sample custody procedures will follow those identified in Section 5.0 of the *Facility-Wide QAPP*.

This page intentionally left blank.

6.0 Calibration Procedures and Frequency

6.1 Field Instruments/Equipment

Field instrument and equipment calibrations will follow the manufactures instructions and the procedures described in Section 6.1 of the *Facility-Wide QAPP*. The expected field equipment will consist of geophysical instruments and an organic vapor meter (OVM) photoionization detector (PID) unit. Calibration and field check requirements for the geophysical instruments are described in detail in the *Final Geophysical Investigation Plan for the RVAAP-34 Sand Creek Disposal Road Landfill, RVAAP-03 Open Demolition Area #1 and RVAAP-28 Mustard Agent Burial Site* (Shaw, 2009). The PID will be checked daily per the manufacturer's instructions and will be calibrated daily with a gas of known concentration. All daily calibrations will be documented in a designated field log book for field instruments.

6.2 Laboratory Instruments

Calibration of laboratory equipment will follow procedures identified in Section 6.2 of the *Facility-Wide QAPP*, the contract laboratory QAPP, laboratory-specific standard operating procedures (SOPs), corporate and facility-specific operating procedures and the *LCG* (USACE, 2002). The Shaw Project Chemist will review the contracted laboratory's written procedures and will perform periodic QA audits to ensure that calibration records are maintained at the locations where the work is performed.

This page intentionally left blank.

7.0 Analytical Procedures

7.1 Laboratory Analysis

Analytical methods, parameters, and quantitation or detection limits are those listed in Tables 3-3 through 3-9 of the *Facility-Wide QAPP*. Laboratory analysis procedures are provided in Section 7.1 of the *Facility-Wide QAP*P and as updated in the *QSM* (DoD, 2009), and *LCG* (USACE, 2002).

7.2 Field Screening Analytical Protocols

Procedures for instrument calibration, calibration frequency, and field analysis are identified in Section 6.0 of the *Facility-Wide FSP*. Only screening of samples for organic vapors using a PID will be conducted. Headspace analysis will not be conducted for environmental samples since volatile organic compounds (VOCs) are not considered primary chemicals of concern at the subject AOCs.

This page intentionally left blank.

8.0 Internal Quality Control Check

8.1 Field Sample Collection

Field QC sample types, numbers, and frequencies are identified in Section 4.0 of the *FSP Addendum*. In general, duplicates will be collected at a frequency of 10%. One field equipment rinsate sample will be collected per field cycle. Equipment rinsate samples pertain only to samples collected using reusable, decontaminated equipment. This will constitute a process check for the effectiveness of the decontamination procedure. Two site source water samples (one potable water source and one deionized source) will be collected for the field effort.

8.2 Field Measurement

Refer to Section 4.0 of the *FSP Addendum* for details regarding field measurements.

8.3 Sample Processing

Surface soil, subsurface soil, and dry sediment samples will be collected using the MI sampling methodology (modified MI for subsurface soils) described in Section 4.0 of the *FSP Addendum*. An additional requirement of the MI sampling technique involves careful sample processing and preparation. Shaw will only contract with a laboratory that has been approved by USACE and the Ohio Environmental Protection Agency (Ohio EPA) for drying and processing procedures associated with MI sample preparation.

8.4 Laboratory Analysis

Analytical QC procedures will follow those identified in the referenced EPA methodologies. These will include method blanks, LCS, MS, MSD, matrix duplicate (for metals), laboratory duplicate analysis, calibration standards, internal standards, surrogate standards, and calibration check standards.

The contract laboratory facilities will conform to their QAPP and implement their established SOPs and *LCG* (USACE, 2002) to perform the various analytical methods required by the project. QC frequencies will follow those identified in Section 8.3 of the *Facility-Wide QAPP*.

Analyses will also be consistent with direction provided by the *QSM* (DoD, 2009) and the *LCG*.

This page intentionally left blank.

9.0 Data Reduction, Validation, and Reporting

9.1 Data Reduction

Data reduction will follow the established protocols defined in Section 9.1 in the *Facility-Wide QAPP*. Sample collection and field measurements will follow the established protocols defined in the *Facility-Wide QAPP*, *FSAP*, and this *QAPP Addendum*. Laboratory data reduction will follow the contract laboratory QAPP guidance and will conform to general direction provided by the *Facility-Wide QAPP*; the *QSM* (DoD, 2009), and the *LCG* (USACE, 2002).

9.2 Data Verification/Validation

Project data verification and validation will follow direction provided in Section 9.2 of the *Facility-Wide QAPP* and diagrammed in Figure 9-1. Data verification and validation will be performed in accordance with the *LCG* and utilize the QC criteria in the *QSM*. In addition, the following documents will be used as needed:

- EPA National Functional Guidelines for Organic Data Review, EPA-540/R-99/008, October 1999.
- EPA National Functional Guidelines for Inorganic Data Review, EPA-540-R-04-004, October 2004.

All data will be reviewed and verified by Shaw according to the *Facility-Wide QAPP*. Data reports will follow the established protocols defined in Section 9.3 in the *Facility-Wide QAPP*.

9.3 Data Quality Assessment

Data quality will be assessed using the procedures provided in Section 9.4 of the *Facility-Wide QAPP*.

This page intentionally left blank.

10.0 Performance and System Audits

10.1 Field Audits

One field audit for the investigation will be performed by the Shaw QA/QC Officer, the Shaw Field Operations Manager, or another properly trained Shaw auditor in accordance with the procedures identified in Section 10.1 of the *Facility-Wide QAPP*.

The USACE or Ohio EPA audits may be conducted at the discretion of the respective agency.

10.2 Laboratory Audits

Routine USACE Hazardous, Toxic, and Radioactive Waste (HTRW) Center of Expertise (CX) on-site laboratory audits may be conducted by USACE, while audits by Ohio EPA may be conducted at the agency's discretion. Shaw will ensure that internal performance and systems audits will be conducted by the contract laboratory's QA staff, as will be defined in their QAPP. Additional information regarding laboratory audits is presented in Section 10.2 of the *Facility-Wide QAPP*.

This page intentionally left blank.

11.0 Preventative Maintenance Procedures

Maintenance of all field and laboratory sampling and analytical equipment will follow direction provided in Section 11.0 of the *Facility-Wide QAPP*. Due to the limited duration of the field investigation sampling activities, Shaw does not anticipate providing a temporary laboratory at the RVAAP. Field sampling equipment is expected to be limited to a PID OVM.

Routine and preventative maintenance for all laboratory instruments and equipment will also follow the direction of the contract laboratory QAPP. Shaw understands that as a part of the contracted laboratory QA/QC Program, a routine preventive maintenance program will be required to minimize the occurrence of instrument failure and other system malfunctions. The Shaw Project Chemist will review the contracted laboratory's QAPP to ensure that all laboratory instruments will be maintained in accordance with manufacturer's specifications and the requirements of the specific method employed.

This page intentionally left blank.

12.0 Specific Routine Procedures to Assess Data Precision, Accuracy, and Completeness

Field and laboratory data will be assessed as outlined in Section 12.0 of the *Facility-Wide QAPP*.

This page intentionally left blank.

13.0 Corrective Actions

Field and laboratory activity corrective action protocol will follow directions provided in Section 13.0 of the *Facility-Wide QAPP*, the procedures included in the contract laboratory QAPP, and the *LCG* (USACE, 2002). The Shaw Project Chemist will review the contracted laboratory's QAPP to ensure that corrective action procedures are in accordance with the requirements of the *Facility-Wide QAPP* and the *LCG*. Any non-compliance with specified criteria and analytical equipment problems will be documented and reported by Shaw to the USACE Project Manager and the USACE Chemist. If corrective actions are deemed insufficient, work may be stopped through a stop work order issued by the Shaw Project Manager or USACE Project Manager.

This page intentionally left blank.

14.0 QA Reports

Procedures and reports will follow the protocol identified in Section 14.0 of the *Facility-Wide QAPP* and those directed by the contract laboratory QAPP. All performance and system audits of laboratories and field operations will be reported directly to the Shaw and USACE project management in accordance with the performance and system audit requirements in Section 10.0 of the *Facility-Wide QAPP*.

In addition, the laboratory will provide case narratives and letters of receipt (LOR). The LOR will identify deviations such as broken or otherwise damaged containers. Shaw will require that the LOR be forwarded to Shaw within two days of sample receipt and will include a signed copy of the chain-of-custody, itemized project sample numbers, laboratory sample numbers, cooler temperature receipt, and itemization of analyses to be performed. Case narratives will accompany analytical results from the laboratory and will form the basis of the project data quality assessment. Final project reports will contain QA sections that summarize data quality information collected during the project including a data verification report.

This page intentionally left blank.

15.0 References

Science Applications International Corporation (SAIC), 2001. *Final Facility-Wide Sampling and Analysis Plan for Environmental Investigations at the Ravenna Army Ammunition Plant, Ravenna, Ohio*. March 2001.

SAIC, 2008. *Draft Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio*. September 2008.

Shaw Environmental & Infrastructure (Shaw), 2009. *Final Geophysical Investigation Plan for the RVAAP-34 Sand Creek Disposal Road Landfill, RVAAP-03 Open Demolition Area #1, and RVAAP-28 Mustard Agent Burial Site*. July 16, 2009.

U.S. Department of Defense (DoD), 2009. *DoD Quality Systems Manual for Environmental Laboratories*, Version 4.1, Environmental Data Quality Workgroup. April 22, 2009.

U.S. Army Corps of Engineers (USACE), 2002. *Louisville Chemistry Guideline*, Louisville District, Environmental Engineering Branch, Revision 5. June 2002.

U.S. Environmental Protection Agency (EPA), 2007. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, publication SW-846, Revision 6. February 2007.

EPA, 2008. Waste Management System; Testing and Monitoring Activities; Notice of Availability of Final Update IV of SW-846. January 3, 2008.

This page intentionally left blank.

PART 3

SAMPLING AND ANALYSIS PLAN ADDENDUM NO. 1 ATTACHMENTS

This page intentionally left blank.

ATTACHMENT 1
COMMENT RESPONSE TABLE

This page intentionally left blank.

DRAFT SAMPLING AND ANALYSIS PLAN ADDENDUM NO. 1 FOR ENVIRONMENTAL SERVICES AT RVAAP-34 SAND CREEK DISPOSAL ROAD LANDFILL, RVAAP-03 OPEN DEMOLITION AREA #1, AND RVAAP-28 MUSTARD AGENT BURIAL SITE, VERSION 1.0
RAVENNA ARMY AMMUNITION PLANT, RAVENNA, OHIO
COMMENT RESPONSE TABLE
February 2, 2010

Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
Ohio EPA – Eileen Mohr (January 28, 2010)					
1	3-3/15-17		This sections needs to be expanded to indicate that site related contaminants such as propellants and explosives cannot be eliminated by the 5% frequency of detection screen.	Please revise.	This section will be revised to state: "Chemicals meeting the less than 5% detected rule (i.e. frequency of detection) may be screened out; however, in order for this to occur, the chemical must have a statistically valid data set with a sample size of at least 20. The frequency of detection screen does not apply to site-related contaminants such as propellants and explosives which will be retained as COPCs through the evaluation process."
2	3-4/33-35 and going onto the next page.		The text sounds as though a chemical will be retained as a COC if it exceeds the most stringent CUG for each receptor based on a 10E-5 or HI of 1. However the text also seems to indicate that a sum of ratios approach will be used to ensure that the risk goal isn't exceeded as a justification to retain the chemical as a COC.	If the CUG is exceeded for the most stringent receptor options it will need to be evaluated during the FS (ex. clean-up). For example, if the CUGs exceed the residential re-use then LUCs and 5 year reviews as costs and alternatives needs to be evaluated in the FS. What is not exactly clear in the text is how you get to the final clean-up numbers. This is where the sum of ratios should come in, i.e. determining whether or not the CUGs are protective for the intended re-use and modifying them if they are not.	Per the June 2009 *Final USACE Position Paper for the Application and Use of Facility-Wide Human Health Cleanup Goals*, that was reviewed and approved by the Ohio EPA, "the CUGs for each of the COCs identified are the actual remediation levels unless there are additive effects". The use of the Sum of Ratios approach is intended to account for any of these potential additive effects. It is agreed that the final application of the CUGs for each COC identified for a receptor will be conducted during the FS; however, it is not expected that any of the CUGs will change with respect to the final cleanup numbers as this is the intent of the CUGs.

DRAFT SAMPLING AND ANALYSIS PLAN ADDENDUM NO. 1 FOR ENVIRONMENTAL SERVICES AT RVAAP-34 SAND CREEK DISPOSAL ROAD LANDFILL, RVAAP-03 OPEN DEMOLITION AREA #1, AND RVAAP-28 MUSTARD AGENT BURIAL SITE, VERSION 1.0
RAVENNA ARMY AMMUNITION PLANT, RAVENNA, OHIO
COMMENT RESPONSE TABLE
February 2, 2010

Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
3	3-5/14-20		The future uses for Sand Creek and ODA1 are listed.	Clarify the status of MABS.	Section 3.2.1 summarily states that the data evaluation process will be applied to the analytical data collected for ODA1 and Sand Creek only Since there will be no intrusive sampling at the MABS, no evaluation of COCs will be performed for this site which is why the future use at MABS is not included in this section.
4	4-2/29-30		Text revision requested.	Revise to read: "…work and any vegetation disturbance…" Specifically, does Shaw intend to disturb wetlands as part of this effort?	Shaw does not intend to disturb any wetland vegetation as part of vegetation clearing activities. Reference to the wetland disturbance will be removed from this sentence. It will now read as: "Shaw will coordinate with the OHARNG/Camp Ravenna environmental office prior to performing work and any vegetation disturbance at Camp Ravenna property."
5	4-3/1-15		Clarification requested.	Hasn't the GPO already been constructed? If so, revise tense.	The tense in Section 4.1.3 will be revised to reflect that GPO activities have already been performed.
6	4-5/31-34		This section contains text from an old MI SOW that was never revised, but that Ohio EPA had repeatedly asked for revisions with respect to discrete vs. MI data defensibility, etc.	Remove these lines from the revised text.	Lines 31-34 on page 4-5 will be removed from the text.

DRAFT SAMPLING AND ANALYSIS PLAN ADDENDUM NO. 1 FOR ENVIRONMENTAL SERVICES AT RVAAP-34 SAND CREEK DISPOSAL ROAD LANDFILL, RVAAP-03 OPEN DEMOLITION AREA #1, AND RVAAP-28 MUSTARD AGENT BURIAL SITE, VERSION 1.0
RAVENNA ARMY AMMUNITION PLANT, RAVENNA, OHIO
COMMENT RESPONSE TABLE
February 2, 2010

Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
7	4-7/7		Revision of text requested.	Change text to read: "….otherwise, decontamination will be…"	Text will be revised to state following: "If feasible, disposal tools may be utilized; otherwise, decontamination *will* be performed on tools between sample areas…."
8	4-8/32 and 34		Clarification requested.	I don't have the draft CUGs in front of me. I am aware that we have a draft CUG for hex chrome, but I am blanking on the total chrome CUG. Please provide.	The soil/dry sediment and subsurface soil draft CUGs for total chrome and hex chrome are the same for each of the receptors (i.e.; for National Guard Trainee, the draft CUGs for both chrome and hex chrome are 5.61 mg/kg for HI=0.1 and 1.64 mg/kg for the 10^{-6} cancer risk; for the Residential Farmer Adult, the draft CUGs are 90.4 mg/kg for HI=0.1 and 187 mg/kg for 10^{-6} cancer risk; for the Residential Farmer Child, the draft CUGs are 19.9 mg/kg for HI=0.1 and 401.4 mg/kg for 10^{-6} cancer risk). The first paragraph will be clarified to state the following: "Previous samples at each AOC have been analyzed for total chromium only. In this *Addendum* and the referenced DQO Reports, the total chromium Draft FWCUG, as presented in the *Draft Facility-Wide Human Health Remediation Goals, Ravenna Army Ammunition Plant* (SAIC, 2008), was used for screening both total and hexavalent chromium results. Although, a Draft FWCUG is provided for hexavalent chromium for each of the receptors, it is the same as the Draft FWCUG for total chromium. The use of the total chromium Draft FWCUG for both chromium states is based on the assumption that chromium exists

DRAFT SAMPLING AND ANALYSIS PLAN ADDENDUM NO. 1 FOR ENVIRONMENTAL SERVICES AT RVAAP-34 SAND CREEK DISPOSAL ROAD LANDFILL, RVAAP-03 OPEN DEMOLITION AREA #1, AND RVAAP-28 MUSTARD AGENT BURIAL SITE, VERSION 1.0
RAVENNA ARMY AMMUNITION PLANT, RAVENNA, OHIO
COMMENT RESPONSE TABLE
February 2, 2010

Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
					predominantly in the trivalent state, rather than the more toxic hexavalent state. In order to confirm this assumption and determine an appropriate risk, chromium speciation samples will be collected at the AOCs to develop AOC-specific ratios of hexavalent chromium to trivalent chromium."
9	4-11/10-12 and 4-11/13-15		The first bullet talks about collecting and securing artifacts or remains. The second bullet talks about not disturbing the area any further.	These seem to contradictory. In one, there is a discussion that even Range Control can collect artifacts/remains… this seems counter to archaeological preservation rules. Please clarify.	The procedures for cultural resource management at the RVAAP included in Section 4.3 were provided by OHARNG/Camp Ravenna. Shaw coordinated this comment with the OHARNG/Camp Ravenna and it was agreed to remove the words "collect or" from the second bullet. This bullet now reads: "The CRM or Range Control will secure any artifacts or remains identified in the AOC for analysis or curation, as appropriate. Human remains are not to be disturbed or removed from the AOC."
10	4-11/11-12		Revision requested.	Remove verbiage that discusses the barrier system, as this relates to another project.	Reference to "*the barrier*" will be removed from this sentence and the sentence will be revised to state: "Human remains are not to be disturbed or removed from *the AOC*"
11	7-1/6		Addition requested.	Add Ohio EPA.	"Ohio EPA" will be added to the text.
12	7-1/33		Text revision.	Change to read: "two 55 gallon drums of decontamination fluid…"	The word "*will*" will be removed from this sentence and it will be revised to state: " two 55 gallon drums of decontamination fluid…."

DRAFT SAMPLING AND ANALYSIS PLAN ADDENDUM NO. 1 FOR ENVIRONMENTAL SERVICES AT RVAAP-34 SAND CREEK DISPOSAL ROAD LANDFILL, RVAAP-03 OPEN DEMOLITION AREA #1, AND RVAAP-28 MUSTARD AGENT BURIAL SITE, VERSION 1.0
RAVENNA ARMY AMMUNITION PLANT, RAVENNA, OHIO
COMMENT RESPONSE TABLE
February 2, 2010

Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
13	App A/A-4/4		Text change requested.	Change text to read: "….potential source areas, it will be necessary..."	This sentence will be revised to state:"In the event the geophysical survey confirms the presence of additional potential source areas, it *will* be necessary to implement a revised sampling program to assess the environmental media."
14	App A/A-4/6-7		Clarification requested.	It is unclear why the FWSAP Addendum would be modified to reflect the proposed sampling design. If the sampling design needs to be modified after the workplans are approved, then any changes will be reflected in approved FCOs and added to the report.	Shaw will remove sentences 6-7 on page A-4 from the text. The text will be revised to state: "In the event the geophysical survey confirms the presence of additional potential source areas, it will be necessary to implement a revised sampling program to assess the environmental media. Shaw will submit any changes to the sampling program in a Field Change Order notification to be approved by the Army and Ohio EPA and details of the changes will be included in the remedial investigation report."
15	App A/TableA-2		Clarification requested, based upon ODA1 surface soil rationale and the ODA1 map (A-1)	Do the 3 proposed MI samples of surface soil close the data gaps? Looking at the map and without having the ODA1 data in front of me… are all other areas on the perimeter "clean" based upon previous analytical work?	The 3 proposed MI samples of surface soils close the data gaps for inorganics, explosives and propellants. However, it is not known if a data gaps exists for VOCs, SVOCs and PCBs due to lack of historical data. To expand upon this, for inorganics, the horizontal and vertical extent of contamination in surface soil is defined by existing data except where additional sampling is proposed as per the ODA1 DQO Report. That is to say that the concentrations of inorganic COPCs are less than

DRAFT SAMPLING AND ANALYSIS PLAN ADDENDUM NO. 1 FOR ENVIRONMENTAL SERVICES AT RVAAP-34 SAND CREEK DISPOSAL ROAD LANDFILL, RVAAP-03 OPEN DEMOLITION AREA #1, AND RVAAP-28 MUSTARD AGENT BURIAL SITE, VERSION 1.0
RAVENNA ARMY AMMUNITION PLANT, RAVENNA, OHIO
COMMENT RESPONSE TABLE
February 2, 2010

Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
					the most conservative risk-based CUGs (risk 10^{-6}/HI=0.1) for existing data points with the exception of four inorganic COPCs in surface soil samples collected at sampling locations DA1-008, -018, -019, -026, -030, -034. Three of these sample locations (DA1-008, -018, -019) are in the central part of the site and are surrounded (horizontally and vertically) by other samples collected during RI and IRA activities. The remaining three locations (DA1-026, -030, -034) are located along the perimeter of the site and the proposed additional surface soil sampling will provide data on horizontal extent of contamination. Vertical extent of contamination for these three perimeter sample locations is defined by existing subsurface soil data. For explosives and propellants, no COPCs were identified. Explosives were detected in surface soil samples at concentrations less than the CUGs. No propellants were detected in the post-IRA surface soil data set. For VOCs, SVOCs, and PCBs, a data gap analysis could not be performed due to lack of surface soil data. The post-IRA data set did not include any samples that had been analyzed for VOCs, SVOCs, or PCBs. Proposed additional sampling includes analysis of 10% of the samples for the full-suite of parameters.

DRAFT SAMPLING AND ANALYSIS PLAN ADDENDUM NO. 1 FOR ENVIRONMENTAL SERVICES AT RVAAP-34 SAND CREEK DISPOSAL ROAD LANDFILL, RVAAP-03 OPEN DEMOLITION AREA #1, AND RVAAP-28 MUSTARD AGENT BURIAL SITE, VERSION 1.0
RAVENNA ARMY AMMUNITION PLANT, RAVENNA, OHIO
COMMENT RESPONSE TABLE
February 2, 2010

Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
16	App A/table A-2		Clarification requested.	The depth intervals listed in the subsurface soil categories are misleading; i.e. it doesn't look like samples will be collected on 4 foot intervals. This concept is, however, picked up by the number of samples in the next column. Perhaps an asterisk could be added to the subsurface depth column and a footnote added to the bottom of the table that indicates that within these depths, samples will be collected on 4 foot intervals.	An asterisk will be added to the depths in the subsurface depth column and a note will be included below the table that states the following: "Depth intervals provided below depict the entire soil column from which the subsurface soils will be collected; however, the actual samples will be collected at maximum intervals of four feet as discussed in the rationale."
17	App B/B-1/2		Text change.	Change "rational" to "rationale."	"*rational*" will be changed to "*rationale*".
18	App C/Table C-2		Clarification requested.	What is meant by the title of this table? Specifically, the meaning of the "Summary of Accumulation Areas" is unclear.	The intended purpose of this table was to provide the reader with a summary of the distribution of contaminants identified at the site during previous investigations. In order to avoid further confusion, it is suggested that the title be changed to "*Distribution of COPCs Greater than the Draft Cleanup Goal Criteria*".
19	App C/C-9/14-17		Clarification requested on the contingency samples.	I did not see these scoped in on the Table C-4. Where are these located?	The intent of the contingency samples is only in the event that additional sampling is required following approval of this work plan. It is suggested that the sentence be revised to state the following: "Additional samples of the environmental media (surface and subsurface soils and dry sediment), otherwise referred to as *contingency samples*, may be necessary following approval of this work plan based on

DRAFT SAMPLING AND ANALYSIS PLAN ADDENDUM NO. 1 FOR ENVIRONMENTAL SERVICES AT RVAAP-34 SAND CREEK DISPOSAL ROAD LANDFILL, RVAAP-03 OPEN DEMOLITION AREA #1, AND RVAAP-28 MUSTARD AGENT BURIAL SITE, VERSION 1.0
RAVENNA ARMY AMMUNITION PLANT, RAVENNA, OHIO
COMMENT RESPONSE TABLE
February 2, 2010

Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
					the results of the geophysical investigation, visible contamination (i.e., stained soils, distressed vegetation or areas of dumping). If additional samples are required, Shaw will submit any changes to the sampling program in a Field Change Order notification to be approved by the Army and Ohio EPA and details of the changes will be included in the remedial investigation report."
20	App C/Table C-3		Clarification requested.	The depth interval listed on one of the subsurface soil categories is misleading; i.e. it doesn't look like samples will be collected on 4 foot intervals. This concept is, however, picked up by the number of samples in the next column. Perhaps an asterisk could be added to this subsurface depth column and a footnote added to the bottom of the table that indicates that within these depths, samples will be collected on 4 foot intervals.	An asterisk will be added to the depths in the subsurface depth column and a note will be included below the table that states the following: "Depth intervals provided below depict the entire soil column from which the subsurface soils will be collected; however, the actual samples will be collected at maximum intervals of four feet as discussed in the rationale."
21	App C/Table C-4		Clarification requested.	Clarify where the contingency samples referenced on page C-9 can be found.	As discussed in the response to comment 19, the intent of the contingency samples is only in the event additional sampling is required following approval of this work plan; therefore, the locations of contingency samples, if any, cannot be provided at this time.

DRAFT SAMPLING AND ANALYSIS PLAN ADDENDUM NO. 1 FOR ENVIRONMENTAL SERVICES AT RVAAP-34 SAND CREEK DISPOSAL ROAD LANDFILL, RVAAP-03 OPEN DEMOLITION AREA #1, AND RVAAP-28 MUSTARD AGENT BURIAL SITE, VERSION 1.0
RAVENNA ARMY AMMUNITION PLANT, RAVENNA, OHIO
COMMENT RESPONSE TABLE
February 2, 2010

Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
22	QAPP 2-1/7-8		Text revision requested.	Revise text to read: "…laboratory QAPP will be forwarded to USACE and Ohio EPA, once the laboratory is selected."	This sentence will be revised to state: "Information on the selected laboratory and the contract laboratory QAPP will be forwarded to USACE and Ohio EPA once the laboratory is selected."

This page intentionally left blank.

ATTACHMENT 2
OHIO EPA APPROVAL LETTER

This page intentionally left blank.

State of Ohio Environmental Protection Agency

Northeast District Office

2110 East Aurora Rd.
Twinsburg, Ohio 44087

TELE: (330) 963-1200 **FAX:** (330) 487-0769
www.epa.state.oh.us

Ted Strickland, Governor
Lee Fisher, Lieutenant Governor
Chris Korleski, Director

February 25, 2010

RE: RAVENNA ARMY AMMUNITION PLANT
PORTAGE/TRUMBULL COUNTIES
FINAL SHAW SAP FOR 3 AOCS

Mr. Mark Patterson
Facility Manager
Ravenna Army Ammunition Plant
8451 State Route 5
Ravenna, OH 44266

CERTIFIED MAIL
7008 2810 0000 5304 9654

Dear Mr. Patterson:

The Ohio Environmental Protection Agency (Ohio EPA), Northeast District Office (NEDO), Division of Emergency and Remedial Response (DERR) has received and reviewed the document entitled: "Final Sampling and Analysis Plan Addendum No. 1 for Environmental Services at RVAAP-34 Sand Creek Disposal Road Landfill, RVAAP-03 Open Demolition Area # 1, and RVAAP-28 Mustard Agent Burial Site." This document, dated February 11, 2010 and received at Ohio EPA, NEDO, on February 12, 2010, was prepared for the U.S. Army Corps of Engineers (USACE) – Louisville District by Shaw Environmental and Infrastructure, under contract number W912QR-08-D-0013. This document was compared to the draft document, dated January 20, 2010, and the approved response to Comment (RTC) table.

The above-referenced document is approved.

If you have any questions, please do not hesitate to contact me at (330) 963-1221.

Sincerely,

Eileen T. Mohr, Project Manager
Division of Emergency and Remedial Response

ETM/kss

cc: Glen Beckham, USACE Louisville
Derek Kinder, USACE Louisville
Katie Elgin, OHARNG Camp Ravenna
Dave Crispo, Shaw
Nat Peters, USACE Louisville
Mark Krivansky, AEC
Dave Cobb, Shaw
Andrea Steele, Shaw

ec: Mike Eberle, Ohio EPA, NEDO, DERR
Todd Fisher, Ohio EPA, NEDO, DERR
Christy Esler, RVAAP Army