RADFORD ARMY AMMUNITION PLANT, VIRGINIA

SWMU 48
Interim Measures Work Plan

Prepared for:

USACE Baltimore District
10 S. Howard St.
Baltimore, MD 21201

Prepared by:

Shaw Environmental, Inc.
2113 Emmorton Park Rd.
Edgewood, MD 21040

Draft Document **June 2011**

RECEIVED: July 20, 2011
11-59

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

July 20, 2011

Commander,
Radford Army Ammunition Plant
Attn: SJMRF-OP-EQ (Jim McKenna)
P.O. Box 2
Radford, VA 24141-0099

P.W. Holt
Environmental Manager
Alliant Techsystems, Inc.
Radford Army Ammunition Plant
P.O. Box 1
Radford, VA 24141-0100

VIA Electronic Mail

Re: Radford Army Ammunition Plant,VA
Solid Waste Management Unit 48
Interim Measures Work Plan

Dear Mr. McKenna and Ms. Holt:

The U.S. Environmental Protection Agency (EPA) and Virginia Department of Environmental Quality (VDEQ) have reviewed the U.S. Army's (Army's) June 2011 Interim Measures Work Plan for Solid Waste Management Unit 48, located at the Radford Army Ammunition Plant (RFAAP) in Radford, Virginia. Based upon our review, the Work Plan is approved, and in accordance with Part II. (E)(5) of RFAAP's Corrective Action Permit; the Work Plan is considered final. If you have any questions, please call me at 215-814-3284.

Sincerely,

Erich Weissbart

Erich Weissbart, P.G.
RCRA Project Manager
Office of Remediation (3LC20)

c: James Cutler, VDEQ

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DEPARTMENT OF THE ARMY
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MCHB-IP-REH

21 JUL 2011

MEMORANDUM FOR Office of Environmental Quality, Radford Army Ammunition Plant (SJMRF-OP-EQ/Mr. Jim McKenna), P.O. Box 2, Radford, VA 24143-0002

SUBJECT: Review of Draft Interim Measures Workplan, SWMU 48, Radford Army Ammunition Plant, Virginia, June 2011

1. The Army Institute of Public Health reviewed the subject document on behalf of the Office of The Surgeon General pursuant to Army Regulation 200-1 (Environmental Protection and Enhancement). We appreciate the opportunity to review this report.

2. We concur that the proposed interim measures are protective of human health and the environment.

3. This document was reviewed by Mr. Jeffrey Leach, Environmental Health Risk Assessment Program. He can be reached at DSN 584-2953, commercial (410) 436-2953 or electronic mail, Jeff.Leach@us.army.mil.

FOR THE DIRECTOR:

JEFFREY S. KIRKPATRICK
Portfolio Director, Health Risk Management

CF:
HQDA (DASG-PPM-NC)
USACE (CEHNC-CX-ES)
PHCR-North

ATK Armament Systems
Energetic Systems
Radford Army Ammunition Plant
Route 114, P.O. Box 1
Radford, VA 24143-0100

www.atk.com

June 20, 2011

Mr. Erich Weissbart and Mr. William Geiger
RCRA General Operations Branch, Mail Code: 3WC23
Waste and Chemicals Management Division
U. S. Environmental Protection Agency, Region III
1650 Arch Street
Philadelphia, PA 19103-2029

Mr. James L. Cutler, Jr.
Virginia Department of Environmental Quality
629 East Main Street
Richmond, VA 23219

Subject: With Certification, SWMU 48Interim Measures Work Plan, Draft Document, June 2011
EPA ID# VA1 210020730

Dear Mr. Weissbart, Mr. Geiger and Mr. Cutler:

Enclosed is the certification for the subject document that was sent to you on June 17, 2011. Also enclosed is the 17 June 2011 transmittal email.

Please coordinate with and provide any questions or comments to myself at (540) 639-8658, Jeremy Flint, ATK staff (540) 639-7668 or Jim McKenna, ACO Staff (540) 731-5782.

Sincerely,

P.W. Holt, Environmental Manager
Alliant Techsystems Inc.

c: Karen Sismour
Virginia Department of Environmental Quality
P. O. Box 1105
Richmond, VA 23218

E. A. Lohman
Virginia Department of Environmental Quality
Blue Ridge Regional Office
3019 Peters Creek Road
Roanoke, VA 24019

11-815-82
JMcKenna

Rich Mendoza
US Army Environmental Center
11711 North IH 35, Suite 110
Attn: Richard Mendoza (C-23)
San Antonio, TX 78233

Tom Meyer
Corps of Engineers, Baltimore District
ATTN: CENAB-EN-HM
10 South Howard Street
Baltimore, MD 21201

11-815-82
JMcKenna

bc: P. W. Holt
J. McKenna, ACO Staff
Rob Davie-ACO Staff
J. J. Redder
Env. File

Coordination: J. McKenna for M. A. Miano

11-815-82
JMcKenna

Concerning the following:

Radford Army Ammunition Plant
SWMU 48 Interim Measures Work Plan
Draft Document, June 2011

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

SIGNATURE:
PRINTED NAME: Antonio Munera
TITLE: LTC, CM
Commanding

SIGNATURE:
PRINTED NAME: Kent Holiday
TITLE: Vice President and General Manager
ATK Energetics Systems

11-815-82
JMcKenna

Greene, Anne

From: McKenna, Jim
Sent: Friday, June 17, 2011 1:06 PM
To: Weissbart.Erich@epamail.epa.gov; Cutler,Jim; ealohman@deq.virginia.gov
Cc: Meyer, Tom NAB02; Mendoza, Richard R Mr CIV USA IMCOM AEC; Redder, Jerome; Radford; Geiger.William@epamail.epa.gov; Pizarro.Luis@epamail.epa.gov; Timothy.Leahy@shawgrp.com; Flint, Jeremy
Subject: RE: Draft SWMU 48 Interim Measures Work Plan (UNCLASSIFIED)

Importance: High

Classification: UNCLASSIFIED
Caveats: FOUO

All:

Note the contractor will ship the subject document with a copy of this email to the POCs and tracking numbers below.
A certification letter will follow.

Thank you for your support of the Radford Army Ammunition Plant Installation Restoration Program.

Jim McKenna

Jim McKenna	1Z63V8841399197656
Jeffrey Leach	1Z63V8841397676070
Tom Meyer	1Z63V8841395824065
Rich Mendoza	1Z63V8841395849682
Erich Weissbart	1Z63V8841396800892
Beth Lohman	1Z63V8841396260118
Jim Cutler	1Z63V8841399945703

Classification: UNCLASSIFIED
Caveats: FOUO

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LIST OF APPENDICES

The Appendices are Included on a CD Located at the Back of This Report

LIST OF ACRONYMS AND ABBREVIATIONS

°C .... degrees Celsius
°F .... degrees Fahrenheit
ACGIH .... American Conference of Governmental Industrial Hygienists
ATK .... Alliant TechSystems, Inc.
bgs .... below ground surface
CAR .... Corrective Action Request
CCB .... Continuing Calibration Blank
CCV .... Continuing Calibration Verification
CFR .... Code of Federal Regulations
CGI/O_2 .... Combustible Gas Indicator/Oxygen
CMO .... Corrective Measures Objective
COC .... Chain-of-Custody
COD .... Chemical Oxygen Demand
COI .... Contaminant of Interest
CPR .... Cardiopulmonary Resuscitation
CQC .... Contractor Quality Control
CQCP .... Contractor Quality Control Plan
CRZ .... Contamination Reduction Zone
DNB .... Dinitrobenzene
DNT .... Dinitrotoluene
DoD .... Department of Defense
DOT .... Department of Transportation
DQO .... Data Quality Objective
E&SCP .... Erosion and Sediment Control Plan
EM .... Engineering Manual
ENG .... Engineering Form
EZ .... Exclusion Zone
FAR .... Federal Acquisition Regulation
FSP .... Field Sampling Plan
ft .... feet
GC/MS .... Gas Chromatography/Mass Spectroscopy
GPS .... Global Positioning System
HRGC .... High-Resolution Gas Chromatography
HRMS .... High-Resolution Mass Spectrometry
ICP .... Inductively Coupled Plasma Emission Spectroscopy
IDLH .... Immediately Dangerous to Life or Health
IDM .... Investigation-Derived Material
IM .... Interim Measures
IMWP .... Interim Measures Work Plan
i-RG .... Industrial Remedial Goal
i-SL .... Industrial Screening Level
LMARC .... Louisville Multiple Award Remediation Contract
LQAP .... Laboratory Quality Assurance Plan
M&TE .... Measuring and Test Equipment
MDL .... Method Detection Limit
MedEvac .... Medical Evacuation
mg/kg .... milligrams per kilogram
mg/m^3 .... milligrams per cubic meter
mL .... milliliters
MRL .... Method Reporting Limit
MS/MSD .... Matrix Spike/Matrix Spike Duplicate
MSDS .... Material Safety Data Sheet
msl .... mean sea level
MWP .... Master Work Plan
NCR .... Nonconformance Report
NIOSH .... National Institute for Occupational Safety and Health
OSHA .... Occupational Safety and Health Administration
OSIC .... On-Scene Incident Commander
OSWER .... Office of Solid Waste and Emergency Response
PAH .... Polynuclear Aromatic Hydrocarbon

PCB ....Polychlorinated Biphenyl
PEL ....Permissible Exposure Limit
PETN.............Pentaerythritol tetranitrate
PID ....Photoionization Detector
PPE.................Personal Protective Equipment
ppm ....parts per million
PRG................Preliminary Remedial Goal
QA..................Quality Assurance
QAPP ....Quality Assurance Project Plan
QC ....Quality Control
QIP ....Quality Improvement Process
QL ....Quantitation Limit
QSM...............Quality Systems Manual
RCRA.............Resource Conservation and Recovery Act
RDW ....Remediation-Derived Wastes
RFA................RCRA Facility Assessment
RFAAP...........Radford Army Ammunition Plant
RFI ....RCRA Facility Investigation
RG ....Remedial Goal
RL ....Regulatory Limit
RMSF.............Rocky Mountain Spotted Fever
r-RG ....Residential Remedial Goal
r-SL ....Residential Screening Level
Shaw...............Shaw Environmental, Inc.
SL...................Screening Level
SOP ....Standard Operating Procedure
sq ft.................square feet
SSHO ....Site Safety and Health Officer
SSHP ....Site Safety and Health Plan
STEL ....Short-Term Exposure Limit
SVOC ....Semivolatile Organic Compound
SWMU ....Solid Waste Management Unit
SZ ....Support Zone
TAL................Target Analyte List
TBD................To Be Determined
TCL ....Target Compound List
TCLP ....Toxicity Characteristic Leaching Procedure
TLV ....Threshold Limit Value
TNT ....Trinitrotoluene
TSDF ....Treatment, Storage, and Disposal Facility
TWA ....Time-Weighted Average
USACE ..........U.S. Army Corps of Engineers
USEPA...........U.S. Environmental Protection Agency
UTL................Upper Tolerance Limit
VDEQ ....Virginia Department of Environment Quality
VI ....Verification Investigation
VOC ....Volatile Organic Compound
WTDP ....Waste Transportation and Disposal Plan
XRF ....X-Ray Fluorescence

1.0 INTRODUCTION

Shaw Environmental, Inc. (Shaw) has been contracted by the U.S. Army Corps of Engineers (USACE) to perform an Interim Measures (IM) action at Solid Waste Management Unit (SWMU) 48 (RAAP-001), the Oily water Burial Area, at Radford Army Ammunition Plant (RFAAP), Radford, VA. This Work Plan comprises ten sections as follows: Introduction; Organization and Technical Approach Plan; Field Sampling Plan (FSP); Quality Assurance Project Plan (QAPP); Environmental Protection Plan; Erosion and Sediment Control Plan (E&SCP); Waste Transportation and Disposal Plan (WTDP); Site Safety and Health Plan (SSHP); Contractor Quality Control Plan (CQCP); and References. This Interim Measures Work Plan (IMWP) is presented as an addendum to, and incorporates by reference, the elements of the *RFAAP Master Work Plan (MWP)* (URS, 2003), including Section 8, which discusses entry to the Installation and security concerns and requirements.

This IMWP details site-specific procedures for the IM at SWMU 48. Specifically, this IMWP addresses the removal of sludge and grossly-contaminated soil with elevated concentrations of copper and lead in accordance with Part II(D)(11-21) IM of the *RFAAP Corrective Action Permit* (USEPA, 2000a). This removal action work is being performed in accordance with Contract No. W912QR-04-D-0027, Delivery Order DA0101.

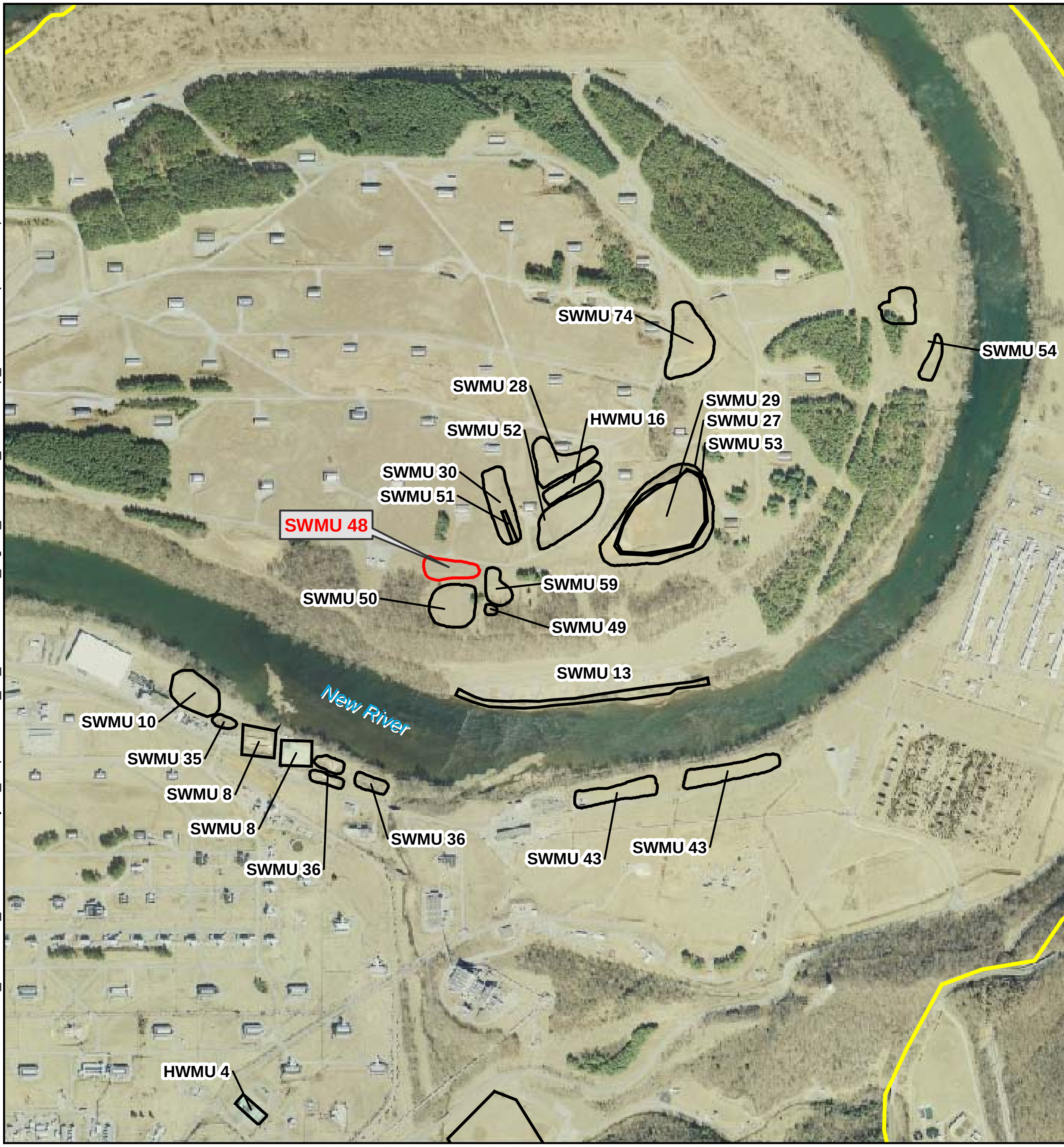
1.1 Background

1.1.1 Site Description

SWMU 48 consists of two unlined trenches, one at the northern end of the site and one at the southern end. SWMU 48 is located approximately 200 feet (ft) northwest of SWMU 49 (Red Ash Burial No.2) (**Figure 1-1**).

As illustrated on **Figure 1-1**, the SWMU is situated on a bluff approximately 120 ft above and overlooking SWMU 13 and the New River. The land surface in the study area gently slopes from approximately 1,830 ft mean sea level (msl) on the north side of SWMU 48 to approximately 1,816 ft msl on the southeast side of SWMU 49. Based on topography, surface water runoff is expected to flow approximately 700 ft south to the New River. The overall study area is grassy with wooded areas to the south, east and west. The site map shown on **Figure 1-2** indicates disturbed soil; however, the site has revegetated in the years since the trenches were active. The subsided area within the southern trench in SWMU 48 provides evidence of its location.

An east-west asphalt road, located at the northern edge of the study area parallels SWMU 48 and provides access to the study area via a gravel and bottom ash covered dirt road that trends north-south between SWMUs 48 and 59. The dirt and gravel road connects to an east-west trending dirt road south of SWMU 50. There are no structures, manholes, catch basins, or storm drains in the combined study area.



ArcGIS File: C:\Radford_MMA\GIS_Documents\Project_Maps\SWMU_48_IMWP\RFAAP_Fig1-1_SWMU48_SiteLocMap_IMWP.mxd (2/23/2011)

LEGEND

SWMU 48 Boundary

Other SWMU Boundary

Installation Boundary

Notes:
1) Aerial photo, dated 2005, was obtained from Montgomery County Planning, VA Planning & GIS Services.

N

Scale:
0 500 1,000 2,000 Feet

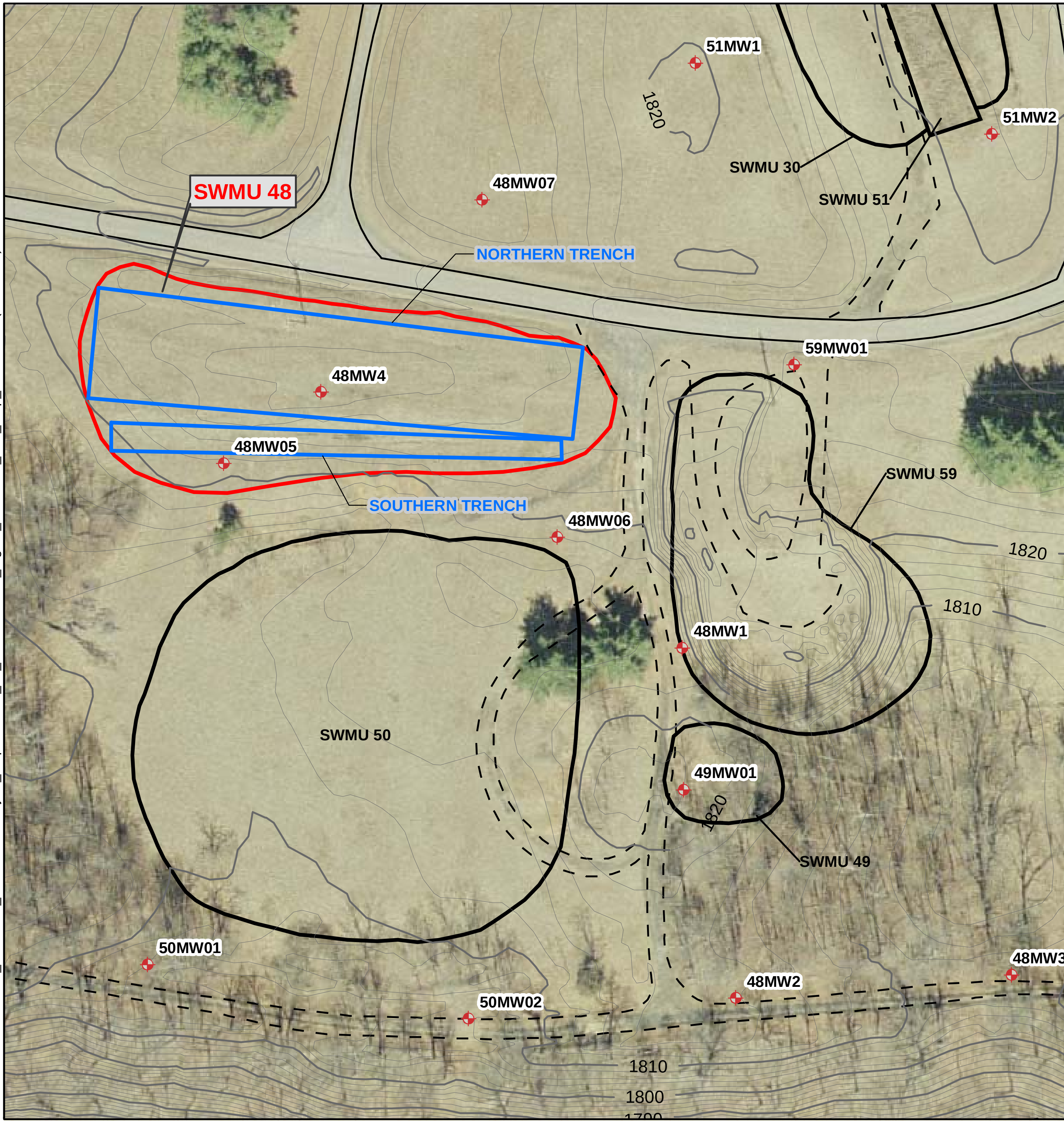
U.S. Army Corps of Engineers

Shaw® Shaw Environmental, Inc.

FIGURE 1-1

SWMU 48 Site Location Map

Radford Army Ammunition Plant, Radford, VA



LEGEND

- Monitoring Well Location
- 10 ft Contour Line
- 2 ft Contour Line
- Dirt Road
- Paved Road
- Trench Boundary
- SWMU 48 Boundary
- Other SWMU Boundary

Notes:
1) Aerial photo, dated 2005, was obtained from Montgomery County, VA Planning & GIS Services.

N

Scale:
0 50 100 200 Feet

U.S. Army Corps of Engineers

Shaw® Shaw Environmental, Inc.

FIGURE 1-2

SWMU 48 Site Map

Radford Army Ammunition Plant,
Radford, VA

ArcGIS File: C:\Radford_MMA\GIS_Documents\Project_Maps\RFAAP_Fig1-2_SWMU48_Site_Map_IMWP.mxd (4/13/2011)

1.2 Site Geology

RFAAP is located in the New River Valley, which crosses the Valley and Ridge Province approximately perpendicular to the regional strike of bedrock, and cross cuts Cambrian and Ordovician limestone or dolostone. Deep clay-rich residuum is prevalent in areas underlain by carbonate rocks. The valley is covered by river floodplain and terrace deposits; karst topography is dominant throughout the area.

Stratigraphic characterization of the subsurface was performed during the advancement of soil and monitoring well borings at the sites. Geologic cross-sections were developed based on the logging descriptions (**Appendix B-1**). Plan view of cross-sectional lines A-A' and B-B' is presented on **Figure 1-3**. As depicted on **Figures 1-4 and 1-5**, the subsurface geology consists of alluvium and residual deposits comprised of clay and silt with some sand and gravel overlying bedrock. Depth to bedrock ranges from approximately 55 to 65 ft below ground surface (bgs). Bedrock consists of highly fractured interbedded siltstone, limestone, and dolostone of the Elbrook Formation. The Max Meadows Breccia is evident in outcrops along the slope leading to the river. In the outcrop along the slope, the tectonic breccias and the limestone and dolostone are highly weathered with many solution cavities.

Excavations at SWMU 48 are planned to approach approximately 10 ft bgs. Red, moist, lean clay is expected to be encountered within the study area at this depth. Bedrock is approximately 55 ft bgs at SWMU 48.

A more detailed discussion of the geology and soil at RFAAP is presented in Sections 3.4 through 3.7 of the *RFAAP MWP* (URS, 2003) and in the *Facility-Wide Background Study Report* (IT, 2001).

1.3 Site History

Aerial photographs taken in 1971 and 1986 indicate that SWMU 48 consists of two unlined trenches, identified as the northern and southern trenches. Prior to off-post waste oil reclamation, approximately 200,000 gallons of oily wastewater removed from oil/water separators throughout RFAAP was reportedly disposed of in SWMU 48 (Dames and Moore, 1992). However, the results of environmental sampling to date indicate that the oily wastewater was likely disposed of in the area associated with SWMU 49. Conversely, sampling indicates that the red water ash associated with SWMU 49 was disposed in the SWMU 48 trenches. Interpretations of aerial photographs indicate that activity first occurred at SWMU 48 in 1970 (USEPA, 1992). The northern trench is visible in the 1971 aerial photograph as light colored east to west trending scars of disturbed soil that parallel the asphalt road. Revegetation has occurred by the time of the 1981 aerial photographs. The filled and revegetated southern trench is prominent in the 1986 aerial photograph, positioned at a slight angle below the northern trench. The trench is marked by the growth of grass visibly different from the surrounding vegetation and by extensive ground subsidence. Documentation for disposal activities in the southern trench is currently unknown, but observations during soil boring and test pit activities during the 1998 Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) indicate a layer of fine black material occurring at approximately 6-7 ft bgs.

LEGEND

- Monitoring Well
- Previous Investigation Soil Sample Location
- Geologic Cross Section Line
- Trench Boundary
- SWMU 48 and SWMU 49 Boundaries
- Other SWMU Boundaries

Notes:
1) Aerial photo, dated 2005, was obtained from Montgomery County, VA GIS & Planning Services.

N

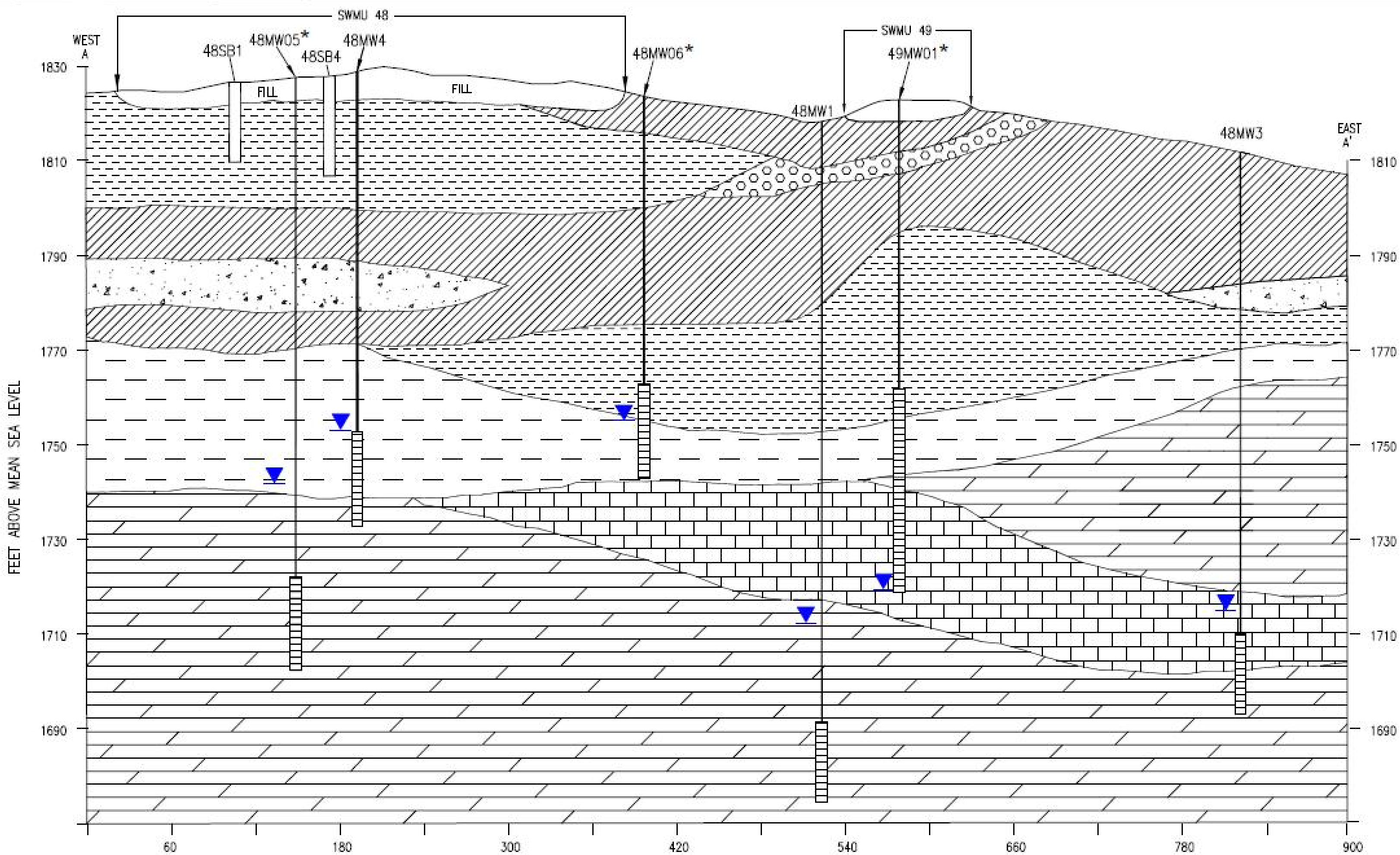
Scale:
0 80 160 320
Feet

U.S. Army Corps of Engineers

Shaw® Shaw Environmental, Inc.

FIGURE 1-3
SWMU 48 and SWMU 49
Geologic Cross Sections Plan View
Radford Army Ammunition Plant,
Radford, VA

ArcGIS File: C:\Radford_MMA\GIS_Documents\Project_Maps\SWMU_48_IMWP\RFAAP_Fig1-3_SWMU48_49_XSect_IMWP.mxd (2/24/2011)



LEGEND

- CLAY AND SILT, LITTLE SAND, RED-BROWN (CL)
- SILT, SOME SAND, SOME CLAY, ORANGE-BROWN (ML)
- SILT AND SAND, GRAVEL ORANGE-BROWN (CM/SM)
- SILT, SAND, AND GRAVEL, ORANGE-BROWN (GM)
- SILTSTONE, WEATHERED RED, GREEN, BROWN, INTERBEDDED DOLOMITE (SLSN)
- DOLOMITE, WEATHERED, GRAY, ARGILLACEOUS (DLMT)
- LIMESTONE, GRAY-BROWN, ARGILLACEOUS (LMSN)
- ▼ STATIC GROUNDWATER LEVEL (MEASURED AUGUST 2007)
- * PROJECTED LOCATION

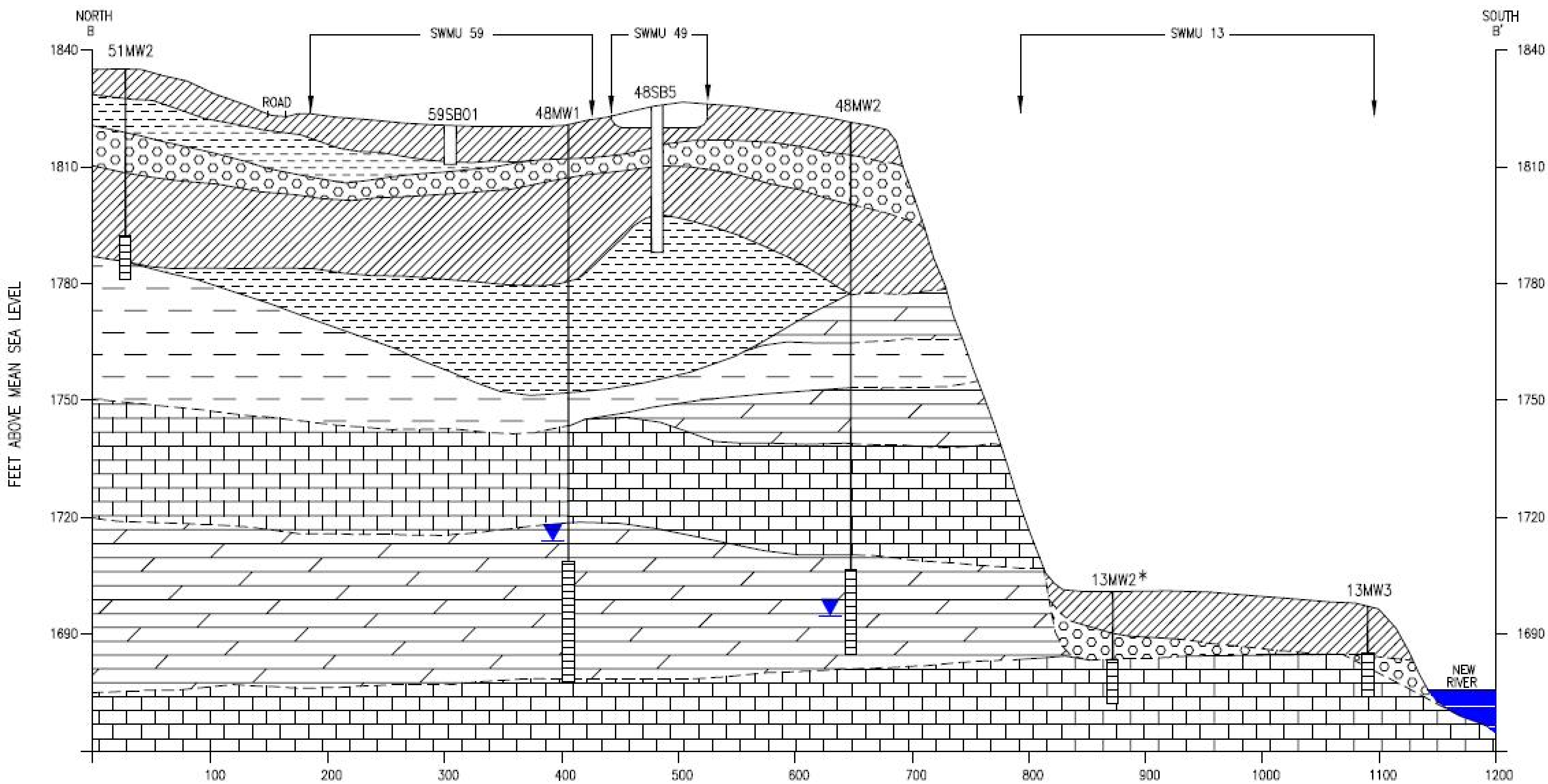
NOTES

1) SOME DATA POINTS ARE PROJECTED ONTO PROFILE.
2) 48SB1 AND 48SB2 LITHOLOGY FROM DAMES AND MOORE.
3) LITHOLOGY PATTERNS DO NOT MATCH DRILL LOG PATTERNS BECAUSE OF DIFFERING GRAPHICS SYSTEMS.
4) CONTACT LINES DASHED WHERE INFERRED.
5) LITHOLOGY IS A COMPILATION FROM SWMUs 48 AND 49.

SOURCE: PARSONS ENGINEERING SCIENCE, INC.

HORIZ. SCALE: 0 60 120
VERT. SCALE: 0 20 40

RADFORD AAP		FIGURE 1-4
PREPARED BY: SHAW	TASK NO: 12346110000002	GEOLOGIC CROSS-SECTION A-A' SWMUs 48 AND 49
CHECKED BY: MT	SHAW DWG NO: FIG2-5.dwg	
DATE: REVISED SEPT. 2009		



HORIZ. SCALE: 0 100 200

VERT. SCALE: 0 30 60

LEGEND

- CLAY AND SILT, LITTLE SAND, RED-BROWN (CL)
- SILT, SOME SAND, SOME CLAY, ORANGE-BROWN (ML)
- SILT AND SAND, GRAVEL ORANGE-BROWN (CM/SM)
- SILT, SAND, AND GRAVEL, ORANGE-BROWN (GM)
- SILTSTONE, WEATHERED RED, GREEN, BROWN, INTERBEDDED DOLOMITE (SLSN)
- DOLOMITE, WEATHERED, GRAY, ARGILLACEOUS (DLMT)
- LIMESTONE, GRAY-BROWN, ARGILLACEOUS (LMSN)
- ▼ STATIC GROUNDWATER LEVEL (MEASURED AUGUST 2007)

NOTES

1) SOME DATA POINTS ARE PROJECTED ONTO PROFILE.
2) 51MW2 AND 13MW2 LITHOLOGY FROM DAMES AND MOORE.
3) LITHOLOGY PATTERNS DO NOT MATCH DRILL LOG PATTERNS BECAUSE OF DIFFERING GRAPHICS SYSTEMS.
4) CONTACT LINES DASHED WHERE INFERRED.
5) ADDITIONAL WELLS SHOWN TO AID IN CROSS SECTION ACCURACY.
6) WELLS 51MW2, 13MW2, AND 13MW3 DID NOT HAVE WATER LEVELS TAKEN IN AUG. 2007.

SOURCE: PARSONS ENGINEERING SCIENCE, INC.

RADFORD AAP		FIGURE 1-5
PREPARED BY: SHAW	TASK NO: 82987002300000	GEOLOGIC CROSS-SECTION B-B' SWMUs 48 AND 49
CHECKED BY: MT	SHAW DWG NO: FIG2-6.dwg	
DATE: REVISED SEPT. 2009		

1.4 Summary of Previous Investigations

Seven previous investigations have been conducted at SWMU 48. In 1987, the U.S. Environmental Protection Agency (USEPA) conducted a RCRA Facility Assessment (RFA) to evaluate potential hazardous waste or hazardous constituent releases and implementing corrective actions, as necessary. In 1992, Dames and Moore performed a Verification Investigation (VI), which included surface and subsurface soil sampling to characterize the nature and extent of contamination. In 1996, Parsons Engineering Science conducted an RFI to further delineate the extent of contamination identified during the 1992 VI sampling. ICF Kaiser Engineers also performed an RFI in 1998 to further refine the understanding of the nature and extent of contamination identified during the previous investigations. Additional sampling was conducted by IT Corporation/Shaw in 2002 and 2006 to collect sufficient data to complete human health and ecological risk assessments. In 2010, Shaw performed additional sampling to further delineate the contamination within the southern trench at SWMU 48.

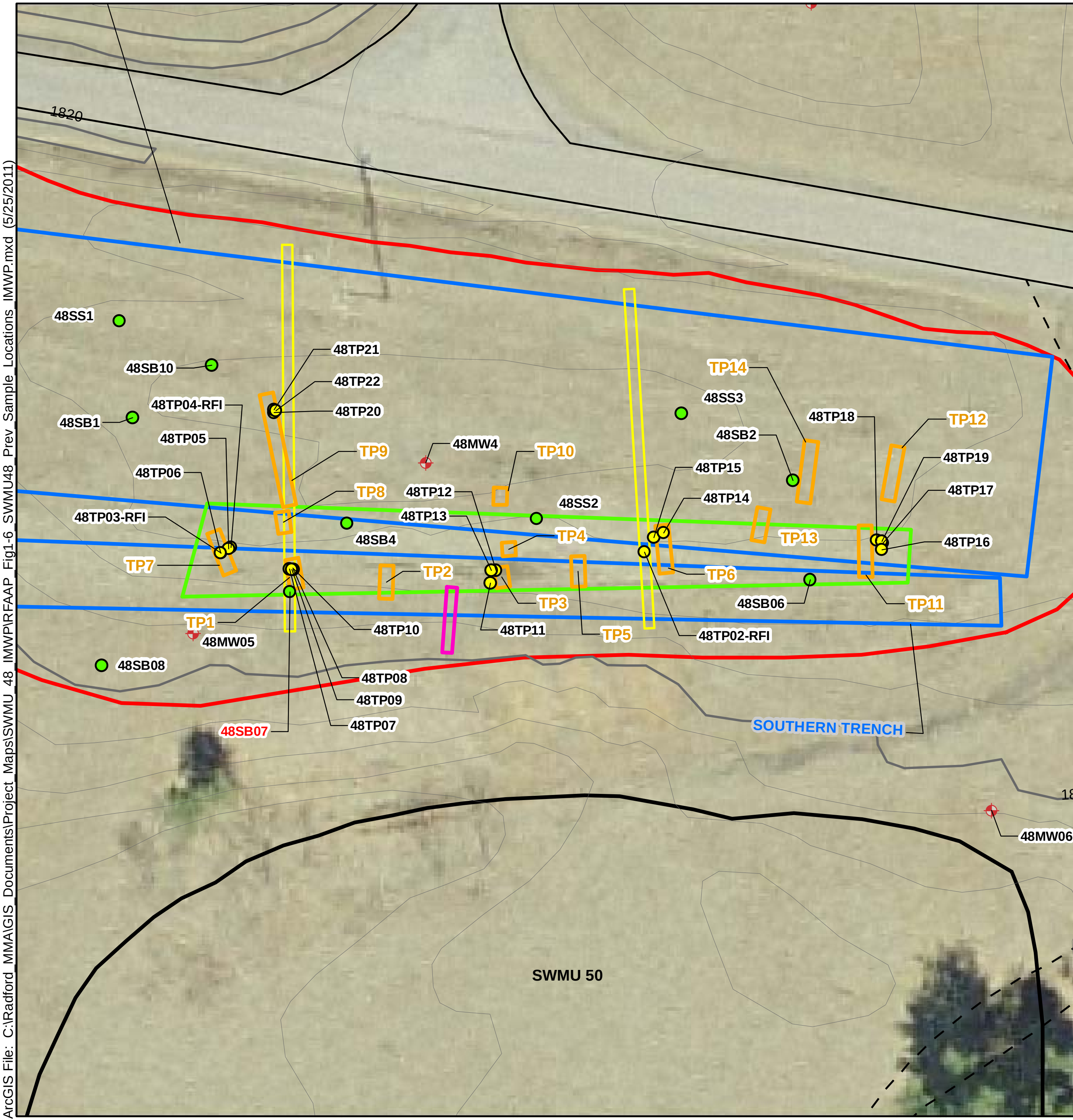
Sample locations from these investigations are illustrated on **Figure 1-6**. A summary of the previous investigation samples collected is presented in **Appendix I**. Detected results from soil samples collected during the 1992 through 2002 sampling events within the fill material (0-6 ft bgs) overlying the ash layer discovered in the southern trench at SWMU 48 are presented in **Table 1-1** and summarized in **Table 1-2**. Detected results from soil samples collected during 1992 through 2002 below the fill material (> 6 ft bgs) at SWMU 48 are presented in **Table 1-3** and summarized in **Table 1-4**. Detected results from the 2010 soil samples are presented in **Table 1-5** and summarized in **Table 1-6**.

1.4.1 1992 through 2002 Data Summary

As shown in **Tables 1-1 and 1-2**, concentrations of constituents detected in the fill material overlying the ash layer at SWMU 48 were below residential screening levels (r-SLs) with the exception of Aroclor-1254, iron, mercury, and 2,4- and 2,6-Dinitrotoluene (DNT). Aroclor-1254 was detected above the r-SL, but below the industrial screening level (i-SL), in one sample (48SB10A) collected from 0-0.5 ft bgs. Iron was detected above the r-SL and i-SL in one sample (48SB10B) collected from 406 ft bgs. The concentration of mercury was above the r-SL only in surface soil sample 48SS1. Concentrations of 2,4-DNT were detected above the "DNT mixture" r-SL and i-SL and the 2,6-DNT concentration was above the "DNT mixture" r-SL and i-SL both in sample 48SB6C from 1-3 ft bgs.

Although 2,4- and 2,6-DNT concentrations are present in one sample above r- and i-SLs for DNT mixture, a comparison of Shaw's recent sample results from waste characterization sampling at SWMU 54 to 2,4- and 2,6-DNT concentrations in SWMU 48 fill samples indicate that the fill material contains theoretical explosive concentrations below the Toxicity Characteristic Leaching Procedure (TCLP) Regulatory Limit (RL). In addition, concentrations of Aroclor-1254 and mercury were isolated in single samples at concentrations below the i-SL and iron was only detected above the i-SL in one sample.

As shown in **Tables 1-3 and 1-4**, three metals (aluminum, iron, and mercury) and four explosives [1,3-Dinitrobenzene (DNB), 2,4,6-Trinitrotoluene (TNT), 2,4- and 2,6-DNT] were detected at concentrations above r-SLs in soil samples collected below the fill material. Two of the explosives (2,4,6-TNT and 2,4-DNT) were present at concentrations above i-SLs below the fill material. Concentrations of explosives above SLs were limited to three samples collected in the southern trench. Subsurface samples 48SB07A (8-9 ft bgs) and 48TP1 (6-6.5 ft bgs) were



ArcGIS File: C:\Radford_MMA\GIS_Documents\Project_Maps\SWMU_48_IMWP\RFAAP_Fig1-6_SWMU48_Prev_Sample_Locations_IMWP.mxd (5/25/2011)

LEGEND

- Test Pit Delineation Soil Sample Location
- Monitoring Well Location
- Soil Sample Location
- Dirt Road
- Paved Road
- 2 ft Contour Line
- 10 ft Contour Line
- 2010 Test Pit Boundary
- 1998 RFI Trench Boundary
- Proposed Test Pit Boundary
- Southern Trench (GPS)
- Trench Boundary
- SWMU 48 Boundary
- Other SWMU Boundary

Notes:
1) Aerial photo, dated 2005, was obtained from Montgomery County, VA Planning & GIS Services.

Scale:
0 20 40 80 Feet

U.S. Army Corps of Engineers

Shaw® Shaw Environmental, Inc.

FIGURE 1-6
SWMU 48 Previous Investigation Sample Locations

Radford Army Ammunition Plant,
Radford, VA

both collected from soil containing ash. Sample 48SB7B (10-11 ft bgs) was collected directly below sample 48SB7A and indicates a marked decrease in the concentration of 2,4,6-TNT. Although explosive concentrations were present in samples collected directly from the ash layer, sample results from samples collected directly below the samples containing ash indicate that the explosives are not mobile in soil.

1.4.2 2010 Test Pit Data Summary

In 2010, test pitting was performed within the southern and northern trenches at SWMU 48 (Shaw, 2010). Three test pits were proposed for advancement perpendicularly across the northern and southern trenches (**Figure 1-6**). The test pits were to be advanced downward and through the ash layer, if present. The initial excavation at test pit 48TP1 encountered the ash layer. As a result, the test pit excavation plan was altered to focus on determining the extent and boundaries of the ash layer. Actual test pit locations are depicted on **Figure 1-6**. Several test pits, approximately 5 to 10 ft in length were advanced and logged until the ash layer visually terminated within or was no longer present in the outlying test pits. As shown on **Figure 1-6**, the initially excavated test pit, 48TP1, was advanced to intersect the 1998 RFI subsurface soil sample 48SB07A, where 2,4,6-TNT was detected at a concentration of 935 milligrams per kilogram (mg/kg).

As shown in **Appendix I**, soil samples were collected to further characterize metals and explosives concentrations associated with the ash were analyzed at an off-site laboratory for target analyte list (TAL) metals and explosives. Three composite soil samples were also collected; one sample from test pits 48TP7, 48TP8, and 48TP11. Each composite sample consisted of three aliquots of soil; above, below and within the encountered ash layer, that were subsequently homogenized. The composite samples were collected and tested to determine if excavated soil contains explosive or waste characteristic concentrations above TCLP RLs. Results from the sampling event are tabulated in **Table 1-5** and summarized in **Table 1-6**. The TCLP results are presented in **Table 1-7**. It should be noted that the November 2010 edition of the USEPA Regional Screening Level (SL) Summary Table were used in these tables and when comparing data for the test pits; whereas, the remedial goals (RG) listed later in this document were from the May 2011 version of the USEPA Regional Screening Level Summary Table.

Twenty-three metals were detected in the soil samples. Arsenic exceeded the i-SL in sample 48TP08 (3.5 to 4 ft bgs). Antimony and cadmium exceed i-SLs in single samples; 48TP04-RFI and 48TP02-RFI, respectively. Lead exceeded its i-SL in one sample (48TP02-RFI) and its r-SL in three samples (48TP02-RFI, 48TP04-RFI, and 48TP05). The single industrial level exceedance was from a sample of a green material. The appearance, color and consistency of this material are similar to ballistic modifiers LC12-6 and LC12-15. The analytical results (specifically the high copper and lead concentrations) of the sample also support that the material is a ballistic modifier used in solvent-less propellant. The Material Safety Data Sheets (MSDSs) for LC12-6 and LC12-15 are included in **Appendix F**. Copper also exceeded its i-SL in sample 48TP02-RFI. Mercury exceeded its i-SL in three samples (48TP04-RFI, 48TP05, and 48TP07) and its r-SL in six samples (48TP03-RFI, 48TP04-RFI, 48TP05, 48TP07, 48TP08, and 48TP08D).

Nine explosives were detected in subsurface samples. All results were below r-SLs, with the exception of a single detection of nitroglycerin (48TO04-RFI) that exceeded the residential criteria.

No TCLP semivolatile organic compounds (SVOCs) were detected in the composite samples. Lead, barium, and mercury were detected in the TCLP metals analysis at concentrations below the TCLP RLs, indicating that this soil would be disposed as non-hazardous waste, except for the green material. During excavation, the green material will be segregated since it was found to have 10,000 ppm lead. If this material is encountered again within the trench excavation, it will be segregated, removed, accumulated in containers and managed as hazardous waste.

In conclusion, Shaw conducted test pits and additional sampling at SWMU 48 to re-characterize the trenches and ash layer based on regulatory concerns about the extent of the ash layer and an elevated TNT result (970 mg/kg) from the 1998 investigation. The results of the test pitting demonstrated that the ash layer is present for much of the length of the southern trench. However, the elevated TNT level found in 1998 was an anomalous result that could not be replicated. Out of the 20 additional samples collected at SWMU 48 in 2010 that were analyzed for explosives, the highest result for TNT was 1.6 mg/kg (**Table 1-7**). Based on the results, a removal action for SWMU 48 will be based on metals, rather than explosives.

The final 2010 test pit characterization of SWMU 48 indicated that detections of explosives within the northern and southern trenches were isolated, and past elevated results were not repeatable. Based on the results of the soil samples collected during the 2010 site characterization metal exceedances, specifically; lead, antimony, arsenic, cadmium, copper, and mercury, will be the driving factor of remediation at SWMU 48.

Table 1-1
Analytes Detected in Fill Samples at SWMU 48

Analyte / Sample ID / Sample Date / Sample Depth				48SS1 12/16/94 0-0.5					48SS2 12/16/94 0-0.5				
	i-SL	r-SL	Background	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
VOCs (ug/kg)													
1,2,4-Trichlorobenzene	99000	22000	na	NT					NT				
Acetone	63000000	6100000	na	3300	U			3300	3300	U			3300
Ethylbenzene	27000	5400	na	190	U			190	190	U			190
Methylene chloride	53000	11000	na	4400	U			4400	4400	U			4400
o-Xylene	1900000	380000	na	NT					NT				
Toluene	4500000	500000	na	100	U			100	100	U			100
PAHs (ug/kg)													
2-Methylnaphthalene	410000	31000	na	NT					NT				
Anthracene	17000000	1700000	na	NT					NT				
Benz(a)anthracene	2100	150	na	NT					NT				
Benzo(a)pyrene	210	15	na	NT					NT				
Benzo(b)fluoranthene	2100	150	na	NT					NT				
Benzo(g,h,i)perylene	1700000	170000	na	NT					NT				
Benzo(k)fluoranthene	21000	1500	na	NT					NT				
Chrysene	210000	15000	na	NT					NT				
Dibenz(a,h)anthracene	210	15	na	NT					NT				
Fluoranthene	2200000	230000	na	NT					NT				
Fluorene	2200000	230000	na	NT					NT				
Indeno(1,2,3-cd)pyrene	2100	150	na	NT					NT				
Naphthalene	18000	3600	na	NT					NT				
Phenanthrene	1700000	170000	na	NT					NT				
Pyrene	1700000	170000	na	NT					NT				
SVOCs (ug/kg)													
bis(2-Ethylhexyl)phthalate	120000	35000	na	1500					1300				
Chrysene	210000	15000	na	86					32	U			32
Di-n-butylphthalate	6200000	610000	na	1300	U			1300	10000				
Fluoranthene	2200000	230000	na	32	U			32	32	U			32
N-nitrosodiphenylamine	350000	99000	na	290	U			290	290	U			290
Phenanthrene	1700000	170000	na	270					32	U			32
Pyrene	1700000	170000	na	83	U			83	83	U			83
Pesticides (ug/kg)													
4,4'-DDD	7200	2000	na	NT					NT				
4,4'-DDE	5100	1400	na	NT					NT				
4,4'-DDT	7000	1700	na	NT					NT				
Endosulfan II	na	na	na	NT					NT				
Endrin aldehyde	na	na	na	NT					NT				
Methoxychlor	310000	31000	na	NT					NT				
PCBs (mg/kg)													
PCB-1254	0.74	0.022	na	NT					NT				
Explosives (mg/kg)													
2,4-Dinitrotoluene	2.5	0.71	na	NT					NT				
2,6-Dinitrotoluene	2.5	0.71	na	NT					NT				
Nitroglycerin	6.2	0.61	na	NT					NT				
Herbicides (ug/kg)													
Metals (mg/kg)													
Aluminum	99000	7700	40041	NT					NT				
Antimony	41	3.1	na	19.6	U				19.6	U			
Arsenic	1.6	0.39	15.8	3.42					7.97				
Barium	19000	1500	209	**572**					82.3				
Beryllium	200	16	1.02	**1.62**					0.739				
Calcium	na	na	na	NT					NT				
Chromium	150000	12000	65.3	5.34					47.8				
Cobalt	30	2.3	72.3	NT					NT				
Copper	4100	310	53.5	NT					NT				
Iron	72000	5500	50962	NT					NT				
Lead	800	400	26.8	4.4					**160**				
Magnesium	na	na	na	NT					NT				
Manganese	2300	180	2543	NT					NT				
Mercury	3.4	0.56	0.13	**1.11**					**0.441**				
Nickel	2000	160	62.8	8.93					25.4				
Potassium	na	na	na	NT					NT				
Selenium	510	39	na	0.449	U				1.07				
Silver	510	39	na	0.0124	U				0.0285				
Sodium	na	na	na	NT					NT				
Thallium	na	na	2.11	34.3	U				34.3	U			
Vanadium	7.2	0.55	108	NT					NT				
Zinc	31000	2300	202	NT					NT				

Analyte / Sample ID / Sample Date / Sample Depth	48SS3 12/16/94 0-0.5					48SB6C 3/26/98 1-3				
	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
VOCs (ug/kg)										
1,2,4-Trichlorobenzene	NT					0.06			0.005	
Acetone	3300	U			3300	0.14		B	0.005	
Ethylbenzene	190	U			190	0.49		K	0.005	
Methylene chloride	4400	U			4400	0.048		B	0.005	
o-Xylene	NT					0.77		K	0.005	
Toluene	100	U			100	0.047	U		0.047	
PAHs (ug/kg)										
2-Methylnaphthalene	NT					NT				
Anthracene	NT					0.002	J	J	0.0032	
Benz(a)anthracene	NT					0.0051			0.0032	
Benzo(a)pyrene	NT					0.0056			0.0032	
Benzo(b)fluoranthene	NT					0.0064	U		0.0064	
Benzo(g,h,i)perylene	NT					0.0064	U		0.0064	
Benzo(k)fluoranthene	NT					0.0054			0.0032	
Chrysene	NT					0.0032	U		0.0032	
Dibenz(a,h)anthracene	NT					0.0064	U		0.0064	
Fluoranthene	NT					0.0082			0.0064	
Fluorene	NT					0.0064	U		0.0064	
Indeno(1,2,3-cd)pyrene	NT					0.007			0.0032	
Naphthalene	NT					0.032	U	UL	0.032	
Phenanthrene	NT					0.0081			0.0032	
Pyrene	NT					0.0046		J	0.0032	
SVOCs (ug/kg)										
bis(2-Ethylhexyl)phthalate	480	U			480	0.35	J	J	0.62	
Chrysene	32	U			32	NT				
Di-n-butylphthalate	1300	U			1300	33			6.2	
Fluoranthene	32	U			32	NT				
N-nitrosodiphenylamine	290	U			290	0.56	J	J	0.62	
Phenanthrene	32	U			32	NT				
Pyrene	83	U			83	NT				
Pesticides (ug/kg)										
4,4'-DDD	NT					NT				
4,4'-DDE	NT					NT				
4,4'-DDT	NT					NT				
Endosulfan II	NT					NT				
Endrin aldehyde	NT					NT				
Methoxychlor	NT					NT				
PCBs (mg/kg)										
PCB-1254	NT					NT				
Explosives (mg/kg)										
2,4-Dinitrotoluene	NT					3.8		L	0.25	
2,6-Dinitrotoluene	NT					1.1		J	0.25	
Nitroglycerin	NT					1.3	U	UL	1.3	
Herbicides (ug/kg)										
Metals (mg/kg)										
Aluminum	NT					11800			1.1	
Antimony	19.6	U				0.94	U		0.94	
Arsenic	2.5	U				5			1.1	
Barium	108					47		L	0.19	
Beryllium	0.872					0.56	B	B	0.19	
Calcium	NT					120000			4.3	
Chromium	24.3					**65.4**			0.19	
Cobalt	NT					4.2	B	L	0.19	
Copper	NT					**149**		**K**	0.19	
Iron	NT					11700			3.4	
Lead	18					**286**			0.38	
Magnesium	NT					4730			5.8	
Manganese	NT					123			0.19	
Mercury	0.05	U				0.18	U		0.18	
Nickel	6.13					39.2		K	0.19	
Potassium	NT					805	B	K	8.3	
Selenium	0.449	U				0.75	U		0.75	
Silver	0.0245					0.38	U		0.38	
Sodium	NT					339	B	K	5.6	
Thallium	34.3	U				1.1	U		1.1	
Vanadium	NT					16.2		K	0.19	
Zinc	NT					73.6		K	0.38	

Analyte / Sample ID / Sample Date / Sample Depth	48SB6C2 4/8/98 1-3					48SB08A 6/24/02 0-0.5				
	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
VOCs (ug/kg)										
1,2,4-Trichlorobenzene	1.2	U		1.2		NT				
Acetone	1.4	B	B	0.005		26		B	2.2	4.9
Ethylbenzene	1.2	U		1.2		4.9	U		0.33	4.9
Methylene chloride	1.2	U		1.2		4.9	U		0.31	4.9
o-Xylene	1.2	U		1.2		4.9	U		1	4.9
Toluene	1.2	U		1.2		0.84	J	B	0.32	4.9
PAHs (ug/kg)										
2-Methylnaphthalene	NT					2.5		B	0.63	1.9
Anthracene	NT					1.9	U		0.2	1.9
Benz(a)anthracene	NT					4.4			0.25	1.9
Benzo(a)pyrene	NT					3.6			0.21	1.9
Benzo(b)fluoranthene	NT					7.9			0.35	1.9
Benzo(g,h,i)perylene	NT					2.4			0.66	1.9
Benzo(k)fluoranthene	NT					2			0.33	1.9
Chrysene	NT					4.7			0.3	1.9
Dibenz(a,h)anthracene	NT					1.9	U		0.64	1.9
Fluoranthene	NT					9.8			0.32	1.9
Fluorene	NT					1.9	U		0.5	1.9
Indeno(1,2,3-cd)pyrene	NT					2.9			0.6	1.9
Naphthalene	NT					1.8	JB	B	0.72	1.9
Phenanthrene	NT					7.6			0.29	1.9
Pyrene	NT					9.5			0.42	1.9
SVOCs (ug/kg)										
bis(2-Ethylhexyl)phthalate	NT					190	U		12	190
Chrysene	NT					190	U		4.3	190
Di-n-butylphthalate	NT					190	U		54	190
Fluoranthene	NT					11	J	J	6.1	190
N-nitrosodiphenylamine	NT					190	U		8.8	190
Phenanthrene	NT					10	J	J	5.8	190
Pyrene	NT					7.9	J	J	5.7	190
Pesticides (ug/kg)										
4,4'-DDD	NT					0.389	J	J	0.155	0.733
4,4'-DDE	NT					0.462	BJ	B	0.154	0.733
4,4'-DDT	NT					0.733	U		0.259	0.733
Endosulfan II	NT					0.733	U		0.262	0.733
Endrin aldehyde	NT					0.733	U		0.37	0.733
Methoxychlor	NT					0.567	J	J	0.559	0.733
PCBs (mg/kg)										
PCB-1254	NT					0.0366	U	UJ	0.0108	0.0366
Explosives (mg/kg)										
2,4-Dinitrotoluene	NT					0.2	U		0.0163	0.2
2,6-Dinitrotoluene	NT					0.2	U		0.0246	0.2
Nitroglycerin	NT					0.12	J	J	0.11	0.33
Herbicides (ug/kg)										
Metals (mg/kg)										
Aluminum	NT					12600			6.1	22
Antimony	NT					0.549	U	UL	0.19	0.549
Arsenic	NT					1.46		L	0.38	0.549
Barium	NT					102			0.37	2.2
Beryllium	NT					0.73			0.0379	0.549
Calcium	NT					415		J	3.1	11
Chromium	NT					27.5			0.41	1.1
Cobalt	NT					10.3		J	0.89	5.49
Copper	NT					5.39			0.68	2.2
Iron	NT					15500		J	3.7	5.49
Lead	NT					18.7			0.033	0.33
Magnesium	NT					587		J	2.6	11
Manganese	NT					998		J	0.061	1.1
Mercury	NT					0.03	B	J	0.0218	0.0549
Nickel	NT					7.16		J	1	4.4
Potassium	NT					673			37	330
Selenium	NT					1.1	U	UL	0.36	1.1
Silver	NT					1.1	U		0.54	1.1
Sodium	NT					22.1		B	4.1	22
Thallium	NT					0.14	B	J	0.033	0.33
Vanadium	NT					32.6		J	0.64	5.49
Zinc	NT					23.8		J	0.39	2.2

Analyte			Sample ID / Sample Date / Sample Depth	48SB08B 6/24/02 4-6					48SB09A 6/24/02 0-0.5					48SB09B 6/24/02 4-6					48SB10A 6/24/02 0-0.5					48SB10B 6/24/02 4-6				
	i-SL	**r-SL**	**Background**	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
VOCs (ug/kg)																												
1,2,4-Trichlorobenzene	99000	22000	na	NT					NT					NT					NT					NT				
Acetone	63000000	6100000	na	5.6	U	UJ	*2.5*	*5.6*	NT					NT					4.8	U	UJ	*2.1*	*4.8*	5.4	U	UJ	*2.4*	*5.4*
Ethylbenzene	27000	5400	na	5.6	U		*0.37*	*5.6*	NT					NT					4.8	U		*0.32*	*4.8*	5.4	U		*0.36*	*5.4*
Methylene chloride	53000	11000	na	5.6	U		*0.35*	*5.6*	NT					NT					4.8	U		*0.3*	*4.8*	5.4	U		*0.34*	*5.4*
o-Xylene	1900000	380000	na	5.6	U		*1.2*	*5.6*	NT					NT					4.8	U		*1*	*4.8*	5.4	U		*1.1*	*5.4*
Toluene	4500000	500000	na	5.6	U		*0.36*	*5.6*	NT					NT					4.8	U		*0.31*	*4.8*	5.4	U		*0.35*	*5.4*
PAHs (ug/kg)																												
2-Methylnaphthalene	410000	31000	na	1.2	J	B	*0.71*	*2.1*	NT					NT					9.6			*0.61*	*1.8*	2	U		*0.69*	*2*
Anthracene	17000000	1700000	na	2.1	U		*0.23*	*2.1*	NT					NT					0.71	J	J	*0.2*	*1.8*	2	U		*0.22*	*2*
Benz(a)anthracene	2100	150	na	2.1	U		*0.28*	*2.1*	NT					NT					2.9			*0.24*	*1.8*	2	U		*0.27*	*2*
Benzo(a)pyrene	210	15	na	2.1	U		*0.24*	*2.1*	NT					NT					2.4			*0.2*	*1.8*	2	U		*0.23*	*2*
Benzo(b)fluoranthene	2100	150	na	2.1	U		*0.4*	*2.1*	NT					NT					4.7			*0.34*	*1.8*	2	U		*0.39*	*2*
Benzo(g,h,i)perylene	1700000	170000	na	2.1	U		*0.74*	*2.1*	NT					NT					1.4	J	J	*0.63*	*1.8*	2	U		*0.72*	*2*
Benzo(k)fluoranthene	21000	1500	na	2.1	U		*0.37*	*2.1*	NT					NT					1.5	J	J	*0.31*	*1.8*	2	U		*0.36*	*2*
Chrysene	210000	15000	na	2.1	U		*0.34*	*2.1*	NT					NT					4.6			*0.29*	*1.8*	2	U		*0.33*	*2*
Dibenz(a,h)anthracene	210	15	na	2.1	U		*0.72*	*2.1*	NT					NT					0.74	J	J	*0.61*	*1.8*	2	U		*0.69*	*2*
Fluoranthene	2200000	230000	na	2.1	U		*0.36*	*2.1*	NT					NT					6.3			*0.31*	*1.8*	2	U		*0.35*	*2*
Fluorene	2200000	230000	na	2.1	U		*0.56*	*2.1*	NT					NT					1.1	J	J	*0.48*	*1.8*	2	U		*0.54*	*2*
Indeno(1,2,3-cd)pyrene	2100	150	na	2.1	U		*0.68*	*2.1*	NT					NT					1.6	J	J	*0.58*	*1.8*	2	U		*0.65*	*2*
Naphthalene	18000	3600	na	1.5	JB	B	*0.82*	*2.1*	NT					NT					6.7	B		*0.7*	*1.8*	1.2	JB	B	*0.79*	*2*
Phenanthrene	1700000	170000	na	2.1	U		*0.32*	*2.1*	NT					NT					18			*0.28*	*1.8*	2	U		*0.31*	*2*
Pyrene	1700000	170000	na	2.1	U		*0.48*	*2.1*	NT					NT					8.2			*0.41*	*1.8*	2	U		*0.46*	*2*
SVOCs (ug/kg)																												
bis(2-Ethylhexyl)phthalate	120000	35000	na	210	U		*14*	*210*	NT					NT					130	J	B	*12*	*180*	200	U		*14*	*200*
Chrysene	210000	15000	na	210	U		*4.8*	*210*	NT					NT					180	U		*4.1*	*180*	200	U		*4.7*	*200*
Di-n-butylphthalate	6200000	610000	na	210	U		*61*	*210*	NT					NT					180	U		*52*	*180*	200	U		*58*	*200*
Fluoranthene	2200000	230000	na	210	U		*6.9*	*210*	NT					NT					7.9	J	J	*5.9*	*180*	200	U		*6.6*	*200*
N-nitrosodiphenylamine	350000	99000	na	210	U		*10*	*210*	NT					NT					180	U		*8.5*	*180*	200	U		*9.6*	*200*
Phenanthrene	1700000	170000	na	210	U		*6.5*	*210*	NT					NT					13	J	J	*5.6*	*180*	200	U		*6.3*	*200*
Pyrene	1700000	170000	na	210	U		*6.4*	*210*	NT					NT					8.1	J	J	*5.5*	*180*	200	U		*6.2*	*200*
Pesticides (ug/kg)																												
4,4'-DDD	7200	2000	na	NT					NT					NT					0.347	J	J	*0.15*	*0.708*	NT				
4,4'-DDE	5100	1400	na	NT					NT					NT					0.525	BJ	B	*0.149*	*0.708*	NT				
4,4'-DDT	7000	1700	na	NT					NT					NT					2.31			*0.251*	*0.708*	NT				
Endosulfan II	na	na	na	NT					NT					NT					0.418	J	J	*0.253*	*0.708*	NT				
Endrin aldehyde	na	na	na	NT					NT					NT					0.55	J	J	*0.358*	*0.708*	NT				
Methoxychlor	310000	31000	na	NT					NT					NT					0.708	U		*0.54*	*0.708*	NT				
PCBs (mg/kg)																												
PCB-1254	0.74	0.022	na	0.0415	U	UJ	*0.0122*	*0.0415*	NT					NT					0.0769		J	*0.0104*	*0.0354*	0.04	U	UJ	*0.0118*	*0.04*
Explosives (mg/kg)																												
2,4-Dinitrotoluene	2.5	0.71	na	0.2	U		*0.0163*	*0.2*	0.2	U		*0.0163*	*0.2*	0.2	U		*0.0163*	*0.2*	0.2	U		*0.0163*	*0.2*	0.2	U		*0.0163*	*0.2*
2,6-Dinitrotoluene	2.5	0.71	na	0.2	U		*0.0246*	*0.2*	0.2	U		*0.0246*	*0.2*	0.2	U		*0.0246*	*0.2*	0.2	U		*0.0246*	*0.2*	0.2	U		*0.0246*	*0.2*
Nitroglycerin	6.2	0.61	na	0.374	U		*0.124*	*0.374*	0.324	U		*0.108*	*0.324*	0.382	U		*0.127*	*0.382*	0.15	J	J	*0.106*	*0.318*	0.36	U		*0.12*	*0.36*
Herbicides (ug/kg)																												
Metals (mg/kg)																												
Aluminum	99000	7700	40041	32900			*6.9*	*24.9*	NT					NT					10900			*5.9*	*21.2*	24200			*6.6*	*24*
Antimony	41	3.1	na	0.36	B	B	*0.21*	*0.623*	NT					NT					0.531	U	UL	*0.18*	*0.531*	0.6	U	UL	*0.2*	*0.6*
Arsenic	1.6	0.39	15.8	0.6	B	L	*0.44*	*0.623*	NT					NT					2.62		L	*0.37*	*0.531*	0.6	U	UL	*0.42*	*0.6*
Barium	19000	1500	209	56.3			*0.42*	*2.49*	NT					NT					73.3			*0.36*	*2.12*	164			*0.4*	*2.4*
Beryllium	200	16	1.02	0.765			*0.043*	*0.623*	NT					NT					0.44	B	J	*0.0366*	*0.531*	0.745			*0.0414*	*0.6*
Calcium	na	na	na	141		J	*3.5*	*12.5*	NT					NT					15900		J	*3*	*10.6*	26.8		B	*3.4*	*12*
Chromium	150000	12000	65.3	36.1			*0.47*	*1.25*	NT					NT					30.7			*0.4*	*1.06*	17.6			*0.45*	*1.2*
Cobalt	30	2.3	72.3	6.1	B	J	*1*	*6.23*	NT					NT					5.98		J	*0.86*	*5.31*	58.2		J	*0.97*	*6*
Copper	4100	310	53.5	15.9			*0.77*	*2.49*	NT					NT					6.59			*0.66*	*2.12*	13.7			*0.74*	*2.4*
Iron	72000	5500	50962	41600		J	*4.2*	*6.23*	NT					NT					12100		J	*3.6*	*5.31*	**81800**		**J**	*4*	*6*
Lead	800	400	26.8	13.6			*0.038*	*0.374*	NT					NT					17			*0.032*	*0.318*	19.9			*0.036*	*0.36*
Magnesium	na	na	na	1100		J	*2.9*	*12.5*	NT					NT					1640		J	*2.5*	*10.6*	1040		J	*2.8*	*12*
Manganese	2300	180	2543	129		J	*0.07*	*1.25*	NT					NT					248		J	*0.059*	*1.06*	2070		J	*0.067*	*1.2*
Mercury	3.4	0.56	0.13	0.0674			*0.0247*	*0.0623*	NT					NT					0.037	B	J	*0.021*	*0.0531*	0.047	B	J	*0.0238*	*0.06*
Nickel	2000	160	62.8	12.3		J	*1.1*	*4.98*	NT					NT					5.54		J	*0.97*	*4.25*	11.3		J	*1.1*	*4.8*
Potassium	na	na	na	1340			*42*	*374*	NT					NT					642			*36*	*318*	1280			*40*	*360*
Selenium	510	39	na	1.25	U	UL	*0.41*	*1.25*	NT					NT					1.06	U	UL	*0.35*	*1.06*	1.2	U	UL	*0.39*	*1.2*
Silver	510	39	na	0.71	B	B	*0.61*	*1.25*	NT					NT					1.06	U		*0.52*	*1.06*	1.2	B	B	*0.59*	*1.2*
Sodium	na	na	na	21	B	B	*4.7*	*24.9*	NT					NT					19	B	B	*4*	*21.2*	19	B	B	*4.5*	*24*
Thallium	na	na	2.11	0.17	B	J	*0.038*	*0.374*	NT					NT					0.14	B	J	*0.032*	*0.318*	0.27	B	J	*0.036*	*0.36*
Vanadium	7.2	0.55	108	73.3		J	*0.72*	*6.23*	NT					NT					30.8		J	*0.61*	*5.31*	55.9		J	*0.69*	*6*
Zinc	31000	2300	202	42.9		J	*0.45*	*2.49*	NT					NT					24.4		J	*0.38*	*2.12*	42.2		J	*0.43*	*2.4*

**Refer to legend immediately following this table for a list of definitions and table notes.

Table 1-1
Legend

12	J	Shading and black font indicate an industrial SL exceedance.
12	J	Bold outline indicates a residential SL exceedance.
<u>12</u>	**<u>J</u>**	Bold, underlined font indicates a background exceedance.
12	*12*	Shading in the MDL/MRL columns indicates the MDL exceeds a criterion.

SLs for non-Carcinogenic compounds have been recalculated to an HI of 0.1.

The pyrene SLs were used for acenaphthylene, benzo(g,h,i)perylene, and phenanthrene.

Inorganic results below background UTLs are not indicated as exceedances on the table.

SL = Screening Level (Source: ORNL Regional Screening Table, April 2009).

Lead screening values from Technical Review Workgroup for Lead: Guidance Document (USEPA, 1999b).

mg/kg = milligrams per kilogram (parts per million).

ng/kg = nanograms per kilogram (parts per trillion).

μg/kg = micrograms per kilogram (parts per billion).

NA = not applicable.

NT = analyte not tested.

Lab Q = Lab Data Qualifiers

* = Laboratory duplicate not within control limits.

B = (organics) Blank contamination. Value detected in sample and associated blank.

A (Dioxins) = B = (metals) Value <MRL and >MDL and is considered estimated.

E (metals) = Reported value is estimated because of the presence of interferences.

EMPC (Dioxins) = The ion-abundance ratio between the two characteristic PCDD/PCDF ions was outside accepted ranges. The detected PCDD/PCDF was reported as an estimated maximum possible concentration (EMPC).

J = (organics) Value <MRL and >MDL and is considered estimated.

U = Analyte not-detected at the method reporting limit.

X = (dioxins) Ion abundance ratio outside acceptable range. Value reported is EMPC.

Val Q = Validation Data Qualifiers

B = blank contamination. Value detected in sample and associated blank.

J = estimated concentration.

K = estimated concentration bias high.

L = estimated concentration bias low.

N = presumptive evidence for tentatively identified compounds using a library search.

U = analyte not detected.

UJ = estimated concentration non-detect.

UL = estimated concentration non-detect bias low.

R = the quality control associated with the analysis or analyte indicates severe uncertainty with the reported result. The analyte was analyzed for, but the presence or absence of the analyte has not been verified.

PG = the percent difference between the original and confirmation analysis is greater than 40%.

Table 1-2
Summary of Analytes Detected in Fill Samples at SWMU 48

Analyte	i-SL	r-SL	Background	# of i-SL Exceedances	# of r-SL Exceedances	# of Background Exceedances	# of Detections	# of Samples	Minimum Concentration	Maximum Concentration	Location of Maximum
VOCs (ug/kg)											
1,2,4-Trichlorobenzene	99000	22000	na	0	0	na	1	2	0.06	0.06	48SB6C
Acetone	63000000	6100000	na	0	0	na	3	9	0.14	26	48SB08A
Ethylbenzene	27000	5400	na	0	0	na	1	9	0.49	0.49	48SB6C
Methylene chloride	53000	11000	na	0	0	na	1	9	0.048	0.048	48SB6C
o-Xylene	1900000	380000	na	0	0	na	1	6	0.77	0.77	48SB6C
Toluene	4500000	500000	na	0	0	na	1	9	0.84	0.84	48SB08A
PAHs (ug/kg)											
2-Methylnaphthalene	410000	31000	na	0	0	na	3	4	1.2	9.6	48SB10A
Anthracene	17000000	1700000	na	0	0	na	2	5	0.002	0.71	48SB10A
Benz(a)anthracene	2100	150	na	0	0	na	3	5	0.0051	4.4	48SB08A
Benzo(a)pyrene	210	15	na	0	0	na	3	5	0.0056	3.6	48SB08A
Benzo(b)fluoranthene	2100	150	na	0	0	na	2	5	4.7	7.9	48SB08A
Benzo(g,h,i)perylene	1700000	170000	na	0	0	na	2	5	1.4	2.4	48SB08A
Benzo(k)fluoranthene	21000	1500	na	0	0	na	3	5	0.0054	2	48SB08A
Chrysene	210000	15000	na	0	0	na	2	5	4.6	4.7	48SB08A
Dibenz(a,h)anthracene	210	15	na	0	0	na	1	5	0.74	0.74	48SB10A
Fluoranthene	2200000	230000	na	0	0	na	3	5	0.0082	9.8	48SB08A
Fluorene	2200000	230000	na	0	0	na	1	5	1.1	1.1	48SB10A
Indeno(1,2,3-cd)pyrene	2100	150	na	0	0	na	3	5	0.007	2.9	48SB08A
Naphthalene	18000	3600	na	0	0	na	4	5	1.2	6.7	48SB10A
Phenanthrene	1700000	170000	na	0	0	na	3	5	0.0081	18	48SB10A
Pyrene	1700000	170000	na	0	0	na	3	5	0.0046	9.5	48SB08A
SVOCs (ug/kg)											
bis(2-Ethylhexyl)phthalate	120000	35000	na	0	0	na	4	8	0.35	1500	48SS1
Chrysene	210000	15000	na	0	0	na	1	7	86	86	48SS1
Di-n-butylphthalate	6200000	610000	na	0	0	na	2	8	33	10000	48SS2
Fluoranthene	2200000	230000	na	0	0	na	2	7	7.9	11	48SB08A
N-nitrosodiphenylamine	350000	99000	na	0	0	na	1	8	0.56	0.56	48SB6C
Phenanthrene	1700000	170000	na	0	0	na	3	7	10	270	48SS1
Pyrene	1700000	170000	na	0	0	na	2	7	7.9	8.1	48SB10A
Pesticides (ug/kg)											
4,4'-DDD	7200	2000	na	0	0	na	2	2	0.347	0.389	48SB08A
4,4'-DDE	5100	1400	na	0	0	na	2	2	0.462	0.525	48SB10A
4,4'-DDT	7000	1700	na	0	0	na	1	2	2.31	2.31	48SB10A
Endosulfan II	na	na	na	na	na	na	1	2	0.418	0.418	48SB10A
Endrin aldehyde	na	na	na	na	na	na	1	2	0.55	0.55	48SB10A
Methoxychlor	310000	31000	na	0	0	na	1	2	0.567	0.567	48SB08A
PCBs (mg/kg)											
PCB-1254	0.74	0.022	na	0	1	na	1	4	0.0769	0.0769	48SB10A
Explosives (mg/kg)											
2,4-Dinitrotoluene	2.5	0.71	na	1	1	na	1	7	3.8	3.8	48SB6C
2,6-Dinitrotoluene	2.5	0.71	na	0	1	na	1	7	1.1	1.1	48SB6C
Nitroglycerin	6.2	0.61	na	0	0	na	2	7	0.12	0.15	48SB10A
Herbicides (ug/kg)											
Metals (mg/kg)											
Aluminum	99000	7700	40041	0	0	0	5	5	10900	32900	48SB08B
Antimony	41	3.1	na	0	0	na	1	8	0.36	0.36	48SB08B
Arsenic	1.6	0.39	15.8	0	0	0	6	8	0.6	7.97	48SS2
Barium	19000	1500	209	0	0	1	8	8	47	572	48SS1
Beryllium	200	16	1.02	0	0	1	8	8	0.44	1.62	48SS1

Table 1-2
Summary of Analytes Detected in Fill Samples at SWMU 48

Analyte	i-SL	r-SL	Background	# of i-SL Exceedances	# of r-SL Exceedances	# of Background Exceedances	# of Detections	# of Samples	Minimum Concentration	Maximum Concentration	Location of Maximum
Calcium	na	na	na	na	na	na	5	5	26.8	120000	48SB6C
Chromium	150000	12000	65.3	0	0	1	8	8	5.34	65.4	48SB6C
Cobalt	30	2.3	72.3	0	0	0	5	5	4.2	58.2	48SB10B
Copper	4100	310	53.5	0	0	1	5	5	5.39	149	48SB6C
Iron	72000	5500	50962	1	1	1	5	5	11700	81800	48SB10B
Lead	800	400	26.8	0	0	2	8	8	4.4	286	48SB6C
Magnesium	na	na	na	na	na	na	5	5	587	4730	48SB6C
Manganese	2300	180	2543	0	0	0	5	5	123	2070	48SB10B
Mercury	3.4	0.56	0.13	0	1	2	6	8	0.03	1.11	48SS1
Nickel	2000	160	62.8	0	0	0	8	8	5.54	39.2	48SB6C
Potassium	na	na	na	na	na	na	5	5	642	1340	48SB08B
Selenium	510	39	na	0	0	na	1	8	1.07	1.07	48SS2
Silver	510	39	na	0	0	na	4	8	0.0245	1.2	48SB10B
Sodium	na	na	na	na	na	na	5	5	19	339	48SB6C
Thallium	na	na	2.11	na	na	0	4	8	0.14	0.27	48SB10B
Vanadium	7.2	0.55	108	0	0	0	5	5	16.2	73.3	48SB08B
Zinc	31000	2300	202	0	0	0	5	5	23.8	73.6	48SB6C

Table 1-3
Analytes Detected in Soil Below Fill Material at SWMU 48

Analyte			Sample ID	48SB1 (RVFS*1)					48SB1 (RVFS*2)					48SB2 (RVFS*3)					48SB2 (RVFS*4)					48SB4A11					48SB4B21					48SB6A				
			Sample Date	8/19/91					8/19/91					8/16/91					8/16/91					12/17/94					12/17/94					3/26/98				
			Sample Depth	7.5-9.5					13-15					10-12					20-22					10-11					20-21					6-7				
	i-SL	r-SL	Background	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
VOCs (ug/kg)																																						
Acetone	63000000	6100000	na	17	U			17	17	U			17	17	U			17	17	U			17	3300	U			3300	3300	U			3300	NT				
Benzene	5600	1100	na	1.5	U			1.5	1.5	U			1.5	1.5	U			1.5	1.5	U			1.5	100	U			100	100	U			100	0.017		J	0.005	
Dichlorodifluoromethane	78000	18000	na	NT					NT					NT					NT					NT					NT					0.008	U	R	0.008	
m- & p-Xylene	na	na	na	NT					NT					NT					NT					NT					NT					0.008	U	R	0.008	
Methylene chloride	53000	11000	na	12	U			12	12	U			12	12	U			12	12	U			12	4400	U			4400	4400	U			4400	0.049		B	0.005	
o-Xylene	1900000	380000	na	NT					NT					NT					NT					NT					NT					0.008	U	R	0.008	
Toluene	4500000	500000	na	0.78	U			0.78	0.78	U			0.78	1					0.78	U			0.78	100	U			100	100	U			100	0.023		J	0.005	
Trichlorofluoromethane	340000	79000	na	5.9	U			5.9	5.9	U			5.9	5.9	U			5.9	5.9	U			5.9	230	U			230	230	U			230	0.008	U	R	0.008	
Vinyl chloride	1700	60	na	6.2	U			6.2	6.2	U			6.2	6.2	U			6.2	6.2	U			6.2	1800	U			1800	1800	U			1800	0.008	U	R	0.008	
PAHs (ug/kg)																																						
2-Methylnaphthalene	410000	31000	na	NT					NT					NT					NT					NT					NT					NT				
Chrysene	210000	15000	na	NT					NT					NT					NT					NT					NT					0.0029	U	UL	0.0029	
Fluoranthene	2200000	230000	na	NT					NT					NT					NT					NT					NT					0.048		L	0.0058	
Naphthalene	18000	3600	na	NT					NT					NT					NT					NT					NT					0.029	U	UL	0.029	
Phenanthrene	1700000	170000	na	NT					NT					NT					NT					NT					NT					0.0029	U	UL	0.0029	
Pyrene	1700000	170000	na	NT					NT					NT					NT					NT					NT					0.025		J	0.0029	
SVOCs (ug/kg)																																						
2,4-Dinitrotoluene	120000	12000	na	700	U			700	140	U			140	3200					140	U			140	2500	U			2500	2500	U			2500	NT				
2,6-Dinitrotoluene	62000	6100	na	400	U			400	85	U			85	1200					85	U			85	2000	U			2000	2000	U			2000	NT				
bis(2-Ethylhexyl)phthalate	120000	35000	na	3000	U			3000	620	U			620	1000					620	U			620	2800					3600					0.13	J	J	0.52	
Di-n-butylphthalate	6200000	610000	na	300	U			300	61	U			61	2900					190					1300	U			1300	6000					0.36	J	J	0.52	
Naphthalene	18000	3600	na	200	U			200	37	U			37	270					37	U			37	740	U			740	740	U			740	NT				
N-nitrosodiphenylamine	350000	99000	na	10000	U			10000	190	U			190	190	U			190	190	U			190	1400					1700					0.65			0.52	
Phenanthrene	1700000	170000	na	200					33	U			33	130					33	U			33	32	U			32	32	U			32	NT				
Pyrene	1700000	170000	na	300					33	U			33	33	U			33	33	U			33	83	U			83	83	U			83	NT				
Pesticides (ug/kg)		None detected																																				
PCBs (mg/kg)		None detected																																				
Explosives (mg/kg)																																						
1,3,5-Trinitrobenzene	2700	220	na	NT					NT					NT					NT					NT					NT					0.25	U	UL	0.25	
1,3-Dinitrobenzene	6.2	0.61	na	NT					NT					NT					NT					NT					NT					0.25	U	UL	0.25	
2,4,6-Trinitrotoluene	7.9	1.9	na	NT					NT					NT					NT					2	U			2	2	U			2	0.25	U	UL	0.25	
2,4-Dinitrotoluene	2.5	0.71	na	NT					NT					NT					NT					NT					NT					0.25	U	UL	0.25	
2,6-Dinitrotoluene	2.5	0.71	na	NT					NT					NT					NT					NT					NT					0.25	U		0.25	
4-amino-2,6-Dinitrotoluene	190	15	na	NT					NT					NT					NT					NT					NT					0.25	U	UL	0.25	
HMX	4900	380	na	NT					NT					NT					NT					2	U			2	2	U			2	0.25	U	UL	0.25	
Nitrobenzene	28	3.1	na	NT					NT					NT					NT					NT					NT					0.25	U	UL	0.25	
RDX	24	5.5	na	NT					NT					NT					NT					1.28	U			1.28	1.28	U			1.28	0.25	U	UL	0.25	
Herbicides (ug/kg)		Samples were not tested for this group.																																				
Metals (mg/kg)																																						
Aluminum	99000	7700	40041	2940					12200					15700					14600					NT					NT					15700			0.95	
Antimony	41	3.1	na	7.14	U				7.14	U				7.14	U				7.14	U				NT					NT					1.6	B	J	0.79	
Arsenic	1.6	0.39	15.8	8.19					3.1					4.7					2.75					NT					NT					2.8			0.95	
Barium	19000	1500	209	42.5					36.7					52.4					70.8					NT					NT					83.4		L	0.16	
Beryllium	200	16	1.02	0.767					**1.73**					**2.15**					**4.98**					NT					NT					0.16	U		0.16	
Calcium	na	na	na	240000					662					9740					198					NT					NT					35800			3.6	
Chromium	150000	12000	65.3	7.78					27.3					29.5					31.9					NT					NT					35.5			0.16	
Cobalt	30	2.3	72.3	3.01					6.34					11.3					17.9					NT					NT					7.6	B	L	0.16	
Copper	4100	310	53.5	10.8					6.87					**135**					14.6					NT					NT					33.3		K	0.16	
Iron	72000	5500	50962	8550					21200					25800					41600					NT					NT					18100			2.9	
Lead	800	400	26.8	**36.9**					10.5	U				**154**					10.5	U				NT					NT					**59.6**			0.32	
Magnesium	na	na	na	130000					784					3390					763					NT					NT					4660			4.9	
Manganese	2300	180	2543	222					195					278					547					NT					NT					148			0.16	
Mercury	3.4	0.56	0.13	**2.6**					0.05	U				**0.23**					0.05	U				NT					NT					0.16	U		0.16	
Nickel	2000	160	62.8	4.91					6.57					25.6					24.5					NT					NT					18.8		K	0.16	
Potassium	na	na	na	327					551					758					934					NT					NT					2200		K	7	
Silver	510	39	na	1.03					0.589	U				0.855					0.589	U				NT					NT					0.16	U		0.32	
Sodium	na	na	na	551					372					391					2880					NT					NT					537	B	K	4.8	
Thallium	na	na	2.11	6.62	U				6.62	U				6.62	U				6.62	U				NT					NT					0.79	U	UL	0.95	
Vanadium	7.2	0.55	108	8.97					30					34.3					32.8					NT					NT					33		K	0.16	
Zinc	31000	2300	202	38.2					23					71.3					29.8					NT					NT					54.5		K	0.32	

Table 1-3
Analytes Detected in Soil Below Fill Material at SWMU 48

Analyte	Sample ID / Sample Date / Sample Depth			48SB6A2 4/8/98 6-7					48SB6B 3/26/98 14-16					48SB6B2 4/8/98 14-16				
	i-SL	**r-SL**	**Background**	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
VOCs (ug/kg)																		
Acetone	63000000	6100000	na	1.3	B	B	*0.005*		NT					1	B	B	*0.005*	
Benzene	5600	1100	na	0.99	U		*0.99*		0.007	U		*0.007*		0.85	U		*0.85*	
Dichlorodifluoromethane	78000	18000	na	0.99	U		*0.99*		0.007	U		*0.007*		0.85	U		*0.85*	
m- & p-Xylene	na	na	na	1.1			*0.005*		0.007	U		*0.007*		0.85	U		*0.85*	
Methylene chloride	53000	11000	na	0.99	U		*0.99*		0.002	J	B	*0.005*		0.85	U		*0.85*	
o-Xylene	1900000	380000	na	0.64	J	J	*0.005*		0.007	U		*0.007*		0.85	U		*0.85*	
Toluene	4500000	500000	na	0.99	U		*0.99*		0.007	U		*0.007*		0.85	U		*0.85*	
Trichlorofluoromethane	340000	79000	na	0.99	U		*0.99*		0.007	U		*0.007*		0.85	U		*0.85*	
Vinyl chloride	1700	60	na	0.99	U		*0.99*		0.007	U		*0.007*		0.85	U		*0.85*	
PAHs (ug/kg)																		
2-Methylnaphthalene	410000	31000	na	NT					NT					NT				
Chrysene	210000	15000	na	NT					0.002	U	UL	*0.002*		NT				
Fluoranthene	2200000	230000	na	NT					0.0039	U	UL	*0.0039*		NT				
Naphthalene	18000	3600	na	NT					0.02	U	UL	*0.02*		NT				
Phenanthrene	1700000	170000	na	NT					0.002	U	UL	*0.002*		NT				
Pyrene	1700000	170000	na	NT					0.002	U	UL	*0.002*		NT				
SVOCs (ug/kg)																		
2,4-Dinitrotoluene	120000	12000	na	NT					NT					NT				
2,6-Dinitrotoluene	62000	6100	na	NT					NT					NT				
bis(2-Ethylhexyl)phthalate	120000	35000	na	NT					0.45	U		*0.45*		NT				
Di-n-butylphthalate	6200000	610000	na	NT					0.45	U		*0.45*		NT				
Naphthalene	18000	3600	na	NT					NT					NT				
N-nitrosodiphenylamine	350000	99000	na	NT					0.45	U		*0.45*		NT				
Phenanthrene	1700000	170000	na	NT					NT					NT				
Pyrene	1700000	170000	na	NT					NT					NT				
Pesticides (ug/kg)		None detected																
PCBs (mg/kg)		None detected																
Explosives (mg/kg)																		
1,3,5-Trinitrobenzene	2700	220	na	NT					0.24	U	UL	*0.24*		NT				
1,3-Dinitrobenzene	6.2	0.61	na	NT					0.24	U	UL	*0.24*		NT				
2,4,6-Trinitrotoluene	7.9	1.9	na	NT					0.24	U	UL	*0.24*		NT				
2,4-Dinitrotoluene	2.5	0.71	na	NT					0.24	U	UL	*0.24*		NT				
2,6-Dinitrotoluene	2.5	0.71	na	NT					0.24	U		*0.24*		NT				
4-amino-2,6-Dinitrotoluene	190	15	na	NT					0.24	U		*0.24*		NT				
HMX	4900	380	na	NT					0.24	U	UL	*0.24*		NT				
Nitrobenzene	28	3.1	na	NT					0.24	U	UL	*0.24*		NT				
RDX	24	5.5	na	NT					0.24	U	UL	*0.24*		NT				
Herbicides (ug/kg)		Samples were not tested fo																
Metals (mg/kg)																		
Aluminum	99000	7700	40041	NT					34200			*0.81*		NT				
Antimony	41	3.1	na	NT					1.1	B	J	*0.67*		NT				
Arsenic	1.6	0.39	15.8	NT					5.4			*0.81*		NT				
Barium	19000	1500	209	NT					72.9		L	*0.13*		NT				
Beryllium	200	16	1.02	NT					0.93		K	*0.13*		NT				
Calcium	na	na	na	NT					860			*3.1*		NT				
Chromium	150000	12000	65.3	NT					42.2			*0.13*		NT				
Cobalt	30	2.3	72.3	NT					11.5		L	*0.13*		NT				
Copper	4100	310	53.5	NT					15.1		K	*0.13*		NT				
Iron	72000	5500	50962	NT					39700			*2.4*		NT				
Lead	800	400	26.8	NT					8			*0.27*		NT				
Magnesium	na	na	na	NT					1440			*4.2*		NT				
Manganese	2300	180	2543	NT					342			*0.13*		NT				
Mercury	3.4	0.56	0.13	NT					0.14	U		*0.14*		NT				
Nickel	2000	160	62.8	NT					17.6		K	*0.13*		NT				
Potassium	na	na	na	NT					1430		K	*5.9*		NT				
Silver	510	39	na	NT					0.13	U		*0.27*		NT				
Sodium	na	na	na	NT					180	B	K	*4*		NT				
Thallium	na	na	2.11	NT					0.67	U	UL	*0.81*		NT				
Vanadium	7.2	0.55	108	NT					41.2		K	*0.13*		NT				
Zinc	31000	2300	202	NT					46.6		K	*0.27*		NT				

Analyte	48SB7A 3/30/98 8-9					48SB7A2 4/9/98 8-9					48SB7B 3/30/98 10-11					48SB08C 6/24/02 8-10				
	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
VOCs (ug/kg)																				
Acetone	0.008		B	*0.005*		1.1	B	B	*0.005*		0.008		B	*0.005*		5.4	U	UJ	*2.4*	*5.4*
Benzene	0.008	U		*0.008*		0.94	U		*0.94*		0.006	U		*0.006*		5.4	U		*0.3*	*5.4*
Dichlorodifluoromethane	0.008	U		*0.008*		0.94	U		*0.94*		0.006	U		*0.006*		NT				
m- & p-Xylene	0.008	U		*0.008*		0.94	U		*0.94*		0.006	U		*0.006*		11	U		*1.1*	*11*
Methylene chloride	0.003	J	B	*0.005*		0.94	U		*0.94*		0.006		B	*0.005*		5.4	U		*0.34*	*5.4*
o-Xylene	0.008	U		*0.008*		0.94	U		*0.94*		0.006	U		*0.006*		5.4	U		*1.1*	*5.4*
Toluene	0.008	U		*0.008*		0.94	U		*0.94*		0.006	U		*0.006*		5.4	U		*0.35*	*5.4*
Trichlorofluoromethane	0.002	J	J	*0.005*		0.7	J	J	*0.005*		0.006	U		*0.006*		NT				
Vinyl chloride	0.008	U		*0.008*		0.94	U		*0.94*		0.006	U		*0.006*		5.4	U		*0.41*	*5.4*
PAHs (ug/kg)																				
2-Methylnaphthalene	NT					NT					NT					0.89	J	B	*0.69*	*2.1*
Chrysene	0.021	U		*0.021*		NT					0.0019	U		*0.0019*		2.1	U		*0.33*	*2.1*
Fluoranthene	0.042	U		*0.042*		NT					0.0038	U		*0.0038*		2.1	U		*0.35*	*2.1*
Naphthalene	0.21	U	UL	*0.21*		NT					0.019	U	UL	*0.019*		1.5	JB	B	*0.79*	*2.1*
Phenanthrene	0.021	U		*0.021*		NT					0.0019	U		*0.0019*		2.1	U		*0.31*	*2.1*
Pyrene	0.021	U		*0.021*		NT					0.0019	U		*0.0019*		2.1	U		*0.46*	*2.1*
SVOCs (ug/kg)																				
2,4-Dinitrotoluene	NT					NT					NT					210	U		*6.9*	*210*
2,6-Dinitrotoluene	NT					NT					NT					210	U		*5.1*	*210*
bis(2-Ethylhexyl)phthalate	0.49	U		*0.49*		NT					0.38	U		*0.38*		210	U		*14*	*210*
Di-n-butylphthalate	0.49	U	UJ	*0.49*		NT					0.081	J	J	*0.38*		210	U		*59*	*210*
Naphthalene	NT					NT					NT					210	U		*7.5*	*210*
N-nitrosodiphenylamine	0.49	U	UJ	*0.49*		NT					0.38	U		*0.38*		210	U		*9.7*	*210*
Phenanthrene	NT					NT					NT					210	U		*6.4*	*210*
Pyrene	NT					NT					NT					210	U		*6.2*	*210*
Pesticides (ug/kg)																				
PCBs (mg/kg)																				
Explosives (mg/kg)																				
1,3,5-Trinitrobenzene	102		L	*25*		NT					0.53		L	*0.25*		0.1	U		*0.0246*	*0.1*
1,3-Dinitrobenzene	3.6		L	*0.25*		NT					0.25	U	UL	*0.25*		0.1	U		*0.0216*	*0.1*
2,4,6-Trinitrotoluene	935		L	*25*		NT					35.68		L	*1*		0.2	U		*0.0187*	*0.2*
2,4-Dinitrotoluene	0.25	U	UL	*0.25*		NT					0.25	U	UL	*0.25*		0.2	U		*0.0163*	*0.2*
2,6-Dinitrotoluene	0.25	U	UL	*0.25*		NT					0.25	U	UL	*0.25*		0.2	U		*0.0246*	*0.2*
4-amino-2,6-Dinitrotoluene	0.25	U	UL	*0.25*		NT					0.25	U	UL	*0.25*		0.2	U		*0.0444*	*0.2*
HMX	0.25	U	UL	*0.25*		NT					0.25	U	UL	*0.25*		0.2	U		*0.0602*	*0.2*
Nitrobenzene	0.25	U	UL	*0.25*		NT					0.25	U	UL	*0.25*		0.2	U		*0.0583*	*0.2*
RDX	0.25	U	UL	*0.25*		NT					0.25	U	UL	*0.25*		0.2	U		*0.035*	*0.2*
Herbicides (ug/kg)																				
Metals (mg/kg)																				
Aluminum	24600			*0.88*		NT					16500			*0.69*		22500			*6.7*	*24.2*
Antimony	0.9	B	J	*0.73*		NT					0.57	U		*0.57*		0.605	U	UL	*0.2*	*0.605*
Arsenic	8			*0.88*		NT					3.5			*0.69*		0.846		L	*0.42*	*0.605*
Barium	111		L	*0.15*		NT					49.8		L	*0.11*		29.4			*0.4*	*2.42*
Beryllium	0.69	B	B	*0.15*		NT					0.76		B	*0.11*		0.701			*0.0418*	*0.605*
Calcium	2640			*3.4*		NT					984			*2.6*		81.7		J	*3.4*	*12.1*
Chromium	33.3			*0.15*		NT					37.4			*0.11*		27.2			*0.45*	*1.21*
Cobalt	12.5		L	*0.15*		NT					15		L	*0.11*		4.6	B	J	*0.98*	*6.05*
Copper	36.9		K	*0.15*		NT					9.6		B	*0.11*		8.03			*0.75*	*2.42*
Iron	45600			*2.6*		NT					25300			*2.1*		27500		J	*4.1*	*6.05*
Lead	25.6			*0.29*		NT					9			*0.23*		4.89			*0.037*	*0.363*
Magnesium	1810			*4.5*		NT					950			*3.6*		832		J	*2.9*	*12.1*
Manganese	176			*0.15*		NT					613			*0.11*		122		J	*0.068*	*1.21*
Mercury	0.15	U		*0.15*		NT					0.12	U		*0.12*		0.033	B	J	*0.024*	*0.0605*
Nickel	24.4		K	*0.15*		NT					10.6		K	*0.11*		7.85		J	*1.1*	*4.84*
Potassium	2220		K	*6.5*		NT					909		K	*5.1*		1490			*40*	*363*
Silver	0.39	B	J	*0.29*		NT					0.23	U		*0.23*		1.21	U		*0.6*	*1.21*
Sodium	211	B	B	*4.4*		NT					100	B	B	*3.4*		14	B	B	*4.5*	*24.2*
Thallium	0.88	U		*0.88*		NT					0.69	U		*0.69*		0.097	B	J	*0.036*	*0.363*
Vanadium	73.2		K	*0.15*		NT					23.1		K	*0.11*		23.8		J	*0.7*	*6.05*
Zinc	67.1		K	*0.29*		NT					29		K	*0.23*		29		J	*0.43*	*2.42*

Table 1-3
Analytes Detected in Soil Below Fill Material at SWMU 48

Analyte	i-SL	r-SL	Background	48SB09C 6/24/02 8-10 Result	Lab Q	Val Q	MDL	MRL	48SB10C 6/24/02 8-10 Result	Lab Q	Val Q	MDL	MRL	48TP1 3/24/98 6-6.5 Result	Lab Q	Val Q	MDL	MRL
VOCs (ug/kg)																		
Acetone	63000000	6100000	na	NT					5.6	U	UJ	*2.5*	*5.6*	NT				
Benzene	5600	1100	na	NT					5.6	U		*0.31*	*5.6*	0.011	U	UJ	*0.011*	
Dichlorodifluoromethane	78000	18000	na	NT					NT					0.006	J	J	*0.005*	
m- & p-Xylene	na	na	na	NT					11	U		*1.2*	*11*	0.011	U	UJ	*0.011*	
Methylene chloride	53000	11000	na	NT					5.6	U		*0.35*	*5.6*	0.007	JB	B	*0.005*	
o-Xylene	1900000	380000	na	NT					5.6	U		*1.2*	*5.6*	0.011	U	UJ	*0.011*	
Toluene	4500000	500000	na	NT					5.6	U		*0.36*	*5.6*	0.011	U	UJ	*0.011*	
Trichlorofluoromethane	340000	79000	na	NT					NT					0.007	J	J	*0.005*	
Vinyl chloride	1700	60	na	NT					5.6	U		*0.42*	*5.6*	0.011	J	J	*0.011*	
PAHs (ug/kg)																		
2-Methylnaphthalene	410000	31000	na	NT					0.95	J	B	*0.71*	*2.1*	NT				
Chrysene	210000	15000	na	NT					2.1	U		*0.34*	*2.1*	0.017		J	*0.003*	
Fluoranthene	2200000	230000	na	NT					2.1	U		*0.36*	*2.1*	0.006	U		*0.006*	
Naphthalene	18000	3600	na	NT					1.6	JB	B	*0.82*	*2.1*	0.03	U		*0.03*	
Phenanthrene	1700000	170000	na	NT					2.1	U		*0.32*	*2.1*	0.094		J	*0.003*	
Pyrene	1700000	170000	na	NT					2.1	U		*0.48*	*2.1*	0.003	U		*0.003*	
SVOCs (ug/kg)																		
2,4-Dinitrotoluene	120000	12000	na	NT					210	U		*7.1*	*210*	NT				
2,6-Dinitrotoluene	62000	6100	na	NT					210	U		*5.2*	*210*	NT				
bis(2-Ethylhexyl)phthalate	120000	35000	na	NT					210	U		*14*	*210*	0.72	U		*0.72*	
Di-n-butylphthalate	6200000	610000	na	NT					210	U		*61*	*210*	0.72	U		*0.72*	
Naphthalene	18000	3600	na	NT					210	U		*7.7*	*210*	NT				
N-nitrosodiphenylamine	350000	99000	na	NT					210	U		*10*	*210*	0.72	U		*0.72*	
Phenanthrene	1700000	170000	na	NT					210	U		*6.5*	*210*	NT				
Pyrene	1700000	170000	na	NT					210	U		*6.4*	*210*	NT				
Pesticides (ug/kg)		None detected																
PCBs (mg/kg)		None detected																
Explosives (mg/kg)																		
1,3,5-Trinitrobenzene	2700	220	na	0.1	U		*0.0246*	*0.1*	0.1	U		*0.0246*	*0.1*	1.4		J	*0.25*	
1,3-Dinitrobenzene	6.2	0.61	na	0.1	U		*0.0216*	*0.1*	0.1	U		*0.0216*	*0.1*	2.7		J	*0.25*	
2,4,6-Trinitrotoluene	7.9	1.9	na	0.2	U		*0.0187*	*0.2*	0.2	U		*0.0187*	*0.2*	0.25	U		*0.25*	
2,4-Dinitrotoluene	2.5	0.71	na	0.2	U		*0.0163*	*0.2*	0.2	U		*0.0163*	*0.2*	6.7		J	*0.25*	
2,6-Dinitrotoluene	2.5	0.71	na	0.2	U		*0.0246*	*0.2*	0.2	U		*0.0246*	*0.2*	1.3			*0.25*	
4-amino-2,6-Dinitrotoluene	190	15	na	0.2	U		*0.0444*	*0.2*	0.2	U		*0.0444*	*0.2*	5.5		J	*0.25*	
HMX	4900	380	na	0.2	U		*0.0602*	*0.2*	0.2	U		*0.0602*	*0.2*	5.2		J	*0.25*	
Nitrobenzene	28	3.1	na	0.2	U		*0.0583*	*0.2*	0.2	U		*0.0583*	*0.2*	1		J	*0.25*	
RDX	24	5.5	na	0.2	U		*0.035*	*0.2*	0.2	U		*0.035*	*0.2*	0.85		J	*0.25*	
Herbicides (ug/kg)		Samples were not tested fo																
Metals (mg/kg)																		
Aluminum	99000	7700	40041	NT					24100			*6.9*	*24.9*	9230			*1.3*	
Antimony	41	3.1	na	NT					0.623	U	UL	*0.21*	*0.623*	0.66	U		*1.1*	
Arsenic	1.6	0.39	15.8	NT					0.623	U	UL	*0.44*	*0.623*	8.1			*1.3*	
Barium	19000	1500	209	NT					63.4			*0.42*	*2.49*	34.6	B	L	*0.22*	
Beryllium	200	16	1.02	NT					1			*0.043*	*0.623*	**1.5**		**K**	*0.22*	
Calcium	na	na	na	NT					16.8		B	*3.5*	*12.5*	4650			*5*	
Chromium	150000	12000	65.3	NT					27.6			*0.47*	*1.25*	23.2			*0.22*	
Cobalt	30	2.3	72.3	NT					18.6		J	*1*	*6.23*	13.8		L	*0.22*	
Copper	4100	310	53.5	NT					15.7			*0.77*	*2.49*	15.4		K	*0.22*	
Iron	72000	5500	50962	NT					**61400**		**J**	*4.2*	*6.23*	16700			*3.9*	
Lead	800	400	26.8	NT					10.5			*0.038*	*0.374*	17.8			*0.44*	
Magnesium	na	na	na	NT					1480		J	*2.9*	*12.5*	442	B	J	*6.8*	
Manganese	2300	180	2543	NT					508		J	*0.07*	*1.25*	314			*0.22*	
Mercury	3.4	0.56	0.13	NT					0.0623	U		*0.0247*	*0.0623*	0.22	U		*0.22*	
Nickel	2000	160	62.8	NT					13		J	*1.1*	*4.98*	8.6	B	K	*0.22*	
Potassium	na	na	na	NT					1720			*42*	*374*	176	B	K	*9.6*	
Silver	510	39	na	NT					0.87	B	B	*0.61*	*1.25*	0.22	U		*0.44*	
Sodium	na	na	na	NT					16	B	B	*4.7*	*24.9*	5740		K	*6.6*	
Thallium	na	na	2.11	NT					0.21	B	J	*0.038*	*0.374*	1.1	U	UL	*1.3*	
Vanadium	7.2	0.55	108	NT					63.7		J	*0.72*	*6.23*	12.1		K	*0.22*	
Zinc	31000	2300	202	NT					53.9		J	*0.45*	*2.49*	58.7		K	*0.44*	

Analyte	48TP2 3/24/98 6-6.5 Result	Lab Q	Val Q	MDL	MRL	48TP3 3/24/98 6-6.5 Result	Lab Q	Val Q	MDL	MRL	48TP4 3/24/98 6-6.5 Result	Lab Q	Val Q	MDL	MRL
VOCs (ug/kg)															
Acetone	NT					NT					NT				
Benzene	0.006	U		*0.006*		0.007	U	UJ	*0.007*		0.006	U		*0.006*	
Dichlorodifluoromethane	0.006	U		*0.006*		0.007	U	UJ	*0.007*		0.006	U		*0.006*	
m- & p-Xylene	0.006	U		*0.006*		0.007	U	UJ	*0.007*		0.006	U		*0.006*	
Methylene chloride	0.002	J	B	*0.005*		0.002	J	B	*0.005*		0.002	J	B	*0.005*	
o-Xylene	0.006	U		*0.006*		0.007	U	UJ	*0.007*		0.006	U		*0.006*	
Toluene	0.006	U		*0.006*		0.007	U	UJ	*0.007*		0.006	U		*0.006*	
Trichlorofluoromethane	0.006	U		*0.006*		0.007	U	UJ	*0.007*		0.006	U		*0.006*	
Vinyl chloride	0.006	U		*0.006*		0.007	U	UJ	*0.007*		0.006	U		*0.006*	
PAHs (ug/kg)															
2-Methylnaphthalene	NT					NT					NT				
Chrysene	0.0021	U		*0.0021*		0.0022	U		*0.0022*		0.0021	U		*0.0021*	
Fluoranthene	0.0042	U		*0.0042*		0.0044	U		*0.0044*		0.0042	U		*0.0042*	
Naphthalene	0.021	U		*0.021*		0.022	U		*0.022*		0.021	U		*0.021*	
Phenanthrene	0.0021	U		*0.0021*		0.0022	U		*0.0022*		0.0021	U		*0.0021*	
Pyrene	0.0021	U		*0.0021*		0.0022	U		*0.0022*		0.0021	U		*0.0021*	
SVOCs (ug/kg)															
2,4-Dinitrotoluene	NT					NT					NT				
2,6-Dinitrotoluene	NT					NT					NT				
bis(2-Ethylhexyl)phthalate	0.43	U		*0.43*		0.44	U		*0.44*		0.43	U		*0.43*	
Di-n-butylphthalate	0.43	U		*0.43*		0.44	U		*0.44*		0.43	U		*0.43*	
Naphthalene	NT					NT					NT				
N-nitrosodiphenylamine	0.43	U		*0.43*		0.44	U		*0.44*		0.43	U		*0.43*	
Phenanthrene	NT					NT					NT				
Pyrene	NT					NT					NT				
Pesticides (ug/kg)															
PCBs (mg/kg)															
Explosives (mg/kg)															
1,3,5-Trinitrobenzene	0.25	U		*0.25*		0.25	U		*0.25*		0.25	U		*0.25*	
1,3-Dinitrobenzene	0.25	U		*0.25*		0.25	U		*0.25*		0.25	U		*0.25*	
2,4,6-Trinitrotoluene	0.25	U		*0.25*		0.25	U		*0.25*		0.25	U		*0.25*	
2,4-Dinitrotoluene	0.25	U		*0.25*		0.25	U		*0.25*		0.25	U		*0.25*	
2,6-Dinitrotoluene	0.25	U		*0.25*		0.25	U		*0.25*		0.25	U		*0.25*	
4-amino-2,6-Dinitrotoluene	0.25	U		*0.25*		0.25	U		*0.25*		0.25	U		*0.25*	
HMX	0.25	U		*0.25*		0.25	U		*0.25*		0.25	U		*0.25*	
Nitrobenzene	0.25	U		*0.25*		0.25	U		*0.25*		0.25	U		*0.25*	
RDX	0.25	U		*0.25*		0.25	U		*0.25*		0.25	U		*0.25*	
Herbicides (ug/kg)															
Metals (mg/kg)															
Aluminum	**47400**			*0.75*		**50700**			*0.79*		**47900**			*0.78*	
Antimony	1.3	B	J	*0.62*		1.5	B	J	*0.66*		1.5	B	J	*0.65*	
Arsenic	4.3			*0.75*		4.8			*0.79*		4.8			*0.78*	
Barium	71.8		L	*0.12*		70.6		L	*0.13*		80.4		L	*0.13*	
Beryllium	0.48	B	K	*0.12*		0.51	B	K	*0.13*		0.55	B	K	*0.13*	
Calcium	697			*2.9*		266	B	J	*3*		246	B	J	*3*	
Chromium	28.4			*0.12*		33			*0.13*		31.2			*0.13*	
Cobalt	6.7		L	*0.12*		7.5		L	*0.13*		6.2	B	L	*0.13*	
Copper	18.6		K	*0.12*		19.7		K	*0.13*		20.1		K	*0.13*	
Iron	**51100**			*2.2*		**55000**			*2.4*		**54800**			*2.3*	
Lead	17			*0.25*		14.7			*0.26*		15.8			*0.26*	
Magnesium	2310			*3.9*		1980			*4.1*		2160			*4*	
Manganese	188			*0.12*		218			*0.13*		163			*0.13*	
Mercury	0.13	U		*0.13*		0.13	U		*0.13*		0.13	U		*0.13*	
Nickel	20.9		K	*0.12*		21.2		K	*0.13*		22		K	*0.13*	
Potassium	2910		K	*5.5*		2670		K	*5.8*		2920		K	*5.7*	
Silver	0.12	U		*0.25*		0.13	U		*0.26*		0.13	U		*0.26*	
Sodium	323	B	K	*3.7*		288	B	K	*4*		224	B	K	*3.9*	
Thallium	1.9		L	*0.75*		0.66	U	UL	*0.79*		0.65	U	UL	*0.78*	
Vanadium	94.6		K	*0.12*		100		K	*0.13*		96.4		K	*0.13*	
Zinc	65.6		K	*0.25*		70.2		K	*0.26*		67.8		K	*0.26*	

**Refer to legend immediately following this table for a list of definitions and table notes.

Table 1-3
Legend

12	J	Shading and black font indicate an industrial SL exceedance.
12	J	Bold outline indicates a residential SL exceedance.
<u>12</u>	**<u>J</u>**	Bold, underlined font indicates a background exceedance.
12	*12*	Shading in the MDL/MRL columns indicates the MDL exceeds a criterion.

SLs for non-Carcinogenic compounds have been recalculated to an HI of 0.1.
The pyrene SLs were used for acenaphthylene, benzo(g,h,i)perylene, and phenanthrene.
Inorganic results below background UTLs are not indicated as exceedances on the table.
SL = Screening Level (Source: ORNL Regional Screening Table, April 2009).
Lead screening values from Technical Review Workgroup for Lead: Guidance Document (USEPA, 1999b).
mg/kg = milligrams per kilogram (parts per million).
ng/kg = nanograms per kilogram (parts per trillion).
µg/kg = micrograms per kilogram (parts per billion).
NA = not applicable.
NT = analyte not tested.

Lab Q = Lab Data Qualifiers

* = Laboratory duplicate not within control limits.
B = (organics) Blank contamination. Value detected in sample and associated blank.
A (Dioxins) = B = (metals) Value <MRL and >MDL and is considered estimated.
E (metals) = Reported value is estimated because of the presence of interferences.
EMPC (Dioxins) = The ion-abundance ratio between the two characteristic PCDD/PCDF ions was outside accepted ranges. The detected PCDD/PCDF was reported as an estimated maximum possible concentration (EMPC).
J = (organics) Value <MRL and >MDL and is considered estimated.
U = Analyte not-detected at the method reporting limit.
X = (dioxins) Ion abundance ratio outside acceptable range. Value reported is EMPC.

Val Q = Validation Data Qualifiers

B = blank contamination. Value detected in sample and associated blank.
J = estimated concentration.
K = estimated concentration bias high.
L = estimated concentration bias low.
N = presumptive evidence for tentatively identified compounds using a library search.
U = analyte not detected.
UJ = estimated concentration non-detect.
UL = estimated concentration non-detect bias low.
R = the quality control associated with the analysis or analyte indicates severe uncertainty with the reported result. The analyte was analyzed for, but the presence or absence of the analyte has not been verified.
PG = the percent difference between the original and confirmation analysis is greater than 40%.

Table 1-4
Summary of Analytes Detected in Soil Below Fill Material at SWMU 48

Analyte	i-SL	r-SL	Background	# of i-SL Exceedances	# of r-SL Exceedances	# of Background Exceedances	# of Detections	# of Samples	Minimum Concentration	Maximum Concentration	Location of Maximum
VOCs (ug/kg)											
Acetone	63000000	6100000	na	0	0	na	5	13	0.008	1.3	48SB6A2
Benzene	5600	1100	na	0	0	na	1	19	0.017	0.017	48SB6A
Dichlorodifluoromethane	78000	18000	na	0	0	na	1	11	0.006	0.006	48TP1
m- & p-Xylene	na	na	na	na	na	na	1	13	1.1	1.1	48SB6A2
Methylene chloride	53000	11000	na	0	0	na	8	19	0.002	0.049	48SB6A
o-Xylene	1900000	380000	na	0	0	na	1	13	0.64	0.64	48SB6A2
Toluene	4500000	500000	na	0	0	na	2	19	0.023	1	48SB2 (RVFS*3)
Trichlorofluoromethane	340000	79000	na	0	0	na	3	17	0.002	0.7	48SB7A2
Vinyl chloride	1700	60	na	0	0	na	1	19	0.011	0.011	48TP1
PAHs (ug/kg)											
2-Methylnaphthalene	410000	31000	na	0	0	na	2	2	0.89	0.95	48SB10C
Chrysene	210000	15000	na	0	0	na	1	10	0.017	0.017	48TP1
Fluoranthene	2200000	230000	na	0	0	na	1	10	0.048	0.048	48SB6A
Naphthalene	18000	3600	na	0	0	na	2	10	1.5	1.6	48SB10C
Phenanthrene	1700000	170000	na	0	0	na	1	10	0.094	0.094	48TP1
Pyrene	1700000	170000	na	0	0	na	1	10	0.025	0.025	48SB6A
SVOCs (ug/kg)											
2,4-Dinitrotoluene	120000	12000	na	0	0	na	1	8	3200	3200	48SB2 (RVFS*3)
2,6-Dinitrotoluene	62000	6100	na	0	0	na	1	8	1200	1200	48SB2 (RVFS*3)
bis(2-Ethylhexyl)phthalate	120000	35000	na	0	0	na	4	16	0.13	3600	48SB4B21
Di-n-butylphthalate	6200000	610000	na	0	0	na	5	16	0.081	6000	48SB4B21
Naphthalene	18000	3600	na	0	0	na	1	8	270	270	48SB2 (RVFS*3)
N-nitrosodiphenylamine	350000	99000	na	0	0	na	3	16	0.65	1700	48SB4B21
Phenanthrene	1700000	170000	na	0	0	na	2	8	130	200	48SB1 (RVFS*1)
Pyrene	1700000	170000	na	0	0	na	1	8	300	300	48SB1 (RVFS*1)
Pesticides (ug/kg)		***None detected***									
PCBs (mg/kg)		***None detected***									
Explosives (mg/kg)											
1,3,5-Trinitrobenzene	2700	220	na	0	0	na	3	11	0.53	102	48SB7A
1,3-Dinitrobenzene	6.2	0.61	na	0	2	na	2	11	2.7	3.6	48SB7A
2,4,6-Trinitrotoluene	7.9	1.9	na	2	2	na	2	13	35.68	935	48SB7A
2,4-Dinitrotoluene	2.5	0.71	na	1	1	na	1	11	6.7	6.7	48TP1
2,6-Dinitrotoluene	2.5	0.71	na	0	1	na	1	11	1.3	1.3	48TP1
4-amino-2,6-Dinitrotoluene	190	15	na	0	0	na	1	11	5.5	5.5	48TP1
HMX	4900	380	na	0	0	na	1	13	5.2	5.2	48TP1
Nitrobenzene	28	3.1	na	0	0	na	1	11	1	1	48TP1
RDX	24	5.5	na	0	0	na	1	13	0.85	0.85	48TP1
Herbicides (ug/kg)		***Samples were not tested for this group.***									
Metals (mg/kg)											
Aluminum	99000	7700	40041	0	3	3	14	14	2940	50700	48TP3
Antimony	41	3.1	na	0	0	na	6	14	0.9	1.6	48SB6A
Arsenic	1.6	0.39	15.8	0	0	0	13	14	0.846	8.19	48SB1 (RVFS*1)
Barium	19000	1500	209	0	0	0	14	14	29.4	111	48SB7A
Beryllium	200	16	1.02	0	0	4	13	14	0.48	4.98	48SB2 (RVFS*4)
Calcium	na	na	na	na	na	na	14	14	16.8	240000	48SB1 (RVFS*1)
Chromium	150000	12000	65.3	0	0	0	14	14	7.78	42.2	48SB6B
Cobalt	30	2.3	72.3	0	0	0	14	14	3.01	18.6	48SB10C
Copper	4100	310	53.5	0	0	1	14	14	6.87	135	48SB2 (RVFS*3)
Iron	72000	5500	50962	0	4	4	14	14	8550	61400	48SB10C
Lead	800	400	26.8	0	0	3	12	14	4.89	154	48SB2 (RVFS*3)

Table 1-4
Summary of Analytes Detected in Soil Below Fill Material at SWMU 48

Analyte	i-SL	r-SL	Background	# of i-SL Exceedances	# of r-SL Exceedances	# of Background Exceedances	# of Detections	# of Samples	Minimum Concentration	Maximum Concentration	Location of Maximum
Magnesium	na	na	na	na	na	na	14	14	442	130000	48SB1 (RVFS*1)
Manganese	2300	180	2543	0	0	0	14	14	122	613	48SB7B
Mercury	3.4	0.56	0.13	0	1	2	3	14	0.033	2.6	48SB1 (RVFS*1)
Nickel	2000	160	62.8	0	0	0	14	14	4.91	25.6	48SB2 (RVFS*3)
Potassium	na	na	na	na	na	na	14	14	176	2920	48TP4
Silver	510	39	na	0	0	na	4	14	0.39	1.03	48SB1 (RVFS*1)
Sodium	na	na	na	na	na	na	14	14	14	5740	48TP1
Thallium	na	na	2.11	na	na	0	3	14	0.097	1.9	48TP2
Vanadium	7.2	0.55	108	0	0	0	14	14	8.97	100	48TP3
Zinc	31000	2300	202	0	0	0	14	14	23	71.3	48SB2 (RVFS*3)

Table 1-5
Analytes Detected in Trenching Investigation Soil Samples at SWMU 48

Analyte			Sample ID / Sample Date / Sample Depth	48TP02-RFI 3/18/10 6-7					48TP03-RFI 3/18/10 1-2					48TP04-RFI 3/18/10 3-4				
	i-SL	r-SL	Background	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
Explosives (mg/kg)																		
1,3,5-Trinitrobenzene	2700	220	na	0.13	J PG		0.01	0.25	0.25	U		0.01	0.25	0.25	U		0.01	0.25
1,3-Dinitrobenzene	6.2	0.61	na	0.25	U		0.004	0.25	0.25	U		0.004	0.25	0.25	U		0.004	0.25
2,4,6-Trinitrotoluene	7.9	1.9	na	0.25	U		0.019	0.25	0.056	J		0.019	0.25	0.18	J		0.019	0.25
2,4-Dinitrotoluene	120	12	na	0.022	J		0.005	0.25	0.079	J		0.005	0.25	1.6			0.005	0.25
2,6-Dinitrotoluene	62	6.1	na	0.25	U		0.007	0.25	0.074	J		0.007	0.25	0.19	J		0.007	0.25
2-amino-4,6-Dinitrotoluene	200	15	na	0.25	U		0.012	0.25	0.25	U		0.012	0.25	0.25	U		0.012	0.25
4-amino-2,6-Dinitrotoluene	190	15	na	0.25	U		0.01	0.25	0.038	J		0.01	0.25	0.01	J PG		0.01	0.25
HMX	4900	380	na	0.25	U		0.012	0.25	0.25	U		0.012	0.25	0.025	J		0.012	0.25
Nitroglycerin	6.2	0.61	na	0.5	U		0.015	0.5	0.051	J PG		0.015	0.5	1.2	PG		0.015	0.5
Metals (mg/kg)																		
Aluminum	99000	7700	40041	96.9			9.2	32.9	18000			8.6	30.8	9910			8.1	28.9
Antimony	41	3.1	na	0.99	U		0.33	0.99	1.2			0.31	0.92	3.2			0.29	0.87
Arsenic	1.6	0.39	15.8	0.82	U		0.25	0.82	4			0.23	0.77	3.5			0.22	0.72
Barium	19000	1500	209	0.96			0.16	0.49	114			0.15	0.46	199			0.14	0.43
Beryllium	200	16	1.02	0.16	U		0.016	0.16	0.79			0.015	0.15	0.69			0.014	0.14
Cadmium	81	7	0.69	**9.2**			0.082	0.25	**1.1**			0.077	0.23	**6.3**			0.072	0.22
Calcium	na	na	na	737			41.1	164	221000	RLA		193	770	16900			36.1	144
Chromium	150000	12000	65.3	2.7			0.33	0.99	31.2			0.31	0.92	48.5			0.29	0.87
Cobalt	30	2.3	72.3	9			0.16	0.49	4.6			0.15	0.46	6.8			0.14	0.43
Copper	4100	310	53.5	**81800**	**B RLA**		247	822	31.7	B		0.23	0.77	**239**	**B**		0.22	0.72
Iron	72000	5500	50962	118			5.1	16.4	13900			4.8	15.4	15500			4.5	14.4
Lead	800	400	26.8	**114000**	**B RLA**		98.7	329	**294**	**B**		0.092	0.31	**665**	**B**		0.087	0.29
Magnesium	na	na	na	382			12.3	82.2	17400			11.6	77	3320			10.8	72.2
Manganese	2300	180	2543	11.3			0.41	1.3	145			0.39	1.2	162			0.36	1.2
Mercury	3.4	0.56	0.13	0.024	J		0.014	0.066	**1.5**	**RLA**		0.026	0.12	**25.5**	**RLA**		0.31	1.4
Nickel	2000	160	62.8	10.7			0.16	0.49	25			0.15	0.46	22.7			0.14	0.43
Potassium	na	na	na	73.3	J		41.1	164	2370			38.5	154	627			36.1	144
Selenium	510	39	na	0.7			0.16	0.49	0.77			0.15	0.46	1.1			0.14	0.43
Silver	510	39	na	0.95			0.049	0.16	1.1			0.046	0.15	30	RLA		0.22	0.72
Sodium	na	na	na	779	J		41.1	822	210	J		38.5	770	77.4	J		36.1	722
Thallium	na	na	2.11	0.25	U		0.082	0.25	0.23	U		0.077	0.23	0.22	U		0.072	0.22
Vanadium	7.2	0.55	108	3.3	U		0.99	3.3	24.4			0.92	3.1	15.2			0.87	2.9
Zinc	31000	2300	202	32.9	U G		9.9	32.9	40.4			0.92	3.1	**499**			0.87	2.9

Analyte	48TP05 3/18/10 5-6					48TP07 3/18/10 2.35-2.5					48TP08 3/18/10 3.5-4					48TP08D 3/18/10 3.5-4				
	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
Explosives (mg/kg)																				
1,3,5-Trinitrobenzene	0.25	U		0.009	0.25	0.25	U		0.01	0.25	0.62			0.009	0.25	0.14	J PG		0.01	0.25
1,3-Dinitrobenzene	0.25	U		0.004	0.25	0.25	U		0.004	0.25	0.25	U		0.004	0.25	0.25	U		0.004	0.25
2,4,6-Trinitrotoluene	0.25	U		0.019	0.25	0.25	U		0.019	0.25	1.6			0.019	0.25	0.42			0.019	0.25
2,4-Dinitrotoluene	0.13	J		0.005	0.25	0.25	U		0.005	0.25	0.75			0.005	0.25	0.32			0.005	0.25
2,6-Dinitrotoluene	0.054	J		0.007	0.25	0.11	J		0.007	0.25	0.9			0.007	0.25	0.27			0.007	0.25
2-amino-4,6-Dinitrotoluene	0.25	U		0.012	0.25	0.25	U		0.012	0.25	1.7			0.012	0.25	2.6			0.012	0.25
4-amino-2,6-Dinitrotoluene	0.022	J		0.009	0.25	0.25	U		0.01	0.25	0.43			0.009	0.25	0.45			0.01	0.25
HMX	0.25	U		0.012	0.25	0.25	U		0.012	0.25	0.25	U		0.012	0.25	0.25	U		0.012	0.25
Nitroglycerin	0.17	J		0.015	0.5	0.5	U		0.015	0.5	0.5	U		0.015	0.5	0.5	U		0.015	0.5
Metals (mg/kg)																				
Aluminum	16200			8.7	30.9	11300			7.6	27.1	18100			7.1	25.2	12200			6.5	23.3
Antimony	1.5			0.31	0.93	1.9			0.27	0.81	1			0.25	0.76	0.36	J		0.23	0.7
Arsenic	4.1			0.23	0.77	6.4			0.2	0.68	**112**			0.19	0.63	7.4			0.17	0.58
Barium	142			0.15	0.46	144			0.14	0.41	96.1			0.13	0.38	95.8			0.12	0.35
Beryllium	0.91			0.015	0.15	0.69			0.014	0.14	0.89			0.013	0.13	0.83			0.012	0.12
Cadmium	**1.8**			0.077	0.23	**2.2**			0.068	0.2	**1.1**			0.063	0.19	**0.71**			0.058	0.17
Calcium	174000	RLA		193	773	31300			33.9	136	18300			31.6	126	49400			29.1	116
Chromium	34.5			0.31	0.93	32.7			0.27	0.81	52			0.25	0.76	23.5			0.23	0.7
Cobalt	6			0.15	0.46	4.9			0.14	0.41	8.5			0.13	0.38	7.1			0.12	0.35
Copper	**87.5**	**B**		0.23	0.77	**98**	**B**		0.2	0.68	27.5	B		0.19	0.63	23.4	B		0.17	0.58
Iron	15100			4.8	15.5	15600			4.2	13.6	24600			3.9	12.6	17100			3.6	11.6
Lead	**450**	**B**		0.093	0.31	**349**	**B**		0.081	0.27	**105**	**B**		0.076	0.25	**106**	**B**		0.07	0.23
Magnesium	14000			11.6	77.3	5840			10.2	67.8	5470			9.5	63.1	14600			8.7	58.2
Manganese	180			0.39	1.2	171			0.34	1.1	456			0.32	1	356			0.29	0.93
Mercury	**5.9**	**RLA**		0.11	0.49	**12.5**	**RLA**		0.29	1.4	**2.1**	**RLA**		0.032	0.15	**0.71**			0.01	0.047
Nickel	23.3			0.15	0.46	16.9			0.14	0.41	13.4			0.13	0.38	15.6			0.12	0.35
Potassium	2340			38.7	155	962			33.9	136	973			31.6	126	1130			29.1	116
Selenium	0.85			0.15	0.46	1.2			0.14	0.41	1.1			0.13	0.38	0.73			0.12	0.35
Silver	13.5			0.046	0.15	16.1	RLA		0.2	0.68	3.1			0.038	0.13	1.8			0.035	0.12
Sodium	153	J		38.7	773	94.4	J		33.9	678	46.8	J		31.6	631	80.2	J		29.1	582
Thallium	0.23	U		0.077	0.23	0.12	J		0.068	0.2	1.3			0.063	0.19	0.11	J		0.058	0.17
Vanadium	24.9			0.93	3.1	24.4			0.81	2.7	37.2			0.76	2.5	33.5			0.7	2.3
Zinc	143			0.93	3.1	**209**			0.81	2.7	158			0.76	2.5	170			0.7	2.3

Table 1-5
Analytes Detected in Trenching Investigation Soil Samples at SWMU 48

Analyte	Sample ID Sample Date Sample Depth			48TP09 3/18/10 5-6					48TP11 3/18/10 1-2					48TP12 3/18/10 1-2				
	i-SL	r-SL	Background	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
Explosives (mg/kg)																		
1,3,5-Trinitrobenzene	2700	220	na	0.25	U		0.01	0.25	0.25	U		0.009	0.25	0.25	U		0.009	0.25
1,3-Dinitrobenzene	6.2	0.61	na	0.25	U		0.004	0.25	0.25	U		0.004	0.25	0.25	U		0.004	0.25
2,4,6-Trinitrotoluene	7.9	1.9	na	0.25	U		0.019	0.25	0.25	U		0.019	0.25	0.25	U		0.019	0.25
2,4-Dinitrotoluene	120	12	na	0.25	U		0.005	0.25	0.25	U		0.005	0.25	0.25	U		0.005	0.25
2,6-Dinitrotoluene	62	6.1	na	0.013	J		0.007	0.25	0.25	U		0.007	0.25	0.3	PG		0.007	0.25
2-amino-4,6-Dinitrotoluene	200	15	na	0.032	J		0.012	0.25	0.25	U		0.012	0.25	0.25	U		0.012	0.25
4-amino-2,6-Dinitrotoluene	190	15	na	0.25	U		0.01	0.25	0.25	U		0.009	0.25	0.13	J		0.009	0.25
HMX	4900	380	na	0.25	U		0.012	0.25	0.25	U		0.012	0.25	0.25	U		0.012	0.25
Nitroglycerin	6.2	0.61	na	0.5	U		0.015	0.5	0.5	U		0.015	0.5	0.5	U		0.015	0.5
Metals (mg/kg)																		
Aluminum	99000	7700	40041	31200			7.2	25.7	35000			7.3	26.1	8620			7.3	25.9
Antimony	41	3.1	na	0.77	U		0.26	0.77	0.78	U		0.26	0.78	0.78	U		0.26	0.78
Arsenic	1.6	0.39	15.8	2.8			0.19	0.64	4			0.2	0.65	3.7			0.19	0.65
Barium	19000	1500	209	55.4			0.13	0.39	67.3			0.13	0.39	41.1			0.13	0.39
Beryllium	200	16	1.02	0.69			0.013	0.13	0.71			0.013	0.13	0.43			0.013	0.13
Cadmium	81	7	0.69	0.31			0.064	0.19	0.37			0.065	0.2	0.19			0.065	0.19
Calcium	na	na	na	2370			32.1	128	169			32.6	130	3570			32.4	130
Chromium	150000	12000	65.3	26.7			0.26	0.77	26.7			0.26	0.78	22.9			0.26	0.78
Cobalt	30	2.3	72.3	4.6			0.13	0.39	14.8			0.13	0.39	6			0.13	0.39
Copper	4100	310	53.5	17.1	B		0.19	0.64	15.6	B		0.2	0.65	5.1			0.19	0.65
Iron	72000	5500	50962	40400			4	12.8	46100			4	13	17400			4	13
Lead	800	400	26.8	26.3	B		0.077	0.26	15.5	B		0.078	0.26	17.6	B		0.078	0.26
Magnesium	na	na	na	1530			9.6	64.2	1350			9.8	65.1	807			9.7	64.8
Manganese	2300	180	2543	130			0.32	1	429			0.33	1	327			0.32	1
Mercury	3.4	0.56	0.13	**0.31**			0.011	0.051	**0.15**			0.011	0.052	0.078			0.011	0.052
Nickel	2000	160	62.8	15.3			0.13	0.39	16.7			0.13	0.39	5.3			0.13	0.39
Potassium	na	na	na	1530			32.1	128	1310			32.6	130	532			32.4	130
Selenium	510	39	na	0.72			0.13	0.39	0.51			0.13	0.39	0.64			0.13	0.39
Silver	510	39	na	0.49			0.039	0.13	0.097	J		0.039	0.13	0.049	J		0.039	0.13
Sodium	na	na	na	642	U		32.1	642	163	J		32.6	651	203	J		32.4	648
Thallium	na	na	2.11	0.21			0.064	0.19	0.32			0.065	0.2	0.12	J		0.065	0.19
Vanadium	7.2	0.55	108	77.6			0.77	2.6	82.3			0.78	2.6	34.7			0.78	2.6
Zinc	31000	2300	202	45.1			0.77	2.6	45.9			0.78	2.6	20.1			0.78	2.6

Analyte	48TP13 3/18/10 3-4					48TP14 3/18/10 2-3					48TP14D 3/18/10 2-3					48TP15 3/18/10 8-9				
	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
Explosives (mg/kg)																				
1,3,5-Trinitrobenzene	0.25	U		0.009	0.25	1.3	U		0.05	1.3	1.2	U		0.049	1.2	0.25	U		0.01	0.25
1,3-Dinitrobenzene	0.25	U		0.004	0.25	1.3	U		0.021	1.3	1.2	U		0.02	1.2	0.073	J PG		0.004	0.25
2,4,6-Trinitrotoluene	0.25	U		0.019	0.25	1.3	U		0.097	1.3	1.2	U		0.094	1.2	0.25	U		0.019	0.25
2,4-Dinitrotoluene	0.25	U		0.005	0.25	6.9	V		0.027	1.3	5.3	V		0.026	1.2	0.25	U		0.005	0.25
2,6-Dinitrotoluene	0.25	U		0.007	0.25	2.7			0.037	1.3	2.8			0.036	1.2	0.25	U		0.007	0.25
2-amino-4,6-Dinitrotoluene	0.25	U		0.012	0.25	1.3	U		0.063	1.3	1.2	U		0.061	1.2	0.25	U		0.012	0.25
4-amino-2,6-Dinitrotoluene	0.25	U		0.009	0.25	1.3	U		0.05	1.3	1.2	U		0.049	1.2	0.25	U		0.01	0.25
HMX	0.25	U		0.012	0.25	1.3	U		0.061	1.3	1.2	U		0.059	1.2	0.25	U		0.012	0.25
Nitroglycerin	0.5	U		0.015	0.5	2.5	U		0.075	2.5	2.4	U		0.073	2.4	0.5	U		0.015	0.5
Metals (mg/kg)																				
Aluminum	29900			6.5	23.1	11000			10.1	36	13000			9.5	33.9	7590			11.8	42.2
Antimony	0.69	U		0.23	0.69	0.81	J		0.36	1.1	0.92	J		0.34	1	1.3	U		0.42	1.3
Arsenic	3			0.17	0.58	3.4			0.27	0.9	3.7			0.25	0.85	14			0.32	1.1
Barium	62.5			0.12	0.35	78.7			0.18	0.54	57			0.17	0.51	76.8			0.21	0.63
Beryllium	0.68			0.012	0.12	0.74			0.018	0.18	0.64			0.017	0.17	0.48			0.021	0.21
Cadmium	0.3			0.058	0.17	0.57			0.09	0.27	0.59			0.085	0.25	0.56			0.11	0.32
Calcium	165			28.9	116	78300			45.1	180	95300			42.4	169	14400			52.8	211
Chromium	21.5			0.23	0.69	**68.3**			0.36	1.1	**75.7**			0.34	1	19.4			0.42	1.3
Cobalt	21			0.12	0.35	5.4			0.18	0.54	4.7			0.17	0.51	6.6			0.21	0.63
Copper	14	B		0.17	0.58	**83.5**	**B**		0.27	0.9	**100**	**B**		0.25	0.85	18			0.32	1.1
Iron	38900			3.6	11.6	14300			5.6	18	19300			5.3	16.9	18500			6.5	21.1
Lead	18.2	B		0.069	0.23	**257**	**B**		0.11	0.36	**305**	**B**		0.1	0.34	**51.3**	**B**		0.13	0.42
Magnesium	1360			8.7	57.8	3980			13.5	90.1	3860			12.7	84.7	2220			15.8	106
Manganese	944			0.29	0.92	237			0.45	1.4	202			0.42	1.4	510			0.53	1.7
Mercury	**0.16**			0.009	0.046	**0.21**			0.015	0.072	**0.24**			0.015	0.068	**0.43**			0.018	0.084
Nickel	15.4			0.12	0.35	55.4			0.18	0.54	59.6			0.17	0.51	13.2			0.21	0.63
Potassium	1290			28.9	116	675			45.1	180	1120			42.4	169	431			52.8	211
Selenium	0.49			0.12	0.35	0.74			0.18	0.54	0.73			0.17	0.51	1.2			0.21	0.63
Silver	0.093	J		0.035	0.12	0.27			0.054	0.18	0.19			0.051	0.17	0.073	J		0.063	0.21
Sodium	109	J		28.9	578	99.6	J		45.1	901	85.9	J		42.4	847	332	J		52.8	1060
Thallium	0.26			0.058	0.17	0.27	U		0.09	0.27	0.25	U		0.085	0.25	0.55			0.11	0.32
Vanadium	74.4			0.69	2.3	19.2			1.1	3.6	15.9			1	3.4	33.9			1.3	4.2
Zinc	40.9			0.69	2.3	66.7			1.1	3.6	60.6			1	3.4	21.7			1.3	4.2

Analyte			Sample ID	48TP16					48TP17					48TP18					48TP20					48TP21					48TP22				
			Sample Date	3/18/10					3/18/10					3/18/10					3/18/10					3/18/10					3/18/10				
			Sample Depth	1-2					4-5					6-7					1-2					3-4					5-6				
	i-SL	r-SL	Background	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
Explosives (mg/kg)																																	
1,3,5-Trinitrobenzene	2700	220	na	0.25	U		0.01	0.25	0.25	U		0.009	0.25	0.25	U		0.009	0.25	0.25	U		0.009	0.25	0.25	U		0.009	0.25	0.25	U		0.009	0.25
1,3-Dinitrobenzene	6.2	0.61	na	0.25	U		0.004	0.25	0.25	U		0.004	0.25	0.25	U		0.004	0.25	0.25	U		0.004	0.25	0.25	U		0.004	0.25	0.25	U		0.004	0.25
2,4,6-Trinitrotoluene	7.9	1.9	na	0.25	U		0.019	0.25	0.25	U		0.019	0.25	0.25	U		0.019	0.25	0.25	U		0.019	0.25	0.25	U		0.019	0.25	0.25	U		0.019	0.25
2,4-Dinitrotoluene	120	12	na	0.25	U		0.005	0.25	0.078	J		0.005	0.25	0.15	J		0.005	0.25	0.25	U		0.005	0.25	0.25	U		0.005	0.25	0.25	U		0.005	0.25
2,6-Dinitrotoluene	62	6.1	na	0.25	U		0.007	0.25	0.04	J		0.007	0.25	0.16	J PG		0.007	0.25	0.25	U		0.007	0.25	0.25	U		0.007	0.25	0.25	U		0.007	0.25
2-amino-4,6-Dinitrotoluene	200	15	na	0.25	U		0.012	0.25	0.25	U		0.012	0.25	0.25	U		0.012	0.25	0.25	U		0.012	0.25	0.25	U		0.012	0.25	0.25	U		0.012	0.25
4-amino-2,6-Dinitrotoluene	190	15	na	0.25	U		0.01	0.25	0.25	U		0.009	0.25	0.25	U		0.009	0.25	0.25	U		0.009	0.25	0.25	U		0.009	0.25	0.25	U		0.009	0.25
HMX	4900	380	na	0.25	U		0.012	0.25	0.25	U		0.012	0.25	0.25	U		0.012	0.25	0.25	U		0.012	0.25	0.25	U		0.012	0.25	0.25	U		0.012	0.25
Nitroglycerin	6.2	0.61	na	0.5	U		0.015	0.5	0.5	U		0.015	0.5	0.5	U		0.015	0.5	0.5	U		0.015	0.5	0.5	U		0.015	0.5	0.5	U		0.015	0.5
Metals (mg/kg)																																	
Aluminum	99000	7700	40041	16000			6.6	23.5	13300			6.6	23.6	26600			7	25	27500			6.9	24.8	36500			7.4	26.4	28000			7.1	25.3
Antimony	41	3.1	na	0.71	U		0.24	0.71	0.71	U		0.24	0.71	0.75	U		0.25	0.75	0.74	U		0.25	0.74	0.79	U		0.26	0.79	0.76	U		0.25	0.76
Arsenic	1.6	0.39	15.8	2.8			0.18	0.59	2.8			0.18	0.59	1.8			0.19	0.62	4.1			0.19	0.62	4.1			0.2	0.66	2.3			0.19	0.63
Barium	19000	1500	209	70.2			0.12	0.35	110			0.12	0.35	47.1			0.12	0.37	63.9			0.12	0.37	53.8			0.13	0.4	46.2			0.13	0.38
Beryllium	200	16	1.02	0.51			0.012	0.12	0.61			0.012	0.12	0.54			0.012	0.12	0.41			0.012	0.12	0.5			0.013	0.13	0.55			0.013	0.13
Cadmium	81	7	0.69	0.18			0.059	0.18	0.16	J		0.059	0.18	0.21			0.062	0.19	0.3			0.062	0.19	0.26			0.066	0.2	0.24			0.063	0.19
Calcium	na	na	na	502			29.4	118	590			29.5	118	1480			31.2	125	361			31	124	307			33	132	124	J		31.6	126
Chromium	150000	12000	65.3	23.7			0.24	0.71	18.9			0.24	0.71	17.9			0.25	0.75	28.6			0.25	0.74	35			0.26	0.79	20.4			0.25	0.76
Cobalt	30	2.3	72.3	5.7			0.12	0.35	6.4			0.12	0.35	4.4			0.12	0.37	18.9			0.12	0.37	4.5			0.13	0.4	9.6			0.13	0.38
Copper	4100	310	53.5	7.6			0.18	0.59	8.8			0.18	0.59	12.9			0.19	0.62	11.4			0.19	0.62	13.8	B		0.2	0.66	15.3	B		0.19	0.63
Iron	72000	5500	50962	18400			3.6	11.8	14800			3.7	11.8	32000			3.9	12.5	32800			3.8	12.4	44700			4.1	13.2	35300			3.9	12.6
Lead	800	400	26.8	16.7	B		0.071	0.24	22.8	B		0.071	0.24	14.1	B		0.075	0.25	**34.5**	**B**		0.074	0.25	14.7	B		0.079	0.26	20	B		0.076	0.25
Magnesium	na	na	na	636			8.8	58.9	560			8.8	59	1210			9.4	62.5	909			9.3	62	928			9.9	66.1	1190			9.5	63.2
Manganese	2300	180	2543	504			0.29	0.94	1250	RLA		2.9	9.4	167			0.31	1	689			0.31	0.99	124			0.33	1.1	280			0.32	1
Mercury	3.4	0.56	0.13	0.086			0.01	0.047	0.071			0.01	0.047	0.052			0.011	0.05	**0.36**			0.011	0.05	**0.24**			0.011	0.053	0.096			0.011	0.051
Nickel	2000	160	62.8	9.9			0.12	0.35	8.4			0.12	0.35	11.6			0.12	0.37	10.3			0.12	0.37	13.3			0.13	0.4	12.6			0.13	0.38
Potassium	na	na	na	834			29.4	118	751			29.5	118	1440			31.2	125	766			31	124	1070			33	132	1300			31.6	126
Selenium	510	39	na	0.66			0.12	0.35	0.89			0.12	0.35	0.47			0.12	0.37	0.7			0.12	0.37	0.79			0.13	0.4	0.52			0.13	0.38
Silver	510	39	na	0.043	J		0.035	0.12	0.037	J		0.035	0.12	0.068	J		0.037	0.12	0.09	J		0.037	0.12	0.07	J		0.04	0.13	0.063	J		0.038	0.13
Sodium	na	na	na	589	U		29.4	589	590	U		29.5	590	625	U		31.2	625	620	U		31	620	37.5	J		33	661	632	U		31.6	632
Thallium	na	na	2.11	0.15	J		0.059	0.18	0.13	J		0.059	0.18	0.14	J		0.062	0.19	0.57			0.062	0.19	0.3			0.066	0.2	0.2			0.063	0.19
Vanadium	7.2	0.55	108	47.8			0.71	2.4	28.8			0.71	2.4	62			0.75	2.5	65.9			0.74	2.5	85.9			0.79	2.6	67			0.76	2.5
Zinc	31000	2300	202	33.1			0.71	2.4	26.8			0.71	2.4	33			0.75	2.5	38.8			0.74	2.5	41.4			0.79	2.6	35.8			0.76	2.5

**Refer to legend immediately following this table for a list of definitions and table notes.

Table 1-5
Legend

12	J	Shading and black font indicate an industrial SL exceedance.
12	J	Bold outline indicates a residential SL exceedance.
<u>12</u>	**<u>J</u>**	Bold, underlined font indicates a background exceedance.
12	*12*	Shading in the MDL/MRL columns indicates the MDL exceeds a criterion.

SLs for non-Carcinogenic compounds have been recalculated to an HI of 0.1.
The pyrene SLs were used for acenaphthylene, benzo(g,h,i)perylene, and phenanthrene.
Inorganic results below background UTLs are not indicated as exceedances on the table.
SL = Screening Level (Source: ORNL Regional Screening Table, April 2009).
BTAG sediment source: USEPA Region III BTAG Sediment Screening Benchmarks. December 2005.
BTAG soil source: USEPA Region III BTAG Soil Screening Values. 1995.
Lead screening values from Technical Review Workgroup for Lead: Guidance Document (USEPA, 1999b).
mg/kg = milligrams per kilogram (parts per million).
ng/kg = nanograms per kilogram (parts per trillion).
μg/kg = micrograms per kilogram (parts per billion).
NA = not applicable.
NT = analyte not tested.

Lab Q = Lab Data Qualifiers

* = Laboratory duplicate not within control limits.
B = (organics) Blank contamination. Value detected in sample and associated blank.
A (Dioxins) = B = (metals) Value <MRL and >MDL and is considered estimated.
E (metals) = Reported value is estimated because of the presence of interferences.
EMPC (Dioxins) = The ion-abundance ratio between the two characteristic PCDD/PCDF ions was outside accepted ranges. The detected PCDD/PCDF was reported as an estimated maximum possible concentration (EMPC).
J = (organics) Value <MRL and >MDL and is considered estimated.
U = Analyte not-detected at the method reporting limit.
X = (dioxins) Ion abundance ratio outside acceptable range. Value reported is EMPC.

Val Q = Validation Data Qualifiers

B = blank contamination. Value detected in sample and associated blank.
J = estimated concentration.
K = estimated concentration bias high.
L = estimated concentration bias low.
N = presumptive evidence for tentatively identified compounds using a library search.
U = analyte not detected.
UJ = estimated concentration non-detect.
UL = estimated concentration non-detect bias low.
R = the quality control associated with the analysis or analyte indicates severe uncertainty with the reported result. The analyte was analyzed for, but the presence or absence of the analyte has not been verified.
PG = the percent difference between the original and confirmation analysis is greater than 40%.

Table 1-6
Summary of Analytes Detected in Trenching Investigation Soil Samples at SWMU 48

Analyte	i-SL	r-SL	Background	# of i-SL Exceedances	# of r-SL Exceedances	# of Background Exceedances	# of Detections	# of Samples	Minimum Concentration	Maximum Concentration	Location of Maximum
Explosives (mg/kg)											
1,3,5-Trinitrobenzene	2700	220	na	0	0	na	3	20	0.13	0.62	48TP08
1,3-Dinitrobenzene	6.2	0.61	na	0	0	na	1	20	0.073	0.073	48TP15
2,4,6-Trinitrotoluene	7.9	1.9	na	0	0	na	4	20	0.056	1.6	48TP08
2,4-Dinitrotoluene	120	12	na	0	0	na	10	20	0.022	6.9	48TP14
2,6-Dinitrotoluene	62	6.1	na	0	0	na	12	20	0.013	2.8	48TP14D
2-amino-4,6-Dinitrotoluene	200	15	na	0	0	na	3	20	0.032	2.6	48TP08D
4-amino-2,6-Dinitrotoluene	190	15	na	0	0	na	6	20	0.01	0.45	48TP08D
HMX	4900	380	na	0	0	na	1	20	0.025	0.025	48TP04-RFI
Nitroglycerin	6.2	0.61	na	0	1	na	3	20	0.051	1.2	48TP04-RFI
Metals (mg/kg)											
Aluminum	99000	7700	40041	0	0	0	20	20	96.9	36500	48TP21
Antimony	41	3.1	na	0	1	na	8	20	0.36	3.2	48TP04-RFI
Arsenic	1.6	0.39	15.8	1	1	1	19	20	1.8	112	48TP08
Barium	19000	1500	209	0	0	0	20	20	0.96	199	48TP04-RFI
Beryllium	200	16	1.02	0	0	0	19	20	0.41	0.91	48TP05
Cadmium	81	7	0.69	0	1	7	20	20	0.16	9.2	48TP02-RFI
Calcium	na	na	na	na	na	na	20	20	124	221000	48TP03-RFI
Chromium	150000	12000	65.3	0	0	2	20	20	2.7	75.7	48TP14D
Cobalt	30	2.3	72.3	0	0	0	20	20	4.4	21	48TP13
Copper	4100	310	53.5	1	1	6	20	20	5.1	81800	48TP02-RFI
Iron	72000	5500	50962	0	0	0	20	20	118	46100	48TP11
Lead	800	400	26.8	1	3	11	20	20	14.1	114000	48TP02-RFI
Magnesium	na	na	na	na	na	na	20	20	382	17400	48TP03-RFI
Manganese	2300	180	2543	0	0	0	20	20	11.3	1250	48TP17
Mercury	3.4	0.56	0.13	3	6	14	20	20	0.024	25.5	48TP04-RFI
Nickel	2000	160	62.8	0	0	0	20	20	5.3	59.6	48TP14D
Potassium	na	na	na	na	na	na	20	20	73.3	2370	48TP03-RFI
Selenium	510	39	na	0	0	na	20	20	0.47	1.2	48TP07
Silver	510	39	na	0	0	na	20	20	0.037	30	48TP04-RFI
Sodium	na	na	na	na	na	na	14	20	37.5	779	48TP02-RFI
Thallium	na	na	2.11	na	na	0	14	20	0.11	1.3	48TP08
Vanadium	7.2	0.55	108	0	0	0	19	20	15.2	85.9	48TP21
Zinc	31000	2300	202	0	0	2	19	20	20.1	499	48TP04-RFI

Table 1-7
SWMU 48 TCLP Results

Analyte	TCLP RL	Sample ID		
		48TP06	**48TP10**	**48TP19**
TCLP SVOCs (ug/L)				
TCLP 2,4-Dinitrotoluene	130	< 0.05	< 0.05	< 0.05
TCLP Hexachlorobenzene	130	< 0.05	< 0.05	< 0.05
TCLP Hexachlorobutadiene	500	< 0.05	< 0.05	< 0.05
TCLP Hexachloroethane	3000	< 0.05	< 0.05	< 0.05
TCLP 2-Methylphenol	200000	< 0.05	< 0.05	< 0.05
TCLP Nitrobenzene	2000	< 0.05	< 0.05	< 0.05
TCLP Pentachlorophenol	100000	< 0.25	< 0.25	< 0.25
TCLP Pyridine	5000	< 0.1	< 0.1	< 0.1
TCLP 2,4,5-Trichlorophenol	400000	< 0.05	< 0.05	< 0.05
TCLP 2,4,6-Trichlorophenol	2000	< 0.05	< 0.05	< 0.05
TCLP 3-Methylphenol & 4-Methylphenol	200000	< 0.05	< 0.05	< 0.05
TCLP 1,4-Dichlorobenzene	7500000	< 0.05	< 0.05	< 0.05
TCLP Metals (mg/L)				
TCLP Arsenic	5	< 1.0	< 1.0	< 1.0
TCLP Lead	5	< 0.5	**0.018**	< 0.5
TCLP Barium	100	**0.35**	**0.70**	**1.1**
TCLP Mercury	0.2	**0.0020**	**0.0015**	**0.0020**
TCLP Selenium	1	< 0.20	< 0.20	< 0.20
TCLP Silver	5	< 0.10	< 0.10	< 0.10
TCLP Chromium	5	< 0.10	< 0.10	< 0.10
TCLP Cadmium	1	< 0.050	< 0.050	< 0.050
Misc				
pH (pH units)	2-12.5	**12.4**	**10.3**	**8.7**
Cyanide, Total (mg/kg)	na	**0.70**	**0.69**	**0.63**

Notes: Detections are shown in bold.
Highlighted cells indicate a value greater than the TCLP RL.
ug/L - micrograms per liter
mg/kg - milligrams per kilogram
mg/L - milligrams per liter
RL - Regulatory Limit
TCLP - Toxicity Characteristic Leaching Procedure

1.5 Development of Corrective Measures Objectives

The site-specific corrective measures objective (CMO) for SWMU 48 is to mitigate the potential threats to human health and the environment that exist from the ash layer and/or grossly-contaminated soil under the ash layer, as well as mitigate the threat for a potential future release of contaminants from the sludge material to groundwater.

Preliminary remedial goals (PRGs) were obtained from USEPA Office of Solid Waste and Emergency Response (OSWER) Directives, where available. For analytes for which published cleanup levels were not identified, PRGs were calculated such that risks to human health are within the USEPA's acceptable range. The published or calculated values were then compared with the background values [95% upper tolerance limit (UTL)] and the maximum of the two values was selected as the remedial goal for the analyte. The future land use for the SWMU 48 study area is industrial and the chosen remedial goals for the site are also industrial, unless background levels were higher. However, for comparison purposes in this Work Plan, RGs for both residential and industrial exposure scenarios were developed.

USEPA has published recommended residential and industrial cleanup levels for lead (USEPA, 2011) in soils. These documents are summarized as follows:

- Lead:
    - Industrial: 800 mg/kg
    - Residential: 400 mg/kg

The background 95% UTL for lead at RFAAP is 26.8 mg/kg (IT, 2001). Therefore, the industrial RG (i-RG) for lead is 800 mg/kg and the residential RG (r-RG) for lead is 400 mg/kg.

USEPA does not have recommended cleanup goals for antimony, but has established regional SLs (USEPA, 2011):

- Antimony:
    - Industrial: 410 mg/kg
    - Residential: 31 mg/kg

The background data set did not have positive detections of antimony to calculate a background level (IT, 2001). Therefore, the industrial RG is 410 mg/kg and the residential RG is 31 mg/kg.

The USEPA does not have recommended cleanup goals for arsenic, but has established regional SLs for arsenic (USEPA, 2011):

- Arsenic:
    - Industrial: 1.6 mg/kg
    - Residential: 0.39 mg/kg

The background 95% UTL for arsenic at RFAAP is 15.8 mg/kg (IT, 2001). Because the background concentration is higher than the SLs, both the industrial and residential RGs for arsenic are 15.8 mg/kg.

The USEPA does not have recommended cleanup goals for cadmium, but has established regional SLs for cadmium (USEPA, 2011):

- Cadmium:
  - o Industrial: 800 mg/kg
  - o Residential: 70 mg/kg

The background 95% UTL for cadmium at RFAAP is 0.69 mg/kg (IT, 2001). Therefore, the industrial RG is 800 mg/kg and the residential RG is 70 mg/kg.

The USEPA does not have a recommended cleanup goal for copper, but has established regional SLs for copper (USEPA, 2011):

- Copper:
  - o Industrial: 41000 mg/kg
  - o Residential: 3100 mg/kg

The background 95% UTL for copper at RFAAP is 53.5 mg/kg (IT, 2001). Therefore, the industrial RG is 41000 mg/kg and the residential RG is 3100 mg/kg.

The USEPA does not have a recommended cleanup goal for mercury, but has established regional SL's for mercury (USEPA, 2011):

- Mercury
  - o Industrial: 43mg/kg
  - o Residential: 10 mg/kg

The background 95% UTL for mercury at RFAAP is 0.13 (IT, 2001). Therefore, the industrial RG for 43 mg/kg and the residential RG is 10 mg/kg.

Table 1-8 summarizes the selected RGs for the contaminants of interest (COIs) in soil at SWMU 48.

Table 1-8
Remedial Goals - Soil

Chemical	r-RG	Selected i-RG
Antimony	**31**	**410**
Arsenic	**15.8***	**15.8***
Cadmium	**70**	**800**
Copper	**3100**	**41000**
Lead	**400**	**800**
Mercury	**10**	**43**

RGs based on published EPA values (2011).

* Arsenic background level is higher than calculated RG.

All values are presented in milligrams per kilogram (mg/kg).

Values in grey are the chosen remedial goals for the site.

X-ray fluorescence (XRF) soil metals screening will be performed in conjunction with confirmation samples. XRF and confirmation samples will be collected from the side walls and bottom of the excavation after visual signs of ash layer have been removed, and concentrations will be compared to the industrial RGs to confirm that the sludge and grossly contaminated soil have been removed. Excavation will continue until confirmation sample concentrations are below the industrial RGs.

1.6 Removal Action Scope

As agreed upon by RFAAP, USEPA and Virginia Department of Environment Quality (VDEQ) during a July 2010 meeting, IMs are to be performed at SWMU 48. The IMs will be conducted to mitigate the threat of a contaminant release, migration, and/or exposure to the public and the environment, as well as facilitate clean closeout in accordance with Part II(D)(11-21) IM of the *RFAAP Corrective Action Permit* (USEPA, 2000a). The IM include:

1. **Site Preparation**.
2. **Location of 2010 Test Pits and Excavation**. Relocate the test pits used to define the extent of the excavation using GPS. Excavate the delineated area such that the remaining soil is below the selected industrial RGs.
3. **Waste Characterization & Off-Site Disposal**.
4. **Confirmation Sampling**. Samples will be collected after removal of the ash layer and grossly contaminated soil to ensure that impacted soil has been removed. Excavation will continue if the industrial RGs have not been met.
5. **Site Restoration**.

Specific details on the contractor organization and technical approach for the IM listed above are provided in the Organization and Technical Approach Plan, *Section 2.0*.

1.7 Work Plan Content

This IMWP is composed of an Introduction (*Section 1.0*), eight sub-plans (*Sections 2.0 through 9.0*), and references (*Section 10.0*). The eight sub-plans are as follows:

<u>Section 2.0 – Organization and Technical Approach Plan</u>

Identifies the Shaw project staff and subcontractors, their roles and responsibilities, and identifies the technical approach to be followed for the IM.

<u>Section 3.0 – Field Sampling Plan</u>

Describes the sampling rationale and field sampling procedures that will be used to collect field samples.

<u>Section 4.0 – Quality Assurance Project Plan</u>

Identifies the sample management methods, analytical methods, and quality control (QC) requirements necessary to achieve data quality objectives (DQOs) associated with chemical sampling.

<u>Section 5.0 – Environmental Protection Plan</u>

Identifies environmental considerations and adequate safeguards to protect the environment during implementation of IM.

Section 6.0 – Erosion and Sediment Control Plan

Defines the steps that will be taken to minimize and/or eliminate erosion and sedimentation during removal action work.

Section 7.0 – Waste Transportation and Disposal Plan

Identifies safe handling, transportation, and disposal procedures for waste material resulting from IM.

Section 8.0 – Site Safety and Health Plan

Provides site-specific safety and health controls to prevent and/or minimize personal injuries, illnesses, and physical damage to equipment and property.

Section 9.0 – Contractor Quality Control Plan

Defines the contractor QC organization and program for the IM.

1.8 Work Plan Changes

Work outside the scope of this Work Plan is not to be performed without the approval of the USACE, Baltimore District. Amendments or supplements to this Work Plan will be submitted in writing to the USACE for approval prior to being implemented by project personnel.

2.0 ORGANIZATION AND TECHNICAL APPROACH PLAN

This section describes the organization and activities to be conducted to accomplish the IM at SWMU 48. Specifically, this section outlines the organization and responsibilities for project personnel as well as presents the step-by-step approach to be performed for each of the IM tasks.

2.1 Organization and Responsibilities

The organizational structure established for this project is depicted on **Figure 2-1** and includes the Shaw management and field staff, and subcontractors. The lines of authority and the lines of communication for the project can be determined from this organizational structure. Communication of project objectives will be provided to project staff through meetings.

Statements of qualifications and resumes of key Shaw staff are given in **Appendix A**. Names, addresses, and phone numbers of key Shaw individuals are presented in **Table 2-1**. The duties and responsibilities of the key members of this organization are described below.

Program Manager, Mr. Bob Culbertson, has complete management authority and responsibility for all work performed under the Louisville Multiple Award Remediation Contract (LMARC) contract. The Program Manager directs the program management organization as a central resource for management, continuity, and control of all LMARC program activities. The centralized program management is organized to facilitate communication with and reporting to the USACE and to expedite and support project execution. The Program Manager has total authority, responsibility, and accountability for managing the contract. He will be involved in the decision-making process and oversight of the management of the project.

RFAAP Project Manager, Mr. Jeffrey Parks, reports to the LMARC Program Manager. He is responsible for ensuring that all activities are conducted in accordance with contractual specifications and technical requirements. The Project Manager will also coordinate with the USACE Project Officer. The Project Manager will monitor the budget and schedule to ensure availability of necessary personnel, equipment, subcontractors, and services.

IM Task Manager, Mr. Jeffrey Hillebrand, reports to the RFAAP Project Manager. He is responsible for ensuring that all activities are conducted in accordance with the IMWP. The IM Task Manager is responsible for management of all operations conducted for this project. He will ensure that all personnel assigned to this project, including subcontractors, have reviewed the technical plans before any task associated with the project is initiated. He will participate in the development of the field program, evaluation of data, and reporting.

Project Engineer, Ms. Laura O'Donnell, is responsible for development and/or approval of field procedures and evaluation of applicable or relevant and appropriate requirements for the ARSAR remedial activities.

Health and Safety (H&S) Manager, Mr. Doug Russell, East Region H&S Manager, will oversee the development and implementation of the SSHP to ensure that it meets all specific needs of the project and that appropriate H&S requirements are defined.

QC Manager, Mr. Kenneth Martinez, is responsible for ensuring that quality planning is accomplished, QC procedures are available, and a qualified Contractor Quality Control (CQC) System Manager is assigned to the project. The LMARC QC Manager will review and ensure

Figure 2-1
RFAAP SWMU 48 Interim Measures Organizational Chart

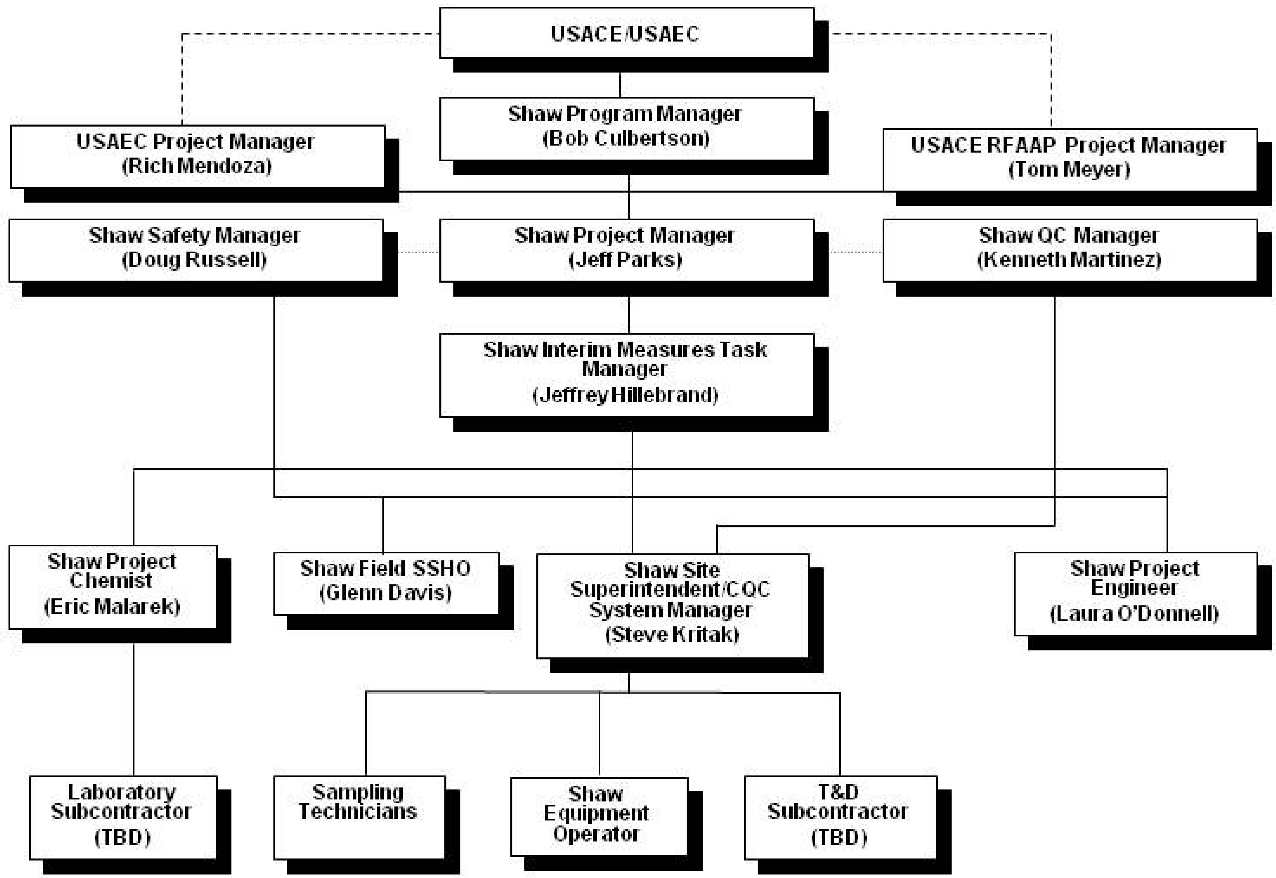


Table 2-1. Shaw Environmental, Inc. and Subcontractor Key Points of Contact

Shaw Environmental, Inc./Subcontractor Personnel	Contact Information
Bob Culbertson Shaw Environmental, Inc. LMARC Program Manager	312 Directors Drive Knoxville, TN 37923 Phone No.: (865) 694-7402 Fax No.: (865) 690-3626 E-Mail: bob.culbertson@shawgrp.com
Jeffrey Parks Shaw Environmental, Inc. Project Manager	2113 Emmorton Park Road Edgewood, MD 21040 Phone No.: (410) 612-6326 Cellular No.: (410) 266-5573 Fax No.: (410) 612-6351 E-Mail: jeffrey.parks@shawgrp.com
Jeffrey Hillebrand Shaw Environmental, Inc. IM Task Manager	2113 Emmorton Park Road Edgewood, MD 21040 Phone No.: (410) 612-6354 Cellular No.: (443) 504-3501 Fax No.: (410) 612-6351 E-Mail: jeffrey.hillebrand@shawgrp.com
Laura O'Donnell Shaw Environmental, Inc. Project Engineer	2113 Emmorton Park Road Edgewood, MD 21040 Phone No.: (410) 612-6313 Fax No.: (410) 612-6351 E-Mail: laura.odonnell@shawgrp.com
Doug Russell, OHST Shaw Environmental, Inc. East Region H&S Manager	312 Directors Drive Knoxville, TN 37923 Phone No.: (865) 692-3584 Cellular No.: (865) 414-9545 Fax No.: (865) 690-3626 E-Mail: winston.russell@shawgrp.com
Kenneth Martinez Shaw Environmental, Inc. LMARC QC Manager	312 Directors Drive Knoxville, TN 37923 Phone No.:(865) 670-4799 Fax No.: (865) 694-7497 E-Mail: kenneth.martinez@shawgrp.com
Steve Kritak Shaw Environmental, Inc. Site Superintendent/CQC System Manager	101 Fieldcrest Avenue Edison, NJ 08837 Phone No.: (609) 584-8900 Cellular No.: (540) 922-3316 E-Mail: steve.kritak@shawgrp.com
Glenn Davis Shaw Environmental, Inc. SSHO	1725 Duke Street Alexandria, VA 22314 Phone No.: (804) 247-2108 (cell)
Eric Malarek Shaw Environmental, Inc. Project Chemist	2113 Emmorton Park Road Edgewood, MD 21040 Phone No.: (410) 612-6322 Fax No.: (410) 612-6351 E-Mail: eric.malarek@shawgrp.com
Analytical Laboratory Subcontractor TBD	
Waste Transportation and Disposal Subcontractor TBD	

that the CQCP (*Section 9.0*) addresses all project-specific QC needs and that all appropriate QC requirements are addressed.

The LMARC will also assess the effective implementation of the CQCP through scheduled audits or assessments.

Site Superintendent/CQC System Manager, Mr. Steve Kritak, will be responsible for dual roles during the removal action work: Site Superintendent and CQC System Manager. As Site Superintendent, he will provide on-site management of field activities during removal actions. The Site Superintendent is responsible for coordinating field team activities and meeting schedule deadlines. The Site Superintendent will ensure that the work is being conducted in accordance with the IMWP. The Site Superintendent will coordinate the initial orientation and safety meeting as well as the daily safety meeting prior to the start of work each day. As the CQC System Manager, he will be responsible for daily QC oversight of field operations and all aspects of environmental samples. He will be responsible for ensuring that the requirements specified in the CQCP are followed during field activities and will maintain all QC documentation. Additional details on the responsibilities of the CQC System Manager are provided in the CQCP (*Section 9.0*).

Site Safety and Health Officer (SSHO), Mr. Glenn Davis, will be responsible for implementing and oversight of the on-site H&S program and maintaining H&S documentation. He will ensure that an adequate level of personal protection is worn by field personnel for anticipated potential hazards and will work in coordination with the IM Task Manager to ensure compliance of project activities with H&S requirements as outlined in the SSHP. Additional details on the responsibilities of the SSHO are provided in the SSHP (*Section 8.0*).

Project Chemist, Mr. Eric Malarek, will be responsible for sample tracking, data management, laboratory coordination, and data validation activities. The Project Chemist will work with field sampling technicians and the contract laboratory to ensure that the work performed is in accordance with the QAPP (*Section 4.0*).

Equipment Operator. An equipment operator will be utilized to perform the IM work in the field. The equipment operator will be experienced and qualified in operating equipment essential to the project. The equipment operator will be a properly trained Occupational Safety and Health Administration (OSHA) qualified worker.

Field Sampling Technicians. Field sampling technicians will be responsible for collecting all samples associated with the removal action work. These technicians will be under the direction of the Site Superintendent. The technicians will coordinate sampling activities with the Project Chemist who in turn coordinates with the contract laboratory.

Subcontractors. Shaw will procure the following subcontractors: waste transportation and disposal and laboratory support.

2.2 Technical Approach

The following sections describe the background and technical approach to the SWMU 48 IM. The field activities to be performed include: site preparation; location of previously sampled test pits; excavation of grossly-contaminated soil and ash material based on visual observations, XRF soil screening, and confirmation sampling; waste characterization and off-site disposal; and site restoration. Detailed safety and health requirements for this scope of work are presented in *Section 8.0*.

2.2.1 Background

RFI activities were conducted at SWMU 48 from 1992 to 2010 (Shaw, 2009). The results from these investigations indicated that the ash layer contains elevated concentrations of explosives and metals exceeding i-SLs. Initially, explosives were the primary driver for corrective action, however; recent investigations to re-characterize the trenches and ash layer were unable to reproduce elevated TNT results detected in 1998 sampling. Explosives within the soil at SWMU 48 have shown a trend of decreasing concentrations from the initial 1998 sampling to the most recent 2010 investigation. Additionally, concentrations of explosives below the ash layer indicate the chemicals are not mobile. Arsenic, antimony, cadmium, copper, lead, and mercury were detected in SWMU 48 at levels exceeding i-RLs in SWMU 48 soil. Analysis of the results from soil samples collected at SWMU 48 indicated that the soil is mainly silt and clay. This means that the soil is composed of mostly low permeability materials that tend to act as barriers to movement of groundwater and contaminants. Also, the clay is highly adsorptive which will also tend to restrict the movement of contaminants. All of the physical soil properties at SWMU 48, as well as the chemical properties and the constituents would both tend to favor partition of constituents to the soil (through precipitation and adsorption), rather than to the groundwater. Constituents bound in soil are more immobile and do not tend to be transported in the environment. Groundwater data from previous sampling events confirm SWMU 48 currently has no impact on local groundwater contamination.

Six COIs (arsenic, antimony, cadmium, copper, lead, and mercury) were identified under both an industrial and residential future-use scenario for total soil at SWMU 48. The RFI determined that unacceptable risks to potential future residential and industrial receptors were associated with the COIs. Based on the results from the RFI, it is concluded that the COIs are limited to the ash layer and grossly-contaminated soil beneath the sludge material. Because the RFI demonstrated that COI contamination is present at concentrations associated with unacceptable human health concerns, corrective measures were suggested to address the ashy material and grossly-contaminated soil under the ashy material at SWMU 48. The alternatives evaluated were as follows:

- Alternative One: No Further Action.
- Alternative Two: Institutional Controls (Land Use Controls, Groundwater Monitoring).
- Alternative Three: Excavation of Ash and Grossly-Contaminated Soil and Off-Site Disposal.

These three alternatives were evaluated using the selection criteria: effectiveness, implementability, and cost. The site-specific CMO for SWMU 48 is to eliminate the potential threats to human health and the environment that exist from the ash material and/or grossly-contaminated soil under the ash material, as well as eliminate the threat for a potential future release of contaminants from the ash material to groundwater. Observations from the SWMU 48 soil investigations indicate that the trench ash material consisted of a black, paste-like sludge material that was very evident when encountered. It is a very sticky substance that exhibits a sweet odor. Therefore, identification and removal of the ash material and green waste will be based on visual observations during excavation. Alternative Three, which entails excavation and off-site disposal as the primary remediation process, was found to achieve the CMO. Therefore, Alternative Three was selected as the final alternative for SWMU 48 because it is implementable and provides a greater level of protection to human health and the environment not provided by other alternatives.

2.2.2 Site Preparation

Prior to performing any intrusive activities at SWMU 48, a utility survey to identify underground service lines within or near the excavation site will be performed and dig permits will be obtained from Alliant TechSystems, Inc. (ATK). A hazard analysis has been completed as detailed in *Section 8.0*, and all potential hazards identified will be reviewed prior to commencement of work activities. Erosion and sediment controls will be utilized according to the procedures outlined in *Section 6.0*, as needed. In order to supply water for site activities (decontamination/dust control), a portable tank or drum will be utilized and filled at the Surveillance Office.

2.2.3 Location of 2010 Test Pits and Excavation

Prior to mobilization of excavation personnel, the test pit boundaries excavated in the Shaw 2010 RFI to delineate the vertical and horizontal extents of the ash layer and grossly-contaminated soil underlying SWMU 48 will be reestablished through GPS coordinates and visual observation of subsidence. These test pits delineated a contaminated area of approximately 6,300 square feet (sq ft). Excavations in SWMU 48 will average 6 ft bgs. The locations of the test pits and test pit logs are illustrated in **Figure 1-1** and **Appendix I**, respectively.

Excavation will be performed using one 20 Ton excavator (trackhoe). Sludge material and contaminated soil will be excavated and directly loaded into dump trucks and transported off site. The excavation will be observed for the green material. The green material will be segregated and placed in containers for proper disposal. If this material is encountered again within the trench excavation, it will be segregated, removed, accumulated in containers and managed as hazardous waste. The sides of all excavations in which employees are exposed to danger from moving ground shall be guarded by a support system, sloping or benching of the ground, or other equivalent means. Sloping and benching, if required, will be in accordance with Engineering Manual (EM) 385-1-1 and Shaw procedure HS307, Excavation and Trenching. Excavations less than 5 ft in depth and which a "competent person" examines and determines there to be no potential for cave-in do not require protective systems. EM 385-1-1 defines a "competent person" as "one who can identify existing and predictable hazards in the working environment or working conditions that are dangerous to personnel and who has the authority to take prompt corrective measures to eliminate them." Shaw Health and Safety provides Excavation Competent Person Training, and Shaw will ensure that the Site Superintendent for the project has completed this training. Excavation work will comply with EM 385-1-1 and 29 Code of Federal Regulations (CFR) 1926 Subpart P – *Excavations*. Excavations greater than 4 ft may constitute a confined space. Personnel will not be allowed to enter the excavation if this situation arises. Confirmation sampling will be done from the bucket of the excavator if the excavation is greater than 4 ft.

Geotextile fabric will be used to construct a temporary loading zone for the trucks to stage on while being loaded. The geotextile fabric will extend from the truck to the edge of the excavation zone. The temporary loading zone will be moved as the leading edge of the excavation moves forward. Backfilling will commence after the excavation has been completed and all analytical results from the confirmation samples have demonstrated that sludge and grossly-contaminated soil above the industrial RGs has been removed from the site.

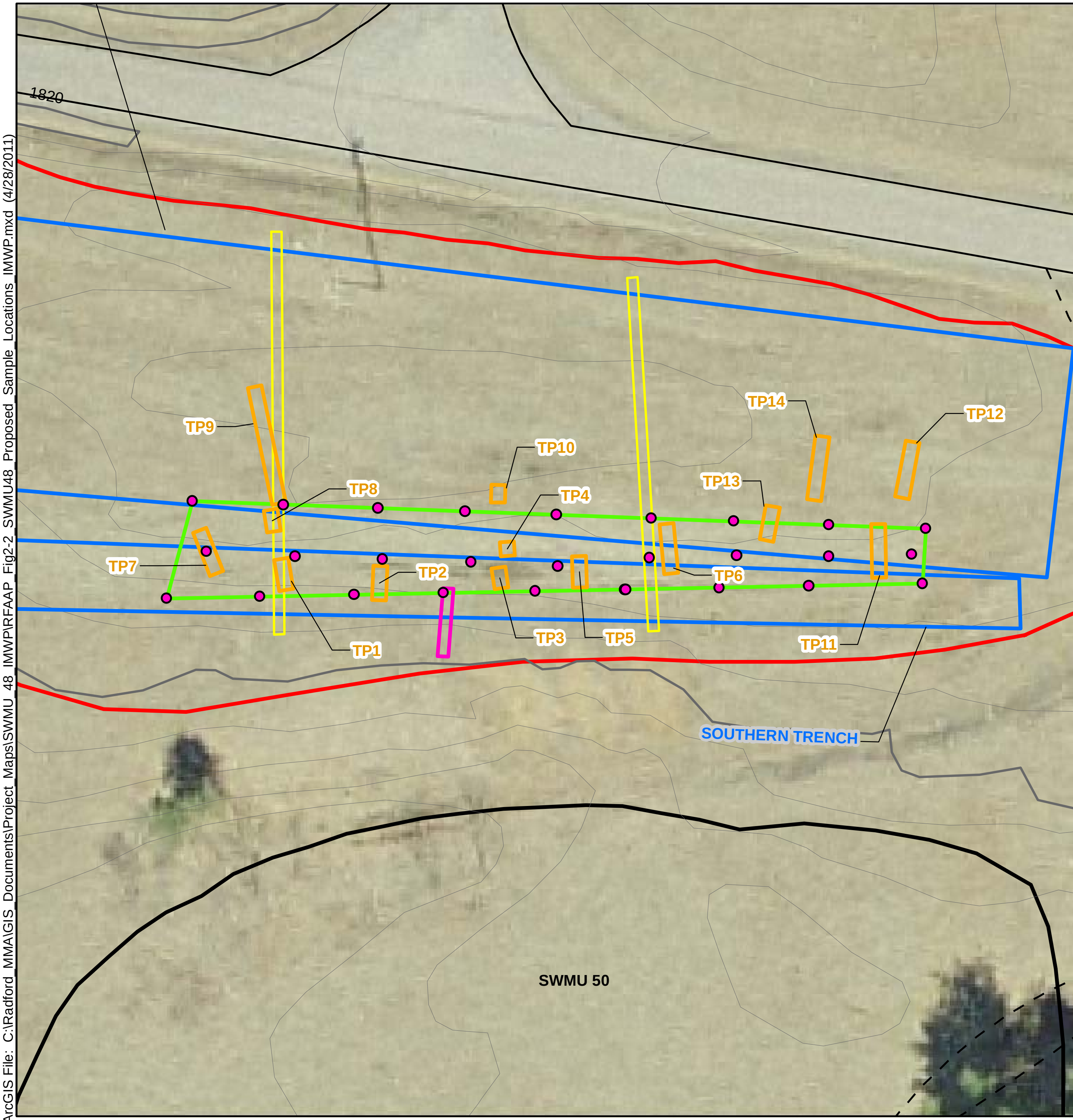
Following soil excavation, XRF confirmation samples will be collected from the excavation bottom and sidewalls to confirm that all contaminated soils have been removed to or below the industrial RG. XRF confirmation samples will be analyzed for arsenic, antimony, cadmium, copper, lead, and mercury. Discrete confirmation samples will be collected from the locations where the ash layer and grossly-contaminated soil were found during the 2010 test pit investigation. The sampling strategy to be employed is a biased sampling strategy [Standard Operating Procedure (SOP) 30.7] (**Appendix B**), since known sources have been previously identified. Excavation will continue until CMOs have been met.

It is estimated that 27 XRF samples (Plus QC) will be collected from the bottom and sides of the excavation at SWMU 48, at a frequency of 1 sample per 625 sq ft at the bottom and 1 sample per 25 linear feet along the sides. Ten percent of the SWMU 48 XRF samples will be sent to an off-site laboratory for TAL metal analysis and explosives analysis, with a minimum of two from the bottom of the excavated and one from the location of sample 48SB07. Locations for the XRF confirmation samples have not been specified because they will be dependent on the exact area that will be excavation. At a minimum, samples will be collected from the floor of the excavation at a rate of one sample per 25x25 ft area. Samples from the sidewall, corners, and inflection points will be collected at a rate of one per 25 linear feet of sidewall. Additional samples will be collected at corners and inflection points. **Figure 2-2** shows the preliminary locations of the confirmation samples. A revised confirmation sample location map will be provided to all stakeholders once the delineation samples have been completed.

All sampling and excavation equipment will be decontaminated according to the procedures outlined in the SSHP (*Section 8.0*). A decontamination pad will be set up on site for the excavator. The excavator will be decontaminated prior to use, after completion of the excavation phase, and after completion of the project. Decontamination procedures will follow those in SOP 80.1 for a drill rig. In addition, a small, temporary decontamination pad will be set up to decontaminate sampling equipment on site. Decontamination water will be pumped out of the pads and containerized in 55-gallon drums.

2.2.4 Waste Characterization and Off-Site Disposal

Past field sampling activities at SWMU 48 indicated that the soil does not contain greater than 10% explosives; therefore, it is not likely that the soil will be determined to be reactive or classified as a K044 waste. The hazardous waste determination would therefore be based on the TCLP metals results, explosives, and RCRA Waste Characteristics. If the TCLP results indicate that the soil is a toxic waste [i.e., TCLP result greater than the 40 CFR 261.30(b) standards] or exhibits any RCRA waste characteristics, it will be disposed per RCRA Subtitle C requirements. An estimated 3,333 cubic yards of soil will be excavated. One waste characterization sample will be collected for every 250 cubic yards, for a total of approximately 14 samples. These samples will be analyzed for TCLP metals and SVOCs and RCRA waste characteristics. Three samples have already been collected and analyzed, (**Table 1-7**). Previous results indicate that the composite excavation waste will be below the TCLP RLs, and will be classified as non-hazardous waste. An additional sample will be collected from the ash layer at test pit locations TP2, TP5, and TP13 to further characterize the toxicity of the ash layer. Previous samples collected within the green, clay like material located within TP6, indicate high levels of lead and copper, likely exceeding the TCLP RL (ppm concentration/20 = estimated TCLP). This material, if encountered, will be segregated and accumulated in containers and managed as hazardous waste. Additional samples will be collected, as required by the testing facility.



LEGEND

- Proposed Confirmation Surface Soil Sample Location
- Dirt Road
- Paved Road
- 2 ft Contour Line
- 10 ft Contour Line
- Test Pit
- 1998 RFI Trench Boundary
- Proposed Test Pit Boundary
- Southern Trench (GPS)
- Trench Boundary
- SWMU 48 Boundary
- Other SWMU Boundary

Notes:
1) Aerial photo, dated 2005, was obtained from Montgomery County, VA Planning & GIS Services.

Scale:
0 20 40 80 Feet

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 2-2
SWMU 48
Proposed Sample Locations

Radford Army Ammunition Plant,
Radford, VA

ArcGIS File: C:\Radford_MMA\GIS_Documents\Project_Maps\SWMU_48_IMWP\RFAAP_Fig2-2_SWMU48_Proposed_Sample_Locations_IMWP.mxd (4/28/2011)

Any decontamination water generated from field activities will be analyzed for chemical oxygen demand (COD), TAL metals, and pH.

As discussed in *Section 2.2.2.*, direct load-out of the soil will be performed. In addition to the ash/soil generated for this remedial effort, disposal of the investigation-derived material (IDM) and silt/construction fence will be required.

Each waste type generated during this effort shall require a different disposal method based on its waste characterization results. Excavated ash/soil that is classified as a hazardous waste will be disposed of, in a RCRA Subtitle C Landfill, after treatment to meet the land disposal restrictions. Any debris that is classified as a non-hazardous waste will be disposed in a RCRA Subtitle D Landfill. Decontamination fluid that is characterized as non-hazardous waste will be disposed in the RFAAP wastewater treatment plant.

Shaw will act as the agent for the Army for treatment and disposal of the wastes. Shaw and the Installation shall select the final disposal facility for the waste based on several factors:

1. Treatment, storage, and disposal facility (TSDF) capacity to accommodate incoming waste.
2. Solicitation of bids using applicable Federal Acquisition Regulations (FARs).
3. Verification of permits and insurance (at time of award).
4. The disposal facility must meet the permit compliance requirements.

The TSDF will be selected from a list of ATK and Army approved facilities. Contact information for disposal facilities selected for the SWMU 48 IM will be presented in the interim measures completion report, once the facilities have been identified.

2.2.5 Site Restoration

Following removal of the trench ash and grossly-contaminated soil and negative confirmation sample results, site restoration activities will commence. The clean materials from the top of the excavation will be placed back in the trench using a D20 excavator. Additional soil will be added such that the trench matches the surrounding grade. Approximately 6 inches of topsoil will then be applied and the area will be graded. Erosion control measures will be implemented and excavation areas will be seeded. Upon completion of site restoration operations, the contractor will remove the temporary facilities from the area.

Prior to adding the soil, all off-site fill will be sampled at a rate of 1 composite sample per 1,000 cubic yards. Four aliquots from separate areas will be composited into each sample. The samples will be analyzed for TAL metals, target compound list (TCL) volatile organic compounds (VOCs), TCL SVOCs, pesticides/polychlorinated biphenyls (PCBs), and explosives. Results will be compared to residential risk-based concentrations and RFAAP 95% UTL background levels to ensure that the fill is acceptable.

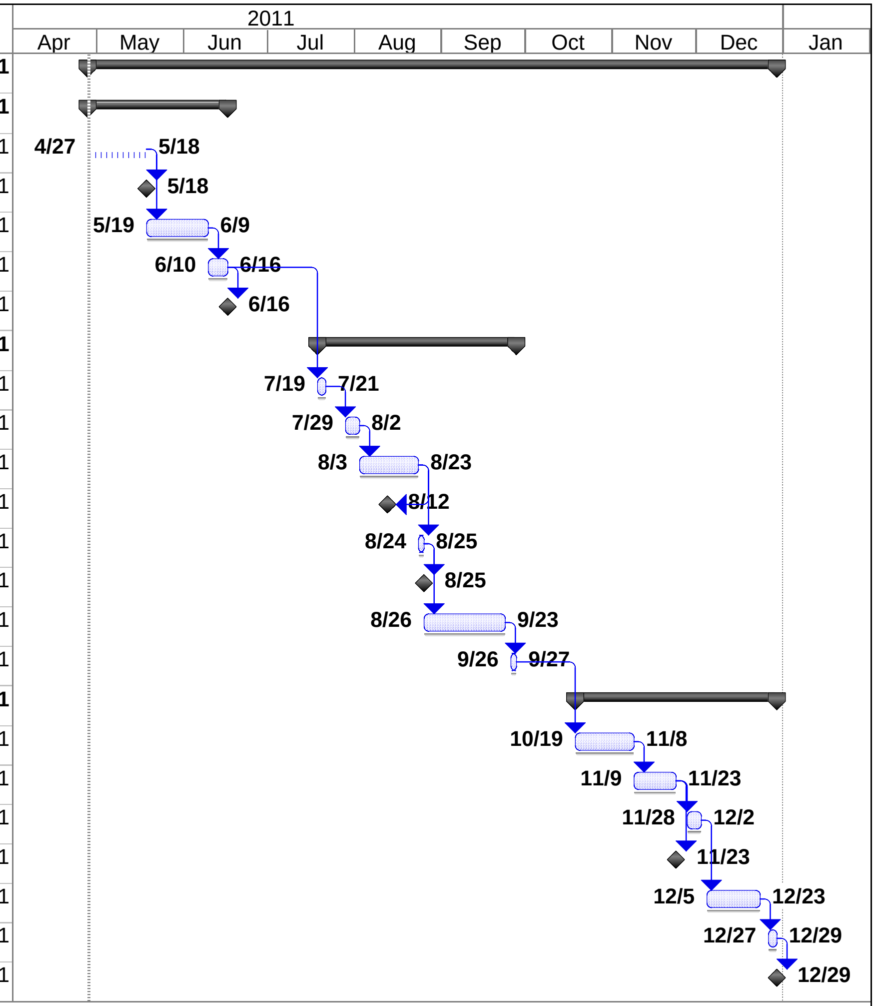
After the site restoration activities are completed, Shaw will demobilize all equipment off site.

2.2.6 Project Schedule

The field activities to be performed as part of the SWMU 48 IM are scheduled to commence in June 2011. The proposed schedule of project tasks is provided on **Figure 2-3**.

[Note: The project schedule will be updated in each subsequent edition of this Work Plan and will be updated and maintained throughout the project.]

ID	Task Name	Duration	Start	Finish
1	**Radford - SWMU 48 Interim Measures**	**168 days**	**Wed 4/27/11**	**Thu 12/29/11**
2	**Interim Measures Work Plan**	**35 days**	**Wed 4/27/11**	**Thu 6/16/11**
3	Draft - Work Plan	15 days	Wed 4/27/11	Wed 5/18/11
4	Draft WP Complete	0 days	Wed 5/18/11	Wed 5/18/11
5	Regulator Review	15 days	Thu 5/19/11	Thu 6/9/11
6	Final Interim Measures Work Plan	5 days	Fri 6/10/11	Thu 6/16/11
7	Final WP Complete	0 days	Thu 6/16/11	Thu 6/16/11
8	**Field Work**	**50 days**	**Tue 7/19/11**	**Tue 9/27/11**
9	Soil Contamination Delineation	3 days	Tue 7/19/11	Thu 7/21/11
10	Mobilization / Site Setup	3 days	Fri 7/29/11	Tue 8/2/11
11	Soil Excavation and Load-out	15 days	Wed 8/3/11	Tue 8/23/11
12	Excavation 50% Complete	0 days	Fri 8/12/11	Fri 8/12/11
13	Confirmation Sampling	2 days	Wed 8/24/11	Thu 8/25/11
14	Excavation 100% Complete	0 days	Thu 8/25/11	Thu 8/25/11
15	Site Restoration	20 days	Fri 8/26/11	Fri 9/23/11
16	Demobilization	2 days	Mon 9/26/11	Tue 9/27/11
17	**Interim Action Report**	**48 days**	**Wed 10/19/11**	**Thu 12/29/11**
18	Internal Draft - Interim Action Report	15 days	Wed 10/19/11	Tue 11/8/11
19	USACE/RFAAP Review	10 days	Wed 11/9/11	Wed 11/23/11
20	Draft Completion Report	5 days	Mon 11/28/11	Fri 12/2/11
21	Draft Completion Report Complete	0 days	Wed 11/23/11	Wed 11/23/11
22	Regulator Review	15 days	Mon 12/5/11	Fri 12/23/11
23	Final Completion Report	3 days	Tue 12/27/11	Thu 12/29/11
24	Final Completion Report Complete	0 days	Thu 12/29/11	Thu 12/29/11



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

Figure 2-3
Radford - SWMU 48 Interim Measure Schedule

3.0 FIELD SAMPLING PLAN

This FSP describes the field sampling activities that will be performed and defines the procedures and methods that will be used to collect field samples. Contents included in this FSP include: procedures for collection of soil delineation, confirmation, waste characterization samples; and requirements for sample chain-of-custody (COC), documentation, and shipping. This FSP also addresses IDM, contractor chemical QC, corrective action procedures, and the schedule for field activities. This FSP was developed in accordance with USACE EM 200-1-3, *Requirements for the Preparation of Sampling and Analysis Plans* (USACE, 2001), and is to be used in conjunction with the QAPP, *Section 4.0*.

3.1 Project Description

A detailed description of the project history and the planned removal action work has been presented in the Introduction, *Section 1.0*, and the Organization and Technical Approach Plan, *Section 2.0*, of this IMWP, respectively. As part of the planned removal action work, field sampling activities will be conducted. These field sampling activities are discussed below.

3.2 Project Organization and Responsibilities

A detailed discussion of project personnel organization and responsibilities was previously provided in *Section 2.0*. Coordination of sample collection activities will be the responsibility of the Site Superintendent, who is responsible for running site operations. Field sampling technicians will be responsible for collection and delivery of samples to the laboratory. After delivery, the Project Chemist will be responsible for ensuring proper analysis and timely delivery of sample results by the laboratory.

3.3 Scope and Objectives

Samples to be collected during the IM work include confirmation and waste characterization samples. QC samples [i.e., field duplicate samples, rinse blanks, matrix spike/matrix spike duplicate (MS/MSD), etc.] will also be collected as described in the QAPP, *Section 4.0*. The following sections describe the function of each type of field sample. Details on the methods used for collection of the samples are presented in **Appendix B**.

3.3.1 Soil Confirmation Samples

Confirmation samples will be used to determine whether or not all contaminated soil has been completely removed from the excavated area(s). XRF soil confirmation samples will be collected from the excavated area (as described in *Section 2.0*) and analyzed for arsenic, antimony, cadmium, copper, lead, and mercury. Ten percent of the XRF confirmation samples (with a minimum of two from the bottom of the excavation and one from the location of sample 48SB07) will be sent to an off-site laboratory, and analyzed for arsenic, antimony, cadmium, copper, lead, mercury, and explosives. Samples will be submitted to a USACE-approved laboratory for analysis. Analytical methods to be used for sample analysis and additional field QC samples are detailed in the QAPP (*Section 4.0*). Analytical results will be compared to the industrial RGs and will be used as the basis for either confirming the completion of the excavation or the requirement for additional soil removal.

3.4 Waste and Borrow Characterization Samples

Waste characterization samples from the 2010 Test Pit Investigation (**Table 1-7**) and additional samples to be taken before disposal will be used in conjunction with one composite sample collected within the ash layer to determine the appropriate disposal methods of waste streams resulting from the IM at SWMU 48. Two types of waste streams will be generated during the IM: solid (soil) and liquid (decontamination water). In addition, the provider will demonstrate that the borrow material is clean, and two samples will be collected and analyzed to confirm that the fill is usable for site fill.

Soil waste characterization samples will be collected during site delineation to assess the appropriate disposal options for the sludge and contaminated soil. The samples will be submitted to a USACE-approved laboratory and analyzed for TCLP metals, explosives, dioxins/furans, and RCRA waste characteristics (corrosivity as pH, reactivity, and ignitability). For reactivity, the analysis will also include explosives. Liquid waste characterization samples from decontamination procedures will be submitted to a USACE-approved laboratory and analyzed for COD, TAL metals, and pH. The borrow material will be analyzed for TAL metals, TCL VOCs, TCL SVOCs, polynuclear aromatic hydrocarbons (PAHs), pesticides/PCBs, and pH. Analytical methods to be used for sample analysis are detailed in the QAPP (*Section 4.0*).

3.5 Anticipated Sampling Program

The sampling program for SWMU 48 removal action is discussed in detail in *Section 2.2*. Samples anticipated for collection during this scope of work include: Soil Delineation; Confirmation; and Waste and Borrow Characterization. A list of all anticipated analytical samples, QC samples, and analyses associated with the SWMU 48 IM are provided in **Table 3-1**. Analytical methods to be used for sample analysis are detailed in the QAPP (*Section 4.0*). Additional samples and/or analyses may be required depending on site conditions and specific disposal facility requirements. If required, this plan will be modified to include any additional analyses.

Table 3-1
Anticipated Sampling Program for SWMU 48 Interim Measures

Site ID	Sample ID	Metals	Explosives	TCLP Metals, Explosives, Dioxin/ Furans, Corrosivity as pH, Reactivity, & Ignitability	TAL Metals, COD, & pH	TAL Metals, PAHs, Pesticides/ PCBs, TCL VOCs, TCL SVOCs, & pH	TAL Metals, TCL VOCs, TCL SVOCs, Pesticide/ PCBs, & Explosives
SWMU 48 IM – XRF Soil Confirmation Samples*							
48XF01	48XF01	X	---	---	---	---	---
48XF02	48XF02	X	---	---	---	---	---
48XF03	48XF03	X	---	---	---	---	---
48XF04	48XF04	X	---	---	---	---	---
48XF05	48XF05	X	---	---	---	---	---
48XF06	48XF06	X	---	---	---	---	---
48XF07	48XF07	X	---	---	---	---	---
48XF08	48XF08	X	---	---	---	---	---
48XF09	48XF09	X	---	---	---	---	---
48XF10	48XF10	X	---	---	---	---	---
48XF11	48XF11	X	---	---	---	---	---
48XF12	48XF12	X	---	---	---	---	---
48XF13	48XF13	X	---	---	---	---	---
48XF14	48XF14	X	---	---	---	---	---
48XF15	48XF15	X	---	---	---	---	---
48XF16	48XF16	X	---	---	---	---	---
48XF17	48XF17	X	---	---	---	---	---
48XF18	48XF18	X	---	---	---	---	---
48XF19	48XF19	X	---	---	---	---	---
48XF20	48XF20	X	---	---	---	---	---
48XF21	48XF21	X	---	---	---	---	---
48XF22	48XF22	X	---	---	---	---	---
48XF23	48XF23	X	---	---	---	---	---
48XF24	48XF24	X	---	---	---	---	---
48XF25	48XF25	X	---	---	---	---	---
48XF26	48XF26	X	---	---	---	---	---
48XF27	48XF27	X	---	---	---	---	---
48XF28	48XF28	X	---	---	---	---	---
48XF29	48XF29	X	---	---	---	---	---
SWMU 48 IM – Soil Confirmation Samples**							
48SC01	48SC01	X	X	---	---	---	---
48SC02	48SC02	X	X	---	---	---	---
48SC03	48SC03	X	X	---	---	---	---
48SC04	48SC04	X	X	---	---	---	---
TMSC##	TMSC##	X	X	---	---	---	---
SWMU 48 IM – Waste and Borrow Characterization							
48DW01	48DW01	---	---	---	X (Aq.)	---	---
48DW02	48DW02	---	---	X (Soil)	---	---	---
48DW03	48DW03	---	---	---	---	X (Borrow)	---
48DW04	48DW04	---	---	---	---	X (Borrow)	---

Table 3-1
Anticipated Sampling Program for SWMU 48 Interim Measures, Continued

XF: XRF Confirmation Sample
SC: Soil Confirmation Sample
DW: Waste and Borrow Characterization Sample
TM: Blind Field Duplicate Sample (## to be assigned in field) will be collected at a frequency of 10% of the total environmental sample volume.
X: Sample group collected.
---: Sample type not collected.
Note: MS/MSD samples will be collected at a frequency of 5% of the total environmental sample volume.
*: XRF Confirmation samples will be collected from bottom and sides of excavated area as described in *Section 2.0*.
**: 10% of XRF samples will be sent to an off-site laboratory for metals and explosives testing.

4.0 QUALITY ASSURANCE PROJECT PLAN

This QAPP describes the policy, organization, functional activities, analytical methods, and quality assurance (QA) and QC protocols necessary to achieve the project DQOs. This QAPP was developed in accordance with USACE EM 200-1-3, *Requirements for the Preparation of Sampling and Analysis Plans* (USACE, 2001), and is to be used in conjunction with the FSP, *Section 3.0*.

4.1 Project Description

A detailed description of the project history and the planned IM work is presented in the Introduction (*Section 1.0*) and the Organization and Technical Approach Plan (*Section 2.0*) of this IMWP, respectively. As part of the planned IM work, field sampling and analysis activities will be conducted. This QAPP, in conjunction with the FSP (*Section 3.0*), describes the sampling and analysis requirements to ensure DQOs are met.

4.2 Project Organization and Responsibilities

A detailed discussion of project personnel organization and responsibilities has been presented in the Organization and Technical Approach Plan, *Section 2.0*. Coordination of sample collection activities will be the responsibility of the Site Superintendent, who is responsible for running site operations. Field sampling technicians will be responsible for collection and delivery of samples to the laboratory. After delivery, the Project Chemist will be responsible for ensuring proper analytical analysis and timely delivery of sample results by the contract laboratory according to the project Statement of Work and QAPP requirements.

The contract laboratory that will be used to support the IM work at SWMU 48 has yet to be determined. A copy of the contract laboratory's Laboratory Quality Assurance Plan (LQAP) will be presented in **Appendix C** upon award.

4.3 Data Quality Objectives

Quality assurance is defined as the overall system of activities for assuring the reliability of data produced. The system integrates the quality planning, assessment, and corrective actions of various groups in the organization to provide the independent QA program necessary to establish and maintain an effective system for collection and analysis of environmental samples and related activities. The program encompasses the generation of complete data with its subsequent review, validation, and documentation.

The overall QA objective is to develop and implement procedures for sample and data collection, shipment, evaluation, and reporting that will allow reviewers to assess whether the field and laboratory procedures meet the criteria and endpoints established in the DQOs. DQOs are qualitative and quantitative statements that outline the decision-making process and specify the data required supporting corrective actions. DQOs specify the level of uncertainty that will be accepted in results derived from environmental data. *Guidance for the Data Quality Objectives Process* (USEPA, 1994a), *USEPA Data Quality Objectives Process for Hazardous Waste Site Investigations EPA QA/G-4HW* (USEPA, 2000b), and the *Department of Defense* (*DoD) Quality Systems Manual (QSM), Version 4.2, November 25, 2010* (DoD, 2010) formed the basis for the DQO process and development of RFAAP data quality criteria and performance specifications. The DQO process consists of the seven steps specified below. Each phase is broken out in the following DQO elements. DQO elements are included in italics following each process step. Project-specific DQOs may be found in **Table 4-1** for SWMU 48 IM.

1. **State the Problem:** Define the problem to focus the study. Specific activities conducted during this process step include (1) the identification of the planning team, (2) primary decision-maker, (3) statement of the problem, and (4) available resources and relevant deadlines.

   (1) The planning team consists of representatives from the VDEQ, USEPA, USACE, and RFAAP.
   (2) The Army is the primary decision-maker.
   *(3) Refer to **Table 4-1**.*
   (4) Resource specifications are contained in the RFAAP SWMU 48 IMWP. The period of performance for this project is approximately 12 months.

2. **Identify the Decision:** Define the decision statement that the study will attempt to resolve. Activities conducted during this step of the process involve (1) identification of the principal study question and (2) definition of resultant alternative actions.

   (1) What is the extent of sludge material and grossly-contaminated soil at SWMU 48? If the areas show symptoms of contamination or confirmation samples exceed the industrial RGs, the soil will be removed and replaced with clean fill.
   (2) Resultant alternative actions include:
   (2a) Further determine extent of contaminated soil for removal.
   (2b) The extent of contamination has been determined.

3. **Identify Inputs to the Decision:** Identify information inputs required to resolve the decision statement and which inputs require environmental measurements. This step of the process includes (1) identification of the data that will be required to make the decision, (2) information source determination, (3) identification of data required for study action level goals, and (4) confirmation of appropriate field sampling and analytical methods.

   *(1) Refer to **Table 4-1**.*
   *(2) Samples for the soil delineation, soil confirmation, and waste and borrow characterization will be analyzed using USEPA SW-846 and USEPA Method of Chemical Analysis of Water and Wastes methodology. Refer to **Table 4-1** and Section 4.6.*
   (3) The removal action RGs for SWMU 48 are identified and will be evaluated against unrestricted use criteria (background and/or established residential Removal Goals), disposal facility permit levels, and/or USEPA disposal criteria (40 CFR 261.24, 40 CFR 761.50, and USEPA SW-846 Chapter 7).
   (4) Field sampling will be performed in accordance with the RFAAP SWMU 48 IMWP. Refer to Section 3.0.

4. **Define the Boundaries:** Define decision statement spatial and temporal boundaries. This step specifies (1) the spatial boundary, (2) population characteristics, applicable geographic areas and associated homogeneous characteristics, and (3) constraints on sample collection.

   *(1, 2, 3) Refer to **Table 4-1**.*

Table 4-1
Specific Data Quality Objectives for SWMU 48 Interim Measures

DQO Elements		On-Site Soil Excavation Delineation Sampling and Analysis	Off-Site Post-Excavation Confirmation Sampling and Analysis	Waste Characterization Sampling and Analysis	Borrow/Top Soil Characterization Sampling and Analysis
PROBLEM STATEMENT	PROBLEM AND OBJECTIVES	Characterize sludge material and grossly-contaminated soil to determine if a soil removal is warranted.	Confirm all sludge and grossly-contaminated soil has been removed.	Waste characterization for disposal.	Confirm borrow soil is suitable for fill.
DECISION INPUTS	CHEMICAL DATA	Soil excavations will be advanced in the area determined during the RFI as containing sludge material and grossly-contaminated soil to approximately 10-15 ft total for removal. The soil will then be delineated at discrete locations using on-site XRF analysis for arsenic, antimony, cadmium, copper, lead and mercury after removal. If warranted, further excavations and subsequent XRF analysis will be used to determine the extent of the contamination. The field SOPs may be found in **Appendix B**.	Discrete confirmation soil samples will be collected and analyzed off-site for arsenic, antimony, cadmium, copper, lead mercury, and explosives at the boundary where found to be fully delineated below the Industrial RGs. Field SOPs may be found in **Appendix B**.	Discrete waste characterization samples will be collected and analyzed off site. The soil samples will be analyzed for TCLP metals, TCLP SVOCs, explosives, dioxins/furans, corrosivity as pH, reactivity (cyanide and sulfide), and ignitability. Decontamination water will be analyzed for COD, TAL metals, and pH. Field SOPs may be found in **Appendix B**.	Discrete characterization samples will be collected for borrow material and top soil prior to placement and analyzed off-site for TCL VOCs, TCL SVOCs, pesticides/PCBs, and TAL metals. Field SOPs may be found in **Appendix B**.
	PHYSICAL DATA	Not Applicable	Map locations for all sample locations will be generated.	Not Applicable	Not Applicable
	SAMPLING METHOD	Environmental, biased, grab, and intrusive.	Environmental, biased, grab, and intrusive.	Environmental, biased, grab and non-intrusive.	Environmental, grab and non-intrusive.
	DATA USE	Interim Measures	Interim Measures	Waste Characterization	Interim Measures
	VALIDATION DATA LEVEL	Limited Validation	Full Validation (USEPA Region III)	Limited Validation	Full Validation (USEPA Region III Validation)
	ANALYTICAL METHOD	Field Data (USEPA SW-846) XRF Metals (As, Sb, Cd, Cu, Pb, & Hg): 6200	Chemical Data (USEPA SW-846) Explosives: 8330B Modified Metals (As, Sb, Cd, Cu, Pb, & Hg): 3050B/6010B/7471A	Chemical Data (USEPA SW-846/MCAWW) Solid IDW: TCLP Metals: 1311/3010A/6010B/7470A TCLP SVOCs: 1311/3510C/8270C Explosives: 8330B Mod. Dioxins/Furans: 8290 Corrosivity as pH: 9045D Ignitability: 1030/1010A Reactivity (CN & H2S): 9013A/9012B/9030B Aqueous IDW: TAL Metals: 3010A/6010B/7470A Chemical Oxygen Demand (COD): 410.4 pH: 9040C	Chemical Data (USEPA SW-846) TAL Metals: 3050B/6010B/7471A TCL Pesticides & PCBs: 3550C/8081A/8082 TCL VOCs: 5035/8260B TCL SVOCs: 3550C/8270C
	METHOD QUANTITATION LIMIT	Refer to **Table 4-2**.	Refer to **Table 4-2**.	Refer to **Table 4-2**.	Refer to **Table 4-2**.
	FIELD QUALITY CONTROL SAMPLES	Not Applicable	Field Duplicates @10% No Rinse Blank (Dedicated Sampling Equipment)	Not Applicable	Not Applicable
STUDY BOUNDARY		1) 240' x 40' 2) No public access permitted, no notable geographic characteristics, sludge material and grossly-contaminated soil expected in excavation area 3) None	1) 240' x 40' 2) No public access permitted, no notable geographic characteristics, sludge material and grossly-contaminated soil expected in excavation area 3) None	1) 240' x 40' 2) No public access permitted, no notable geographic characteristics, sludge material and grossly-contaminated soil expected in excavation area 3) None	1) 240' x 40' 2) No public access permitted, no notable geographic characteristics, sludge material and grossly-contaminated soil expected in excavation area 3) None

5. **Develop a Decision Rule:** Define the (1) parameters of interest, (2) action levels, and (3) develop a decision rule.

   *(1) Parameters of interest are listed in the decision inputs. Refer to **Table 4-1**.*
   (2) The identification and removal action of the sludge material and grossly-contaminated soil for SWMU 48 will be based on XRF metals (As, Sb, Cd, Cu, Pb, and Hg) results during excavation.
   (3) If the soil characterization sample exceeds the industrial RG, the soil will be removed. If the confirmation sample exceeds the metals industrial RGs, excavation will continue until all soil above industrial RGs has been removed. Metals and explosives soil samples will be analyzed off-site and compared to the industrial RGs as conformation of removal. Waste characterization samples will be compared to disposal facility criteria. If concentrations of chemicals in these samples exceed target levels, the soil will be disposed at an appropriate disposal facility.

6. **Specify Acceptable Limits on Decision Errors:** Specify the decision maker's tolerable limits on decision errors. This step of the process includes (1) parameter range of interest, (2) decision errors, (3) potential parameter values, and (4) the probability tolerance for decision errors are identified during this phase.

   (1) Parameter ranges are not defined at this time.
   (2) Decision errors include:
      (2a) Deciding that the soil characteristics exceed cleanup goals (soil removed) when they do not and deciding that the soil characteristics do not exceed cleanup goals (soil not removed) when they actually do. The consequences of deciding that the soil characteristics exceed cleanup goals (soil removed) when they do not will result in unnecessary removal actions. The consequences of deciding that the soil characteristics do not exceed cleanup goals (soil not removed) when they do will result in liabilities associated with future damages and environmental cleanup costs. Additionally, public opinion will be compromised.
      (2b) (I) The true state when the most severe decision error occurs [deciding that the soil characteristics exceed cleanup goals (soil removed) when they actually do] is that the soil characteristics exceed cleanup goals and it is removed. (II) The true state when the less severe decision error occurs (deciding the soil characteristics do not exceed cleanup goals (soil not removed) when they do not) is that the soil characteristics do not exceed cleanup goals and no removal occurs.
      (2c) The null hypothesis (H0) is: the soil characteristics exceed cleanup goals (soil removed). The alternative hypothesis (Ha) is the soil characteristics do not exceed cleanup goals (soil not removed).
      (2d) The false positive decision error occurs when H0 is erroneously rejected corresponding to decision error I. The false negative decision error occurs when Ha is erroneously accepted corresponding to decision error II. Project-specific Type I and II error rates are 0.05 and 0.2, respectively.
   (3, 4) The consequence of decision errors and acceptable probability will be determined as part of the final report.

7. **Optimize Data Design:** Identify data collection activities commensurate with data quality specifications. This final step in the process consists of (1) reviewing DQO outputs and

existing environmental data, (2) developing data collection design alternatives, (3) formulating mathematical expressions to resolve design problems for each alternative, (4) selecting cost-effective data design capable of achieving DQOs, and (5) documentation of operational details and theoretical assumptions.

(1) This Work Plan contains the proposed IM sampling design program for SWMU 48. A phased focus approach has been adopted for site excavation, delineation, confirmation, and waste characterization to optimize resource utilization and minimize decision errors. DQO refinement will be an iterative process throughout the project life cycle.
(2) Non-statistical sampling procedures are proposed. Biased and judgmental sampling will be performed for the collection of the characterization and confirmation samples for the removal action.
(3) Mathematical and qualitative assessments will be established during the refinement process.
(4) This Work Plan contains the proposed IM sampling design program based on cost and project DQOs.

4.3.1 Background

The ash material and grossly-contaminated soil removal action objective, rationale, and sampling scope for SWMU 48 are presented in **Table 4-1**.

4.3.2 Applicable or Relevant and Appropriate Requirements

Applicable or relevant and appropriate requirements selected for the ash material and grossly-contaminated soil removal action at SWMU 48 may be found in **Table 4-2** and include:

- Waste Disposal Criteria per USEPA 40 CFR 261.24; USEPA SW-846 Chapter 7 for TCLP analysis.

To-Be-Considered Guidance selected for the contaminated soil removal action at SWMU 48 include:

- The metals industrial RGs not to exceed for the following: lead = 800 mg/kg; antimony = 410 mg/kg; arsenic = 15.8 mg/kg; cadmium = 800 mg/kg; copper = 41000 mg/kg; mercury = 43 mg/kg. The metals residential SLs are listed in **Table 4-2** for comparison; however, the industrial values will be used for the RGs not to exceed for the SWMU 48 IM.
- The explosives industrial RGs not to exceed based upon the *USEPA Regional Screening Level Summary Table* (USEPA, 2011) industrial soil SL values presented in **Table 4-2**. [Note: Hazard index (HI) = 1.0 for non-carcinogens and the SLs will be updated as new versions of the USEPA Regional SL table become available.] The explosives residential SLs are listed in **Table 4-2** for comparison; however, the industrial values will be used for the RGs not to exceed for the SWMU 48 IM.

Sampling locations and procedures and sampling activities and procedures for the IM at SWMU 48 are presented in the FSP (*Section 3.0*). Parameter, container and preservation requirements, and holding times for analytical samples to be collected as part of the SWMU 48 IM are presented in **Table 4-3**.

Table 4-2
Analyte List and Levels of Concern for SWMU 48 Interim Measures

Parameter	Quantitation Limits		Soil Remedial Goals (Residential)	Selected Soil Remedial Goals (Industrial)	Background
	Aqueous	Soil			
On-Site Excavation Delineation Sampling and Analysis					
XRF Metals[1]	**Aqueous (µg/L)**	**Soil (mg/kg)**	**Soil (mg/kg)**	**Soil (mg/kg)**	**Soil (mg/kg)**
Arsenic	NA	10	15.8	15.8	15.8
Antimony	NA	115	31	410	NA
Cadmium	NA	50	70	800	0.69
Copper	NA	50	3100	41000	53.5
Lead	NA	16	400	800	26.8
Mercury	NA	14	10	43	0.13
Off-Site Post-Excavation Confirmation Sampling and Analysis					
Metals[1]	**Aqueous (µg/L)**	**Soil (mg/kg)**	**Soil (mg/kg)**	**Soil (mg/kg)**	**Soil (mg/kg)**
Arsenic	NA	0.50	15.8	15.8	15.8
Antimony	NA	0.50	31	410	NA
Cadmium	NA	0.10	70	800	0.69
Copper	NA	2.0	3100	41000	53.5
Lead	NA	0.30	400	800	26.8
Mercury	NA	0.050	10	43	0.13
Explosives[2]	**Aqueous (µg/L)**	**Soil (mg/kg)**	**ORNL SV-r (mg/kg)**	**ORNL SV-i (mg/kg)**	**Carcinogen or Non-carcinogen**
1,3,5-Trinitrobenzene	NA	0.25	2200	27000	N
1,3-Dinitrobenzene	NA	0.25	6.1	62	N
2,4,6-Trinitrotoluene	NA	0.25	19	79	C
2,4-Dinitrotoluene	NA	0.25	1.6	5.5	C
2,6-Dinitrotoluene	NA	0.25	61	620	N
2-Amino-4,6-dinitrotoluene	NA	0.25	150	2000	N
2-Nitrotoluene	NA	0.25	2.9	13	C
3-Nitrotoluene	NA	0.25	6.1	62	N
4-Amino-2,6-dinitrotoluene	NA	0.25	150	1900	N
4-Nitrotoluene	NA	0.25	30	110	C
HMX	NA	0.25	3800	49000	N
Nitrobenzene	NA	0.25	4.8	24	C
Nitroglycerin	NA	0.50	6.1	62	N
PETN	NA	0.50	NA	NA	N
RDX	NA	0.25	5.5	24	C
Tetryl	NA	0.25	240	2500	N
3,5-Dinitroaniline	NA	0.25	NA	NA	N

Table 4-2
Analyte List and Levels of Concern for SWMU 48 Interim Measures, Continued

Parameter	Quantitation Limits				
	Aqueous	Soil			
Waste Characterization Sampling and Analysis					
TCLP Metals (For Soil IDW)	**Aqueous (µg/L)**	**Soil (mg/kg)**		**RCRA Limits (µg/L)**	**Carcinogen or Non-carcinogen**
TCLP Arsenic	1000	NA	NA	5000	C
TCLP Barium	1000	NA	NA	100000	N
TCLP Cadmium	50	NA	NA	1000	N
TCLP Chromium	100	NA	NA	5000	N
TCLP Lead	500	NA	NA	5000	N
TCLP Mercury	2.0	NA	NA	200	N
TCLP Selenium	200	NA	NA	1000	N
TCLP Silver	100	NA	NA	5000	N
TCLP SVOCs (For Soil IDW)	**Aqueous (µg/L)**	**Soil (mg/kg)**		**RCRA Limits (µg/L)**	**Carcinogen or Non-carcinogen**
TCLP 2,4-Dinitrotoluene	50	NA	NA	130	C
TCLP Hexachlorobenzene	50	NA	NA	130	C
TCLP Hexachlorobutadiene	50	NA	NA	500	C
TCLP Hexachloroethane	50	NA	NA	3000	C
TCLP 2-Methylphenol	50	NA	NA	200000	N
TCLP Nitrobenzene	50	NA	NA	2000	C
TCLP Pentachlorophenol	250	NA	NA	100000	C
TCLP Pyridine	100	NA	NA	5000	N
TCLP 2,4,5-Trichlorophenol	50	NA	NA	400000	N
TCLP 2,4,6-Trichlorophenol	50	NA	NA	2000	C
TCLP 3-Methylphenol & 4-Methylphenol	50	NA	NA	200000	N
TCLP 1,4-Dichlorobenzene	50	NA	NA	7500	C
Explosives[2] (For Soil IDW)	**Aqueous (µg/L)**	**Soil (mg/kg)**	**ORNL SV-r (mg/kg)**	**ORNL SV-i (mg/kg)**	**Carcinogen or Non-carcinogen**
1,3,5-Trinitrobenzene	NA	0.25	2200	27000	N
1,3-Dinitrobenzene	NA	0.25	6.1	62	N
2,4,6-Trinitrotoluene	NA	0.25	19	79	C
2,4-Dinitrotoluene	NA	0.25	1.6	5.5	C
2,6-Dinitrotoluene	NA	0.25	61	620	N
2-Amino-4,6-dinitrotoluene	NA	0.25	150	2000	N
2-Nitrotoluene	NA	0.25	2.9	13	C
3-Nitrotoluene	NA	0.25	6.1	62	N
4-Amino-2,6-dinitrotoluene	NA	0.25	150	1900	N
4-Nitrotoluene	NA	0.25	30	110	C
HMX	NA	0.25	3800	49000	N
Nitrobenzene	NA	0.25	4.8	24	C
Nitroglycerin	NA	0.50	6.1	62	N
PETN	NA	0.50	NA	NA	N
RDX	NA	0.25	5.5	24	C
Tetryl	NA	0.25	240	2500	N
3,5-Dinitroaniline	NA	0.25	NA	NA	N

Table 4-2
Analyte List and Levels of Concern for SWMU 48 Interim Measures, Continued

Parameter	Quantitation Limits				
	Aqueous	Soil			
Dioxins/Furans[3] (For Soil IDW)	**Aqueous (µg/L)**	**Soil (mg/kg)**		**RGs (mg/kg)**	**Carcinogen or Non-carcinogen**
2,3,7,8-TCDD	0.0010	0.0000010	NA	0.0125	C
1,2,3,7,8-PeCDD	0.0050	0.0000050	NA	0.0125	C
1,2,3,4,7,8-HxCDD	0.0050	0.0000050	NA	0.0125	C
1,2,3,6,7,8-HxCDD	0.0050	0.0000050	NA	0.0125	C
1,2,3,7,8,9-HxCDD	0.0050	0.0000050	NA	0.0125	C
1,2,3,4,6,7,8-HpCDD	0.0050	0.0000050	NA	0.0125	C
OCDD	0.010	0.000010	NA	0.0125	C
2,3,7,8-TCDF	0.0010	0.0000010	NA	0.0125	C
1,2,3,7,8-PeCDF	0.0050	0.0000050	NA	0.0125	C
2,3,4,7,8-PeCDF	0.0050	0.0000050	NA	0.0125	C
1,2,3,4,7,8-HxCDF	0.0050	0.0000050	NA	0.0125	C
1,2,3,6,7,8-HxCDF	0.0050	0.0000050	NA	0.0125	C
2,3,4,6,7,8-HxCDF	0.0050	0.0000050	NA	0.0125	C
1,2,3,7,8,9-HxCDF	0.0050	0.0000050	NA	0.0125	C
1,2,3,4,6,7,8-HpCDF	0.0050	0.0000050	NA	0.0125	C
1,2,3,4,7,8,9-HpCDF	0.0050	0.0000050	NA	0.0125	C
OCDF	0.010	0.000010	NA	0.0125	C
Total TCDD	NA	NA	NA	0.0125	C
Total PeCDD	NA	NA	NA	0.0125	C
Total HxCDD	NA	NA	NA	0.0125	C
Total HpCDD	NA	NA	NA	0.0125	C
Total TCDF	NA	NA	NA	0.0125	C
Total PeCDF	NA	NA	NA	0.0125	C
Total HxCDF	NA	NA	NA	0.0125	C
Total HpCDF	NA	NA	NA	0.0125	C
Miscellaneous (For Soil IDW)	**Aqueous**	**Soil**		**RCRA Limits**	**Carcinogen or Non-carcinogen**
Ignitability	±1°F	NA	NA	>140°F	N
Corrosivity as pH	±1 Units	NA	NA	<2 or >12 Units	N
Reactive Cyanide	5 mg/kg	NA	NA	250 mg/kg	N
Reactive Sulfide	20 mg/kg	NA	NA	500 mg/kg	N
Miscellaneous (For Aq. IDW)	**Aqueous**	**Soil**		**Criteria Limits**	**Carcinogen or Non-carcinogen**
Corrosivity as pH	±1 Units	NA	NA	<2 or >12 Units	N
Chemical Oxygen Demand	3000	NA	NA	Per RFAAP WTP Permit	N

Table 4-2
Analyte List and Levels of Concern for SWMU 48 Interim Measures, Continued

Parameter	Quantitation Limits			Criteria (µg/L)	Carcinogen or Non-carcinogen
	Aqueous (µg/L)	Soil (mg/kg)			
TAL Metals (For Aq. IDW)					
Aluminum	200	NA	NA	Per RFAAP WTP Permit	N
Antimony	5.0	NA	NA	Per RFAAP WTP Permit	N
Arsenic	3.0	NA	NA	Per RFAAP WTP Permit	C
Barium	20	NA	NA	Per RFAAP WTP Permit	N
Beryllium	2.0	NA	NA	Per RFAAP WTP Permit	N
Cadmium	2.0	NA	NA	Per RFAAP WTP Permit	N
Calcium	100	NA	NA	Per RFAAP WTP Permit	N
Chromium	10	NA	NA	Per RFAAP WTP Permit	N
Cobalt	50	NA	NA	Per RFAAP WTP Permit	N
Copper	20	NA	NA	Per RFAAP WTP Permit	N
Iron	50	NA	NA	Per RFAAP WTP Permit	N
Lead	2.0	NA	NA	Per RFAAP WTP Permit	N
Magnesium	100	NA	NA	Per RFAAP WTP Permit	N
Manganese	10	NA	NA	Per RFAAP WTP Permit	N
Mercury	0.10	NA	NA	Per RFAAP WTP Permit	N
Nickel	40	NA	NA	Per RFAAP WTP Permit	N
Potassium	3000	NA	NA	Per RFAAP WTP Permit	N
Selenium	5.0	NA	NA	Per RFAAP WTP Permit	N
Silver	10	NA	NA	Per RFAAP WTP Permit	N
Sodium	200	NA	NA	Per RFAAP WTP Permit	N
Thallium	2.0	NA	NA	Per RFAAP WTP Permit	N
Vanadium	50	NA	NA	Per RFAAP WTP Permit	N
Zinc	20	NA	NA	Per RFAAP WTP Permit	N

Table 4-2
Analyte List and Levels of Concern for SWMU 48 Interim Measures, Continued

Parameter	Quantitation Limits		ORNL SV-r (µg/kg)	ORNL SV-i (µg/kg)	Carcinogen or Non-carcinogen
	Aqueous (µg/L)	Soil (µg/kg)			
Borrow/Top Soil Characterization Sampling and Analysis					
TCL VOCs					
1,1,1-Trichloroethane	1.0	5.0	8700000	38000000	N
1,1,2,2-Tetrachloroethane	1.0	5.0	560	2800	C
1,1,2-Trichloroethane	1.0	5.0	1100	5300	C
1,1-Dichloroethane	1.0	5.0	3300	17000	C
1,1-Dichloroethene	1.0	5.0	240000	1100000	N
1,2-Dichloroethane	1.0	5.0	430	2200	C
1,2-Dichloropropane	1.0	5.0	890	4500	C
2-Butanone	5.0	25	28000000	200000000	N
2-Hexanone	5.0	25	NA	NA	N
4-Methyl-2-Pentanone	5.0	25	5300000	53000000	N
Acetone	25	50	61000000	630000000	N
Benzene	1.0	5.0	1100	5400	C
Bromodichloromethane	1.0	5.0	270	1400	C
Bromoform	1.0	5.0	61000	220000	C
Bromomethane	2.0	5.0	73000	320000	N
Carbon Disulfide	2.0	5.0	820000	3700000	N
Carbon Tetrachloride	1.0	5.0	610	3000	C
Chlorobenzene	1.0	5.0	290000	1400000	N
Chloroethane	1.0	5.0	15000000	61000000	N
Chloroform	1.0	5.0	290	1500	C
Chloromethane	2.0	5.0	12000	50000	C
Dibromochloromethane	1.0	5.0	680	3300	C
Ethylbenzene	1.0	5.0	5400	27000	C
Methylene Chloride	1.0	5.0	11000	53000	C
Styrene	1.0	5.0	6300000	36000000	N
Tetrachloroethene	1.0	5.0	550	2600	C
Toluene	1.0	5.0	5000000	45000000	N
Trichloroethene	1.0	5.0	2800	14000	C
Vinyl Chloride	1.0	5.0	60	1700	C
cis-1,2-Dichloroethene	1.0	5.0	160000	2000000	N
cis-1,3-Dichloropropene	1.0	5.0	NA	NA	N
m- & p-Xylene	2.0	10	630000	2700000	N
o-Xylene	1.0	5.0	3800000	19000000	N
trans-1,2-Dichloroethene	1.0	5.0	150000	6900000	N
trans-1,3-Dichloropropene	1.0	5.0	NA	NA	N

Table 4-2
Analyte List and Levels of Concern for SWMU 48 Interim Measures, Continued

Parameter	Quantitation Limits		ORNL SV-r (µg/kg)	ORNL SV-i (µg/kg)	Carcinogen or Non-carcinogen
	Aqueous (µg/L)	Soil (µg/kg)			
TCL SVOCs					
1,2,4-Trichlorobenzene	5.0	170	2200	9900	C
1,2-Dichlorobenzene	5.0	170	1900000	9800000	N
1,3-Dichlorobenzene	5.0	170	NA	NA	N
1,4-Dichlorobenzene	5.0	170	2400	12000	C
2,4,5-Trichlorophenol	5.0	170	6100000	62000000	N
2,4,6-Trichlorophenol	5.0	170	4400	16000	C
2,4-Dichlorophenol	5.0	170	180000	1800000	N
2,4-Dimethylphenol	5.0	170	1200000	12000000	N
2,4-Dinitrophenol	20	830	120000	1200000	N
2,4-Dinitrotoluene	5.0	170	1600	5500	C
2,6-Dinitrotoluene	5.0	170	61000	620000	N
2-Chloronaphthalene	5.0	170	6300000	82000000	N
2-Chlorophenol	5.0	170	390000	5100000	N
2-Methylnaphthalene	5.0	170	310000	4100000	N
2-Methylphenol	5.0	170	3100000	31000000	N
2-Nitroaniline	10	330	610000	6000000	N
2-Nitrophenol	5.0	170	NA	NA	N
3,3'-Dichlorobenzidine	10	330	1100	3800	C
3-Nitroaniline	10	330	NA	NA	N
4,6-Dinitro-2-Methylphenol	10	330	4900	49000	N
4-Bromophenyl Phenyl Ether	5.0	170	NA	NA	N
4-Chloro-3-methylphenol	5.0	170	6100000	62000000	N
4-Chloroaniline	5.0	170	2400	8600	C
4-Chlorophenyl Phenyl Ether	5.0	170	NA	NA	N
3&4-Methylphenol	5.0	170	3100000	31000000	N
4-Nitroaniline	10	330	240000	860000	N
4-Nitrophenol	20	830	NA	NA	N
Acenaphthene	5.0	170	3400000	33000000	N
Acenaphthylene	5.0	170	1700000	17000000	N
Anthracene	5.0	170	17000000	170000000	N
Benzo(a)anthracene	5.0	170	150	2100	C
Benzo(a)pyrene	5.0	170	15	210	C
Benzo(b)fluoranthene	5.0	170	150	2100	C
Benzo(g,h,i)perylene	5.0	170	1700000	17000000	N
Benzo(k)fluoranthene	5.0	170	1500	21000	C
Benzoic acid	20	830	240000000	2500000000	N
Benzyl Alcohol	5.0	170	6100000	62000000	N
Bis(2-Chloroethoxy)methane	5.0	170	180000	1800000	N
Bis(2-chloroethyl)ether	5.0	170	210	1000	C
Bis(2-chloroisopropyl)ether	5.0	170	4600	22000	C
Bis(2-ethylhexyl)phthalate	10	330	35000	120000	C
Butylbenzylphthalate	10	330	260000	910000	C
Carbazole	5.0	170	NA	NA	N
Chrysene	5.0	170	15000	210000	C
Di-n-butylphthalate	10	330	6100000	62000000	N
Di-n-octylphthalate	10	330	NA	NA	N
Dibenz(a,h)Anthracene	5.0	170	15	210	C
Dibenzofuran	5.0	170	NA	NA	N

Table 4-2
Analyte List and Levels of Concern for SWMU 48 Interim Measures, Continued

Parameter	Quantitation Limits		ORNL SV-r (µg/kg)	ORNL SV-i (µg/kg)	Carcinogen or Non-carcinogen
	Aqueous (µg/L)	Soil (µg/kg)			
Diethylphthalate	10	330	49000000	490000000	N
Dimethylphthalate	10	330	NA	NA	N
Fluoranthene	5.0	170	2300000	22000000	N
Fluorene	5.0	170	2300000	22000000	N
Hexachlorobenzene	5.0	170	300	1100	C
Hexachlorobutadiene	5.0	170	6200	22000	C
Hexachlorocyclopentadiene	5.0	170	370000	3700000	N
Hexachloroethane	5.0	170	35000	120000	C
Indeno(1,2,3-cd)pyrene	5.0	170	150	2100	C
Isophorone	5.0	170	510000	1800000	C
N-Nitrosodi-n-propylamine	5.0	170	69	250	C
N-nitrosodiphenylamine	5.0	170	99000	350000	C
Naphthalene	5.0	170	3600	18000	C
Nitrobenzene	5.0	170	4800	24000	C
Pentachlorophenol	20	830	890	2700	C
Phenanthrene	5.0	170	1700000	17000000	N
Phenol	5.0	170	18000000	180000000	N
Pyrene	5.0	170	1700000	17000000	N
TCL Pesticides					
4,4'-DDD	0.10	3.3	2000	7200	C
4,4'-DDE	0.10	3.3	1400	5100	C
4,4'-DDT	0.10	3.3	1700	7000	C
Aldrin	0.050	1.7	29	100	C
alpha-BHC	0.050	1.7	77	270	C
alpha-Chlordane	0.050	1.7	NA	NA	C
beta-BHC	0.050	1.7	270	960	C
delta-BHC	0.050	1.7	NA	NA	N
Dieldrin	0.050	1.7	30	110	C
Endosulfan II	0.10	3.3	370000	3700000	N
Endosulfan I	0.050	1.7	370000	3700000	N
Endosulfan Sulfate	0.10	3.3	NA	NA	N
Endrin aldehyde	0.10	3.3	NA	NA	N
Endrin Ketone	0.10	3.3	NA	NA	N
Endrin	0.10	3.3	18000	180000	N
gamma-Chlordane	0.10	3.3	NA	NA	N
Heptachlor Epoxide	0.050	1.7	53	190	C
Heptachlor	0.050	1.7	110	380	C
Lindane	0.050	1.7	520	2100	C
Methoxychlor	0.50	6.7	310000	3100000	N
Toxaphene	3.0	33	440	1600	C
TCL PCBs					
PCB-1016	1.0	17	3900	21000	N
PCB-1221	2.0	33	140	540	C
PCB-1232	1.0	17	140	540	C
PCB-1242	1.0	17	220	740	C
PCB-1248	1.0	17	220	740	C
PCB-1254	1.0	17	220	740	C
PCB-1260	1.0	17	220	740	C

Table 4-2
Analyte List and Levels of Concern for SWMU 48 Interim Measures, Continued

Parameter	Quantitation Limits		ORNL SV-r (mg/kg)	ORNL SV-i (mg/kg)	Carcinogen or Non-carcinogen
	Aqueous (µg/L)	Soil (mg/kg)			
TAL Metals					
Aluminum	200	10	77000	990000	N
Antimony	6.0	3.0	31	410	N
Arsenic	10.0	0.30	0.39	1.6	C
Barium	200	10	15000	190000	N
Beryllium	4.0	0.25	160	2000	N
Cadmium	5.0	0.20	70	800	N
Calcium	1000	250	NA	NA	N
Chromium	10.0	0.50	120000	1500000	N
Cobalt	50.0	2.5	23	300	N
Copper	25.0	2.0	3100	41000	N
Iron	300.0	5.0	55000	720000	N
Lead	5.0	5.0	400	800	N
Magnesium	5000	250	NA	NA	N
Manganese	15.0	0.75	1800	23000	N
Mercury	1.0	0.083	10	43	N
Nickel	40.0	2.0	1500	20000	N
Potassium	10000	500	NA	NA	N
Selenium	10.0	5.0	390	5100	N
Silver	10.0	0.50	390	5100	N
Sodium	10000	500	NA	NA	N
Thallium	10.0	0.50	NA	NA	N
Vanadium and compounds	50.0	2.5	390	5200	N
Zinc	20.0	1.0	23000	310000	N

(1) RG values are the project defined remedial goals.
(2) RG values are USEPA Regional Screening Table – Residential and Industrial Scenarios (May 2011).
(3) Dioxin and furan values are the remedial goals based off the USEPA published OSWER Directive 9200.4-26 for dioxins/furans (USEPA, 1998b) in soil.
µg = microgram
mg = milligram
kg = kilogram
L = liter
NA = Not Applicable or Not Available

Table 4-3
Parameter, Container, Preservation Requirements, and Holding Times for SWMU 48 Interim Measures

Parameter	Sample Container*		Preservation Requirement*	Holding Time
	Solid	Aqueous		
VOCs	3x, 5 gram EnCore samplers or Terracore samplers, zero headspace	3x, 40 mL vials with Teflon septum, zero headspace	Cool: 4 ± 2°C, HCl to pH<2 for aqueous, No Sodium Bisulfate for solids due to sample effervescence. TerraCore's are pre-tarred and contain MeOH or DIUF.	Aqueous: Analysis 14 days Solid: Preparation: 2 days Analysis: 14 days
SVOCs	1x, 8 oz, wide mouth glass with Teflon cap	2, 1-L amber glass with Teflon lined cap	Cool: 4 ± 2°C	Aqueous: Extraction: 7 days Analysis: 40 days Solid: Extraction: 14 days Analysis: 40 days
Pesticides/ PCBs	1x, 8 oz, wide mouth glass with Teflon cap	2x, 1-L amber glass with Teflon lined cap	Cool: 4 ± 2°C	Aqueous: Extraction: 7 days Analysis: 40 days Solid: Extraction: 14 days Analysis: 40 days
Metals (ICP & Hg)	1x, 8 oz, wide mouth glass with Teflon cap	1x, 1-L HDPE	Cool: 4 ± 2°C solid; Cool: 4 ± 2°C; (HNO_3 to pH<2 for aqueous)	ICP Metals: 180 days Mercury: 28 days
Explosives	1x, 8 oz, wide mouth glass with Teflon cap	2x, 1-L amber glass with Teflon lined cap	Cool: 4 ± 2°C	Aqueous: Extraction: 7 days Analysis: 40 days Solid: Extraction: 14 days Analysis: 40 days
Dioxin/ Furans	1x, 8 oz, wide mouth glass with Teflon cap	2x, 1-L amber glass with Teflon lined cap	Cool: 4 ± 2°C	Aqueous: Extraction: 30 days Analysis: 45 days Solid: Extraction: 30 days Analysis: 45 days
TCLP Metals	1x, 8 oz, wide mouth glass with Teflon cap	1x, 1-L glass or HDPE	Cool: 4 ± 2°C	TCLP Extraction: 180 days ICP and 28 days Mercury Sample Analysis: 180 days ICP and 28 days Mercury
TCLP SVOCs	1x, 8 oz, wide mouth glass with Teflon cap	2x, 1-L amber glass with Teflon lined cap	Cool: 4 ± 2°C	TCLP Extraction: 7 days (Aq.) and 14 days (Solid) Sample Analysis: Extraction: 7 days Analysis: 40 days
Ignitability	1x, 8 oz, wide mouth glass with Teflon cap	1x, 1-L glass or HDPE	Cool: 4 ± 2°C	28 days
Reactive Sulfide	1x, 8 oz, wide mouth glass with Teflon cap	1x, 1-L glass or HDPE	Cool: 4 ± 2°C	7 days
Reactive Cyanide	1x, 8 oz, wide mouth glass with Teflon cap	1x, 1-L glass or HDPE	Cool: 4 ± 2°C	14 days
Corrosivity as pH & pH	1x, 8 oz, wide mouth glass with Teflon cap	1x, 250 mL glass or HDPE	Cool: 4 ± 2°C	ASAP
Chemical Oxygen Demand	Not Applicable	1x, 250 mL glass	Cool: 4 ± 2°C, HCl or H_2SO_4 to pH<2 for aqueous	28 days

*Parameters with same preservation and bottle requirements may be combined at laboratory's discretion.

Legend:
L = liter
mL = milliliter
ASAP = As Soon As Possible
HDPE = High Density Polyethylene
ICP = Inductively Coupled Plasma
PCB = Polychlorinated Biphenyl
TAL = Target Analyte List
TCL = Target Compound List
TCLP = Toxicity Characteristic Leaching Procedure
SVOC = Semivolatile Organic Compound
VOC = Volatile Organic Compound

4.4 Number and Type

The anticipated number and type of samples to be collected during the cadmium-contaminated soil removal action at SWMU 48 are presented in **Table 4-4**. **Table 4-4** also presents guidelines for the collection of QC samples that will be taken in conjunction with environmental sampling during the soil removal action at SWMU 48.

Table 4-4
Estimated Number and Type of Samples for SWMU 48 Interim Measures

Sample Type	Total Samples
Environmental	
Soil XRF Delineation (on-site)	29
Soil Confirmation (off-site)	4
Total Environmental	**33**
QC (For Off-Site Soil Confirmation only)	
Matrix Spike/Matrix Spike Duplicate (5% frequency)	1
Field Duplicate (10% frequency)	1
Total QC	**2**
Waste and Borrow Characterization	
Decontamination Rinse Water	1
Soil	1
Borrow Material	2
Total Waste and Borrow Characterization	**4**
TOTAL SAMPLES	**39**

*: Total samples assuming areas sampled at SWMU 48 are excavated as described in *Section 2.0*.

4.5 Sample Identification

The sample identification system will be similar with past nomenclature at RFAAP. The sample identification number will consist of an alphanumeric designation related to the sampling location, media type, and sequential order sampling location, sample type, and sequential order according to the sampling event. Each sample will be assigned a unique sequential number at the time of sampling on the sample label, which will be permanently affixed to the sample container. **Table 3-1** in the FSP (*Section 3.0*) contains sample identification numbers that will be used for the IM at SWMU 48.

4.5.1 Environmental Samples

The field sample identification number consists of an alphanumeric designation according to the following convention:

- **Site Location Code:** The first two or three characters will be the site location number or code. The identification will include the following:

48	=	SWMU 48
TM	=	Blind Field Duplicate

- **Sample/Media Type:** The second two characters will be the sample/media type. Sample types will be designated by the following codes:

XF	=	Soil XRF Delineation Sample
SC	=	Soil Confirmation Sample
DW	=	Waste & Borrow Characterization Sample

- **Sampling Location Number:** The next two characters will be the number of the sampling location (e.g., 01, 02, 03,...).
- **Duplicate:** Field duplicate samples will be identified with a "TM" designation as noted in the "Site Location Code." A record of the samples that correspond to the duplicates will be kept in the field logbook.

4.5.2 Field QC Blank Samples

No rinse blanks will be required for the SWMU 48 IM given the use of dedicated disposable field equipment. Trip blanks will also not be required for the soil borrow material.

4.5.3 Documentation Requirements

Information pertinent to the sampling effort will be recorded in a field logbook, and a COC form will trace the sample. Field logbook SOPs 10.1 and 10.2 may be found in **Appendix B**. All entries will be made in indelible ink on consecutively numbered pages, and corrections will consist of lineout deletions that are initialed and dated. At a minimum, required field logbook entries include:

- Time and date of sample collection.
- Sampler identification.
- Sample identification number.
- Sample type.
- Analytical request.
- Sampling methodology (grab and composite sample).
- Preservation used, as applicable.
- Associated QA/QC samples.
- Physical field measurements.
- Signature and date of personnel responsible for observations.

Each sample will be assigned a unique sequential number at the time of sampling, which will be permanently affixed to the sample container with polyethylene tape to prevent the loss of the label during shipment. Further discussion as to sample labeling is provided in SOP 50.1 in **Appendix B**. The sample label will be filled out using indelible ink and will include the following information:

- Project name and number.

- Sample location/site ID.
- Sampling date and time.
- Analyses to be performed.
- Preservative, as applicable.
- Sampler name.

4.6 Packaging and COC Requirements

Environmental samples required for shipment must be packaged appropriately in leak-proof coolers to the laboratory. Appropriate custody procedures and documentation must be performed to ensure sample integrity. The following sections discuss sample packaging, shipment, and custody requirements.

4.6.1 Shipping Coolers

Leak proof sample coolers will be shipped to arrive at the laboratory the morning after sampling (priority overnight). The laboratory will be notified of the sample shipment and the estimated date of arrival of the samples being delivered. Shipping coolers are to be clean, leak proof, contamination-free, and in good condition. These containers will be used to transport environmental samples to the laboratory. Suitable sample cooler(s) to handle sample containers packed with bagged ice will be required for sample shipment.

4.6.2 Temperature Blanks

Temperature blanks are to be provided to Shaw and will be included in each environmental sample shipping container requiring wet ice. Temperature blanks are required for each cooler for where samples have to meet the USEPA storage requirements of 4±2 degrees Celsius (ºC) during shipment. See **Table 4-3** for sample preservation requirements. These blanks will be used by the laboratory to measure the shipping container internal temperatures at receipt. These samples will not be analyzed for any scoped analysis.

4.6.3 Sample Packaging and Shipment

Samples will be transferred to the contract laboratory for analysis via waterproof plastic coolers. Before samples can be put in the cooler, any drains will be sealed with tape to prevent leaking. Each cooler will be packed in the following manner:

1. Ensure sample lids are tight.
2. Wrap environmental samples and associated QC samples in bubble wrap.
3. Fill cooler with enough packing material to prevent breakage of glass bottles.
4. Place sufficient ice in cooler to maintain the internal temperature at 4±2°C during transport. The ice will be double-bagged in sealed 1-gallon size Zip-loc bags to prevent contact of the melt water with the samples.
5. Place a temperature blank (if applicable) in cooler.
6. Place associated COCs in a water proof plastic bag and tape it to the inside lid of the cooler.

7. Seal coolers at a minimum of two locations with signed custody seals or evidence tape before being transferred off site. Attach completed shipping label and Saturday Delivery label (if applicable) to top of the cooler. Cover seals with wide, clear packing tape, and continue around the cooler to seal the lid. If the cooler has a drain spout, it may also be sealed with tape.

4.6.4 Chain-of-Custody

Sampling will be evidenced through the completion of a COC form, which accompanies the sample containers in the field, during transit to the laboratory, and upon receipt by the laboratory. The COC will be annotated to indicate time and date that samples are relinquished. In addition, shipping containers will be affixed with custody seals. Further discussion of COC may be found in SOP 10.4 of **Appendix B**. The COC will be filled out using indelible ink and will include the following information:

- Project name and number.
- The signatures of the sampling personnel.
- The site code and sample number.
- Sampling dates, locations, and times (military format).
- List of the chemical analysis, volume, and preservatives used.
- The total number of sample containers per location.
- The custody seal number.
- Sample relinquisher, date, and time.
- Any special remarks (e.g., MS/MSD this sample).

4.7 Analytical Procedures and Data Validation

4.7.1 Method Selection for Chemical Analyses

Sample collection will be performed in accordance with established Shaw SOPs designed to ensure the collection of representative samples. Shaw SOPs may be found in **Appendix B**. A DOD-approved laboratory through the Environmental Laboratory Accreditation Program (ELAP) will perform the analytical sample analysis. All laboratory analytical methods will be performed in accordance with USEPA protocols and methods. Shaw will have the laboratory data validated according to the Work Plan/QAPP requirements, *DoD QSM, Version 4.2, November 25, 2010* (DoD, 2010) requirements, the analytical method, and laboratory SOPs. Data validation qualifiers will be consistent with the *USEPA Region III Modifications to the National Functional Guidelines for Organic Data Review* (USEPA, 1994b), *Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (USEPA, 1993), and *USEPA Region III Dioxin/Furan Data Validation Guidance* (USEPA, 1999). The analytical compound lists and quantitation limits (QLs) are provided in **Table 4-2**.

Analytical QLs were compared to SLs to ensure that they do not exceed the SLs listed in **Table 4-2**. During the planning stage, the QLs are used for comparison rather than method reporting limits (MRLs) or method detection limits (MDLs) because MRLs are sample specific and take into account characteristics such as dilutions, sample volumes, and percent moistures which are unknown prior to sampling and analysis. The laboratory will be required to perform and report MRLs and MDLs for each sample and analysis. These limits are specific to the laboratory, instrumentation, and methodology and are updated at least annually. The MDLs represent the lowest level the laboratory can detect a constituent at a 99% confidence for a specific compound. If a compound is detected >MDL and <MRL, it will be treated as an estimated "J" value. The QLs are conservative limits and, although some exceedances of the SLs are indicated, this does not necessarily indicate that the method will not detect the compound at, or below, the SL.

Although some QLs are above the SLs for certain compounds because the values cannot be met practically with the given USEPA methodology, the best available methods were selected to attain SL requirements. Economical, technical, comparability, and sensitivity factors were considered during the method selection process for this IM. The MRLs and MDLs will be compared to SLs during the data analysis stage in the IM once a laboratory is procured.

4.7.2 Laboratory Procedures for Chemical Analyses

Analytical testing will be performed by the contracted DoD-approved laboratory. The methods listed for the SWMU 48 IM are in accordance with *DoD QSM, Version 4.2, November 25, 2010* (DoD, 2010), *USEPA OSWER Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), Update IV* (USEPA, 2007) and *USEPA Methods for Chemical Analysis of Water and Wastes* (USEPA, 1983). The LQAP for the subcontracted analytical laboratory for the SWMU 48 IM is presented as **Appendix C**. The on-site XRF delineation samples will be analyzed for arsenic, antimony, cadmium, copper, lead, and mercury. Off-site confirmation analysis will be analyzed for the XRF metals suite and for explosives. The waste characterization analysis includes the IDM for disposal and the characterization of the borrow material. The soil IDM will be analyzed for TCLP metals, TCLP SVOCs, explosives, dioxins/furans, corrosivity as pH, reactivity (cyanide and sulfide), and ignitability. The aqueous IDM will be analyzed for COD, TAL metals, and pH. The borrow material will be analyzed for TCL VOCs, TCL SVOCs, pesticides/PCBs, and TAL metals.

4.7.2.1 Laboratory Calibration

Prior to sample analysis, chemical calibration of each target analyte/compound must be performed to ensure analytical instrumentation is functioning within the established sensitivity range. Laboratory calibration steps include the performing of solution validation, initial calibration, daily calibration, and continuing calibration procedures. Protocols defining the QC procedures, rounding rules, corrective actions, and QC measurements for instrument calibration should be done in accordance with criteria specified in the analytical method, laboratory QA plan, and the prime contractor's SOPs. The QA/QC method calibration requirements may be found in **Tables 4-5 through 4-11**. Further details as to laboratory calibrations and equipment use may be found in the laboratory's LQAP located in **Appendix C**.

Table 4-5
Quality Control Method Criteria for Metals and TCLP Metals by SW-846 6010B/7470A/7471A

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-7. Inorganic Analysis by Inductively Coupled Plasma (ICP) Atomic Emission Spectrometry and Atomic Absorption Spectrophotometry (AA) (Methods 6010 and 7000 Series)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Demonstrate acceptable analytical capability	Prior to using any test method and at any time there is a significant change in instrument type, personnel, test method, or sample matrix.	QC acceptance criteria published by DoD, if available; otherwise, method-specified criteria.	Recalculate results; locate and fix problem, then rerun demonstration for those analytes that did not meet criteria (see Section C.1.f).	NA.	This is a demonstration of analytical ability to generate acceptable precision and bias per the procedure in Appendix C. No analysis shall be allowed by analyst until successful demonstration of capability is complete.
LOD determination and verification (See Box D-13)					
LOQ establishment and verification (See Box D-14)					
Instrument detection limit (IDL) study (ICP only)	At initial set-up and after significant change in instrument type, personnel, test method, or sample matrix.	IDLs shall be ≤ LOD.	NA.	NA.	Samples may not be analyzed without a valid IDL.
Linear dynamic range or high-level check standard (ICP only)	Every 6 months.	Within ± 10% of true value.	NA.	NA.	

Table 4-5
Quality Control Method Criteria for Metals and TCLP Metals by SW-846 6010B/7470A/7471A, Continued

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-7. Inorganic Analysis by Inductively Coupled Plasma (ICP) Atomic Emission Spectrometry and Atomic Absorption Spectrophotometry (AA) (Methods 6010 and 7000 Series) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Initial calibration (ICAL) for all analytes **ICP: minimum one high standard and a calibration blank;** **GFAA: minimum three standards and a calibration blank;** **CVAA: minimum 5 standards and a calibration blank**	Daily ICAL prior to sample analysis.	If more than one calibration standard is used, $r \geq 0.995$.	Correct problem, then repeat ICAL.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be run until ICAL has passed.
Second source calibration verification (ICV)	Once after each ICAL, prior to beginning a sample run.	Value of second source for all analyte(s) within ± 10% of true value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be run until calibration has been verified.
Continuing calibration verification (CCV)	After every 10 field samples and at the end of the analysis sequence.	ICP: within ± 10% of true value; GFAA: within ± 20% of true value; CVAA: within ± 20% of true value.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable calibration verification.	Problem must be corrected. Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Low-level calibration check standard (ICP only)	Daily, after one-point ICAL.	Within ± 20% of true value.	Correct problem, then reanalyze.	Flagging criteria are not appropriate.	No samples may be analyzed without a valid low-level calibration check standard. Low-level calibration check standard should be less than or equal to the reporting limit.

Table 4-5
Quality Control Method Criteria for Metals and TCLP Metals by SW-846 6010B/7470A/7471A, Continued

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-7. Inorganic Analysis by Inductively Coupled Plasma (ICP) Atomic Emission Spectrometry and Atomic Absorption Spectrophotometry (AA) (Methods 6010 and 7000 Series) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Method blank	One per preparatory batch.	No analytes detected > ½ RL and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > RL (see Box D-1).	Correct problem, then see criteria in Box D-1. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid method blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Calibration blank	Before beginning a sample run, after every 10 samples, and at end of the analysis sequence.	No analytes detected > LOD.	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.	Apply B-flag to all results for specific analyte(s) in all samples associated with the blank.	
Interference check solutions (ICS) (ICP only)	At the beginning of an analytical run.	ICS-A: Absolute value of concentration for all non-spiked analytes < LOD (unless they are a verified trace impurity from one of the spiked analytes); ICS-AB: Within ± 20% of true value.	Terminate analysis; locate and correct problem; reanalyze ICS, reanalyze all samples.	If corrective action fails, apply Q-flag to all results for specific analyte(s) in all samples associated with the ICS.	
LCS containing all analytes to be reported	One per preparatory batch.	QC acceptance criteria specified by DoD, if available; see Box D-3 and Appendix G.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available (see full explanation in Appendix G).	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.

Table 4-5
Quality Control Method Criteria for Metals and TCLP Metals by SW-846 6010B/7470A/7471A, Continued

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-7. Inorganic Analysis by Inductively Coupled Plasma (ICP) Atomic Emission Spectrometry and Atomic Absorption Spectrophotometry (AA) (Methods 6010 and 7000 Series) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Matrix spike (MS)	One per preparatory batch per matrix (see Box D-7).	For matrix evaluation, use QC acceptance criteria specified by DoD for LCS.	Examine the project-specific DQOs. If the matrix spike falls outside of DoD criteria, additional quality control tests are required to evaluate matrix effects.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.
Matrix spike duplicate (MSD) or sample duplicate	One per preparatory batch per matrix (see Box D-7).	MSD: For matrix evaluation use QC acceptance criteria specified by DoD for LCS. MSD or sample duplicate: RPD ≤ 20% (between MS and MSD or sample and sample duplicate).	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	The data shall be evaluated to determine the source of difference.
Dilution test (ICP and GFAA only)	One per preparatory batch.	Five-fold dilution must agree within ± 10% of the original measurement.	ICP: Perform post-digestion spike (PDS) addition; GFAA: Perform recovery test.	Flagging criteria are not appropriate.	Only applicable for samples with concentrations > 50 x LOQ.
Post-digestion spike (PDS) addition (ICP only)	When dilution test fails or analyte concentration in all samples < 50 x LOD.	Recovery within 75-125% (see Table B-1).	Run all associated samples in the preparatory batch by method of standard additions (MSA) or see flagging criteria.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	Spike addition should produce a concentration of 10 – 100 x LOQ.
Recovery test (GFAA only)	When dilution test fails or analyte concentration in all samples < 25 x LOD.	Recovery within 85-115%.	Run all associated samples in the preparatory batch by method of standard additions (MSA) or see flagging criteria.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	
Method of standard additions (MSA)	When matrix interference is confirmed.	NA.	NA.	NA.	Document use of MSA in the case narrative.
Results reported between DL and LOQ	NA.	NA.	NA.	Apply J-flag to all results between DL and LOQ.	

Table 4-6
Quality Control Method Criteria for Explosives by USEPA SW-846 8330B

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-3. Nitroaromatics, Nitramines, and Nitrate Esters Analysis by High-Performance Liquid Chromatography (Method 8330B)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Demonstrate acceptable analytical capability	Prior to using any test method and at any time there is a significant change in instrument type, personnel, test method, or sample matrix.	QC acceptance criteria published by DoD, if available; otherwise, method-specified criteria.	Recalculate results; locate and fix problem, then rerun demonstration for those analytes that did not meet criteria (see Section C.1.f).	Flagging criteria are not appropriate.	This is a demonstration of analytical ability to generate acceptable precision and bias per the procedure in Appendix C. No analysis shall be allowed by analyst until successful demonstration of capability is complete.
LOD determination and verification (See Box D-13)					
LOQ establishment and verification (See Box D-14)					
Soil drying procedure	Each sample and batch LCS.	Laboratory must have a procedure to determine when the sample is dry to constant weight. Record date, time, and ambient temperature on a daily basis while drying samples.	NA.	Flagging criteria are not appropriate.	
Soil sieving procedure	Each sample and batch LCS.	Weigh entire sample. Sieve entire sample with a 10 mesh sieve. Breakup pieces of soil (especially clay) with gloved hands. Do not intentionally include vegetation in the portion of the sample that passes through the sieve unless this is a project specific requirement. Collect and weigh any portion unable to pass through the sieve.	NA.	Flagging criteria are not appropriate.	

Table 4-6
Quality Control Method Criteria for Explosives by USEPA SW-846 8330B, Continued

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-3. Nitroaromatics, Nitramines, and Nitrate Esters Analysis by High-Performance Liquid Chromatography (Method 8330B) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Soil grinding procedure	Initial demonstration.	The laboratory must initially demonstrate that the grinding procedure is capable of reducing the particle size to < 75 µm by passing representative portions of ground sample through a 200 mesh sieve (ASTM E11).	NA.	Flagging criteria are not appropriate.	
Soil grinding blank	Between each sample.	A grinding blank using clean solid matrix (such as Ottawa sand) must be prepared (e.g., ground and subsampled) and analyzed in the same manner as a field sample. Grinding blanks can be analyzed individually or composited. No target analytes detected greater than 1/2 Reporting Limit (RL).	All blank results must be reported and the affected samples must be flagged accordingly if blank criteria is not met.	If the composite grinding blank exceeds the acceptance criteria, apply B-flag to all samples associated with the grinding composite. If any individual grinding blank is found to exceed the acceptance criteria, apply B-flag to the sample following that blank.	
Soil subsampling process	Each sample, duplicate, and batch LCS.	Entire ground sample is mixed, spread out on a large flat surface (e.g., baking tray), and 30 or more randomly located increments are removed from the entire depth to sum a ~10 g subsample.	NA.	Flagging criteria are not appropriate.	
Soil sample triplicate	At the subsampling step, one sample per batch. Cannot be performed on any type of blank sample.	Three 10 g subsamples are taken from a sample expected to contain the highest levels of explosives within the Quantitation Range of the method. The RSD for results above the RL must not exceed 20%.	Corrective action must be taken if this criterion is not met (e.g., the grinding process should be investigated to ensure that the samples are being reduced to a sufficiently small particle size).	Apply J-flag if corrective action does not solve problem and no sample available.	

Table 4-6
Quality Control Method Criteria for Explosives by USEPA SW-846 8330B, Continued

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-3. Nitroaromatics, Nitramines, and Nitrate Esters Analysis by High-Performance Liquid Chromatography (Method 8330B) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Aqueous sample preparation	Each sample.	Solid phase extraction (SPE) using resin-based solid phase disks or cartridges is required. The salting-out procedure is not permitted.	NA.	Flagging criteria are not appropriate.	
Initial calibration (ICAL)	Minimum of 5 calibration standards with the lowest standard concentration at or below the RL. Once calibration curve or line is generated, the lowest calibration standard must be re-analyzed.	The apparent signal-to-noise ratio at the RL must be at least 5:1. If linear regression is used, r ≥ 0.995. If using Internal Standardization, RSD ≤ 15%.	Correct problem, then repeat ICAL.	Flagging criteria are not appropriate.	No samples can be run without a valid ICAL. Analysis by HPLC UV, LC/MS, or LC/MS/MS is allowed.
Second source calibration verification (ICV)	Immediately following ICAL.	All analyte(s) and surrogates within ± 20% of true value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be run until calibration has been verified.
Continuing calibration verification (CCV)	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All target analytes and surrogates within ± 20% of the expected value from the ICAL.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable calibration verification.	Problem must be corrected. Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Method blank	One per preparatory batch.	No analytes detected > ½ RL and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Correct problem, then see criteria in Box D-1. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid method blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.

Table 4-6
Quality Control Method Criteria for Explosives by USEPA SW-846 8330B, Continued

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-3. Nitroaromatics, Nitramines, and Nitrate Esters Analysis by High-Performance Liquid Chromatography (Method 8330B) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
LCS containing all analytes to be reported	One per preparatory batch.	A solid reference material containing all reported analytes must be prepared (e.g., ground and subsampled) and analyzed in exactly the same manner as a field sample. In-house laboratory control limits for the LCS must demonstrate the laboratory's ability to meet the project's MQOs.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available (see full explanation in Appendix G).	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Matrix Spike (MS)	One per preparatory batch per matrix (see Box D-7).	For matrix evaluation only, therefore is taken post grinding from same ground sample as parent subsample is taken. Percent recovery must meet LCS limits.	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.
Matrix spike duplicate (MSD) or sample duplicate	One per preparatory batch per matrix (see Box D-7).	For matrix evaluation only, therefore is taken post grinding from same ground sample as parent subsample is taken. Percent recovery must meet LCS limits and relative percent difference (RPD) < 20%.	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	The data shall be evaluated to determine the source of difference.

Table 4-6
Quality Control Method Criteria for Explosives by USEPA SW-846 8330B, Continued

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-3. Nitroaromatics, Nitramines, and Nitrate Esters Analysis by High-Performance Liquid Chromatography (Method 8330B) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Confirmation analysis	When target analytes are detected on the primary column using the UV Detector (HPLC) at concentrations exceeding the Limit of Detection (LOD).	Calibration and QC criteria are the same as for initial or primary column analysis. Results between primary and second column RPD ≤ 40%.	Report from both columns.	If there is a > 40% RPD between the two column results, data must be J-flagged accordingly.	Confirmation analysis is not needed if LC/MS or LC/MS/MS was used for the primary analysis. Secondary column – Must be capable of resolving (separating) all of the analytes of interest and must have a different retention time order relative to the primary column. Any HPLC column used for confirmation analysis must be able to resolve and quantify all project analytes. Detection by HPLC UV, LC/MS or LC/MS/MS. Calibration and calibration verification acceptance criteria is the same as for the primary analysis.
Results reported between DL and LOQ	NA.	NA.	NA.	Apply J-flag to all results between DL and LOQ.	

Table 4-7
Quality Control Method Criteria for Volatile Organic Compounds by SW-846 8260B and Semivolatile Organic Compounds by SW-846 8270C

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-4. Organic Analysis by Gas Chromatography/Mass Spectrometry (Methods 8260 and 8270)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Demonstrate acceptable analytical capability	Prior to using any test method and at any time there is a significant change in instrument type, personnel, test method, or sample matrix.	QC acceptance criteria published by DoD, if available; otherwise, method-specific criteria.	Recalculate results; locate and fix problem, then rerun demonstration for those analytes that did not meet criteria (see Section C.1.f).	NA.	This is a demonstration of analytical ability to generate acceptable precision and bias per the procedure in Appendix C. No analysis shall be allowed by analyst until successful demonstration of capability is complete.
LOD determination and verification (See Box D-13)					
LOQ establishment and verification (See Box D-14)					
Tuning	Prior to ICAL and at the beginning of each 12-hour period.	Refer to method for specific ion criteria.	Retune instrument and verify. Rerun affected samples.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be accepted without a valid tune.
Breakdown check (DDT Method 8270 only)	At the beginning of each 12-hour period, prior to analysis of samples.	Degradation ≤ 20% for DDT. Benzidine and pentachlorophenol should be present at their normal responses, and should not exceed a tailing factor of 2.	Correct problem then repeat breakdown check.	Flagging criteria are not appropriate.	No samples shall be run until degradation ≤ 20%.

Table 4-7
Quality Control Method Criteria for Volatile Organic Compounds by SW-846 8260B and Semivolatile Organic Compounds by SW-846 8270C, Continued

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-4. Organic Analysis by Gas Chromatography/Mass Spectrometry (Methods 8260 and 8270) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Minimum five-point initial calibration (ICAL) for all analytes	ICAL prior to sample analysis.	1. Average response factor (RF) for SPCCs: VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachlorolethane; ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane. SVOCs ≥ 0.050. 2. RSD for RFs for CCCs: VOCs and SVOCs ≤ 30% and one option below: Option 1: RSD for each analyte ≤ 15%; Option 2: linear least squares regression r ≥ 0.995; Option 3: non-linear regression–coefficient of determination (COD) r^2 ≥ 0.99 (6 points shall be used for second order, 7 points shall be used for third order).	Correct problem then repeat ICAL.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be run until ICAL has passed. Calibration may not be forced through the origin.
Second source calibration verification (ICV)	Once after each ICAL.	All project analytes within ± 20% of true value.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be run until calibration has been verified.
Retention time window position establishment for each analyte and surrogate	Once per ICAL.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA.	NA.	

Table 4-7
Quality Control Method Criteria for Volatile Organic Compounds by SW-846 8260B and Semivolatile Organic Compounds by SW-846 8270C, Continued

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-4. Organic Analysis by Gas Chromatography/Mass Spectrometry (Methods 8260 and 8270) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Evaluation of relative retention times (RRT)	With each sample.	RRT of each target analyte within ± 0.06 RRT units.	Correct problem, then rerun ICAL.	Flagging criteria are not appropriate.	Laboratories may update the retention times based on the CCV to account for minor performance fluctuations or after routine system maintenance (such as column clipping). With each sample, the RRT shall be compared with the most recently updated RRT. If the RRT has changed by more than ±0.06 RRT units since the last update, this indicates a significant change in system performance and the laboratory must take appropriate corrective actions as required by the method and rerun the ICAL to reestablish the retention times.
Continuing calibration verification (CCV)	Daily before sample analysis and every 12 hours of analysis time.	<u>1. Average RF for SPCCs</u>: VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachlorolethane; ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane. SVOCs ≥ 0.050. <u>2. %Difference/Drift for all target compounds and surrogates</u>: VOCs and SVOCs ≤ 20%D (Note: D = difference when using RFs or drift when using least squares regression or non-linear calibration).	DoD project level approval must be obtained for each of the failed analytes or corrective action must be taken. Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since last acceptable CCV.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since last acceptable CCV.	Problem must be corrected. Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed.

Table 4-7
Quality Control Method Criteria for Volatile Organic Compounds by SW-846 8260B and Semivolatile Organic Compounds by SW-846 8270C, Continued

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-4. Organic Analysis by Gas Chromatography/Mass Spectrometry (Methods 8260 and 8270) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Internal standards verification	Every field sample, standard, and QC sample.	Retention time ± 30 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions. Reanalysis of samples analyzed while system was malfunctioning is mandatory.	If corrective action fails in field samples, apply Q-flag to analytes associated with the non-compliant IS. Flagging criteria are not appropriate for failed standards.	Sample results are not acceptable without a valid IS verification.
Method blank	One per preparatory batch.	No analytes detected > ½ RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > RL (see Box D-1).	Correct problem, then see criteria in Box D-1. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid method blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
LCS containing all analytes to be reported, including surrogates	One per preparatory batch.	QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits. In-house control limits may not be greater than ± 3 times the standard deviation of the mean LCS recovery. See Box D-3 and Appendix G.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available (see full explanation in Appendix G).	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Matrix Spike (MS)	One per preparatory batch per matrix (see Box D-7).	For matrix evaluation, use LCS acceptance criteria specified by DoD, if available. Otherwise, use in-house LCS control limits.	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.

Table 4-7
Quality Control Method Criteria for Volatile Organic Compounds by SW-846 8260B and Semivolatile Organic Compounds by SW-846 8270C, Continued

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-4. Organic Analysis by Gas Chromatography/Mass Spectrometry (Methods 8260 and 8270) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Matrix spike duplicate (MSD) or sample duplicate	One per preparatory batch per matrix (see Box D-7).	MSD: For matrix evaluation, use LCS acceptance criteria specified by DoD, if available. Otherwise, use in-house LCS control limits. MSD or sample duplicate: RPD ≤ 30% (between MS and MSD or sample and sample duplicate).	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	The data shall be evaluated to determine the source of difference.
Surrogate spike	All field and QC samples.	QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits.	For QC and field samples, correct problem then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary.	Apply Q-flag to all associated analytes if acceptance criteria are not met.	Alternative surrogates are recommended when there is obvious chromatographic interference.
Results reported between DL and LOQ	NA.	NA.	NA.	Apply J-flag to all results between DL and LOQ.	

Table 4-8
Quality Control Method Criteria for Pesticides and PCBs by USEPA SW-846 8081A/8082

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-2. Organic Analysis by Gas Chromatography and High-Performance Liquid Chromatography (Methods 8011, 8015, 8021, 8070, 8081, 8082, 8121, 8141, 8151, 8310, 8330, and 8330A)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Demonstrate acceptable analytical capability	Prior to using any test method and at any time there is a significant change in instrument type, personnel, test method, or sample matrix.	QC acceptance criteria published by DoD, if available; otherwise, method-specified criteria.	Recalculate results; locate and fix problem, then rerun demonstration for those analytes that did not meet criteria (see Section C.1.f).	Not Applicable (NA).	This is a demonstration of analytical ability to generate acceptable precision and bias per the procedure in Appendix C. No analysis shall be allowed by analyst until successful demonstration of capability is complete.
LOD determination and verification (See Box D-13)					
LOQ establishment and verification (See Box D-14)					
Retention time (RT) window width calculated for each analyte and surrogate	At method set-up and after major maintenance (e.g., column change).	RT width is ± 3 times standard deviation for each analyte RT from a 72-hour study.	NA.	NA.	
Breakdown check (Endrin / DDT Method 8081 only)	At the beginning of each 12-hour period, prior to analysis of samples.	Degradation ≤ 15% for both DDT and Endrin.	Correct problem then repeat breakdown check.	Flagging criteria are not appropriate.	No samples shall be run until degradation ≤ 15% for both DDT and Endrin.

Table 4-8
Quality Control Method Criteria for Pesticides and PCBs by USEPA SW-846 8081A/8082, Continued

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-2. Organic Analysis by Gas Chromatography and High-Performance Liquid Chromatography (Methods 8011, 8015, 8021, 8070, 8081, 8082, 8121, 8141, 8151, 8310, 8330, and 8330A) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Minimum five-point initial calibration (ICAL) for all analytes	ICAL prior to sample analysis.	One of the options below: Option 1: RSD for each analyte ≤ 20%; Option 2: linear least squares regression: r ≥ 0.995; Option 3: non-linear regression: coefficient of determination (COD) r^2 ≥ 0.99 (6 points shall be used for second order, 7 points shall be used for third order).	Correct problem then repeat ICAL.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be run until ICAL has passed. Calibration may not be forced through the origin. Quantitation for multicomponent analytes such as chlordane, toxaphene, and Aroclors must be performed using a 5-point calibration. Results may not be quantitated using a single point.
Retention time window position establishment for each analyte and surrogate	Once per ICAL and at the beginning of the analytical shift.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA.	NA.	
Second source calibration verification (ICV)	Immediately following ICAL.	All project analytes within established retention time windows. <u>GC methods</u>: All project analytes within ± 20% of expected value from the ICAL; <u>HPLC methods</u>: All project analytes within ± 15% of expected value from the ICAL.	Correct problem, rerun ICV. If that fails, repeat ICAL.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be run until calibration has been verified.

Table 4-8
Quality Control Method Criteria for Pesticides and PCBs by USEPA SW-846 8081A/8082, Continued

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-2. Organic Analysis by Gas Chromatography and High-Performance Liquid Chromatography (Methods 8011, 8015, 8021, 8070, 8081, 8082, 8121, 8141, 8151, 8310, 8330, and 8330A) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Continuing calibration verification (CCV)	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All project analytes within established retention time windows. GC methods: All project analytes within ± 20% of expected value from the ICAL; HPLC methods: All project analytes within ± 15% of expected value from the ICAL.	Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable calibration verification.	Problem must be corrected. Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed. Retention time windows are updated per the method.
Method blank	One per preparatory batch.	No analytes detected > ½ RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results (see Box D-1).	Correct problem, then see criteria in Box D-1. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid method blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Laboratory control sample (LCS) containing all analytes to be reported, including surrogates	One per preparatory batch.	QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits. In-house control limits may not be greater than ± 3 times the standard deviation of the mean LCS recovery. See Box D-3 and Appendix G.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available (see full explanation in Appendix G).	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Matrix spike (MS)	One per preparatory batch per matrix (see Box D-7).	For matrix evaluation, use LCS acceptance criteria specified by DoD, if available. Otherwise, use in-house LCS control limits.	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.

Table 4-8
Quality Control Method Criteria for Pesticides and PCBs by USEPA SW-846 8081A/8082, Continued

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-2. Organic Analysis by Gas Chromatography and High-Performance Liquid Chromatography (Methods 8011, 8015, 8021, 8070, 8081, 8082, 8121, 8141, 8151, 8310, 8330, and 8330A) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Matrix spike duplicate (MSD) or sample duplicate	One per preparatory batch per matrix (see Box D-7).	MSD: For matrix evaluation, use LCS acceptance criteria specified by DoD, if available. Otherwise, use in-house LCS control limits. MSD or sample duplicate: RPD ≤ 30% (between MS and MSD or sample and sample duplicate).	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	The data shall be evaluated to determine the source of difference.
Surrogate spike	All field and QC samples.	QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits.	For QC and field samples, correct problem then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary.	Apply Q-flag to all associated analytes if acceptance criteria are not met.	Alternative surrogates are recommended when there is obvious chromatographic interference.
Confirmation of positive results (second column or second detector)	All positive results must be confirmed (with the exception of Method 8015).	Calibration and QC criteria same as for initial or primary column analysis. Results between primary and second column RPD ≤ 40%.	NA.	Apply J-flag if RPD > 40%. Discuss in the case narrative.	Use project-specific reporting requirements if available; otherwise, use method reporting requirements; otherwise, report the result from the primary column (see Box D-16).
Results reported between DL and LOQ	NA.	NA.	NA.	Apply J-flag to all results between DL and LOQ.	

Table 4-9
Quality Control Method Criteria for Dioxins/Furans by SW-846 8290

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-6. Dioxin/Furan Analysis by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (Method 8290)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Demonstrate acceptable analytical capability	Prior to using any test method and at any time there is a significant change in instrument type, personnel, test method, or sample matrix.	QC acceptance criteria published by DoD, if available; otherwise, method-specified criteria.	Recalculate results; locate and fix problem, then rerun demonstration for those analytes that did not meet criteria (see Section C.1.f).	NA.	This is a demonstration of analytical ability to generate acceptable precision and bias per the procedure in Appendix C. No analysis shall be allowed by analyst until successful demonstration of capability is complete.
LOD determination and verification (See Box D-13)					
LOQ establishment and verification (See Box D-14)					
Tuning	At the beginning and the end of each 12-hour period of analysis.	Static resolving power ≥ 10,000 (10% valley) for identified masses per method, <u>and</u> lock-mass ion between lowest and highest masses for each descriptor and level of reference compound ≤ 10% full-scale deflection, per method.	Retune instrument and verify. Rerun affected samples.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be accepted without a valid tune.

Table 4-9
Quality Control Method Criteria for Dioxins/Furans by SW-846 8290, Continued

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-6. Dioxin/Furan Analysis by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (Method 8290) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
GC column performance check	Prior to ICAL or calibration verification. Use GC performance check solution per method.	Peak separation between 2,3,7,8-TCDD and other TCDD isomers result in a valley of ≤ 25%, per method; and Identification of all first and last eluters of the eight homologue retention time windows and documentation by labeling (F/L) on the chromatogram; and Absolute retention times for switching from one homologous series to the next ≥ 10 sec. for all components of the mixture.	Correct problem then repeat column performance check.	Flagging criteria are not appropriate.	
Initial calibration (ICAL) for all analytes identified in method	ICAL prior to sample analysis, as needed by the failure of calibration verification standard, and when a new lot is used as standard source for HRCC-3, sample fortification (IS), or recovery solutions.	Ion abundance ratios in accordance with criteria in Table 8 of the method; and S/N ratio ≥ 10 for all target analyte ions; and RSD ≤ 20% for the response factors (RF) for all 17 unlabeled standards and RSD ≤ 20% for the RFs for the 9 labeled IS.	Correct problem, then repeat ICAL.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be run until ICAL has passed. Calibration may not be forced through origin.

Table 4-9
Quality Control Method Criteria for Dioxins/Furans by SW-846 8290, Continued

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-6. Dioxin/Furan Analysis by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (Method 8290) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Calibration verification	At the beginning of each 12-hour period, and at the end of each analytical sequence.	Ion abundance ratios in accordance with criteria in Table 8 of the method; <u>and</u> For unlabeled standards, RF within ± 20% D of RF established in ICAL; <u>and</u> For labeled standards, RF within ± 30% D of RF established in ICAL.	Correct problem, repeat calibration verification standard. If that fails, repeat ICAL and reanalyze all samples analyzed since the last successful CCV. <u>End-of-run CCV</u>: If the RF for unlabeled standards ≤ 25% RPD and the RF for labeled standards ≤ 35% RPD (relative to the RF established in the ICAL), the mean RF from the two daily CCVs must be used for quantitation of impacted samples instead of the ICAL mean RF value. If the starting and ending CCV RFs differ by more than 25% RPD for unlabeled compounds or 35% RPD for labeled compounds, the sample may be quantitated against a new initial calibration if it is analyzed within two hours. Otherwise reanalyze samples with positive detections if necessary.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last successful calibration verification.	Problem must be corrected. Results may not be reported without a valid calibration verification. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Method blank	One per preparatory batch, run after calibration standards and before samples.	Use project-specific criteria, if available. Otherwise, no analytes detected ≥ LOD for the analyte or ≥ 5% of the associated regulatory limit for the analyte or ≥ 5% of the sample result for the analyte, whichever is greater, per method.	Correct problem, then see criteria in Box D-1. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid method blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.

Table 4-9
Quality Control Method Criteria for Dioxins/Furans by SW-846 8290, Continued

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-6. Dioxin/Furan Analysis by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (Method 8290) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
LCS (or fortified field blank)	One per preparatory batch.	QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits. In-house control limits may not be greater than ± 3 times the standard deviation of the mean LCS recovery. See Box D-3 and Appendix G.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available (see full explanation in Appendix G).	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Sample duplicate	One per preparatory batch per matrix (see Box D-7).	RPD ≤ 25% (between sample and sample duplicate), per method.	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	
Matrix spike (MS)	One per preparatory batch per matrix (see Box D-7).	For matrix evaluation, use LCS acceptance criteria specified by DoD, if available. Otherwise, use in-house LCS control limits.	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.
Matrix spike duplicate (MSD)	One per preparatory batch per matrix (see Box D-7).	For matrix evaluation, use LCS acceptance criteria specified by DoD, if available. Otherwise, use in-house LCS control limits. RPD ≤ 20% (between MS and MSD) per method.	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	The data shall be evaluated to determine the source of difference.
Internal standards (IS)	Every field sample, standard, and QC sample.	% recovery for each IS in the original sample (prior to dilutions) must be within 40-135%, per method.	Correct problem, then reprep and reanalyze the samples with failed IS.	Apply Q-flag to results of all affected samples.	

Table 4-9
Quality Control Method Criteria for Dioxins/Furans by SW-846 8290, Continued

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-6. Dioxin/Furan Analysis by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (Method 8290) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Sample PCDD/PCDF identification	Identify all positive sample detections per method.	2,3,7,8-substituted isomers with labeled standards: Absolute RT at maximum height within -1 to +3 seconds of that for corresponding labeled standard; 2,3,7,8-substituted isomers with unlabeled standards: RRT within 0.005 RRT units of that in calibration verification standard; Non-2,3,7,8-substituted isomers: RT within RT window established by column performance check solution for corresponding homologue, per method; and Ions for quantitation must maximize simultaneously (± 2 sec.); and Ion abundance ratios in accordance with criteria in Table 8 of the method; and S/N ratio of ISs ≥ 10 times background noise; and S/N ratio of all remaining ions for unlabeled analytes ≥ 2.5 times background noise; and For PCDF: No signal present having a S/N ratio ≥ 2.5 for the corresponding ether (PCDPE) detected at the same retention time (± 2 sec).	Correct problem, then reprep and reanalyze the samples with failed criteria for any of the internal, recovery, or cleanup standards. If PCDPE is detected or if sample peaks present do not meet ion abundance ratio criteria, calculate the EMPC (estimated maximum possible concentration) according to method.	Flagging criteria are not appropriate.	Positive identification of 2,3,7,8-TCDF on the DB-5 or equivalent column must be reanalyzed on a column capable of isomer specificity (DB-225) (see method).

Table 4-9
Quality Control Method Criteria for Dioxins/Furans by SW-846 8290, Continued

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-6. Dioxin/Furan Analysis by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (Method 8290) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Sample specific estimated detection limit / estimated quantitation limit (EDL / EQL)	Calculated for each 2,3,7,8-substituted isomer that is not identified.	Per method.	NA.	Flagging criteria are not appropriate.	
Sample estimated maximum possible concentration (EMPC)	Every sample that indicates a detection ≥ 2.5 times S/N response.	Identification criteria per method must be met, and response for both quantitation ions must be ≥ 2.5 times S/N ratio for background.	NA.	Flag as appropriate.	
Sample 2,3,7,8-TCDD toxicity equivalents (TE) concentration	All positive detections, as required.	Per method.	NA.	Flagging criteria are not appropriate.	Recommended reporting convention by the EPA and CDC for positive detections in terms of toxicity of 2,3,7,8-TCDD.
Results reported between DL and LOQ	Positive detections calculated per method.	NA.	NA.	Apply J-flag to all results between DL and LOQ.	

Table 4-10
Quality Control Method Criteria for Cyanide by SW-846 9013A/9012B

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-10. Cyanide Analysis (Methods 9010, 9012, and 9014)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Demonstrate acceptable analytical capability	Prior to using any test method and at any time there is a significant change in instrument type, personnel, test method, or sample matrix.	QC acceptance criteria published by DoD, if available; otherwise use method-specified criteria.	Recalculate results; locate and fix problem, then rerun demonstration for those analytes that did not meet criteria (see Section C.1.f).	NA.	This is a demonstration of analytical ability to generate acceptable precision and bias per the procedure in Appendix C. No analysis shall be allowed by analyst until successful demonstration of capability is complete.
LOD determination and verification (See Box D-13)					
LOQ establishment and verification (See Box D-14)					
Initial calibration (ICAL) (six standards and a calibration blank)	Daily ICAL prior to sample analysis.	r ≥ 0.995.	Correct problem, then repeat ICAL.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be run until calibration has passed. All calibration standards must be distilled if samples are expected to contain sulfides.
Distilled standards (one high and one low)	Once per multipoint calibration.	Within ± 15% of true value.	Correct problem, then repeat distilled standards.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be run until distilled standards have passed.
Second source calibration verification (ICV)	Once after each ICAL, prior to beginning a sample run.	Within ± 15% of true value.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be run until calibration has been verified.

Table 4-10
Quality Control Method Criteria for Cyanide by SW-846 9013A/9012B, Continued

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Table F-10. Cyanide Analysis (Methods 9010, 9012, and 9014) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Method blank	One per preparatory batch.	No analytes detected > ½ RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > RL (see Box D-1).	Correct problem, then see criteria in Box D-1. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid method blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
LCS	One per preparatory batch.	QC acceptance criteria specified by DoD, if available; see Box D-3 and Appendix G.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available (see full explanation in Appendix G).	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Matrix spike (MS)	One per preparatory batch per matrix (see Box D-7).	For matrix evaluation, use QC acceptance criteria specified by DoD for LCS.	Examine the project-specific DQOs. If the matrix spike falls outside of DoD criteria, the method of standard additions shall be used for the analysis.	For the specific analyte in the parent sample, apply J-flag if acceptance criteria are not met.	If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.
Matrix spike duplicate (MSD) or sample duplicate (replicate)	One per preparatory batch per matrix (see Box D-7).	MSD: For matrix evaluation use QC acceptance criteria specified by DoD for LCS. MSD or sample duplicate: RPD ≤ 20% (between MS and MSD or sample and sample duplicate).	Correct problem and reanalyze sample and duplicate.	Apply J-flag if sample cannot be rerun or reanalysis does not correct problem.	The data shall be evaluated to determine the source of difference.
Results reported between DL and LOQ	NA.	NA.	NA.	Apply J-flag to all results between DL and LOQ.	

Table 4-11
Quality Control Method Criteria for Chemical Oxygen Demand by USEPA Methods for Chemical Analysis of Water and Wastes 410.4

Ref: Methods for the Examination of Water and Wastes (USEPA, 1983) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

Procedure	Frequency of QC Procedure	Acceptance Criteria	Corrective Action
Initial calibration curve 5-pt curve	Major maintenance, instrument modification, per manufacturer's specifications	$r \geq 0.995$ r: linear correlation coefficient Predicted response within ±10%	If outside criteria, the standards must be prepared again.
Initial calibration standard (calibration verification)	1 per batch	Recovery ±10% of true value.	If criteria are not met, reanalyze the daily standards. If the daily standard fails a second time, initial calibration must be repeated.
Continuing calibration verification (CCV)	Every 10 samples, end of analytical run	Recovery ±10% of true value.	Reanalyze CCV. If the CCV fails second time, the analysis must be terminated, the problem corrected, the instrument re-calibrated, and the calibration re-verified prior to continuing sample analyses.
Continuing calibration blank (CCB)	Every 10 samples, end of analytical run	<½ MRL	If not within criteria, terminate the analysis, correct the problem, re-calibrate, and reanalyze each sample analyzed since the last acceptable CCB.
Preparation reagent blank	1 per 20 samples or batch per matrix	<½ MRL	Documented source of contamination.
Laboratory control sample	1 per 20 samples per matrix	75%≤%Rec.≤125% or ± 3 standard deviations of the mean from historical data points.	Qualify associated data biased high or biased low as appropriate.
Matrix spike (MS) and duplicate	1 per 10 samples per batch, per matrix	75%≤%Rec.≤125% or ± 3 standard deviations of the mean from historical data points.	If MS recovery does not meet criteria, qualify results in accordance with Regional criteria.

4.7.2.2 On-Site Delineation Chemical Analyses Summaries

XRF Metals. Soil samples will be screened for arsenic, antimony, cadmium, copper, lead, and mercury using dispersive XRF technology following USEPA SW-846 Method 6200. With this technology, a sealed source of radiation is directed at the sample. The radiation excites the metals atoms in the sample, causing the emission of electrons in the form of photoelectrons. The atoms are thus converted into ions. To restore the atoms to a more stable state, electrons move to fill the empty electron orbitals. This movement causes an energy emission in the form of a secondary x-ray photon, which is referred to as fluorescence. Each element has a characteristic x-ray response, or wavelength, that is recorded by the instrument. The instrument identifies the specific element by the wavelength received. The amount, or concentration, of the element in the sample is determined by the number of the fluorescent x-rays. The instrument is calibrated prior to any measurements following manufacture specified guidelines.

4.7.2.3 Off-Site Post-Excavation Confirmation Chemical Analyses Summaries

Metals (excluding mercury). For soil samples, metals (excluding mercury) will be analyzed using inductively coupled plasma (ICP) techniques using USEPA SW-846 Methods 3050B/6010B. The ICP method involves the simultaneous or sequential multi-element assessment of trace elements in solution. The basis of the method is the measurement of atomic emission by optical spectrometry. Samples are nebulized and the aerosol that is produced is transported to the plasma torch where excitation occurs. Characteristic atomic-line emission spectra are produced by a radio-frequency ICP. A background correction technique is utilized to compensate for variable background contribution for the assessment of trace elements.

Mercury. For soil samples, mercury will be analyzed using cold vapor atomic absorption technique according to USEPA SW-846 Method 7471A for soil samples. A sample aliquot is initially digested with nitric acid to free combined mercury. The mercury is then reduced to its elemental state and aerated from the solution into a closed system. The mercury vapor is passed through a cell positioned in the path of the mercury light source, and the measured abundance is proportional to the concentration of mercury in the sample.

Explosives. Soil samples will be analyzed for explosives using USEPA SW-846 Method 8330B modified using high performance liquid chromatography using a dual wavelength ultraviolet detector. For soil samples, soil samples will be homogenized and analyzed using USEPA SW-846 Method 8330B modified. For SWMU 48 soil samples, the method modifications include discrete sampling (i.e., no field IS), no triplicate samples, no lab reference material standard, no puck mill grinding, and no grinding blank. Rather, a 10-g portion is taken for analysis and thoroughly mixed to allow for representative homogenizing. This is achieved by air-drying at room temperature for 24 hours, sieving through a 10-mesh sieve, grinding (mortar and pestle), and mixing the bulk sample. This is based upon the project DQOs. The modification also includes the subjectively removing vegetation (organic debris) and pebbles as well as the sampling and analysis of discrete samples (i.e., no field compositing). Soil samples will be extracted using acetonitrile in an ultrasonic bath, then filtered and data reduction similarly to that for the aqueous samples. Sample concentrations are to be confirmed on dissimilar columns.

4.7.2.4 Off-Site Waste Characterization Chemical Analyses Summaries

TCLP Extraction: Solid waste samples for disposal will undergo TCLP extraction by USEPA SW-846 Method 1311. For SWMU 48, this includes TCLP metals and TCLP SVOCs. Samples are separated by phase, particle size reduced (for solids), and extracted for 18 hours in an extraction fluid. The final liquid extract is separated from the solid material and combined with the initial liquid phase (if applicable). The sample TCLP extract is then treated as an aqueous sample for analysis of TCLP analysis following the analytical procedures noted below.

Metals (excluding mercury). For solid waste samples, TCLP metals (excluding mercury) will be analyzed using ICP techniques using USEPA SW-846 Methods 3010A/6010B for aqueous digestions after TCLP extraction. For aqueous waste samples, TAL metals will be analyzed for the using USEPA Methods 3010A/6010B. The ICP method involves the simultaneous or sequential multi-element assessment of trace elements in solution. The basis of the method is the measurement of atomic emission by optical spectrometry. Samples are nebulized and the aerosol that is produced is transported to the plasma torch where excitation occurs. Characteristic atomic-line emission spectra are produced by a radio-frequency ICP. A background correction technique is utilized to compensate for variable background contribution for the assessment of trace elements.

Mercury. For solid waste samples, TCLP mercury will be analyzed using cold vapor atomic absorption technique according to USEPA SW-846 Method 7470A after TCLP extraction. For aqueous waste samples, total mercury will be analyzed using cold vapor atomic absorption technique according to USEPA SW-846 Method 7470A. A sample aliquot is initially digested with nitric acid to free combined mercury. The mercury is then reduced to its elemental state and aerated from the solution into a closed system. The mercury vapor is passed through a cell positioned in the path of the mercury light source, and the measured abundance is proportional to the concentration of mercury in the sample.

TCLP SVOCs. The solid waste samples will be analyzed for TCLP SVOCs using USEPA SW-846 Method 8270C. The TCLP extracts will be extracted using a separatory funnel extraction technique according to USEPA SW-846 Method 3510C. The extract is injected into a gas chromatograph programmed to separate the compounds, which are then detected with a mass spectrometer. The gas chromatography/mass spectroscopy (GC/MS) instrument is calibrated for a series of target analytes using chemical standards of known concentration and purity. Quantification of these target analytes is performed against specific internal standards as identified in the respective method. Identification of these target analytes is based on a comparison of the analyte to the chemical standards used during calibration based on the analyte's retention time and mass spectra.

Explosives. The solid waste samples will be analyzed for explosives using USEPA SW-846 Method 8330B modified using high performance liquid chromatography using a dual wavelength ultraviolet detector. Solid samples will be homogenized and analyzed using USEPA SW-846 Method 8330B modified. For SWMU 48 IM, the method modifications include discrete sampling (i.e., no field IS), no triplicate samples, no lab reference material standard, no puck mill grinding, and no grinding blank. Rather, a 10-g portion is taken for analysis and thoroughly mixed to allow for representative homogenizing. This is achieved by air-drying at room temperature for 24 hours, sieving through a 10-mesh sieve, grinding (mortar and pestle), and mixing the bulk sample. This is based upon the project DQOs. The modification also includes the subjectively removing vegetation (organic debris) and pebbles as well as the sampling and analysis of discrete samples (i.e., no field compositing). Solid samples will be extracted using acetonitrile in an ultrasonic bath, then filtered and data reduction similarly to that for the aqueous samples. Sample concentrations are to be confirmed on dissimilar columns.

Dioxins/Furans. The solid waste samples will be analyzed for dioxins/furans using USEPA SW-846 Method 8290 using high-resolution gas chromatography (HRGC) and high-resolution mass spectrometry (HRMS) techniques. This method is specific for the analysis of 2,3,7,8-tetrachlorinated dibenzofuran, substituted penta-, hexa-, hepta- and octachlorinated dibenzo-p-dioxins and dibenzofurans in water and solid media. Solid samples are extracted in organic solvent methylene chloride or toluene. The extracts are injected into a high-resolution gas chromatograph programmed to separate the compounds, which are then detected with a high-resolution mass spectrometer. The HRGC/HRMS instrument is calibrated for a series of target analytes using chemical standards of known concentration and purity. Quantification of these target analytes is performed against specific internal standards as identified in the respective method. Identification of these target analytes is based on a comparison of the analyte to the chemical standards used during calibration based on the analyte’s retention time and mass spectra.

pH and Corrosivity as pH. pH and corrosivity as pH will be analyzed using USEPA SW-846 Method 9040C for aqueous waste samples and Method 9045D for solid waste samples. A sample pH is directly measured electrometrically using either a glass electrode in combination with a reference potential or a combination electrode. For solids, samples are mixed 1:1 with reagent water prior to measurement.

Total Sulfide: Reactive sulfide will be analyzed in solid samples as total sulfide using USEPA SW-846 Method 9030B. For acid-soluble sulfide samples, separation of sulfide from the sample matrix is accomplished by the addition of sulfuric acid to the sample. The sample is heated to 70EC and the hydrogen sulfide (H2S) which is formed is distilled under acidic conditions and carried by a nitrogen stream into zinc acetate gas scrubbing bottles where it is precipitated as zinc sulfide. For acid-insoluble sulfide samples, separation of sulfide from the sample matrix is accomplished by suspending the sample in concentrated hydrochloric acid by vigorous agitation. Tin(II) chloride is present to prevent oxidation of sulfide to sulfur by the metal ion [as in copper(II)], by the matrix, or by dissolved oxygen in the reagents. The prepared sample is distilled under acidic conditions at 100EC under a stream of nitrogen. Hydrogen sulfide gas is released from the sample and collected in gas scrubbing bottles containing zinc(II) and a strong acetate buffer. Zinc sulfide precipitates. The sulfide in the zinc sulfide precipitate is quantified titrimetrically by Method 9034 or by ion selective electrode, Method 9215.

Total Cyanide: Reactive cyanide will be analyzed in solid samples as total cyanide using USEPA SW-846 Methods 9013A/9012B. If the waste sample contains so much solid, or solids of such a size as to interfere with agitation and homogenization of the sample mixture in the distillation flask, or so much oil or grease as to interfere with the formation of a homogeneous emulsion, the sample may be extracted with water at pH 10 or greater, and the extract distilled and analyzed by Method 9012B. Samples that contain free water are filtered and separated into an aqueous component and a combined oil and solid component. The nonaqueous component may then be extracted, and an aliquot of the extract combined with an aliquot of the filtrate in proportion to the composition of the sample. Alternatively, the components may be analyzed separately, and cyanide levels reported for each component. However, if the sample solids are known to contain sufficient levels of cyanide (about 50 µg/g) as to be well above the limit of detection, the extraction step may be deleted and the solids analyzed directly by Method 9012B. This can be accomplished by diluting a small aliquot of the waste solid (1-10 g) in 500 mL water in the distillation flask and suspending the slurry during distillation with a magnetic stir-bar.

Ignitability. Ignitability is analyzed using USEPA SW-846 Method 1010A for aqueous samples and USEPA SW-846 Method 1030 for solid samples. A sample is heated at a slow, constant rate with continual stirring. A small flame is directed into the cup at regular intervals with simultaneous interruption of stirring. The flash point is the lowest temperature at which application of the test flame ignited the vapor above the sample.

Chemical Oxygen Demand. For aqueous waste samples, COD will be analyzed using *USEPA Methods for Chemical Analysis of Water and Wastes Method 410.4* (USEPA, 1983). A sample is heated under acidic conditions at a slow, constant rate in an oven or block digestor in the presence of dichromate at 150°C for 2 hours. The COD is measured at 600 nanometers spectrophotometrically.

4.7.2.5 Off-Site Borrow Material Characterization Chemical Analyses Summaries

TCL VOCs. Soil samples will be analyzed for TCL VOCs using USEPA SW-846 5035/8260B for soil matrices using purge and trap technology. Soil samples will be collected using either an EnCore sampling or Terra-core sampling device and subsequently sent to the laboratory for analysis. No sodium bisulfate will be added to the soils due to the possibility of effervescence and ketone formation. An inert gas is bubbled through a mixture of reagent water and 5-gram soil sample in a specifically designed purging chamber at 40°C. The vapor is swept through a sorbent column where the purgeable compounds were trapped. After purging was completed for both soil and aqueous samples, the sorbent column was heated and backflushed with the inert gas to desorb the purgeable compounds onto a gas chromatograph programmed to separate the purgeable compounds, which are then detected with a mass spectrometer. The GC/MS instrument is calibrated for a series of target analytes using chemical standards of known concentration and purity. Quantification of these target analytes is performed against specific internal standards as identified in the respective method. Identification of these target analytes is based on a comparison of the analyte to the chemical standards used during calibration based on the analyte's retention time and mass spectra.

TCL SVOCs. Soil samples will be analyzed for TCL SVOCs using USEPA SW-846 Method 8270C. The soil samples will be extracted using ultrasonic method USEPA SW-846 Method 3550C. The extract is injected into a gas chromatograph programmed to separate the compounds, which are then detected with a mass spectrometer. The GC/MS instrument is calibrated for a series of target analytes using chemical standards of known concentration and purity. Quantification of these target analytes is performed against specific internal standards as identified in the respective method. Identification of these target analytes is based on a comparison of the analyte to the chemical standards used during calibration based on the analyte's retention time and mass spectra.

TCL Pesticides and PCBs. The soil samples will be analyzed for TCL pesticides and PCBs using USEPA SW-846 Methods 8081A and 8082, respectively. Soil samples will be prepared for analysis using ultrasonic method USEPA SW-846 Method 3550C. The extract will be injected into a gas chromatograph programmed to separate the compounds, which are then detected with an electron capture detector. Sulfur cleanups will be employed to aid in the quantification based upon the matrix interferences. Sample concentrations are confirmed on dissimilar columns. Identification of these target analytes is based on a comparison of the analyte to the chemical standards used during calibration based on the analyte's retention time using primary and secondary columns.

TAL Metals (excluding mercury). The soil samples will be analyzed for TAL metals (excluding mercury) using ICP techniques using USEPA SW-846 Methods 3050B/6010B for soil samples. The ICP method involves the simultaneous or sequential multi-element assessment of trace elements in solution. The basis of the method is the measurement of atomic emission by optical spectrometry. Samples are nebulized and the aerosol that was produced was transported to the plasma torch where excitation occurs. Characteristic atomic-line emission spectra are produced by a radio-frequency ICP. A background correction technique is utilized to compensate for variable background contribution for the assessment of trace elements.

Mercury. The soil samples will be analyzed for mercury using cold vapor atomic absorption technique according to USEPA SW-846 Method 7471A. A sample aliquot is initially digested with nitric acid to free combined mercury. The mercury is then reduced to its elemental state and aerated from the solution into a closed system. The mercury vapor is passed through a cell positioned in the path of the mercury light source, and the measured abundance is proportional to the concentration of mercury in the sample.

4.7.3 Data Validation for Chemical Analyses

Data validation is the process whereby data are determined to be of acceptable or unacceptable quality based on a set of predefined criteria by Shaw. These criteria depend upon the type(s) of data involved and the purpose for which data are collected. Data packages will be validated to ensure project compliance with specified analytical, QA, and data reduction procedures; data reporting requirements; and required accuracy, precision, and completeness criteria. Full level data packages including the raw data will be provided for the full data validation samples. All parameters of interest for the post-excavation soil confirmation samples and borrow soil samples will be validated for the IM. The XRF delineation and waste characterization sample data will not require the full USEPA Region III data validation. The validation will be performed using USEPA Region III guidance. The Project Chemist will oversee the performance of data validation functions. Specific validation levels may be found in the DQO tables in *Section 4.3* of this QAPP. Data validation results will be reported with the final findings. Data will be validated using a combination of the following criteria:

- Project-specific Work Plan and/or QAPP criteria (**Tables 4-5 through 4-11**).
- Master Quality Assurance Plan (*Section 9.5*) requirements.
- DoD QSM V4.2 (DoD, 2010).
- Method-specific criteria following *USEPA OSWER Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), Update IV* (USEPA, 2007).
- Subcontract Laboratory SOPs.

Table 4-12 presents the laboratory and data validation qualifiers to be used for IM and are applied as appropriate. The laboratory qualifiers are as per DoD QSM, and the data validation qualifiers are consistent with the following USEPA guidance:

Table 4-12
Laboratory and Data Validation Qualifiers

Qualifier	Definition
Laboratory Qualifiers[1]	
U	Analyte was not detected and is reported as less than the reporting limit. The reporting limit has been adjusted for any dilution or concentration of the sample.
J	The reported result is an estimated value.
B	Blank contamination. The recorded result is associated with a contaminated blank.
N	Non-target analyte. The analyte is a tentatively identified compound using mass spectrometry.
Q	One or more quality control criteria failed.
USEPA Region III Data Validation Qualifiers[2]	
U	Not detected. The associated number indicates the compound reporting limit for the sample.
B	Not detected substantially above the level reported in laboratory or field blanks. The analyte was detected in the sample and the associated laboratory or field blank.
J	Analyte present. Reported value may not be accurate or precise.
K	Analyte present. Reported value may be biased high. Actual value is expected to be lower.
L	Analyte present. Reported value may be biased low. Actual value is expected to be higher.
UL	Not detected, quantitation limit is probably higher.
UJ	Not detected, quantitation limit may be inaccurate or imprecise.
N	Tentative Identification. Consider present. Special methods may be to confirm its presence or absence in future.
NJ	Qualitative identification questionable due to poor resolution. Presumptively present at approximate quantity.
R	Unreliable result. Analyte may or may not be present in the sample. Supporting data necessary to confirm result.

[1] The noted laboratory qualifiers are a minimum. If a laboratory has more and they are consistent with DoD and properly defined, the laboratory may use them. Data qualifiers may be combined when appropriate. Ref.: *DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2* (DoD, 2010).

[2] The USEPA data validation qualifiers are referenced from *USEPA Region III Modifications to the National Functional Guidelines for Organic Data Review Multi-media, Multi-concentration* (USEPA, 1994), *USEPA Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (USEPA, 1993), and *USEPA Region III Dioxin/Furan Data Validation Guidance* (USEPA, 1999).

- *USEPA Region III Modifications to the National Functional Guidelines for Organic Data Review Multi-media, Multi-concentration* (USEPA, 1994b).
- *USEPA Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (USEPA, 1993).
- *USEPA Region III Dioxin/Furan Data Validation Guidance* (USEPA, 1999).

Shaw will direct the overall data management. Data activity for the sampling program will be divided between Shaw and the subcontract laboratory. Each firm has the equipment needed to perform the required data management functions. The laboratory will perform data entry and manipulation operations associated with the analysis of raw analytical data and provisions of chemical analysis results by sampling location. These data will be transmitted to Shaw for evaluation and interpretation. Data generated will be assessed for accuracy, precision, comparability, representativeness, completeness, and sensitivity.

4.8 Corrective Action Procedures

Corrective action will be initiated through the development and implementation of routine internal QC checks. Specific limits beyond which corrective action is required will be established for each system. Corrective action requirements will be implemented in response to deficiencies encountered during system inspections. A closed-loop corrective action system will be used to address system and data quality issues. Steps comprising a closed-loop corrective action system include:

- Defining the problem.
- Assigning responsibility for problem investigation.
- Investigating and determining the cause of the problem.
- Assigning responsibility for problem resolution.
- Verifying that the resolution has corrected the problem.

Documentation will be done on all of the steps of the corrective action system, including the dates and parties involved. Such documentation will be reviewed during system inspections. Problems identified by assessment procedures will be resolved at the level it occurred with support from upper management. Problems that cannot be resolved at this level will be reported to the QC Manager for resolution, who will determine at which management level the problem can best be resolved, and will notify the appropriate manager.

Corrective actions will be categorized as either routine or non-routine and will require short-term or long-term action. Both types will require administrative coordination between the person initiating the corrective action and the QC staff.

4.8.1 Routine Corrective Action

Work plans and SOPs will establish technical procedures and the associated QC requirements. Where possible, SOPs will include specific criteria for determining the expected quality and examples of the appropriate corrective action procedures that may be taken if the criteria are not met. Routine corrective action will involve either short-term action for sporadic problems or long-term action for more chronic problems. Corrective action initiated at the project level will be reported to the QC Manager to ensure corrective action is implemented and the problem is resolved.

4.8.2 Non-Routine Corrective Action

Activities that are not covered by a specific SOP require an iterative process whereby the systems and QC specifications are estimated prior to the activity, and adjustments are made, as needed, during the course of the activity. Documentation on the corrective action requirements, the assignment of responsibility for corrective action, due dates for completion of corrective action, and validation of completion will be maintained. Such documentation will be reviewed during system inspections.

Problems identified by assessment procedures will be resolved at the level it occurred with support from upper management. Problems that cannot be resolved at this level will be reported to the QC Manager for resolution, who will determine at which management level the problem can best be resolved, and will notify the appropriate manager.

4.8.3 Quality Improvement

The Shaw Quality Improvement Process (QIP) comprises the internal systems that evaluate our quality program's effectiveness in ensuring and continually improving the quality of our work. The primary goals of our QIP and the QC program defined in this document are to prevent non-conformances and facilitate continual process improvement. The Shaw QIP is based on problem prevention, resolution, and corrective action. QIP goals include the timely identification and resolution of the quality problems in a manner that minimizes their impact on work products and prevents their reoccurrence. To the extent that the first of these goals is not achieved, identified deficiencies or non-conformances are to be corrected in a timely and cost-effective manner and with the intent of preventing their recurrence. This QC Plan includes provisions for preventing quality problems and facilitating process improvements as well as for identifying, documenting, and tracking deficiencies until corrective action has been verified.

Project staff is encouraged to provide recommendations for improvements in established work processes and techniques. The intent is to identify activities that are compliant but can be performed in a more efficient or cost-effective manner. Typical quality improvement recommendations include identifying an existing practice that should be improved (e.g., a bottleneck in production) and/or recommending an alternative practice that provides a benefit without compromising prescribed standards of quality. Project staff is encouraged to bring their recommendations to the attention of project management or the QC staff through verbal or written means. Deviations from established protocols will not be implemented without prior written approval by the USACE Project Manager and concurrence of the Shaw CQC Systems Manager. Prior to receipt of such approvals, the Shaw Project Manager will determine whether the change requires a modification to the Work Plan or a generation of a Project Procedure. If so, proposed changes to the Work Plan and protocols will be evaluated and implemented in accordance with the process described herein. Where a staff-initiated recommendation results in a tangible benefit to the project, acknowledgment will be given by the Shaw Project Manager.

4.8.4 Problem Prevention

The preventive action program is intended to identify problems before they are adverse to quality. Inspections, self-assessments, and peer review are examples of the tools that will be used by the project staff to identify potential quality problems. Input regarding project operations will be regularly sought from clients, subcontractors, and staff. The Project Manager will foster a no-fault attitude for problem identification, and staff is encouraged to identify process improvement opportunities, problems, and solutions. While the entire QC program is directed towards problem prevention, certain elements of the program have greater potential to be proactive. The primary tools for problem prevention on this project and the specific sections of this QAPP where they are addressed include: a project organization, instrument calibration, preventive maintenance, and QC data checks and inspections. Should these preventive measures fail, tracking and communicating deficiencies provides a mechanism for preventing their recurrence.

4.8.5 Stop Work Protocols

All Shaw personnel have the authority to issue a stop work order. A stop work order will be issued under conditions such that the quality of work jeopardizes the attainment of the project objectives. A stop work order must not create an operational, safety, public health, or environmental hazard. Under a stop work order, work may not be conducted within affected activities until the responsible manager acknowledges the implementation of a corrective action in accordance with the resolution criteria of the order. Immediate notification of work stoppage must be made to the Project Manager, SSHO, QA Manager, CQC System Manager, and Program Manager. Proper notification will also be made to the USACE.

4.9 Quality Assessments

This section discusses the inspection program used to monitor the total measurement system and to evaluate the quality of operation in the field and at the laboratory. A performance inspection is a planned independent check of the operation of a system to obtain a quantitative measure of the quality of data generated, and involves the use of standard reference samples or materials which are certified as to their chemical composition or physical characteristics. Systems inspection is of a qualitative nature and consists of on-site review of a system's QA system and physical facilities for sampling/analysis, calibration, and measurement.

4.9.1 Document Review

Project plans will be reviewed and approved prior to implementation. The Project Manager and QC Manager will provide a qualitative self-evaluation for establishing whether the prevailing management structure, polices, practices, and procedures are adequate to ensuring that the results needed are obtained. The Project Manager will provide an independent qualitative evaluation of a particular program operation and/or organization to establish whether the prevailing management structure, policies, practices, and procedures are adequate for ensuring that the results needed are obtained.

4.9.2 Document Control

The goal of Shaw's Document Control Program is to ensure that the project documents issued or generated will be accounted for upon completion of the project. The program includes a numerical document control system, document inventory procedure, and a central filing system with a designated person(s) responsible for its maintenance. Documents used or generated during the course of the project are accounted for and become a part of the project files upon completion of the task. These may include, but are not limited to, the following:

- Project deliverables.
- Investigation requirements.
- Reports and correspondence material.
- Contract documents.

5.0 ENVIRONMENTAL PROTECTION PLAN

This section was developed to address environmental considerations during the performance of IM at SWMU 48. The objective of this section is to provide adequate procedures to safeguard the environmental condition of RFAAP property in and around disturbed areas, and to mitigate and/or minimize the environmental impact of IM.

Environmental pollution and damage is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the utility of the environment for aesthetic, cultural and/or historical purposes. The control of environmental pollution and damage requires consideration of land, water, and air, and includes management of visual aesthetics, noise, solid waste, as well as other pollutants.

For the soil removal action at SWMU 48, the Site Superintendent will coordinate all land resource management, waste management, pollution control, and abatement activities, and ensure compliance with the Environmental Protection Plan by all subcontractors.

5.1 Applicable Regulations

Shaw will follow all applicable regulations and obtain all necessary permits concerning environmental protection, pollution control, and abatement necessary for the proposed field operations. Applicable regulations include, but are not limited to:

- Fish and Wildlife Coordination Act (16 USC 661).
- Migratory Bird Treaty Act (16 USC 703).
- Endangered Species Act (16 USC 1531, 50 CFR 402).
- Hazardous Materials Transportation Act (49 USC 1801-1812).
- Noise Pollution and Abatement Act (42 USC 4901).
- Land Disposal Restrictions (40 CFR 268).
- Erosion and Sediment Control (4 VAC 50-30-40).
- Stormwater Management (9 VAC 25-690).
- Visible Emissions and Fugitive Dust/Emissions (9 VAC 5-50).
- Virginia Air Quality Standards (9 VAC 5-50 and 9 VAC 5-30).

5.2 Pre-Construction Survey of Existing Conditions

A survey of environmental conditions will be performed prior to performance of IM actions. This survey will include written records and photographs. Specifically, the status of the trees, roadways, utilities, and other site characteristics will be documented to establish a pre-IM record of initial site conditions. This survey record will be used to restore the site to as close to pre-IM conditions as possible, where applicable, as well as document pre-existing conditions for contractor liability purposes.

5.3 Previously Used Equipment

All previously used equipment shall be cleaned before it is brought into a new work area, ensuring that soil residuals are removed and that egg deposits from pests are not present.

5.4 Protection of Land Resources

Removal activities will be confined to areas defined in the Operations and Technical Approach Plan, *Section 2.0*. Prior to the start of removal activities, Shaw will identify the land resources to be preserved within the work areas. Except for those areas indicated in *Section 2.0*, Shaw will not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without permission from ATK and the RFAAP Environmental Office. No ropes, cables, or guys will be fastened to or attached to any trees for anchorage unless authorized. When such use is permitted, Shaw will provide protection for land and vegetation resources. Stone, earth, or other material displaced into uncleared areas will be removed.

5.4.1 Work Area Limits/Traffic Control

Prior to start of removal actions, Shaw will mark any areas that need not be disturbed. Isolated areas within the general work area, which are to be saved and protected, shall also be marked or fenced. Shaw personnel and subcontractors will be informed of the purpose for marking and/or protecting particular objects.

Outside of designated work areas, all personnel and subcontractor equipment and vehicles will remain on established or paved roadways in order to prevent damage of manicured lawns and green spaces as well as to limit the amount of mud transported onto base and public roadways.

5.4.2 Landscape

Trees, shrubs, vines, grasses, land forms, and other landscape features indicated in *Section 2.0* to be preserved shall be clearly identified by marking, fencing, or wrapping with boards, or any other approved technique.

5.4.3 Unprotected Erodible Soils

All earthwork will be completed as planned. Side slopes and back slopes shall be protected as soon as practicable upon completion of rough grading. All earthwork shall be planned and conducted to minimize the duration of exposure of unprotected soils. Except in cases where the constructed feature obscures waste material areas, these areas will not initially be totally cleared. Clearing of such areas will progress in reasonably sized increments, as needed.

5.4.4 Disturbed Areas

Erosion and sedimentation control will be effectively implemented through control of surface runoff and installation of erosion and sedimentation control devises, as needed. Runoff from the removal site or from storms shall be controlled, retarded, and diverted to protected drainage courses by means of diversion ditches, benches, berms, or other structure. Temporary erosion and sedimentation control features will be installed as needed. A detailed E&SCP is provided as *Section 6.0* to this IMWP.

5.4.5 Staging and Work Areas

Staging areas will be located as designated in the Operations and Technical Approach Plan, *Section 2.0*. Relocation of areas will be made with approval from ATK and the RFAAP Environmental Office.

5.5 Water Resources

Removal activities will be managed and controlled to avoid pollution of surface water and groundwater. Toxic or hazardous chemicals will not be applied to soil or vegetation as part of IM actions. The management of erosion and sedimentation is presented in the E&SCP, *Section 6.0*.

5.5.1 Waste Waters

Waste waters will be generated from decontamination operations including general equipment decontamination. Waste waters will be collected in storage tanks or drums. Sampling and analysis will be performed to determine the proper disposal requirements for the water.

5.5.2 Diversion Operations

Removal operations involving dewatering activities will be controlled at all times to limit the impact of water turbidity on the habitat for wildlife and on water quality for downstream use.

5.5.3 Fish and Wildlife

Interferences with, disturbances to, and damage of fish and wildlife will be minimized during removal actions. No federally listed, or proposed endangered, or threatened species are known to exist in this area at RFAAP.

5.6 Air Resources

Dust particles generated from removal activities will be controlled at all times. Excavations, haul roads, work sites, and other areas will be maintained so as not to cause air pollution standards to be exceeded or which would cause a hazard or nuisance. Water sprinkling or other methods will be used to control particulates in the work areas as work proceeds and whenever a hazard or nuisance occurs. The performance of air monitoring during removal action work is described in the SSHP, *Section 8.0*.

Hydrocarbons and carbon monoxide emissions from equipment will be controlled to federal and state allowable limits.

5.7 Noise

Removal actions will be managed and controlled to minimize environment damage by noise.

5.8 Waste Disposal

Waste handling, transportation, and disposal will be performed in accordance with the WTDP, *Section 7.0*, and as specified below.

5.8.1 Solid Wastes

Solid wastes will be direct loaded in dump trucks and transported off site for disposal. Handling and disposal will be conducted to prevent contamination. Segregation measures will be employed so that no hazardous or toxic waste will become co-mingled with solid waste. Solid waste generated as part of IM actions will be transported off site and disposed in compliance with federal, state, and local requirements.

5.8.2 Chemical Wastes

Chemicals shall be dispensed ensuring no spillage to the ground. Periodic inspections of dispensing areas to identify leakage and initiate corrective action will be performed and documented. Chemical waste will be collected in corrosion resistant, compatible containers. Collection drums shall be monitored and removed to a staging or storage area when contents are within 6 inches of the top. Waste generated as part of removal actions will be transported off site and disposed of in compliance with federal, state, and local requirements.

5.8.3 Hazardous Waste

Sufficient measures will be taken to prevent spillage of hazardous and toxic materials during dispensing and waste will be collected in suitable, compatible containers. Waste generated as part of removal actions will be transported off site and disposed of in compliance with federal, state, and local requirements. Soil containing leachable concentrations greater than the TCLP Regulatory Levels will be treated as hazardous waste. Spills of hazardous or toxic materials will be immediately (within 20 minutes) reported using the spill notification procedures presented in *Section 5.15.5*.

5.9 Burning

No burning is allowed, nor will be conducted, during IM actions.

5.10 Historical, Archaeological, and Cultural Resources

There have not been any historical, archaeological, or cultural resources identified in the SWMU 48 area. If during excavation or other IM activity, any previously unidentified or unanticipated resources are discovered or found, all activities that may damage or alter such resources will be temporarily suspended. These resources include, but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rocks or coral alignments, pavings, wall, or other constructed features; and any indication of agricultural or other human activities. Upon such a discovery or find, the USACE Project Officer will be immediately notified.

5.11 Post-Removal Cleanup

Following IM actions, all areas used as part of IM activities will be cleaned up.

5.12 Restoration of Landscape Damage

Any landscape features damaged or destroyed outside the limits of the approved work areas during IM activities will be restored.

5.13 Maintenance of Pollution Control Facilities

Permanent and/or temporary pollution control facilities and devices will be maintained for the length of time IM activities create the particular pollutant.

5.14 Training of Personnel

Shaw and subcontractor personnel will be instructed on all phases of this Environmental Protection Plan prior to starting removal work to ensure adequate and continuous environmental pollution control.

5.15 Spill Prevention and Response

The following sections describe the type/amount of potential spills that could occur during removal actions, spill prevention and control measures, spill countermeasures, spill response equipment, and spill notification procedures.

5.15.1 Potential Spill Types

Potential spill types that may occur during the SWMU 48 IM actions include waste liquids (decontamination liquids, excavation water, etc.), waste solids (soils, etc.), and materials brought on site for IM work that contain hazardous constituents.

The only hazardous liquids that will be brought and stored on site for IM actions will be small quantities of gasoline and diesel, motor oil, paints, and solvents. Throughout operations, these materials will be stored and transported in approved containers.

5.15.2 Spill Prevention

- Wastes collected from the IM actions will be properly containerized, stored, treated, and disposed in accordance with applicable federal and state regulations.
- Equipment fueling and/or lubrication will be performed utilizing drip pans to contain any spills which may occur.
- Wastes and/or chemicals will be stored in a manner to prevent contact with stormwater, including the use of tarpaulins and/or storage under a roofed structure.
- All storage containers for liquid storage will be certified for aboveground use.
- The storage drums/containers will be inventoried periodically to determine if leakage is occurring, and the exterior of the tanks will be examined.
- All transport drivers will be trained in Department of Transportation (DOT) and USEPA spill prevention measures.
- The transport driver will be required to remain on duty and with his truck during filling operations to protect against spills.
- The volume of waste material will be calculated prior to filling drums or containers.
- No pump operations are to continue unless attended constantly.
- Personnel training will be conducted on spill prevention, containment, and retrieval methods at the start of IM work.
- Phone numbers will be posted regarding the report of a spill to the response agencies and the state.

5.15.3 Spill Countermeasures

- Any fuel leakage, oil drips, or hydraulic line rupture that may occur during the operation of trucks, heavy equipment, etc., will be immediately cleaned up.
- Any spill of hazardous materials will be reported through the local spill response system and addressed immediately.
- Emergency containment action will consist of placing absorbent materials around the site of the spill.

- Accidental spills will be cleaned up immediately. The spilled medium (liquid or solid) will be collected and containerized awaiting waste characterization, transportation, and disposal.

5.15.4 Spill Mitigation Equipment

The following spill mitigation equipment will be available on site for use during the removal actions:

- Drip pans.
- Shovels.
- 55-gallon drums (for containerization).

5.15.5 Notification Procedures

If a spill occurs on site, the following notification procedure will be initiated immediately (within 20 minutes max):

1.	Steve Kritak, Site Superintendent	(540) 922-3316
2.	RFAAP Security Dispatcher	(540) 639-7323
	-or-	(540) 639-7324
	-or-	(540) 639-7325
3.	Rob Davie	(540) 239-4475 (cell)
4.	Jerry Redder	(540) 659-7536
	-or-	(540) 577-9594 (pager)
5.	Jim McKenna	(540) 731-5782
6.	Brad Jennings	(540) 731-5781
7.	Jeffrey Hillebrand, Shaw IM Task Manager	(410) 612-6354
8.	Doug Russell, Shaw Health and Safety Manager	(865) 692-3584
9.	Jeff Parks, Shaw RFAAP Project Manager	(410) 612-6326
10.	Tom Meyer, USACE Project Officer	(410) 962-7677

6.0 EROSION AND SEDIMENT CONTROL PLAN

The purpose of this E&SCP is to provide a document that defines the steps which will be taken to minimize and/or eliminate erosion and sedimentation during completion of the SWMU 48 IM. This plan has been developed in accordance with the guidelines provided in 4 VAC 50-30-40, the Virginia Erosion and Sediment Control Regulations. The following five basic principles along with environmental concerns should be considered when developing an E&SCP:

- Plan the development to fit the site – areas of high erosion potential should be left undisturbed whenever possible.
- Expose the smallest practical area of land for the shortest possible time – when soil disturbances occur and the natural vegetation is removed, the extent and duration of exposure should be minimized.
- Apply erosion control as a first line of defense against on-site damage – implementing practices that prevent or minimize erosion on a construction site is called "erosion control."
- Use sediment control practices as perimeter protection to prevent off-site damage – controls placed along the perimeter of a site to collect eroded sediments must be implemented.
- Implement a thorough maintenance and follow-up operation – a site must have thorough periodic maintenance checks of soil erosion and sediment control practices.

6.1 Plan Approval

According to 4 VAC 50-30-40, an E&SCP is required for approval by VDEQ for all land clearing, grading or other earth disturbances, with the exception of projects involving less than 1 acre of grading. As discussed below, the SWMU 48 IM are not anticipated to involve grading work greater than or equal to 1 acre; therefore, review and approval of this plan by VDEQ is not required.

6.2 Erosion and Sediment Control Plans

The scope of the SWMU 48 IM was previously described in the Organization and Technical Operations Plan (*Section 2.0*) and includes contaminated soil removal activities. The total area to be disturbed may be 700 square yards (approximately 0.144 acres). Further, all land-disturbing activities will be planned and conducted to minimize the size of the area to be exposed at any one time and the length of the time of exposure if additional areas are to be impacted.

All land-disturbing activities will be planned and conducted to minimize the size of the area to be exposed at any one time and the length of the time of exposure. Surface water runoff originating upgrade of the exposed areas should be controlled to reduce erosion and sediment loss during the time of exposure. If needed, temporary sump pumps will be used in excavations to control accumulation of standing water. All surface water that contacts exposed contaminated areas will be pumped into storage tanks for subsequent characterization and disposal.

The following subsections summarize the site-specific E&SC Plans for each of the planned removal actions.

6.2.1 SWMU 48 IM

SWMU 48 IM will consist of excavating the area to a depth of approximately 10-15 ft bgs at the deepest locations. Determination of whether or not removal will occur will be based on soil visual observation of the ash layer and XRF confirmation samples. Sludge material and grossly-contaminated soil will be excavated and direct loaded into trucks and disposed off site.

Excavated areas will be immediately backfilled with clean soil following receipt of confirmation samples indicating removal to below the industrial RG has been achieved. A silt fence will not be required for sediment and erosion control at SWMU 48. Due to the flat topography of the site, movement of soil/contamination due to rain events or remediation activities from the site is not anticipated.

6.3 Dust Control

Field operations at SWMU 48 will be conducted in a manner that produces minimal dust and/or air pollution. Dust control measures such as water spray will be utilized if dusty conditions exist.

6.4 Installation and Maintenance of Erosion and Sediment Control Structures

Erosion and sediment control structures shall be installed and maintained according to minimum standards and specifications of 4 VAC 50-30-40. As indicated previously, the following erosion and sediment control standards and specifications are anticipated to be used during remedial activities:

- Silt Fence – Provides instructions for the design and installation of silt fence.
- Vegetative Stabilization – Describes vegetative stabilization methods and materials, and temporary and permanent seeding requirements.
- Erosion Control Matting – Describes use and installation of erosion control matting.
- Tree Protection – Describes applicable conditions for and use of tree protection measures.
- Material Specifications – Describes the different classifications of geotextile fabrics for silt fence.
- Dust Control – Provides temporary and permanent methods of controlling dust blowing and movement.

Erosion control measures will be established at the beginning of removal action work and maintained during the entire period of work. Erosion control measures will be repaired or replaced as needed.

E&SC structures, disturbed areas, and areas used for storage of materials exposed to precipitation shall be inspected every 7 days and within 24 hours of the end of a storm event that has rain accumulation of 0.5 inches or greater. Cleanout or replacement of structures will be performed immediately to prevent sediments from entering a live watercourse and discharging off site.

Locations where vehicles enter or exit the sites shall be inspected for evidence of sediment tracking. Construction vehicles and equipment shall be appropriately decontaminated during the course of the IM actions, if necessary.

7.0 WASTE TRANSPORTATION AND DISPOSAL PLAN

The primary objective of this WTDP and the activities mandated by the plan is the safe handling, transportation, and disposal of contaminated materials resulting from IM actions at SWMU 48. This objective will be achieved through compliance with local, state, and federal regulations, and the requirements of this plan. The WTDP details the waste management responsibilities of Shaw and subcontractor personnel and identifies potential waste streams. It also describes the waste management practices that will be implemented for minimizing, segregating, packaging, staging, tracking, and transporting and disposing of the generated wastes.

A secondary objective of the WTDP is the handling of generated waste in a cost-effective manner. This will be accomplished by three activities:

- Waste minimization.
- Waste segregation.
- Waste classification.

These activities begin with the design of the individual removal actions and are integrated into the planning and execution of waste management activities associated with the overall project.

7.1 Regulatory Requirements

Wastes generated during IM actions at SWMU 48 will be handled, staged, labeled, transported, and disposed in full compliance with local, state, and federal regulations. Applicable local, state, and federal regulations governing the treatment, storage, transportation, and disposal of wastes include, but are not necessarily limited to, the following:

- 40 CFR 261: Identification and Listing of Hazardous Waste.
- 40 CFR 262: Standards Applicable to Generators of Hazardous Waste.
- 40 CFR 263: Standards Applicable to Hazardous Waste Transporters.
- 40 CFR 268: Land Disposal Restrictions.
- 40 CFR 270: Regulations controlling the transportation, manifesting, and disposal of hazardous waste.
- 49 CFR 171-179: DOT regulations on the packaging and shipping of hazardous materials and samples.
- 9VAC 20-60-261: Standards Applicable to Generators of Hazardous Waste.
- 9 VAC 20-60-268: Land Disposal Restrictions.
- 9 VAC 20-60-263: Regulations Applicable to Transporters of Hazardous Waste.
- 9 VAC 20-110: Transportation of Hazardous Materials.
- 9 VAC 20-60-264 Subparts C, Preparedness and Prevention; and Subpart D, Contingency Plan and Emergency Procedure.
- 9 VAC 20-60-264 Subpart E, Manifest System, Recordkeeping, and Reporting.

7.2 Anticipated Waste Streams

This section presents a brief overview of the anticipated wastes that may be generated during IM actions at SWMU 48. Waste can be divided into two primary categories which include:

- Remediation-derived wastes (RDW).
- Secondary waste.

A summary of anticipated wastes that will be generated from the IM actions are described below.

7.2.1 Remediation-Derived Wastes

RDW are those wastes that are generated through the removal of original, pre-existing contaminated material from the site. Anticipated RDW for each the removal action includes, but is not limited to, contaminated soil.

7.2.2 Secondary Wastes

Secondary wastes will be produced by the contractor during the course of the IM work. Examples of secondary wastes that may be produced are:

- Non-hazardous trash and potentially contaminated materials.
- IDM from sampling activities.
- Personal protective equipment (PPE).
- Temporary facilities (such as decon pads, and erosion and sediment control materials).
- Decontamination water.

Production of secondary wastes will be minimized to the fullest extent possible, typically by the segregation of hazardous and non-hazardous materials. When produced, wastes will typically be co-disposed with the RDW. Where co-disposal results in significant additional costs or is not possible due to incompatibilities with the selected disposal/treatment/recycling method, alternative means of characterization/disposal for secondary wastes will be considered.

7.3 Waste Management Procedures

7.3.1 Waste Minimization

Waste minimization is a primary objective during the design and implementation of the IM actions at SWMU 48. The principal components of this program include:

- Control of waste removal to prevent over-excavation.
- Segregation of waste streams.
- Minimization or elimination of hazardous material that must be used.
- Strict inventory control of hazardous material.

Where a waste stream (such as potentially contaminated soil) has the potential to exhibit differing characteristics, each waste stream will be segregated. Wastes will be segregated into the following groupings:

- Uncontaminated material.
- Potentially contaminated material.
- Contaminated material.

Potentially contaminated and contaminated materials may be further subdivided into different groups by contaminant types such as:

- Hazardous (“RCRA”) waste.
- Non-hazardous solid waste.

Waste characterization for certain waste streams will be attempted prior to or at the beginning of IM activities, in order to minimize waste storage and holding time prior to transportation and disposal.

Generation of secondary waste will typically occur prior to receipt of complete analytical results. Decisions regarding waste segregation will be based on knowledge of the waste and appearance. This segregation will minimize the mixing of contaminated and uncontaminated materials.

Each of the above steps will reduce the amount of contaminated wastes being generated. Audits will be conducted by the CQC Systems Manager to monitor the waste minimization activities.

7.3.2 On-Site Waste Labeling

Following the generation of waste, each container will be clearly labeled with the following information:

- Waste generation activity and location collected.
- Identification numbers.
- Contents of the container (type of material and expected hazard level).
- Accumulation start date.
- The words “HAZARDOUS WASTE” if the waste is hazardous or may be hazardous.
- Comments/special handling instructions.

This information will be augmented as needed according to applicable requirements during off-site transportation and disposal.

7.3.3 Sampling and Characterization

Each waste stream generated during the IM work will be characterized within 30 days of completion of waste stream generation. Waste characterization sampling and analysis will be performed by Shaw in accordance with the provisions in the FSP (*Section 3.0*) and the QAPP (*Section 4.0*). Based on the analytical results for the waste characterization samples, the wastes will be classified in accordance with Virginia and USEPA waste classification systems. The waste classification will define the waste storage, transportation, and disposal requirements that are applicable. Waste profile sheets for the disposal of each waste will then be prepared in accordance with the requirements of the disposal facility. If required by the disposal facility for acceptance of the waste, additional waste analysis will be conducted beyond that specified in **Table 3-1**.

7.3.4 Recordkeeping

Shaw will maintain an inventory of waste on site. Excavated soil will be direct loaded into dump trucks for transport to the disposal facility and will not be stored on site. An example of the waste inventory form is provided as **Figure 7-1**. This form will be updated daily.

Figure 7-1. Waste Inventory Form
SWMU 48 IM Action

Waste Container ID	Container Type	Waste Description	Quantity	Date Packaged	Waste Profile	Date Shipped	Disposal Facility	Disposal Method	Disposal/ Destruction Date

Notes:

7.3.5 Spill Response Materials

Spill response materials including, but not limited to the following, will be kept on site in case of emergencies: containers, adsorbents, shovels, and PPE. Spill response materials will be available at all times in which hazardous materials/wastes are being handled or transported, and be compatible with the wastes being handled.

7.4 Off-Site Transportation and Disposal

7.4.1 Identification of Off-Site Disposal Facility

Through a competitive bidding process, one or more waste disposal subcontracts will be awarded. Each subcontract will include several permitted disposal facilities that offer a range of disposal options (e.g., landfilling, incineration) for a variety of waste types (e.g., non-hazardous waste, hazardous waste). Based on the waste characterization results and subsequent waste classification, an appropriate waste disposal facility will be identified. Shaw will then prepare a two-way memo, including the analytical results, estimated quantity of waste, waste profile sheet(s), and proposed method of disposition and disposal facility, to gain approval from the USACE to dispose of the waste. Advanced planning and coordination by Shaw, USACE, and RFAAP/ATK will be necessary to minimize the staging of waste (non-hazardous debris only, as hazardous debris will not be staged) on site.

7.4.2 Transportation of the Waste

The transport documentation and transport vehicle will be inspected prior to shipment of any hazardous wastes to ensure that the packaging, marking, labeling, handling, and placarding of waste complies with federal, state, and local laws and regulations. Shaw will supervise loading activities and monitor the stages of waste handling by the disposal subcontractor.

7.5 Documentation and Reporting

7.5.1 Complete Manifest Package

Shaw will prepare manifests for the transportation and disposal of hazardous wastes in accordance with USEPA and DOT requirements. The principal components of the completed manifest package include:

- Waste profile sheets (signed by an ATK representative).
- Waste disposal characterization.
- Hazardous waste manifests.
- Hazardous material shipping papers.
- Land disposal restriction notification and certification form.

Hazardous waste manifests, waste profile sheets, and land disposal restriction notification and certification forms will list RFAAP as the generator and will be signed by an appointed representative of RFAAP. The manifests will include the shipper’s license number, address and contact information, and the permit number for the disposal facility. Shaw will provide 3 days notice of shipping to the appointed representative of RFAAP and provide manifest blanks at that time. Final weight for each load will be calculated using an excavator bucket scale during truck loading. Final weights will be filled in on the manifest for signature at that time. Close coordination will be required to minimize demurrage charges.

The supporting information will contain at a minimum the following information:

- Date of initial waste generation.
- Description of process that generated the waste.
- All analytical data and/or process knowledge used to characterize the wastes, including QC data.
- Dates samples were collected.
- Description of the sampling location(s) and sampling methods and equipment utilized.
- Description of sample handling techniques including containerization, preservation, and COC.
- Any correspondence supporting waste classification determination.
- Specific type of inner and outer packaging.
- Markings, labeling, and placards offered by the transporter.

7.5.2 Transportation and Disposal Reporting Requirements

7.5.2.1 Tabulated Waste Handling Information

Shaw will maintain a list of all waste materials going off site on the Waste Inventory Form (**Figure 7-1**). Where applicable, this list will include the description, quantity, hazardous waste classification, date the waste was shipped, disposal facility, method of disposal, and date of disposal. Copies of the Waste Inventory Form as well as other supporting documentation related to the disposal operation audit trail will be included in the SWMU 48 IM Summary Report following completion of the IM.

7.5.2.2 Transportation and Disposal Procedures

After the waste leaves RFAAP, Shaw will maintain a clear audit trail of the entire disposal operation including, but not limited to, the following:

- Manifest copy(s).
- Driver information and truck numbers.
- Profile sheet(s).
- Certificate of Transfer.
- Certificate of Disposal.

7.5.2.3 Discrepancies

Any discrepancies due to differences between the quantities or types of wastes designated on the manifest or shipping papers, and the quantity or type of wastes a facility actually receives must be reported. Shaw will investigate these discrepancies and rectify the identified discrepancy.

7.5.2.4 Exception Reports

The following procedures will be used for determining if an exception report is needed. On or before the 35th day after the transporter signs the manifest, it will be verified that the generator or the generator's representative has received a copy of the signed manifest from the TSDF. If the generator's representative has failed to receive a signed copy of the manifest by the 44th day, an exception report will be prepared and submitted to the USACE and RFAAP no later than day 45.

8.0 SITE SAFETY AND HEALTH PLAN

This section discusses safety and health concerns for the SWMU 48 IM actions and serves as the SSHP. The safety and health policies and procedures that will be followed during the removal actions are defined within this section. This SSHP has been prepared by the RFAAP Health and Safety Manager. The SSHP signature approval form is provided in **Appendix D** and documents health and safety and project management's acceptance of the plan for the performance of IM at SWMU 48.

This SSHP was prepared for use at SWMU 48 by Shaw personnel and subcontractors performing a specific scope of work. It was prepared based on the best available information regarding the physical and chemical hazards known, or suspected, to be present on the project site. Adherence to the requirements of this Plan will significantly reduce, but not eliminate, the potential for occupational injury or illness at the project site. The guidelines contained in this SSHP were developed specifically for the project site described herein, and should not be used at any other site without the review and approval of a qualified health and safety professional.

8.1 Pre-Work Meeting

Due to the potentially dangerous nature of the explosives-related work conducted at RFAAP, a Pre-Work Meeting will be conducted by ATK, the operating contractor at RFAAP. All Shaw employees and subcontractors will attend this meeting prior to initiating work on site. The Propellant Incinerator adjacent to SWMU 39 has strict safety requirements that may differ from the requirements specified in this plan. Where there are differences, ATK's rules will apply. A copy of ATK's *Safety, Security and Environmental Rules for Contractors, Subcontractors, Tenants and Government Employees* (ATK, 2005) will be provided to employees and subcontractors before mobilization on site.

8.2 Introduction

This SSHP was developed to provide the field team/visitors with safe working conditions during field activities to ensure protection of personnel during the excavation, removal, waste handling, and restoration activities at SWMU 48. In addition, an objective of this SSHP is to provide site-specific safety and health controls that will prevent and minimize personal injuries, illnesses, and physical damage to equipment and property. The plan stresses management responsibilities, pre-planning for new activities, medical surveillance, training, periodic work site evaluations and audits, accident prevention and investigation recordkeeping, PPE, air monitoring requirements, site controls, decontamination procedures, and general safety requirements.

Shaw and subcontractor personnel performing field activities are responsible for the adherence to the SSHP procedures and policies during the performance of all work. Site personnel and visitors will be required to read or be instructed in the content of this SSHP and to sign the acknowledgment form (located in **Appendix D**) to document their understanding of the contents. Shaw will not, however, accept responsibility for the use of the plan by others.

Site personnel will exercise caution at all times and immediately report any site conditions to supervisory personnel, which may pose safety or health and environmental hazards to workers or the public.

8.2.1 Site Removal Activities

Site IM activities to be completed as part of this scope of work at SWMU 48 include excavation and disposal of sludge material and grossly-contaminated soil. Background site information and details on the approach and components for each of the removal actions are provided in the Organization and Technical Approach Plan (*Section 2.0*).

8.2.2 Applicable Standards and Regulations

Site activities covered by this SSHP must comply with the requirements of the following regulations and appropriate guidance including, but not limited to:

- 29 CFR 1910, Occupational Safety and Health Standards, General Industry.
- 29 CFR 1926, Safety and Health Regulations, Construction Industry.
- FAR, Clause 52.236-13, Accident Prevention.
- USEPA OSWER Directive 9355.3-01.
- USACE Safety and Health Requirements Manual EM 385-1-1.
- USACE Safety and Occupational Health Document Requirements for Hazardous, Toxic, and Radioactive Waste and Ordnance and Explosives Activities, ER 385-1-92.
- Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities [National Institute for Occupational Safety and Health (NIOSH) 85-115].
- 40 CFR 260-276, Hazardous Waste Management.
- 40 CFR Subchapter C, Air Programs.
- Occupational Safety and Health Guidance for Hazardous Waste Site Activities, U.S. Department of Health and Human Services, October 1985.
- Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents and Biological Exposure Indices, American Conference of Governmental Industrial Hygienists (ACGIH).
- Shaw Safety and Health Requirements Program Manual.
- Alliant TechSystem's *Safety, Security and Environmental Rules for Contractors, Subcontractors, Tenants and Government Employees* (ATK, 2005).

All Shaw and subcontractor field staff will be required to follow these and other applicable federal and/or state safety and health standards, regulations, and guidance manuals.

8.2.3 Site Safety and Health Documentation

Recordkeeping requirements for safety and health are necessary to ensure accurate and complete monitoring of all personnel. Any changes to the approved SSHP will be documented using the Shaw Revision Form presented in **Appendix D**, and reviewed and approved by the USACE prior to implementation. All on-site personnel shall read or be instructed in this SSHP and sign the acknowledgment form (located in **Appendix D**) to document their understanding of the contents. The SSHO will keep this form on file.

8.2.4 Safety Statement

It is Shaw's plan to provide a safe work environment for all personnel involved in the IM activities at SWMU 48. Shaw considers no phase of operations or administration to be of greater importance than the prevention of personnel injury and illness at the work site.

Any authorized USACE representative has the right to notify Shaw and/or any subcontractor of any condition that poses a serious or imminent danger to health and safety. Upon such notification, Shaw and/or any subcontractor shall immediately take corrective action. Furthermore, any authorized USACE representative may issue an order stopping all or part of the work until satisfactory corrective action has been taken.

This SSHP prescribes the procedures that must be followed by all site personnel. Operational changes which could affect the health and safety of personnel, the community, or the environment will not be made without prior approval of the USACE, Shaw Project Manager, Shaw Health and Safety Manager, and SSHO.

The following is Shaw's corporate policy as it pertains to safety:

The Shaw Group, Inc. is firmly committed to operating all of its facilities and projects in a safe, efficient manner and in compliance with applicable safety, health, and environmental regulations. Its goal is to provide an injury-free work environment where facilities and projects are free of recognized hazards; and people, equipment, and the environment are not placed at unreasonable risk of injury or damage.

The most valuable resource Shaw has is its people. While quality and productivity are critical to operations, they will never take precedence over the safety of personnel or protection of the environment.

Accomplishing these goals requires a unified team effort from all levels of the organization. Safety must be planned into all of our activities and receive the same level of attention as quality and productivity.

This project will be conducted under the guidance of applicable federal, state, and local requirements. It is the policy of Shaw to adhere to or exceed the minimum requirements of each governing document (see References, *Section 10.0*). When any conflict exists between referenced documents, the most stringent position of the standard will apply.

The Shaw Group, Inc. believes in two fundamental principles of safety:

- All accidents, injuries, and occupational illnesses are preventable.
- If an operation cannot be done safely, it will not be done.

To put these principles into practice, all Shaw personnel and subcontractor employees will receive the appropriate training, equipment, and other resources necessary to complete their assigned tasks in a safe and efficient manner. Subcontractors must also be appropriately trained, participate in the necessary medical surveillance programs, and comply with the required policies, procedures, and regulations.

Safety, industrial hygiene, and loss prevention are the direct responsibility of all members of management, who must create an environment in which everyone shares a concern for their own safety and the safety of their associates. Safety will take precedence over expediency. It is a condition of employment that all employees work safely.

8.3 Project Organization and Personnel Qualifications and Responsibilities

The project organization and reporting structure is presented in *Section 2.0* of this Work Plan. Qualifications for key individuals are as follows:

- The Health and Safety Manager must be a Certified Industrial Hygienist or Certified Safety Professional with experience in hazardous waste site operations.
- The SSHO must be fully trained and experienced and able to implement and continually enforce the SSHP.
- At least two site workers will be certified in first aid/cardiopulmonary resuscitation (CPR) by the Red Cross, or equivalent agency.

All personnel are responsible for the adherence to the SSHP procedures and policies during the performance of all work. Site personnel and visitors will be required to read this SSHP and to sign the acknowledgment form (located in **Appendix D**) to document their understanding of the contents. Failure to comply with the provisions of this Plan may lead to disciplinary action and/or dismissal from the work site. Ensuring the safe and healthful conduct of site operations is the responsibility of everyone assigned to the site; therefore, all personnel are responsible for the following:

- Complying with the SSHP and all other required safety and health guidelines.
- Taking all necessary precautions to prevent injury to themselves and to their fellow employees.
- Continually being alert to any potentially harmful situation and immediately informing the SSHO of any such conditions.
- Performing only those tasks that they believe they can do safely and have been trained to do.
- Notifying the SSHO of any special medical conditions (i.e., allergies, restrictions, diabetes, etc.) which could affect their ability to safely perform site operations.
- Notifying the SSHO of any prescription and/or over-the-counter medication which they are taking that might cause drowsiness, anxiety, or other unfavorable side effects.
- Preventing spillage and splashing of materials to the greatest extent possible.
- Practicing good housekeeping by keeping the work area neat, clean, and orderly.
- Immediately reporting all injuries, no matter how minor, to the SSHO.
- Maintaining site equipment in good working order, and reporting defective equipment to the SSHO.
- Properly inspecting and using the PPE required by the SSHP or the SSHO.

8.3.1 Subcontractor Responsibilities

In conformance with the Department of Labor, OSHA Hazardous Waste Operations (29 CFR 1910.120), each subcontractor employee proposed for on-site activities must participate in a medical monitoring program, must be certified for hazardous waste field work by a licensed physician, and must have successfully completed the required safety and health training. The subcontractor shall also be responsible for providing equipment that is safe for operations and free from any hazards.

8.3.2 Visitor Responsibilities

Authorized visitors to IM areas on site will be briefed on the hazards present at that location by the SSHO. Visitors will be responsible for compliance with the requirements specified in this SSHP. Visitors will not be permitted to enter potentially contaminated work zones unless they have completed the appropriate training and medical surveillance requirements, and have the proper PPE. All visitors will be escorted by a member of Shaw site management.

8.4 Hazard Analysis

8.4.1 Activity Hazard Analysis

Activity Hazard Analyses define the activities being performed and identify the sequences of work, the specific hazards anticipated, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level.

8.4.1.1 Soil Removal

An activity hazard analysis for the SWMU 48 soil removal is included as **Tables 8-1a through 8-1c**. This activity will be performed subject to the safety provisions of 29 CFR Parts 1910 and 1926, and USACE EM 385-1-1.

8.4.2 Physical Hazards

This section discusses specific physical hazards that may be encountered at RFAAP during the removal actions. If additional hazards other than the ones listed in this section are encountered, this SSHP will be revised to address these hazards.

8.4.2.1 Heavy Equipment

Tests shall be made at the beginning of each day during which the equipment is to be used to determine that the brakes and operating systems are in proper working condition and that all required safety devices are in place. Whenever any machinery or equipment is found to be unsafe or a deficiency which affects the safe operation of equipment is observed, the equipment shall be immediately taken out of service and shall not be used until all of the unsafe conditions are corrected. Machinery and mechanized equipment shall be operated by designated qualified personnel. Equipment safety requirements must be in accordance with 29 CFR 1926 and EM 385-1-1, Section 16 and the guidelines listed below:

- Operation of heavy equipment will be limited to properly trained personnel.
- Operator's certifications, qualification letters, and necessary SOPs will be maintained on site.
- Operator shall use the safety devices provided with the equipment (i.e., seatbelts, backup warning indicators, and horns).
- Visually inspect equipment daily, prior to operation, and report any deficiencies. Document observations.
- Good housekeeping practices will be maintained in the cab area of heavy equipment.

Table 8-1. Activity Hazard Analysis – Soil Removal
a. Pre-Removal Soil Characterization Sampling

Activity: Pre-Removal Soil Characterization Sampling **Analyzed by/date: ____________________**
Reviewed by/date:____________ (/ /) **Approved by/date: ____________________ (/ /)**

PRINCIPLE STEPS	POTENTIAL SAFETY/ HEALTH HAZARDS	RECOMMENDED CONTROLS
• Soil Delineation ***Stop work and notify your supervisor if you are not sure how to perform your task!***	**Physical Hazards**	
	Cold or heat stress	Wear appropriate clothing and follow recommended work schedules and monitoring controls as stated in *Sections 8.4.2.6 or 8.4.2.7*
	Manual lifting of coolers	Use proper lifting techniques as discussed in See *Section 8.4.2.10*
	Slip, trip, and fall hazards	Safety training and personal awareness See *Section 8.4.2.11* for general slip, trip, and fall controls
	Electrical storm	Shut down operations, see *Section 8.4.2.12*
	Repetitive Motion	Stretch and flex when using hand auger, alternate auger sampling between coworkers
	Utilities	Complete utility mark outs prior to sampling, follow Shaw Procedure HS308
	Chemical Hazards	
	Exposure to contaminants in soil	Minimize dust generation, wash hands and face, see *Section 8.4.3* for chemical hazard controls Use appropriate PPE
	Biological Hazards	
	Ticks	Tape pant legs to boots, avoid tall grass and bushes if possible, check for ticks frequently, see *Section 8.4.4.1*
	Stinging insects	Watch out for and avoid stinging insects, see *Section 8.4.4.2*
	Spiders	Watch out for and avoid black widow and brown recluse spiders, see *Section 8.4.4.3*
	Poisonous Plants ***Stop work and notify your supervisor if you are not sure how to perform your task!***	Watch out for and avoid poisonous plants likely to grow near sampling locations, avoid contact with plant oils that may be present on clothes or equipment, wash hands to prevent spreading oils, see *Section 8.4.4.6* ***Stop work and notify your supervisor if you are not sure how to perform your task!***
EQUIPMENT TO BE USED	**INSPECTION REQUIREMENTS**	**TRAINING REQUIREMENTS**
Direct push rig	None	All site workers must have OSHA Training in accordance with 29 CFR 1910.120. All site workers must attend the Daily Safety Meetings. Hazard Communication for all site workers.

Table 8-1. Activity Hazard Analysis – Soil Removal
b. Soil and Fence Removal

Activity: Soil Removal **Analyzed by/date:** ____________________
Reviewed by/date:____________ (/ /) **Approved by/date:** ____________________ (/ /)

PRINCIPLE STEPS	POTENTIAL SAFETY/HEALTH HAZARDS	RECOMMENDED CONTROLS
• Excavate soil and direct load into dump trucks • Collect waste characterization samples ***Stop work and notify your supervisor if you are not sure how to perform your task!***	**Physical Hazards**	
	General heavy equipment hazards	Safety training, personal awareness, and safety devices Maintain a safe equipment distance exclusion zone Use hand signals See *Section 8.4.2.1* for general heavy equipment controls
	Power and hand tools hazard	See *Section 8.4.2.2* for power and hand tool controls
	Electrical shock	Locate and shut down all utilities in work zone, obtain dig permit, watch out for overhead power lines, use GFCI on all temporary electrical devices
	Noise	Use hearing protection if noise exceeds 85 dBA, see *Section 8.4.2.8*
	Cold or heat stress	Wear appropriate clothing and follow recommended work schedules and monitoring controls as stated in *Sections 8.4.2.6 or 8.4.2.7*
	Manual lifting	Use proper lifting techniques as discussed in See *Section 8.4.2.10*
	Slip, trip, and fall hazards	Safety training and personal and situational awareness, see *Section 8.4.2.11.*
	Electrical storm	Shut down operations, follow the 30/30 rule, see *Section 8.4.2.12*
	Chemical Hazards	
	Exposure to contaminants in soil, primarily arsenic, lead, vanadium, and dioxin/furans.	Minimize dust generation, wash hands and face, see *Section 8.4.3* for chemical hazard controls Use appropriate PPE
	Cross Contamination	Avoid spillage from excavator bucket, utilize plastic sheeting where spillage may occur
	Biological Hazards	
	Ticks	Tape pant legs to boots, avoid tall grass and bushes if possible, check for ticks frequently, see *Section 8.4.4.1*
	Stinging insects	Watch out for and avoid stinging insects, see *Section 8.4.4.2*
	Spiders	Watch out for and avoid black widow and brown recluse spiders, see *Section 8.4.4.3*
	Poisonous Plants ***Stop work and notify your supervisor if you are not sure how to perform your task!***	Watch out for and avoid poisonous plants, avoid contact with plant oils that may be present on clothes or equipment, wash hands to prevent spreading oils, see *Section 8.4.4.6* ***Stop work and notify your supervisor if you are not sure how to perform your task!***
EQUIPMENT TO BE USED	**INSPECTION REQUIREMENTS**	**TRAINING REQUIREMENTS**
Excavator, shovels	Daily inspection and maintenance of equipment	All site workers must have OSHA Training in accordance with 29 CFR 1910.120 All site workers must attend the Daily Safety Meetings Hazard Communication for all site workers Appropriate heavy equipment and/or power tools training

Table 8-1. Activity Hazard Analysis – Soil Removal
c. Backfill and Site Restoration

Activity: Backfill and Site Restoration **Analyzed by/date: ____________________**
Reviewed by/date:____________(/ /) **Approved by/date: ____________________(/ /)**

PRINCIPLE STEPS	POTENTIAL SAFETY/HEALTH HAZARDS	RECOMMENDED CONTROLS
• Backfill excavation • Re-seed ***Stop work and notify your supervisor if you are not sure how to perform your task!***	**Physical Hazards**	
	General heavy equipment hazards	Safety training, personal awareness, and safety devices Maintain a safe exclusion zone Use hand signals See *Section 8.4.2.1* for general heavy equipment controls
	Electrical shock	Watch for overhead power lines
	Cold or heat stress	Wear appropriate clothing and follow recommended work schedules and monitoring controls as stated in *Sections 8.4.2.6 or 8.4.2.7*
	Manual lifting	Use proper lifting techniques as discussed in *Section 8.4.2.10*
	Slip, trip, and fall hazards	Safety training and personal awareness *See Section 8.4.2.11* for general slip, trip, and fall controls
	Electrical storm	Shut down operations, see *Section 8.4.2.12*
	Chemical Hazards – The potential for exposure to chemical hazards will be minimal	
	Biological Hazards	
	Ticks	Tape pant legs to boots, avoid tall grass and bushes if possible, check for ticks frequently, see *Section 8.4.4.1*
	Stinging insects	Watch out for and avoid stinging insects, see *Section 8.4.4.2*
	Spiders	Watch out for and avoid black widow and brown recluse spiders, see *Section 8.4.4.3*
	Poisonous Plants ***Stop work and notify your supervisor if you are not sure how to perform your task!***	Watch out for and avoid poisonous plants, avoid contact with plant oils that may be present on clothes or equipment, wash hands to prevent spreading oils, see *Section 8.4.4.6* ***Stop work and notify your supervisor if you are not sure how to perform your task!***
EQUIPMENT TO BE USED	**INSPECTION REQUIREMENTS**	**TRAINING REQUIREMENTS**
Excavator, shovels	Daily inspection and maintenance of equipment	All site workers must have OSHA Training in accordance with 29 CFR 1910.120 All site workers must attend the Daily Safety Meetings Hazard Communication for all site workers Appropriate heavy equipment training

- Additional riders shall not be allowed on equipment, unless it is specifically designed for that purpose.

As presented in **Appendix E**, Shaw Procedure HS810, Commercial Motor Vehicle Operation and Maintenance, will be implemented.

8.4.2.2 Power and Hand Tools

By their very nature, power tools have great capability for inflicting serious injury upon site personnel if they are not used and maintained properly. Use of improper or defective tools can contribute significantly to the occurrence of accidents on site. To control the hazards associated with power and hand tool operation, the requirements outlined in EM 385-1-1 and the safe work practices listed below shall be observed when using these tools:

- Operation/use will be conducted by authorized and experienced personnel.
- Tools will be inspected prior to use, and defective equipment will be removed from service until repaired.
- Tools will be selected and used in the manner for which they were designed and in accordance with manufacturer’s recommendations.
- Be sure of footing and grip before using any tool.
- Power tools designed to accommodate guards will have such guards properly in place prior to use.
- Do not use tools that have split handles, mushroom heads, and worn parts.
- Safety glasses or a face shield will be used if use of tools presents an eye or face hazard.
- Do not use makeshift tools or other improper tools.
- Use non-sparking tools in the presence of explosive vapors, gases, or residue.
- Loose-fitting clothing or long hair will not be permitted around moving parts.
- Hands, feet, etc. will be kept away from moving parts.
- Maintenance and adjustments to equipment will not be made while equipment is in operation. Power will be disconnected prior to maintenance.
- An adequate operating area will be provided, allowing sufficient clearance and access for operation.
- Proper PPE in accordance with equipment operating manual will be used (i.e., chainsaw chaps, leather gloves, hard hats, hearing protection, shin guards, face shield, safety glasses, etc.).

8.4.2.3 Fire and Explosion Hazards

SWMU 48 is located within the Magazine Area and Shaw employees and subcontractors MUST strictly follow ATK’s protocols to prevent fires and/or explosions in this area.

Although fires and explosions may arise spontaneously, they are more commonly the result of carelessness during the conduct of site activities such as mixing/bulking of site chemicals, and during refueling of heavy or handheld equipment. Some potential causes of explosions and fires include:

- Mixing of incompatible chemicals, which cause reactions that spontaneously ignite due to the production of both flammable vapors and heat.
- Ignition of explosive or flammable chemical gases or vapors by external ignition sources.
- Ignition of materials due to oxygen enrichment.
- Agitation of shock or friction-sensitive compounds.
- Sudden release of materials under pressure.
- Improper labeling of flammable and combustible material containers.

Explosions and fires not only pose the obvious hazards of intense heat, open flames, smoke inhalation, and flying objects, but may also cause the release of toxic chemicals into the environment. Such releases can threaten both personnel on site and members of the general public living or working nearby. Site personnel involved with potentially flammable material or operations will follow the guidelines listed below and EM 385-1-1, Section 9, to prevent fires and explosions:

- Potentially explosive/flammable atmospheres involving gases or vapors will be monitored using a combustible gas indicator/oxygen (CGI/O_2) meter.
- Prior to initiation of site activities involving explosive/flammable materials, all potential ignition sources will be removed or extinguished.
- Non-sparking and explosion-proof equipment will be used whenever the potential for ignition of flammable/explosive gases/vapors/liquids exists.
- Dilution or induced ventilation may be used to decrease the airborne concentration of explosive/flammable atmospheres.
- Smoking will be prohibited in the vicinity of operations which may present a fire hazard.
- Flammable and/or combustible liquids must be handled only in approved, properly labeled metal safety cans equipped with flash arresters and self-closing lids.
- Transfer of flammable liquids from one metal container to another will be done only when the containers are electrically interconnected (bonded).
- The motors of all equipment being fueled will be shut off during the fueling operations.
- Spark- or flame-producing operations will require a hot work permit in accordance with Shaw Procedure HS314.

8.4.2.4 Electrical

While it is anticipated that all electrical hookups at SWMU 48 have been terminated, this section is included as this will be verified prior to demolition of SWMU 48. All electrical work performed shall comply with applicable National Electric Safety Code, National Electric Code, and National Fire Protection Association regulations. All electrical work shall be performed by qualified personnel familiar with applicable code requirements. All safe guarding of hazardous energy sources will comply with Shaw Procedure HS315.

Above or below ground utilities may pose a hazard to team members during field activities. Below ground utilities will need to be located by Department of Public Works personnel prior to excavation activities. As presented in **Appendix E**, Shaw Procedure HS308, Underground and

Overhead Utility Contact Prevention, will be followed to prevent utility damage and employee injury. A safe distance between all equipment and overhead power lines must be maintained at all times. Minimum safe clearances are as follows:

Nominal System Voltage	Minimum Rated Clearance
0 to 50 kV	9.8 ft (3 meters)
51 to 200 kV	14.7 ft (4.5 meters)
201 to 300 kV	19.7 ft (6 meters)
301 to 500 kV	24.6 ft (7.5 meters)
501 to 750 kV	34.4 ft (105 meters)
751 to 1000 kV	44.3 ft (135 meters)

8.4.2.5 Excavations and Trenching

Excavation activities will be conducted in accordance with EM 385-1-1, Section 25 and Subpart P of 29 CFR 1926. As presented in **Appendix E**, Shaw Procedure HS307, Excavation and Trenching, will be implemented during excavation and trenching operations. The guidelines below are intended to reflect minimum requirements to be followed on this site:

- Prior to initiation of any excavation or trenching activity, the location of underground installations will be determined in accordance with Shaw Procedure HS308.
- The excavation(s) will be inspected and documented daily by the SSHO or by the Competent Excavation and Trenching person prior to commencement of work activities.
- Evidence of cave-ins, slides, sloughing, or surface cracks will be cause for work to cease until necessary precautions are taken to safeguard workers.
- Excavations 5 ft or deeper where employees must enter and cannot be sloped will require a registered civil engineer to design a protective system.
- Protective systems shall be selected from OSHA 29 CFR 1926 Subpart P and/or designed by a registered professional civil engineer.
- Spoils and other materials will be placed 2 ft or more from the edge of the excavation.
- Materials used for sheeting, shoring, or bracing will be in good condition.
- Timbers will be sound, free of large or loose knots, and of appropriate dimensions for the excavation.
- Safe access will be provided into the excavation(s) by means of a gradually sloped personnel access/egress ramp or ladders.
- Excavations 4 ft or more in depth will have a means of egress at a frequency such that lateral travel to the egress point does not exceed 25 ft.

8.4.2.6 Heat Stress

Heat stress is caused by a number of interacting factors including environmental conditions, clothing, workload, and the individual characteristics of the worker. Because heat stress is probably one of the most common illnesses at a site, regular monitoring and other preventive measures are vital.

Heat stress manifests itself in progressive stages (listed below), each increasing in severity, and if not remedied, can threaten life or health. Factors which may predispose a worker to heat stress include: lack of physical fitness, lack of acclimatization to hot weather, degree of hydration, current health status, alcohol or drug use, and the worker's age and sex. Therefore, it is important that all workers be able to recognize symptoms of these conditions and be capable of arresting the problem as quickly as possible.

As with any illness, the best cure for heat stress is avoidance/prevention. Heat stress is most likely to occur early in the summer, prior to acclimatization. Full acclimatization takes 5 to 7 days of consecutive controlled exertion in heat. Individual physical conditioning, pre-existing illnesses, and use of alcohol contribute significantly to the potential for heat stress. Avoidance includes drinking plenty of fluids, taking frequent breaks, revising work schedule around hot periods of the day, and assuring that workers are acclimated before allowing them to work for extended periods of time. **Table 8-2** shows an example work/rest schedule to be implemented as it relates to the work load and regimen. The SSHO will determine when work/rest schedules will be implemented based on temperature and work load.

As presented in **Appendix E**, Shaw Procedure HS400, Working in Hot Environments, will be implemented to control heat-related illness. The SSHO will determine the potential for heat stress based on planned activities and weather forecasts.

Table 8-2
Examples of Permissible Heat Exposure Threshold Limit Values

Work – Rest Regimen	***Work Load**		
	Light	**Moderate**	**Heavy**
Continuous Work	30.0 (86)	26.7 (80)	25.0 (77)
75% Work - 25% Rest, each hour	30.6 (87)	28.0 (82)	25.9 (78)
50% Work - 50% Rest, each hour	31.4 (89)	29.4 (85)	27.9 (82)
25% Work - 75% Rest, each hour	32.2 (90)	31.1 (88)	30.0 (86)

*Consult the ACGIH TLV booklet for definitions of Light, Moderate and Heavy workloads. Values are given in °C and [degrees Fahrenheit (°F)] WBGT, and are intended for workers wearing single layer summer type clothing. As workload increases, the heat stress impact on an unacclimatized worker is exacerbated. For unacclimatized workers performing a moderate level of work, the permissible heat exposure TLV should be reduced by approximately 2.5°C.

Heat Rash

Heat rash is caused by continuous exposure to heat and humid air and is aggravated by wet chafing clothes. This condition can decrease a worker's ability to tolerate hot environments.

> Symptoms – Symptoms of heat rash include a mild red rash, especially in areas of the body which sweat heavily.
>
> Treatment – Treatment includes decreasing the amount of time in protective gear and providing powder (such as corn starch or baby powder) to help absorb moisture and decrease chafing. Maintain good personal hygiene standards and change into dry clothes if needed.

Heat Fatigue

Heat fatigue is characterized by discomfort and reduced mental awareness, with a greater effect in unacclimated workers. Medical treatment is usually not needed. Heat fatigue usually effects people who work in hot environments and perspire a great deal. Loss of salt from the body causes very painful cramps of the leg and abdominal muscles. Heat fatigue also may result from drinking iced water or other drinks too quickly or in too large a quantity.

> Symptoms – Heat fatigue symptoms include muscle cramps in legs and abdomen, pain accompanying the cramps, faintness, and profuse perspiration.
>
> Treatment – Treatment includes removing a victim to a cool area and loosening clothing, stretching and massaging affected muscle, drinking 1 to 2 cups of water immediately, and every 20 minutes thereafter.

Heat Exhaustion

Heat exhaustion results from sustained exertion in heat, combined with failure to replace water and salts lost in sweat. Heat syncope results in fainting and can occur when standing immobile in heat. It is caused by the pooling of venous blood in the dilated vessels of the skin and lower body.

> Symptoms – Symptoms include weak pulse, rapid and shallow breathing, fatigue, nausea, headache, profuse perspiration, dizziness, unconsciousness, and clammy, moist skin which may be flushed or pale.
>
> Treatment – Replacement of water is required to recover. Electrolyte replacement fluids should be taken until urine volume increases. Recovery is complete and rapid following rest in a recumbent position at a cool location. Treat the person for shock if necessary, and remove him/her to a medical facility if there is any indication of a more serious problem.

Heat Stroke

The most serious heat injury is *heat stroke*. Heat stroke is a medical emergency; treatment must be immediate, and professional medical attention must be obtained. Heat stroke is caused by a combination of factors including heavy exertion heat, inadequate replacement of fluids, poor physical condition, and individual susceptibility.

> Symptoms – Failure of sweat response occurs, leading to a rapidly accelerated increase in core temperature. The victim usually has hot, dry red skin and, if conscious, is confused;

convulsions may be present. Additional symptoms include dilated pupils and a full and fast pulse.

Treatment – The victim must be cooled immediately; heat stroke is fatal if treatment is incomplete or delayed. Emergency care includes transportation to a medical facility, placing person in a cool environment, assuring an open airway, reducing the body temperature (wrap in wet sheet or douse body with water), and if available, placing cold packs under arms, around neck, at the ankles, or any place where blood vessels lie close to skin.

8.4.2.7 Cold Stress

As with high temperatures, outdoor work in low temperatures can result in risks to the health of employees exposed without adequate preparation. The combined temperature/wind chill affect is shown in **Table 8-3**. To minimize impacts from cold stress, the information and precautions given below shall be observed.

Table 8-3
Wind Chill

COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED AS EQUIVALENT TEMPERATURE												
	Actual Temperature Reading (°F)											
Estimated	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
Wind Speed (in mph)	**Equivalent Chill Temperature (°F)**											
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect)	***LITTLE DANGER*** In<hr with dry skin. Maximum danger of false sense of security.				***INCREASING DANGER*** Danger from freezing of Exposed flesh within One minute.				***GREAT DANGER*** Flesh may freeze within 30 seconds.			
	Trenchfoot and immersion foot may occur at any point on this chart.											

Cold-related worker fatalities have resulted from failure to escape low environmental air temperatures, or from immersion in low temperature water. Most hypothermia cases develop in air temperatures between 30-50°F. The single most important aspect of life-threatening hypothermia is a fall in the deep core temperature of the body. Lower body temperature will very likely result in reduced mental alertness, reduction in rational decision making, or loss of consciousness with the threat of fatal consequences.

Persons working outdoors in temperatures at or below freezing may be frostbitten. Extreme cold for a short time may cause severe injury to the surface of the body, or result in profound generalized cooling, causing death. Areas of the body that have high surface-area-to-volume ratio, such as fingers, toes, and ears, are the most susceptible.

Local injury resulting from cold is included in the generic term frostbite. There are several degrees of damage. Frostbite of the extremities can be categorized into:

- Frost Nip or Initial Frostbite: Characterized by sudden blanching or whitening of skin.
- Superficial Frostbite: Skin has a waxy or white appearance and is firm to the touch, but tissue beneath is resilient.
- Deep Frostbite: Tissues are cold, pale, and solid; extremely serious injury.
- Systemic Hypothermia: This condition is caused by exposure to freezing or rapidly dropping temperature. Its symptoms are usually exhibited in five stages: 1) shivering; 2) apathy, listlessness, sleepiness, and sometimes rapid cooling of the body to less than 95°F; 3) unconsciousness, glassy stare, slow pulse, and slow respiratory rate; 4) freezing of the extremities; and finally 5) death.

Treatment of cold stress includes bringing the body core temperature back to its normal temperature of 98.6°F. Personnel exhibiting symptoms of cold stress should be brought into a warm area and allowed to rest and warm up. Warm, non-alcoholic, decaffeinated drinks (not coffee) or soup should be given to increase body temperature, and rewarming should be gradual.

For frostbite emergency treatment, the victim should be sheltered from the wind and cold and given warm drinks. If superficial, the frozen area should be covered with extra clothing or warmed against the body. Do not use direct heat, and do not pour hot water over or rub the effected area. Warming should be gentle and gradual. If the frostbite is deep (area is frozen and hard to the touch), immediate medical attention should be obtained.

For hypothermia emergency treatment, all stages are treated by either passive or active rewarming. This is accomplished by better conservation of the patient's body heat. It is important to note that if a victim is found in a remote area, despite the death-like appearance, the person may be saved. All attempts should be made to revive the victim. Active rewarming means heat is applied to the victim by an external source, either to the skin surface and/or through the core. Treatment includes:

- Preventing further heat loss. Remove the victim to a warm, dry place.
- Remove wet clothing piece-by-piece and dry underlying skin.
- Dress in several layers of warm, dry clothing, giving preference to the central body core rather than the extremities.
- Cover the victims head, then wrap the victim in blankets.
- If the victim is conscious, ask him/her to drink hot fluids.
- Monitor oral body temperature every 15 minutes. If the body temperature falls below 98.6°F, the team member should not be allowed outside until the body temperature returns to normal.
- In more severe cases of hypothermia, implement the above actions, but also institute some type of active rewarming, including:

- Electric pads or blankets.
- Hot-air blowers or heaters.
- Heated blankets or clothes.
- Use of human body heat.

- It is important to watch for signs of return of the normal thermoregulatory mechanisms (shivering, teeth chattering, etc.) and to monitor mental status.
- The victim should be transferred to a medical facility after the emergency care steps have been initiated and should not be allowed to return to work for at least 48 hours.
- Perform CPR if the victim is pulseless and not breathing.
- Avoidance of cold stress emergencies can be performed by the general practices stated below:
  - Wear layered clothing, including a water-repellent outer layer.
  - Wear gloves, socks, and a hat that are synthetic or wool insulated.
  - Remove outer layers of clothing during breaks to prevent inner layer from getting wet from perspiration.
  - Eat well-balanced meals and maintain an adequate intake of fluids.
  - Seek shelter in a warm protected area when signs and symptoms of cold stress become evident.

Table 8-4 provides a work/warm-up schedule for a 4-hour shift as it relates to temperature and wind speed. This schedule will be applied during all field work.

Table 8-4
Threshold Limit Values Work/Warm-Up Schedule for 4-Hour Shift*

Air Temperature-Sunny Sky		No Wind		5 MPH Wind		10 MPH Wind		15 MPH Wind		20 MPH Wind	
°C (approx.)	°F (approx.)	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
-26° to -28°	-15° to -19°	Normal	1	Normal	1	75 min.	2	55 min.	3	40 min.	4
-29° to -31°	-20° to -24°	Normal	1	75 min.	2	55 min.	3	40 min.	4	30 min.	5
-32° to 34°	-25° to -29°	75 min.	2	55 min.	3	40 min.	4	30 min.	5		
-35° to -37°	-30° to -34°	55 min.	3	40 min.	4	30 min.	5				
-38° to -39°	-35° to -39°	40 min.	4	30 min.	5						
-40° to -42°	-40° to -44°	30 min.	5								
-43° to below	-45° & Below	Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease	

Notes for Table:

1. Schedule applies to any 4-hour work period with moderate to heavy work activity, with warm-up periods of 10 minutes in a warm location and with an extended break (e.g., lunch) at the end of the 4-hour work period in a warm location. For Light-to-Moderate Work (limited physical movement): apply the schedule one step lower. For example, at -35°C (-30°F) with no noticeable wind (Step 4), a worker at a job with little physical movement should have a maximum work period of 40 minutes with 4 breaks in a 4-hour period (Step 5).

2. The following is suggested as a guide for estimating wind velocity if accurate information is not available:

   mph: light flag moves; 10 mph: light flag fully extended; 15 mph: raises newspaper sheet; 20 mph: blowing and drifting snow.

3. If only the wind chill cooling rate is available, a rough rule of thumb for applying it rather than the temperature and wind velocity factors given above would be: 1) special warm-up breaks should be initiated at a wind chill cooling rate of about 1750 W/m^2; 2) all non-emergency work should have ceased at or before a wind chill of 2250 W/m^2. In general, the warm-up schedule provided above slightly under-compensates for the wind at the warmer temperatures, assuming acclimatization and clothing appropriate for winter work. On the other hand, the chart slightly over-compensates for the actual temperatures in the colder ranges because windy conditions rarely prevail at extremely low temperatures.

4. TLVs apply only for workers in dry clothing.

* Adapted from the *1995-1996 Threshold Limit Values and Biological Exposure Indices*, American Conference of Governmental Industrial Hygienist. Cincinnati, OH.

As presented in **Appendix E**, Shaw Procedure HS401, Cold Stress, will be implemented to control cold-related illness.

8.4.2.8 Noise

Hearing protection may be required during certain noisy activities. Hearing protection will be required when sound pressure levels in work areas or on equipment exceed 85 dBA, the TLV for noise. Permissible noise exposure levels for different durations are shown in **Table 8-5**. A field guideline for knowing when hearing protection is recommended is if people 3 ft apart must raise their voices to be heard in normal conversation.

Table 8-5
Permissible Noise Exposure

A-Weighted Sound Level (dB)	Permitted Duration Per Workday (Hours)	A-Weighted Sound Level (dB)	Permitted Duration Per Workday (Hours)
80	32.0	106	0.87
81	27.9	107	0.76
82	24.3	108	0.66
83	21.1	109	0.57
84	18.4	110	0.50
85	16.0	111	0.44
86	13.9	112	0.38
87	12.1	113	0.33
88	10.6	114	0.29
89	9.2	115	0.25
90	8.0	116	0.22
91	7.0	117	0.19
92	6.2	118	0.16
93	5.3	119	0.14
94	4.6	120	0.125
95	4.0	121	0.11
96	3.5	122	0.095

Table 8-5
Permissible Noise Exposure, Continued

A-Weighted Sound Level (dB)	Permitted Duration Per Workday (Hours)	A-Weighted Sound Level (dB)	Permitted Duration Per Workday (Hours)
97	3.0	123	0.082
98	2.6	124	0.072
99	2.3	125	0.063
100	2.0	126	0.054
101	1.7	127	0.047
102	1.5	128	0.041
103	1.3	129	0.038
104	1.1	130	0.031
105	1.0		

Source: Shaw Procedure HS402.

As presented in **Appendix E**, Shaw Procedure HS402, Hearing Conservation Program, will be implemented when elevated noise levels exist. The SSHO will provide training on the proper use of hearing protection in accordance with 29 CFR 1910.95. The training will be conducted as a part of the pre-work safety and health briefing and documented in the safety files.

8.4.2.9 Dust

It is possible that dust could be generated during soil excavation and load-out operations. In such cases, a water spray will be used to minimize dust generation. Real-time dust monitors may be used if necessary to protect site personnel (*Section 8.6*).

8.4.2.10 Manual Lifting

Investigation and IM activities may require personnel to move large, heavy objects by hand. The human body is subject to severe damage in the forms of back injury and hernia if caution is not observed when handling, lifting, or moving these large, heavy objects.

The following fundamentals should be followed while manual lifting objects:

- The size, shape, and weight of the object to be lifted must be considered. Site personnel will not lift more than they can handle comfortably. No individual employee is permitted to lift any object that weighs over 60 pounds. Multiple employees or the use of mechanical lifting devices are required for objects over the 60-pound limit.
- A firm grip on the object is essential; therefore, the hands and objects shall be free of oil, grease, and water.
- The hands and fingers shall be kept away from any points that could cause them to be pinched or crushed, especially when setting the object down.
- The item shall be inspected for metal slivers, jagged edges, burrs, and pinch points, and gloves shall be used to protect the hands.
- The feet will be placed far enough apart for good balance and stability.
- Personnel will ensure that solid footing is available prior to lifting the object.

- To lift the object, the legs are straightened from their bending position.
- Never carry a load that you cannot see around.
- When placing an object down, the stance and position are identical to that for lifting.
- If needed, back support devices will be provided to aid in preventing back injury.

The following steps will be followed during manual lifting:

- Ensure the route on which you will carry the object is clear and free from trip hazards.
- Get a good footing.
- Place feet about one shoulder-width apart.
- Bend at knees to grasp weight.
- Keep the back straight.
- Get a firm hold.
- Lift gradually by straightening the legs.
- If weight is uncomfortable to lift, get help.

8.4.2.11 Slips, Trips, Falls

Field operations may place personnel in situations where they may be exposed to slip, trip, and fall hazards. Slipping hazards will exist when the ground is wet, or on steep slopes. Tripping hazards will exist on rough, uneven terrain, or if the work area is cluttered with tools, equipment, debris, soil piles, etc. Falling hazards will exist as a result of slip or trip hazards, or in elevated work areas with inadequate railing.

The following precautions should be followed by all site personnel:

- Field personnel shall become familiar with the general terrain of the site and potential physical hazards (i.e., rocky conditions, uneven terrain) that would be associated with accidental slips, trips, and falls.
- Be cautious after periods of heavy rainfall, which may cause earth movement and slides.
- Be attentive where you walk since pits, holes, or similar hazards may be partially covered or visually obstructed.
- Be cautious around soil or terrain which recently may have been disturbed, relocated, or otherwise made less stable.
- Avoid the top edges of drop-off areas whether they have been disturbed or not.
- Use the three-point rule when getting on and off heavy equipment.

8.4.2.12 Lightning

Electrical storms commonly occur during Spring and Fall. The resulting lightning poses a safety hazard to field personnel. Since the storms are sometimes fast moving, field personnel should watch for indications of electrical storms. The distance to an electrical storm can be estimated by observing the interval between the lightning flash and the sound of thunder. Since sound travels approximately 1,100 ft per second, an interval of 5 seconds corresponds to a storm distance of approximately 1 mile. This is also referred to as the flash/bang process. If lightning is observed and thunder is heard within 30 seconds, work shall be suspended. Work will not resume for 30 minutes or until the flash/bang time exceeds 30 seconds (30:30 rule).

If an electrical storm is observed within 6 miles of the site, field personnel shall cease outside activities and proceed to the site office for further instructions, and all heavy equipment will be shut down. If caught in the open by an electrical storm, all personnel will immediately seek shelter in their vehicle and proceed as above. In the event that their vehicle is inaccessible, they will move to a topographically low area away from tall objects and conductors (e.g., transformer, power lines, metal sheds) and wait for the storm to leave the area.

8.4.2.13 Drum Handling

Hazardous materials are often shipped, stored, or disposed in 55-gallon drums. If a drum or other container is encountered with unknown contents, caution will be exercised to avoid explosion or chemical hazards. The discovery of unknown drums shall require immediate notification to the Health and Safety Manager. Unknown drums will not be handled until the appropriate precautions and PPE are in place.

8.4.3 Chemical Hazards

This section discusses chemical hazards that may be encountered at RFAAP during the IM at SWMU 48. Chemical hazards can be encountered either from chemicals brought on site by the contractor for use during activities, chemicals stored at the site, or chemicals that have been released to the environment and are present in various media such as air, soil, or water.

8.4.3.1 Site-Related Chemicals

Antimony, arsenic, cadmium, copper, lead, and mercury were identified equal to or above the calculated RGs of 410, 15.8, 800, 41000, 800, and 43 mg/kg, respectively, during the RFI investigation at SWMU 48 (Shaw, 2010) as presented on **Table 1-8**.

8.4.3.2 Exposure Pathways

Chemicals may pose a hazard to humans when inhaled, ingested, or through dermal absorption. Inhalation can occur when chemicals are present as vapors, aerosols, or attached to airborne dust particles. Ingestion usually occurs incidentally, as chemicals present in the air enter the mouth or nose, or from hand to mouth activities such as eating, drinking, and smoking. Dermal absorption occurs when chemicals contact unprotected skin.

8.4.3.3 Exposure Assessment

The toxic hazards to site personnel associated with chemicals can be assessed through comparison of actual exposures with several established occupational exposure limits using quantitative collection and analysis through real-time and/or time-integrated personal air sampling.

Permissible Exposure Limits (PELs) are established by OSHA. TLVs are established by ACGIH. Immediately Dangerous to Life or Health (IDLH) values are established by NIOSH. **Table 8-6** presents occupational exposure limits (if available) for potential chemicals, including OSHA PELs, ACGIH TLVs, and NIOSH IDLH values. The table also indicates if there are potential significant contributions to the overall exposure for the chemical of concern through dermal contact, and identifies the acute symptoms resulting from exposure.

Table 8-6
Occupational Health Exposure Guidelines for Potential Contaminants

Contaminant	Acute Symptoms of Exposure	PEL (TWA unless otherwise noted)	TLV-TWA	Skin Notation (Yes/No)	IDLH
Antimony	Irritation, cough, anoxia, dizziness, nausea, vomit, diarrhea, cramps, inability to smell properly	0.5 mg/m^3	1 mg/m^3	Y	0.5 mg/m^3
Arsenic	Ulceration of nasal septum, GI disturbances, respiratory irritation, hyper pigmentation of the skin; [potential occupational carcinogen]	0.010 mg/m^3	0.010 mg/m^3	Y	5 mg/ m^3
Cadmium	Pulmonary edema, dysplasia, cough, chest tightness, headache, chills, nausea, vomit diarrhea, mild anemia, muscle aches, protienuria, anosmia, emphysima	0.005 mg/m^3	0.005 mg/m^3	Y	9 mg/m^3
Copper	Irritated eyes, nose, and pharynx; nasal septum perforation; metallic taste; dermatitis	1 mg/m^3	1 mg/m^3	Y	100 mg/m^3
Lead	Lassitude (weakness, exhaustion), insomnia; facial pallor; anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis wrist, ankles; encephalopathy; kidney disease; irritation eyes; hypotension	0.05 mg/m^3	0.05 mg/m^3	Y	100 mg/m^3
Mercury	Irritated eyes and skin; chest pain, dyspnea, bronchitis, pneumonia; tremors, insomnia, irritability, indecision, headache, lassitude, stomatitis, salivation; GI disorder, anorexia, loss of weight, pfoteinuria	0.1 mg/m^3	0.05 mg/m^3	Y	10 mg/m^3

The occupational exposure limits are described as follows:

PELs may be expressed as an 8-hour Time-Weighted Average (TWA), a Short-Term Exposure Limit (STEL), or a ceiling limit. Ceiling limits may not be exceeded at any time. PELs are enforceable by law. STELs are allowable exposure limits for durations ranging from 5 to 15 minutes, without causing the 8-hour TWA to be exceeded.

The ACGIH TLV is defined as the TWA concentrations for a substance to which nearly all workers (8 hours/day, 40 hours/week) may be repeatedly exposed, day after day, without experiencing adverse health effects. For some substances, the overall exposure to a substance is enhanced by skin, mucous membrane, or eye contact. These substances are identified by “yes” in the skin notation column.

The IDLH values represent the maximum concentrations from which, in the event of respirator failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing symptoms or any irreversible health effects.

8.4.3.4 Chemical Hazard Communication

In order to comply with Shaw Procedure HS060 and with the OSHA Hazard Communication Standard 29 CFR 1910.1200 to ensure that site personnel are informed of the hazards associated with the materials with which they work, the following requirements will apply to all commercial products containing hazardous substances which are brought on site.

- Material Safety Data Sheets (MSDSs) will be maintained for each product containing a hazardous substance that will be used on site. MSDSs will also be maintained for COIs identified in site soil. MSDSs are included in **Appendix F**.
- All containers not supplied with adequate hazard labeling will have a hazard communication label affixed to the container providing the health and physical hazards associated with the material.
- All personnel, including subcontractors who work with products containing hazardous substances, will be trained in accordance with the requirements of 29 CFR 1910.1200. This training will be performed and documented by the SSHO and maintained on site in the safety files.
- An inventory of all products containing hazardous substances used on site will be maintained using a site-specific Chemical Inventory.

8.4.4 Biological Hazards

Biological hazards that may be found at SWMU 48 include ticks, spiders, snakes, and poisonous plants. The following sections discuss the potential biological hazards that may be encountered at SWMU 48 during removal actions.

8.4.4.1 Ticks

From April through October, particular caution will be exercised to prevent site workers from being bitten by deer ticks and potentially contracting Lyme Disease. The Centers for Disease Control has noted an increase of Lyme Disease and Rocky Mountain Spotted Fever (RMSF), which are caused by tick bites. Ticks are small, ranging from the size of a comma up to about 1/4 inch; when embedded in the skin, they may look like a freckle. Ticks live in and near wooded areas, tall grass, and brush.

Lyme Disease – Lyme Disease is caused by deer ticks and lone star ticks that have become infected with spirochetes. Female deer ticks are about 1/4 inch in size, and are black and brick red in color. Male deer ticks are smaller and completely black. Lone star ticks are larger and chestnut brown in color. The illness typically occurs in the summer and is characterized by a slowly expanding red rash that develops in a few days to a few weeks after the bite of an infected tick. This may be accompanied by flu-like symptoms along with headache, stiff neck, fever, muscle aches, and/or general malaise. At this stage, treatment by a physician usually is effective. If left alone, these early symptoms may disappear, but more serious problems may follow. The most common late symptom of the untreated disease is arthritis. Other problems which may occur include meningitis, neurological abnormalities, and cardiac abnormalities. It is important to note that some people do not get the characteristic rash and may have diminished progress to the later manifestations. Treatment of later symptoms is more difficult than early symptoms and is not always successful.

Rocky Mountain Spotted Fever – RMSF has occurred in this area of the country. It is caused by Rocky Mountain wood ticks and dog ticks which have become infected with rickettsia. Both are black in color.

RMSF disease is transmitted by the infected dog tick *Dermacentor variabilis* and is common in the western U.S. It is important to note that the dog tick is significantly larger than the deer tick, previously discussed. Nearly all cases of RMSF occur in the Spring and Summer, generally several days after exposure to infected ticks. The onset of illness is abrupt, often with high fever, headache, chills, and severe weakness. After the fourth day of fever, victims develop a spotted pink rash, which usually starts at the hands and feet and gradually extends to most of the body.

The first symptoms of either disease are flu-like chills, fever, headache, dizziness, fatigue, stiff neck, and bone pain. If immediately treated by a physician, most individuals recover fully in a short period of time. If not treated, more serious symptoms can occur.

If a site employee believes they have been bitten by a tick, or if any of the signs and symptoms noted above appear, the employee will contact the SSHO, who will authorize the employee to visit a physician for an examination and possible treatment.

The following precautions should be taken when working in areas that might be infested with ticks:

- Cover your body as much as possible. Wear long pants and long-sleeved shirts. Light color clothing makes spotting of ticks easier.
- Try to eliminate possible paths by which the deer tick may reach unprotected skin. For example, tuck bottoms of pants into socks or boots and sleeves into gloves. (Duct tape may be used to help seal cuffs and ankles.) If heavy concentrations of ticks or insects are anticipated or encountered, Tyvek® coveralls may be used for added protection.
- Conduct periodic and frequent (e.g., hourly) surveys of your clothing for the presence of ticks. Remove any ticks and insects that become attached to clothing.
- Spray outer clothing, particularly your pant legs and socks, but not your skin, with an insect repellent that contains permethrin or permanone, or use a repellent with DEET, which can be applied to the skin.

- When walking in wooded areas, avoid contact with bushes, tall grass, or brush as much as possible.
- Tuck pant legs into boot tops or tape pants to boot tops to prevent ticks from crawling up the pant leg (this may not be an option at sites where extreme heat stress is anticipated).
- If dressed in Level D or Modified Level D and no other head protection is required, wear a hat to prevent ticks from getting into the hair.

The following actions should be taken if a tick is found:

- If you find a tick, remove it by pulling on it gently with tweezers.
- If the tick resists, cover the tick with salad oil for about 15 minutes to asphyxiate it, then remove it with tweezers.
- Do not use matches, a lit cigarette, nail polish, or any other type of chemical to "coax" the tick out.
- Be sure to remove all parts of the tick's body and disinfect the area with alcohol or a similar antiseptic after removal.
- For several days to several weeks after removal of the tick, look for the signs of the onset of Lyme disease, such as a rash that looks like a bulls-eye or an expanding red circle surrounding a light area.
- Look for the signs of the onset of RMSF, such as a rash-like inflammation consisting of red spots under the skin that appear 3 to 10 days after the tick bite.

Removal of ticks is best accomplished using small tweezers. Do not squeeze the tick's body. Grasp it where the mouth parts enter the skin and tug gently, but firmly, until it releases its hold on the skin. Save the tick in a jar labeled with a date, body location of the bite, and place it where it may have been acquired.

Wipe the bite thoroughly with an antiseptic and notify the safety officer as soon as possible. The various stages and symptoms are well recognized and if detected can be treated with antibiotics. Early detection and treatment with antibiotics significantly reduces the severity of Lyme disease and RMSF. If necessary, seek medical attention.

8.4.4.2 Ants, Bees, Wasps, Hornets, and Yellow Jackets

Contact with stinging insects like bees, hornets, and wasps may result in site personnel experiencing adverse health effects that range from being mild discomfort to life threatening. Therefore, stinging insects present a serious hazard to site personnel, and extreme caution must be exercised whenever site and weather conditions increase the risk of encountering stinging insects.

Nests and hives for bees, wasps, hornets, and yellow jackets often occur in ground, trees, and brush. The area will be checked for obvious nests and hives before it is cleared. If a nest or hive is found, the SSHO will be contacted before the nest is disturbed or removed; and, if possible, an alternate sampling location will be selected. Bites and stings can be painful and may elicit an allergic reaction. Medical surveillance will identify any individuals with life-threatening allergies. These individuals will not work in areas where there is a great potential for insect stings. If simple first aid measures do not alleviate the symptoms, the victim will be taken to the nearest medical center. An attempt will be made to kill the offending insect and take it to the emergency room with the victim if this can be done quickly and without endangering personnel.

Some of the factors related to stinging insects that increase the degree of risk associated with accidental contact are as follows:

- The nests for these insects are frequently found in remote, wooded, grassy areas.
- The nests can be situated in trees, rocks, bushes, or in the ground, and are usually difficult to see.
- Accidental contact with these insects is highly probable, especially during warm weather conditions when the insects are most active.
- If a site worker accidentally disturbs a nest, the worker may be inflicted with multiple stings, causing extreme pain and swelling which can leave the worker incapacitated and in need of medical attention.
- Some people are hypersensitive to the toxins injected by a sting, and when stung, experience a violent and immediate allergic reaction resulting in a life-threatening condition known as anaphylactic shock.
- Anaphylactic shock manifests itself very rapidly and is characterized by extreme swelling of the body, eyes, face, mouth, and respiratory passages.
- The hypersensitivity needed to cause anaphylactic shock, can in some people, accumulate over time and exposure; therefore, even if someone has been stung previously, and has not experienced an allergic reaction, there is no guarantee that they will not have an allergic reaction upon receipt of another sting.

With these things in mind and with the high probability of contact with stinging insects, all site personnel shall comply with the following safe work practices:

- If a worker knows that he is hypersensitive to bee, wasp, or hornet stings, they must inform the SSHO of this condition prior to participation in site activities. The SSHO will question all site personnel concerning allergies or sensitivities prior to initiating work on site.
- All site personnel will be watchful for the presence of stinging insects and their nests, and shall advise the SSHO if a stinging insect nest is located or suspected in the area.
- Any nests located on site shall be flagged off, and site personnel shall be notified of its presence.
- If stung, site personnel shall immediately notify the SSHO to obtain treatment and allow the SSHO to observe them for signs of allergic reaction.
- Site personnel with a known hypersensitivity to stinging insects shall keep required emergency medication on or near their person at all times.

Stings of these insects are responsible for more deaths in the U.S. than bites and stings of all venomous creatures. This is due to the sensitization by the victim to the venom from repeated stings, which can result in anaphylactic reactions. The stinger may remain in the skin and should be removed by teasing or scraping rather than pulling. An ice cube placed over the sting will reduce pain. An analgesic-corticosteroid lotion is often used. People with known hypersensitivity to such stings should carry a kit containing antihistamine and epinephrine.

8.4.4.3 Spiders

The biting insects of greatest concern are spiders, especially the black widow and the brown recluse. These spiders are of special concern due to the significant adverse health effects that can be caused by their bite.

Black Widow – The black widow is a coal-black, bulbous spider 3/4 to 1-1/2 inches in length, with a bright red hourglass on the underside of the abdomen. The black widow is usually found in dark moist locations, especially under rocks and rotting logs, and may even be found in outdoor toilets where they inhabit the underside of the seat. Victims of a black widow bite may exhibit the following signs or symptoms:

- Sensation of pinprick or minor burning at the time of the bite.
- Appearance of small punctures (sometimes none are visible).
- After 15 to 60 minutes, intense pain is felt at the site of the bite which spreads quickly and is followed by profuse sweating, rigid abdominal muscles, muscle spasms, breathing difficulty, slurred speech, poor coordination, dilated pupils, and generalized swelling of face and extremities.

Brown Recluse – The brown recluse is brownish to tan in color, rather flat, 1/2 to 5/8 inches long with a dark brown "violin" shape on the underside. It may be found in trees or in dark locations. Victims of a brown recluse bite may exhibit the following signs or symptoms:

- Blistering at the site of the bite, followed by a local burning at the site 30 to 60 minutes after the bite.
- Formation of a large, red, swollen, pustulating lesion with a bull's-eye appearance.
- Systemic effects may include a generalized rash, joint pain, chills, fever, nausea, and vomiting.
- Pain may become severe after 8 hours with the onset of tissue necrosis.

There is no effective first aid treatment for either of these bites. Except for very young, very old, or weak victims, these spider bites are not considered to be life threatening; however, medical treatment must be sought to reduce the extent of damage caused by the injected toxins. If either of these spiders are suspected or known to be on site, the SSHO shall brief the site personnel as to the identification and avoidance of the spiders. Site personnel should notify the SSHO if they locate either of these spiders.

8.4.4.4 Snakes

The possibility for encountering snakes exists. Although rare in the southwestern Virginia area, the species of greatest concern is the copperhead *(Agkistrodon contortix)*. Copperheads grow to 36 inches and can be recognized by the copper-color head and a reddish-brown hourglass pattern on the body. Copperheads are normally lethargic; once aroused, however, they strike vigorously and may rapidly vibrate their tails. Rocky hillsides are favorite habitats.

To minimize the threat of snake bites, all personnel walking through the brush will be aware of the potential for encountering snakes and will avoid actions that increase the likelihood of encounters (e.g., turning over logs). Additional caution will be exercised around sawdust or rock piles, which are known to support copperheads. In the event of a snake bite, the following rules should be followed:

- Do not cut "X's" over the bite area as this will intensify the effect of the venom.
- Do not apply suction to the wound since this has a minimal effect in removing venom.
- Do not apply a tourniquet since this will concentrate the venom and increase the amount of tissue damage in the immediate area.
- If possible, kill the snake, bag it, and transport it with the victim. Try to identify the snake for proper selection of anti-venom.
- Do not allow the victim to run for help since running increases the heart rate and will increase the spread of the venom throughout the body.
- Keep the victim calm and immobile.
- Have the victim hold the affected extremity lower than the body while waiting for medical assistance.
- Transport the victim to a medical facility immediately.

8.4.4.5 Animals

Normally, wildlife avoid people and areas where activities are ongoing. Small animals, such as raccoons, infected with rabies or when cornered, may become aggressive. When working remain alert for likely locations that animals inhabit. Avoid nests, dens, and holes in the ground that may be the animal's home.

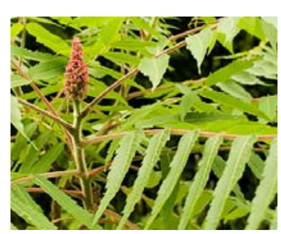
The only effective measure to preclude animal bites is avoidance. Contact with all wild animals at SWMU 48 will be avoided at all times. Persons bitten by an animal should seek medical assistance immediately, especially if it is suspected that the animal is rabid. Aggressive or disoriented behavior, as well as foaming of the mouth, can be signs of rabid animals. Until medical assistance can be reached, persons should watch for symptoms of severe swelling, nausea, and shock.

8.4.4.6 Poison Ivy, Poison Oak, Poison Sumac

Poison ivy thrives in all types of light and usually grows in the form of a trailing vine; however, it can also grow as a bush and can attain heights of 10 ft or more. Poison ivy has shiny, pointed leaves that grow in clusters of three. Poison sumac is a tall shrub or slender tree that usually grows along swampy areas or ponds in wooded areas. Each poison sumac leaf stalk has 7 to 13 leaflets which have smooth edges. Poison oak is mostly found in the southeast and west. Poison

Summer Poison Ivy

Poison Oak



Poison Sumac

oak resembles poison ivy, with one important difference. Poison oak leaves are more rounded than jagged like poison ivy, and the underside of poison oak leaves are covered with hair.

All personnel should become familiar with and be able to recognize poison ivy, poison oak, and poison sumac in the field. All personnel that know they are over-sensitive to poison ivy or poison sumac will notify their Site Superintendent or the SSHO. They will not be allowed to work in the area until the poison ivy/sumac has been removed. This information will be noted on their medical data sheet. Reaction to poison ivy can be prevented if the exposed skin is washed with mild soap and water within 10 minutes of contact. Contact can be prevented by site workers wearing appropriate clothing. Preventive measures which can prove effective for most site personnel are:

- Avoid contact with any poisonous plants on site and keep a steady watch to identify, report, and mark poisonous plants found outside.
- Wash hands, face, or other exposed areas at the beginning of each break period and at the end of each work day.
- Avoid contact with, and wash on a daily basis, contaminated tools, equipment, and clothing.
- Barrier creams, detoxification/wash solutions, and orally administered desensitization may prove effective and should be tried to find the best preventive solution.
- Avoid spreading oils from these plants to hands and other parts of the body.

The skin reaction associated with contacting these plants is caused by the body's allergic reaction to toxins contained in the oils produced by the plant. Contamination from the oils of these plants may occur through contact with leaves, branches, stems or berries, or contact with contaminated items such as tools and clothing. The allergic reaction associated with exposure to these plants will generally cause the following signs and symptoms:

- Blistering at the site of contact, usually occurring within 12 to 48 hours after contact.
- Reddening, swelling, itching, and burning at the site of contact.
- Pain, if the reaction is severe.
- Conjunctivitis, asthma, and other allergic reactions if the person is extremely sensitive to the poisonous plant toxin.

Blisters form during the subsequent 24 to 36 hours. Crusting and scaling occurs within a few days. Signs and symptoms included redness, swelling, and sometimes intense itching. Symptoms usually disappear in 1 to 2 weeks in cases of mild exposure and up to 3 weeks when exposure is severe.

8.4.4.7 Biological Agents

Microbial hazards can potentially occur when workers handle materials with biological contamination. One source of infection for response workers is poor sanitation. Waterborne and foodborne diseases can be a problem if adequate precautions are not taken to keep food and drinking water properly stored and isolated. An example of such a disease is salmonellosis. Workers must also avoid creating any sanitation problems by making sure that properly designed lavatory facilities are available at the work site.

Tetanus is another biological hazard encountered on hazardous materials sites. Workers must avoid puncture hazards, wear appropriate protective clothing, and should be current in Tetanus Inoculations.

8.4.4.8 Bloodborne Pathogens

In July of 1992, OSHA issued a final Standard for Protection of Workers Potentially Exposed to Bloodborne Pathogens (29 CFR 1910.1030). This primarily involves medical and research personnel. Bloodborne pathogens are pathogenic microorganisms which may be present in human blood and can cause disease in humans. These pathogens include, but are not limited to, hepatitis B virus and human immunodeficiency virus.

Potential exposure during site activities results from workers who are infected. The OSHA Standard specifically includes first aid providers and is enforceable on site subject to the Hazardous Waste Site Work and Emergency Response Standard (29 CFR 1910.120). The basic concept of this standard is that medical care workers and first aiders must take the "Universal Precaution" of assuming that any blood-containing fluid or person bleeding or contaminated with blood-containing fluid is positive (infected) with both viruses.

Protection involves the use of personal protection such as gloves, eye shields, one-way valve rescue breather devices, and training. In order to effectively protect against any hazards, workers must have a basic understanding of the hazard. This is particularly true of Site Superintendents and SSHOs and others expected to administer first aid if necessary.

8.5 Site Control Procedures

8.5.1 Site Control

To protect the public and maintain security at SWMU 48 during working hours, the site will be controlled as follows:

- Work areas and support areas will be established prior to the start of activities.
- Only authorized workers will be permitted in work areas.
- Work will cease if unauthorized personnel enter work areas.
- Temporary fencing will be utilized around excavations to protect site visitors.

8.5.2 Site Work Zones

If site conditions dictate an upgrade in PPE due to the presence of contaminants at high concentrations, work zones will be established to ensure against the accidental spread of hazardous substances by workers from contaminated areas to clean areas. Zones will be delineated on site where removal activities occur, and the flow of personnel in these zones will be controlled. The establishment of site work zones will help ensure that personnel are properly protected against the hazards present where they are working, work activities and contamination are confined to the appropriate areas, and personnel can be located and evacuated in an emergency. The site work zones that will be used during site activities, as deemed necessary by the SSHO, will include:

- Exclusion Zone (EZ) – the contaminated area.
- Contamination Reduction Zone (CRZ) – the area where decontamination of PPE takes place.

- Support Zone (SZ) – the uncontaminated area where workers should not be exposed to hazardous conditions.

A "hotline" where personnel routinely enter or exit the EZ will be located upwind of the work activities. Site work zones, including hotlines, will be established as deemed necessary by the SSHO during field activities. All site work zones will be adequately marked using traffic cones or banner guard.

Access to the EZ and CRZ will be strictly limited to individuals who meet all medical monitoring, training, and PPE requirements of the site. Visitors who have received the appropriate training, are medically qualified, and are wearing the appropriate level of protection must receive a site safety briefing and will be escorted within these zones by the SSHO. Visitors who do not meet the specified requirements will remain in the SZ.

8.5.3 Buddy System

The buddy system will be employed by all personnel entering a hazardous waste operation. This system requires that a partner, or buddy, accompany each worker. The buddy provides the co-worker/partner with assistance, observes the partner for signs of exposure, periodically checks the integrity of the partner's PPE, and notifies the SSHO if help is needed. The buddy must be in a line of sight or hearing of the partner and be prepared to enter any area the partner enters. The buddy must be fully certified to work in the level of protection that the employee is working in, and must have the appropriate PPE available.

8.5.4 Communications

This section describes the on- and off-site communications that are required during operations at SWMU 48. At SWMU 48, at least one cellular telephone will be available at each work site for off-site transmissions and emergency response.

8.6 Personal Protective Equipment

PPE consistent with Shaw Procedure HS600 (**Appendix E**) will be required during field work at SWMU 48. **Table 8-7** presents the PPE requirements for the IM actions planned at SWMU 48. The SSHO will review the required level of protection and safety equipment with each work crew. The ultimate decision on which protective level is most appropriate will be made by the SSHO. The level of protection selected will be based on:

- The type and measured concentration of the chemical substance having the lowest PEL, TLV, and/or IDLH concentration in the ambient atmosphere, its range of toxic properties and lower explosive limit, and the evaluated degree of hazard.
- Potential for exposure to substances in the air, liquid splashes, or other direct contact with hazardous materials.

Table 8-7
Personal Protective Equipment Requirements

Activity/Location	PPE Level	Comment
Delineation Sampling and Soil Removal	Level D/ Modified D	Modified Level D when in contact with contaminated material. Upgrade to Level C if action levels warrant.
Site Setup and Restoration	Level D	Level D when no contact with contaminated material exists.

In situations where the chemical identity, concentrations, and possibility of contact are not well-characterized, the appropriate level of protection will be one level higher than the suspected level of protection, based on professional experience and judgment, until the hazards can be better identified.

PPE shields the body against contact with a known or suspected chemical. OSHA specifies four PPE levels: A, B, C, and D. The minimum level of protection for all Shaw sites is Level D. It is not expected that the type and level of contaminant exposure during activities performed under this task will require either Level A or B protection. If unforeseen conditions arise which would require Level A or B, work will halt so that the task can be reevaluated and this SSHP can be revised or replaced.

8.6.1 Level D

Level D protection will be worn only as a work uniform and not on any site with respiratory or skin hazards. It provides minimal protection and consists of:

- Coveralls or work clothes (dictated by weather).
- Leather safety boots, steel toes, and shanks.
- Nitrile surgical gloves: non-latex or non-powdered, low-protein latex gloves (when necessary).
- Work gloves: cotton or leather (when necessary).
- Eye protection (safety glasses or goggles).
- Hearing protection (when necessary).
- Hard hat.

8.6.2 Modified Level D

- Cotton, Saranex, Chemrel (or equivalent), or polycoated Tyvek® or regular Tyvek® coveralls (dependent upon location and splash potential).
- Rain suit or Saranex apron, and face shield (when there is a splash hazard).
- Leather safety boots/shoes with chemical-resistant soles, steel toes, and shanks with chemical resistant (disposable latex) boot covers (outer).
- Inner gloves: non-latex or non-powdered, low-protein latex gloves.

- Outer gloves: chemical-resistant butyl/neoprene or Viton/neoprene gloves.
- Eye protection (safety glasses or goggles).
- Hearing protection (when necessary).
- Hard hat.

8.6.3 Level C

Level C protection will be worn when the criteria for using air-purifying respirators are met. Level C consists of:

- Tyvek® or Saranex coveralls (dependent upon location and splash potential).
- Full-face air-purifying respirator (NIOSH-approved) or Powered air-purifying respirator w/HEPA cartridge.
- Prescription insert for workers who require corrective lenses (individuals will not be permitted to wear contact lenses).
- Leather safety boots/shoes with chemical-resistant soles, steel toes, and shanks.
- Latex boot covers or pullover slush boots (dependent upon location and splash potential).
- Inner gloves: chemical-resistant nitrile or non-latex surgical gloves.
- Outer gloves: chemical-resistant butyl or neoprene gloves.
- Other PPE such as hearing protection (dependent upon the activities performed).
- Hard hat.

8.6.4 Respirator Selection and Fit Test

Shaw's Safety and Health Program Requirements Manual requires that all personnel who work on potentially hazardous sites participate in Shaw's Respiratory Protection Program (Shaw Procedure HS600 provided in **Appendix E**). A qualitative fit test will be performed on each individual required to wear respiratory protection at least once per year. Training on use, maintenance, cleaning, and sanitizing of respiratory protective equipment is included as part of the employee's 8-hour annual refresher training course. Each person receives documentation of the size, brand, and model number of the air purifying respirator that he or she is approved to use. This information is retained in Shaw's corporate safety and health files and also in the site safety files.

8.7 Air Monitoring Requirements

Environmental monitoring equipment to be used at SWMU 48 is discussed in this section, along with action levels for each monitoring instrument. Based on these action levels, the SSHO, or designated alternate, will authorize downgrades or upgrades in the level of PPE, as appropriate. One or more of the following instruments may be used as directed/needed by task:

- CGI/O_2 meter.
- Real-time dust monitor.
- Photoionization detector (PID).

Initial air monitoring instruments for the IM activity are presented in **Table 8-8**.

Air monitoring data from these instruments will be recorded in field logbooks. The use of this equipment is intended to provide warning and allow appropriate action to be taken to prevent exposure to contaminants released into the atmosphere. Instruments are calibrated annually by the manufacturers. In addition, calibration and maintenance checks of monitoring equipment will be performed daily prior to each use according to the manufacturer's specifications.

Table 8-8
Air Monitoring Requirements

Activity/Location	Air Monitoring Instrument Required
Soil Removal	CGI/O_2; Real-Time Dust Monitor; PID

8.7.1 Real-Time Particulate Monitor

A real-time particulate monitoring instrument is used to determine the concentration of total particulate in the breathing zone. Dust monitoring will not initially be required during SWMU 48 Removal Actions, as justified in this section. This instrument will be employed during ground intrusive activities where heavy metals and dioxins/furans are the point of contact. A water spray will be used to minimize dust generation during soil removal activities.

The following calculation represents the total particulate in milligrams per cubic meter (mg/m^3) which must be detected in the breathing zone of site workers to potentially exceed the PEL for inorganic chemicals:

$$\frac{10^6 \text{ mg/kg} \times \text{PEL in mg/m}^3}{\text{maximum soil concentration (mg/kg)}} = \text{Calculated Action Level}$$

Using this equation and sampling results for soil from SWMU 48, action levels were calculated for arsenic, lead, vanadium, and dioxins/furans. The calculated action levels are as follows:

COI	PEL	Max. Concentration in Soil	Calculated Action Level
Antimony	0.5 mg/m^3	3.2 mg/kg	156,250 mg/m^3
Arsenic	0.01 mg/m^3	122 mg/kg	81.96 mg/m^3
Cadmium	0.005 mg/m^3	9.2 mg/kg	543.47 mg/m^3
Copper	0.01 mg/m^3	81,800 mg/kg	0.12 mg/m^3
Lead	0.05 mg/m^3	114,000 mg/kg	0.43 mg/m^3
Mercury	0.1 mg/m^3	25.5 mg/kg	3921.56 mg/m^3

In addition to these concentrations, the 15 mg/m^3 OSHA PEL for "particulates not otherwise regulated" applies to this site. This action level is shown in **Table 8-9**.

Table 8-9
Air Monitoring Action Levels for PNOR

Readings	Level of Protection/Action
Real-Time Particulate Monitor	
≤ 15 mg/m^3	Normal Operations
> 15 mg/m^3	Use engineering controls to reduce dust levels.

Since the OSHA PEL for the SWMU 48 contaminants is lower than the calculated dust action level, the real-time particulate monitor action level has been based on the sum of the maximum contaminant concentrations in soil. The dust exposure level as a mixture of the compounds and safety factor of 4 as recommended by ACGIH is 0.95 mg/m^3 and this will be considered the dust action level for the site. Water spray shall be used for dust control when the real-time particulate monitor measures 0.95 mg/m^3 or greater for 5 minutes sustained or 5 separate measurements within a 15-minute period (**Table 8-10**).

Table 8-10
Air Monitoring Action Levels for SWMU 48

Readings	Level of Protection/Action
Real-Time Particulate Monitor	
≤ 0.95 mg/m^3	Normal Operations, Modified Level D PPE
> 0.95 mg/m^3	Use engineering controls to reduce dust levels. Upgrade to Level C PPE if engineering controls are not effective.

Water spray shall be used for dust control when the real time particulate monitor measures > 0.95 mg/m^3 for 5 minutes sustained or 5 separate measurements > 0.95 mg/m^3 within a 15-minute period.

Readings	Level of Protection/Action
Combustible Gas/Oxygen Meter	
≤ 10% LEL	Normal Operations, Modified Level D PPE
> 10% LEL	Stop work, eliminate ignition sources and locate source of elevated combustible gases.

Four instantaneous peaks in any 15-minute period or a sustained reading for 5 minutes in excess of the action level will trigger a response.

Readings	Level of Protection/Action
PID	
≤ 2.0 ppm	Normal Operations, Modified Level D PPE
> 2.0 ppm	Use engineering controls to reduce VOC levels. Allow area to passively volatilize. Upgrade to Level C PPE if engineering controls are not effective.

Four instantaneous peaks in any 15-minute period or a sustained reading for 5 minutes in excess of the action level will trigger a response.

8.7.2 Time-Integrated Air Sampling

Time-integrated air sampling may be performed during activities when site characterization data and real-time instrumentation indicate that chemical and/or dust exposures to personnel are suspected to be approaching established limits (PEL/TLV) for target compounds such as arsenic, lead, vanadium, or dioxins/furans. Initially, personal air samples will be collected for each craft job classification to determine if an employee may be exposed to these chemicals/materials at or above the action levels. Additional periodic monitoring may be performed based on the results of the initial monitoring. Samples will be collected and analyzed following OSHA or NIOSH methods. All time-integrated, personal air samples for chemical constituents will be analyzed using a laboratory accredited by the American Industrial Hygiene Association. Employees who are subject to time-integrated air sampling will be informed of the results in accordance with Shaw Procedure HS104.

8.8 Decontamination Procedures

Decontamination procedures are necessary to protect field personnel and to control the spread of contamination by either personnel or equipment. Decontamination procedures to be followed are discussed below, and additional information is provided in Shaw SOP 80.1 (**Appendix B**).

8.8.1 Personnel Decontamination Procedures

During site activities, personnel will attempt to minimize the degree of contact with contaminated materials. This involves a conscientious effort to keep "clean" during site activities. Personnel will minimize physical contact with contamination (when possible). This may ultimately minimize the degree of decontamination required and the generation of waste materials from site operations.

A step-by-step description of decontamination procedures for contaminated personnel for Levels C and Modified D is as follows:

- <u>Segregated Equipment Drop</u> – All monitoring instruments, samples, hand tools, and notebooks are dropped in this area to be decontaminated by one of the decontamination team members. To aid in decontamination, instruments can be sealed in plastic bags or wrapped in polyethylene. This will also protect the instruments against contaminants.
- <u>Outer Boot Cover and Outer Glove Wash and Rinse</u> – Scrub the outer disposable boot covers and outer gloves with a brush, soap, and water. Rinse the boot covers and glove covers.
- <u>Tape Removal</u> – Remove all sealing tape from around boots, gloves, zippers, etc. Place in the disposable clothing drum.
- <u>Outer Boot Cover and Outer Glove Cover Removal</u> – Remove the outer boots and gloves by pulling down the items and exposing the clean inner lining. Place the boots and gloves in the disposable equipment drum.
- <u>Outer Coverall Removal</u> – Unzip and remove the outer coverall. Remove protective clothing in an "inside out" manner. Do not remove contaminants from clothing by blowing, shaking, or any other means that may disperse material into the air. Secure disposable PPE in plastic bags placed in 55-gallon drums designated for PPE.

- Facepiece Removal – Remove facepiece and place in a designated area for further cleaning.
- Inner Glove Removal – Remove inner gloves and place in the disposable clothing drum. Remove inner coverall, if one is used, and wash hands and face.

The decontamination line will be oriented so that the SZ and CRZ exit is upwind from the EZ and the first stages of decontamination. The decontamination line will be assembled so that it can be easily moved in case of a significant change in wind direction. All receptacles for contaminated protective clothing will be equipped with a lid that can be closed to prevent the release of contaminants.

The SSHO will determine whether conditions warrant wet or dry personnel decontamination procedures based on weather conditions, contaminant risk, and experience.

8.8.1.1 Decontamination During Medical Emergencies

If immediate life-saving first aid or medical treatment is required, decontamination procedures will be omitted. Outer garments can be removed as long as it does not delay giving the proper care or aggravate the condition. Grossly-contaminated clothing should be removed carefully, because clothing can transfer contaminants to people administering first aid. If the outer contaminated garments cannot be safely removed, the individual will be wrapped in plastic, rubber, or blankets to help prevent the spread of contamination to emergency personnel. On-site personnel will accompany contaminated victims to the medical facility to advise on matters involving decontamination.

8.8.2 Equipment Decontamination Procedures

Equipment used to excavate contaminated soil will be decontaminated after use to minimize the spread of contaminants. Decontamination procedures will vary depending upon the contaminant involved, but may include sweeping, wiping, scraping, hosing, or steaming the exterior of the equipment. Personnel performing this task will wear the proper PPE as prescribed by the SSHO.

8.9 Emergency Response Plan

8.9.1 General

The frequency and severity of emergency situations can be dramatically reduced through proper implementation of the SSHP Emergency Response Plan. If an emergency does occur, quick, decisive action is required since delays in minutes can create or escalate life-threatening situations. In an emergency situation, site personnel involved in emergency response and rescue must be prepared to respond immediately, and all required equipment must be on hand, in proper working order, and ready to use. To ensure rapid, effective response to a site emergency, the procedures and contingency plans outlined in this section are implemented prior to and during the conduct of any site activities involving exposure to safety and health hazards.

8.9.2 Pre-Emergency Planning

8.9.2.1 Identification of Local Emergency Services

Prior to the conduct of site operations, Shaw contacted and/or gathered information/phone numbers of the local and site emergency response authorities. The authorities contacted were informed of the nature of the site activities to be performed under this SSHP, and the potential hazards that the conduct of these activities pose to investigation personnel, the environment, and the general public. Shaw personnel were informed as to the type of emergency services available through the local authorities and were given the contact phone numbers for these services. In the event that evacuation of the general public is required due to either normal site operations or an emergency event, the SSHO is responsible for contacting the appropriate local authorities who execute and coordinate an evacuation. The phone numbers for local and site emergency services, as well as key personnel involved with the investigation, are listed in **Table 8-11**.

Table 8-11
Emergency Assistance Information
RFAAP, Radford, Virginia

Contact	Phone Number
Tom Meyer (USACE)	(410) 962-7677 (office)
Steve Bowers, C.C.M. (USACE ERRO Project Officer)	(410) 671-6003 (office)
Jim McKenna (Environmental Coordinator and Site Contact)	(540) 639-8641 (office)
Jerry Redder, P.E. (ATK Environmental Manager)	(540) 639-7536 (office)
Jeff Parks, P.G. (Shaw RFAAP Project Manager)	(410) 612-6326 (office)
Bob Culbertson, P.E. (Shaw LMARC Program Manager	(865) 694-7402 (office)
RFAAP Field Office (Site Superintendent/SSHO)	(540) 922-3316 (Cellular)
Doug Russell (Shaw East Region Health and Safety Manager)	(865) 414-9545 (Cellular)
Shaw Help Desk	(866) 299-3445
Health Resources	800-350-4511
Emergency Response Services	
Installation Fire Department	7457 (On Post)
Installation Security Police	7325 (On Post) (540) 639-7325 (Off Post)
Installation Safety Department	7294 (On Post) (540) 639-7294 (Off Post)
Installation Spill Response	7323, 7324 or 7325 (On Post) (540) 639-7323, 7324, or 7325 (Off Post)
Installation Medical Facility (Occupational Medicine Services)	7123 (On Post) (540) 639-7123 (Off Post)
Installation Ambulatory Services	7323 (On Post) (540) 639-7323 (Off Post)
Local Non-Emergency Clinic (Occupational Medical Services)	540-961-4675
Local Police Department	911
National Poison Control Center	(800) 492-2414
National Response Center	(800) 424-8802
Regional USEPA Emergency Response	(215) 597-9800
Chemical Manufacturers Association Chemical Referral Center	(800) 262-8200

Table 8-11
Emergency Assistance Information, Continued
RFAAP, Radford, Virginia

Non-Emergency Services:
Occupational Medical Services
3700 South Main Street
Blacksburg, VA 24060
Hours of Operation: M-F 8:30-3:30 pm; closed 12-1 pm for lunch

Directions to Occupational Medical Services From RFAAP (see Figure 8-1):

Turn Left out of RFAAP onto Route 114 (Pepper's Ferry Road), go 6.5 miles
Turn Left onto Route 460 Business (Franklin Street), go 1.0 miles
Make a U-turn at Yellow Sulphur Rd, Hightop Rd onto S Main St [US-460-Business], go 0.2 mi
Arrive at 3700 S Main Street, on the Right

- Comfort Inn and Cinco de Mayo restaurant will be on the right

Emergency Services:
RFAAP Installation Hospital
Alliant Techsystems, Inc.
Rt. 114
PO Box 1
Radford, VA 24141

Directions from the Main Gate to the Radford Army Ammunition Plant Hospital:

Enter through Main Gate
Turn Left at Building 220, Administrative Building
Proceed downhill to the gate house at Gate 1
Go through the gate, Turn left and the hospital is the white building on right through the gate house (Building 205)

Directions from SWMU 48 to the Radford Army Ammunition Plant Hospital (see Figure 8-2):

Follow the Contractor Route back across bridge toward Gate No. 1
The hospital is the white building on the left just inside of the gate (Building 205)

Figure 8-1
Directions to Occupational Medical Services

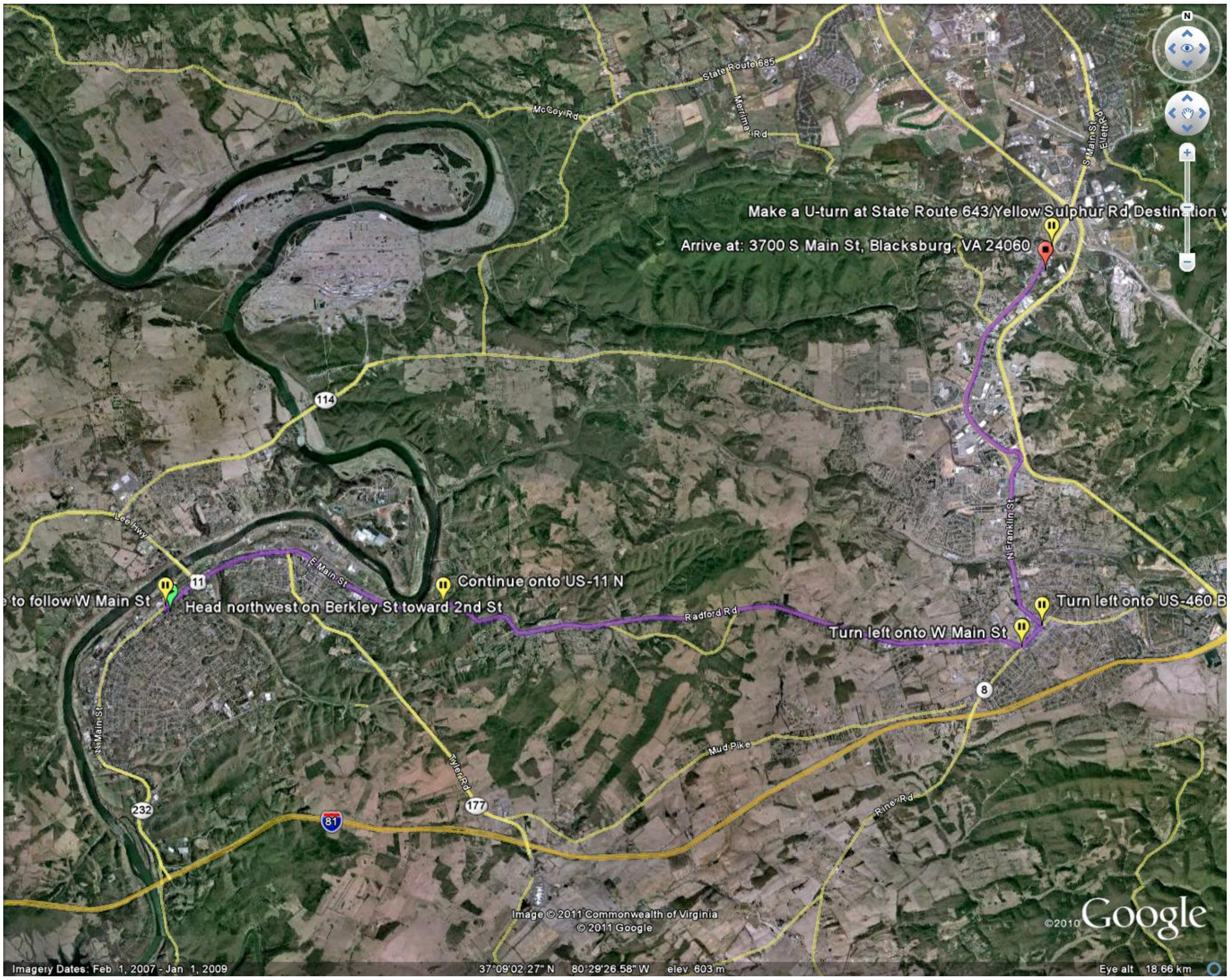
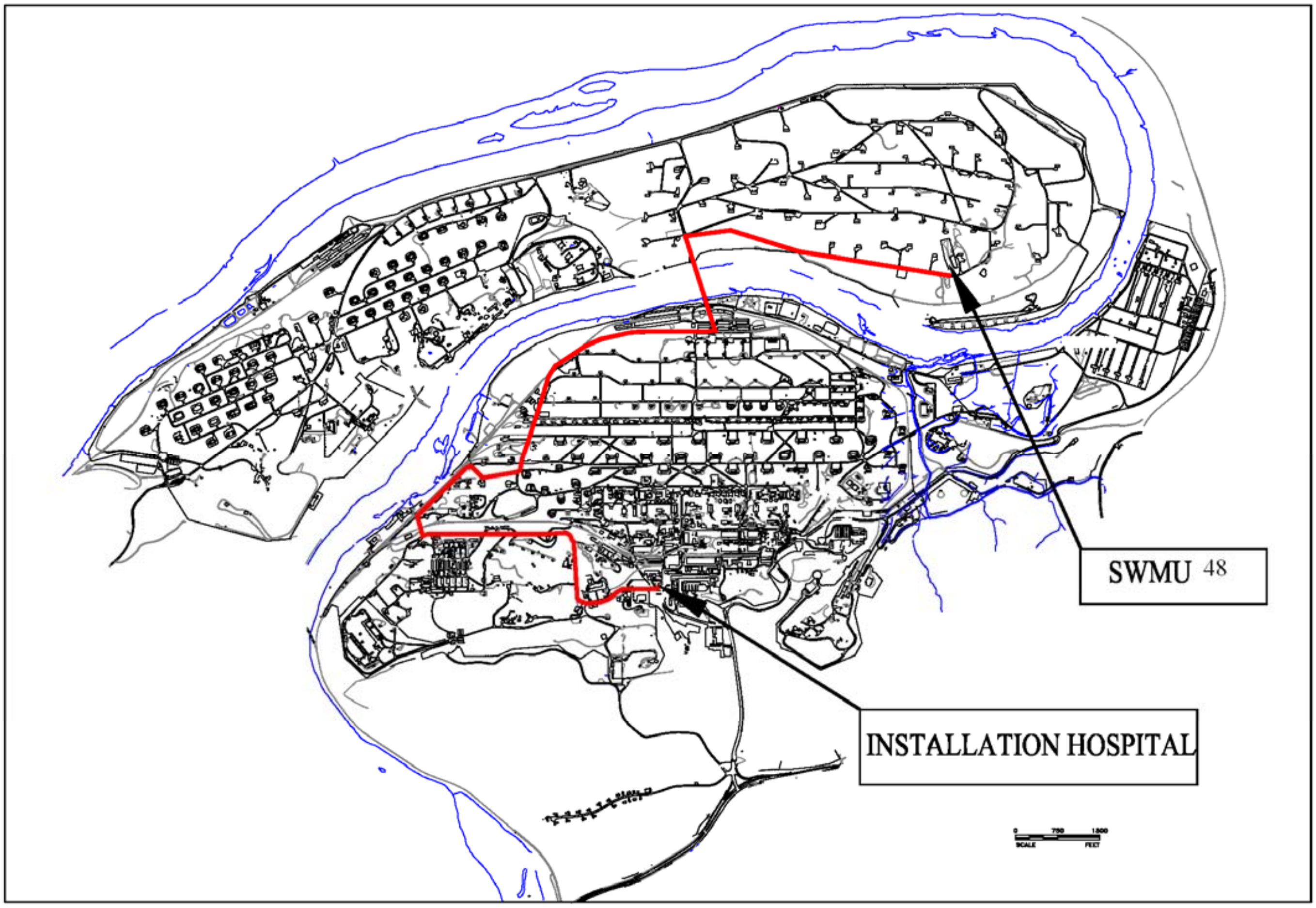


Figure 8-2
Directions to Radford Army Ammunition Plant Hospital



8.9.2.2 Identification of Potential Emergencies

During the development of this SSHP, great attention has been given to identifying potential health and safety hazards associated with the conduct of site activities. Once identified, these hazards were assessed to determine the risk that these hazards could result in an emergency situation. Contingency plans for responding to the potential emergency situations have been developed and are included in this section. The potential emergencies which may result during the conduct of site activities are as follows:

- Injury or illness.
- Fire/explosion.
- Adverse weather conditions.

8.9.2.3 Other Hazard Information

In the event that additional site or task hazard information becomes available during the conduct of site investigation activities, this information will be assessed by the SSHO to determine if the contingency plans in this section need to be updated.

8.9.3 Personnel Responsibilities

8.9.3.1 On-Scene Incident Commander

In the event of an emergency, the SSHO assumes the responsibility of On-Scene Incident Commander (OSIC). The alternate person to assume this role, in the event that the SSHO is unavailable or incapacitated, is the task supervisor. The OSIC has responsibility for directing all on-site and off-site response personnel.

8.9.3.2 On-Site Emergency Response Services

Shaw personnel/subcontractor personnel are trained to provide first aid treatment for minor injuries. At least two persons on site at all times are first aid and CPR certified.

The SSHO will determine if the injury requires further treatment. If emergency response is needed, the SSHO, or other designee, will call emergency response personnel by dialing 911.

8.9.3.3 Off-Site Emergency Response Services

Off-site emergency response services that may be needed in the event of a site emergency, such as fire, medical, and police personnel, are listed in **Table 8-11**.

8.9.3.4 Medical Evacuation

Medical evacuation (MedEvac) requirements are determined by the emergency first responder. Personnel requiring additional treatment are evacuated to the New River Valley Medical Center by ambulance. Helicopter MedEvac will be initiated by the emergency first responder, if necessary.

8.9.4 Emergency Site Control and Security

In an emergency, it is imperative that site control and security be maintained. To control site personnel, the OSIC will utilize the Site Entry/Exit Log to ensure all personnel are present or accounted for at the assembly point(s). Depending upon site size and configuration, weather and wind conditions, and the nature of the emergency, the following will be, as applicable, used to maintain site security:

- Close, but do not lock, gates as evacuation occurs.
- Erect flagging or barrier tape to prevent accidental entry.
- Use a megaphone, walkie-talkies, and/or cell phones to alert personnel to stay clear of the site.
- Use vehicles to block access routes to the site, but ensure they can be moved rapidly if emergency vehicles must use the access route.

8.9.5 Medical Facilities

The directions to the Occupational Medical Facilities are presented on **Figure 8-1**. Directions for emergency services at the RFAAP Installation Hospital are presented in **Table 8-11**.

8.9.6 General Emergency Procedures

Emergency response procedures include all steps to be taken for notifying, evaluating, reacting to, documenting, and following-up on a given emergency situation. To ensure all necessary elements are covered, the procedural steps outlined in this paragraph are implemented for each emergency, regardless of its nature.

8.9.6.1 Notification

Once the OSIC has been informed of the emergency, the OSIC alerts site personnel to the presence of the emergency by radios. This is done to:

- Notify personnel and get their attention.
- Stop all work activity as required.
- Lower noise levels in order to speed and simplify communication.
- Begin emergency and/or evacuation procedures.

If on-site Shaw personnel/subcontractors or off-site emergency personnel are to enter the site in response to the emergency, the OSIC, to the extent possible, will notify response personnel about the nature of the emergency, to include:

- What happened and when it happened.
- Where on site the emergency situation occurred.
- Who is involved and, if possible, the cause of the emergency.
- The extent of damage and what hazards may be involved.
- What actions should be taken.

8.9.6.2 Assessing the Emergency

Available information related to the emergency and the on-site response capabilities should be evaluated and the information listed below obtained to the extent possible:

- What happened.
- Type of incident.
- Casualties involved.
- Victims (number, location, and condition).

- Treatment required.
- Missing personnel.
- Cause of incident.
- Extent of damage to structures, equipment, and terrain.
- What could happen from this point.
- Potential for fire or explosion.
- Location of all personnel in relation to hazardous areas.
- Potential for emergency affecting the general public or the environment.
- What can be done to remediate the situation.
- Equipment and personnel needed for rescue and hazard mitigation.
- Number of uninjured personnel available for response.
- Resources available on site.
- Resources available from off-site response groups and agencies.
- Time needed for off-site response to reach the site.
- Hazards involved in rescue and response.

8.9.6.3 Rescue and Response Actions

Based on the information collected during the emergency assessment, the general actions listed below are taken, with some actions being conducted concurrently. No one is to attempt emergency response/rescue until the situation has been assessed and the appropriate response outlined by the OSIC.

- Enforce the Buddy System.
- Allow no one to enter a hazardous area without a partner.
- Personnel in the EZ should be in line-of-sight or in communication with the OSIC or his designee.
- Survey Casualties.
- Locate all victims and assess their condition.
- Determine resources needed for stabilization and transport.
- Assess Existing and Potential Hazards and Determine.
- Whether and how to respond.
- The need for evacuation of site personnel and off-site population.
- The resources needed for evacuation and response.
- Request Aid.
- Contact the required off-site and on-site personnel or facilities, such as ambulance, fire department, police, etc.

- Allocate Resources.
- Allocate on-site personnel and equipment to rescue and initiate incident response operations.
- Control.
- Assist in bringing the hazardous situation under complete or temporary control and use measures to prevent the spread of the emergency (i.e., control fire, secure site, etc.).
- Extricate.
- Remove or assist victims from the area.
- Stabilize.
- Administer any medical procedures that are necessary before the victims can be moved.
- Stabilize or permanently fix the hazardous condition.
- Attend to what caused the emergency and anything damaged or endangered by the emergency (e.g., drums, tanks, etc.).
- Transport.
- Using either on-site or off-site assets.
- Casualty Logging.
- Record who, time, destination and condition upon transport.
- Evacuate.
- Move site personnel to the rally point, a safe distance upwind of the incident.
- Monitor the incident for significant changes; the hazards may diminish, permitting personnel to re-enter the site, or hazards may increase and require public evacuation.
- Casualty Tracking.
- Record disposition, condition, and location.

8.9.6.4 Post Emergency Follow-Up

Immediately following an emergency, it is imperative that all federal, state, and local regulatory agencies be notified of the emergency. The following activities will be conducted:

- Notify all appropriate governmental agencies as required. Accidents will be reported immediately by telephone to the USACE and in writing within 2 working days of occurrence. Complete the USACE Accident Investigation Report (Eng Form 3394-see **Appendix D**). Any chemical exposure or occupational injuries and illnesses also will be reported and recorded, if recordable per 29 CFR 1904, on an OSHA Form No. 300 Log (see **Appendix D**). Any incident will be reported to OSHA by Shaw's Health and Safety Manager as soon as possible. Any incident or accident will be reported to the LMARC Safety Manager and the Shaw Corporate Help Desk. If a person is injured, Health Resources need to be notified prior to/during transportation of the injured party to the emergency room or the Health Clinic. Any damage to government or contractor property (which occurs during the performance of the contract at the project site) in excess of $2,000 will be reported to the USACE within 8 hours of occurrence.

- Complete a Shaw Accident Report (see **Appendix D**). Any recommended hazard control will be discussed with the Shaw Health and Safety Manager for approval prior to implementing the control. The SSHO will maintain records of all site accidents and first aid treatments. Accident investigation and injury/illness record-keeping procedures are outlined in Shaw Procedure HS020 (**Appendix E**).
- Conduct an accident investigation and root cause analysis to determine the cause of the emergency and what preventive measures could be taken to ensure the emergency does not occur again.
- Review and revise, as needed, the site operational procedures, and if necessary, update the SSHP to reflect the new procedures.
- Restock and clean all equipment and supplies utilized or damaged in the emergency.

8.9.6.5 Documentation

Documentation related to the emergency will be recorded in an accurate, authentic, and complete fashion. Documentation shall be recorded as soon as possible after the emergency to ensure it is recorded while the events are vivid in the minds of the personnel involved. The information recorded will include:

- A chronological record of events.
- A listing of the personnel involved, including personnel on site, site personnel who responded, personnel in charge, and off-site groups or agencies that responded.
- A listing of the actions taken to minimize the effects of or mitigate the emergency.
- An assessment of the potential exposures received by site personnel and the surrounding public.
- A recording of the injuries or illnesses which occurred as a result of the emergency. All information gathered will be forwarded to the LMARC Safety Manager and to the Corporate Safety Group in Louisiana.

8.9.7 On-Site Emergency Equipment

The emergency equipment listed in **Table 8-12** below will be available at each work site. The team support vehicle is designated as an emergency vehicle. All emergency equipment will be maintained in proper working order and inspected by the SSHO to ensure completeness and proper working order. The results of the inspection will be documented in the safety log. In the event that any of the disposable items are utilized, the SSHO will ensure they are replaced immediately. Site operations will not be conducted if the required emergency equipment is not available on site.

Table 8-12
Emergency Response Equipment

Emergency Equipment	Number per Location	Location where Emergency Equipment is Stored
First Aid/Burn Kit	1 each	Team Support Vehicle
Eye Wash	1 each	All First Aid Kits
CPR Pocket Mask	1 each	All First Aid Kits
Disposable Latex Gloves	5 each	All First Aid Kits
Fire Extinguisher 10 BC Rated	1 each	Team Support Vehicle

8.9.8 Contingency Plans

The following paragraphs contain emergency specific contingency plans. These plans outline the procedures for mitigating each of the potential emergency situations that were identified in the pre-emergency planning. These contingency plans specify the minimum emergency procedures and may be subject to alteration by the SSHO, based on actual or changing site conditions.

8.9.8.1 Injury or Illness

In the event of an emergency involving personal injury or illness, immediate response is key in preventing further injury/illness and providing comfort to the affect party. When personnel are injured or overcome by illness, the following procedure is followed:

- Upon notification of the occurrence and nature of the injury/illness, the OSIC, if deemed necessary, summon emergency personnel.
- Administer life support if necessary until emergency response personnel arrive.

8.9.8.2 Fires and Explosions

The occurrence of a fire on site presents a serious threat to all site personnel, the environment, and the general public. Due to the site's location within the Magazine Area, it is imperative that Radford's emergency services be notified immediately [(540) 639-7325 – from cell phone; x7325 from installation phone]. To ensure immediate, aggressive response to emergencies dry-chemical-type fire extinguishers will be available at each individual work site. Dry chemical fire extinguishers are also provided at any other site location where flammable materials may present a fire risk. Additionally, a fire extinguisher rated at least 2A:10B:C will be located with each piece of heavy equipment and in each site vehicle.

<u>Small Fires</u>

A small fire is defined as a fire that can be extinguished with a 4A:20B:C type fire extinguisher. In the event of a small fire, site personnel take the following actions:

- All unnecessary personnel are evacuated from the immediate area, to an upwind location.
- Extinguish the fire using portable fire extinguishers or by smothering from an upwind location.

- 911 Emergency response services (ambulance, fire, police) will be notified by the OSIC immediately.
- Do not attempt to extinguish a fire, even a small one, involving explosives.
- Notify the SSHO and site supervisor.

Large Fires

In the event of a large fire or small fire which cannot be extinguished, the following actions are taken:

- All personnel will be evacuated from the site, to an upwind location.
- The 911 emergency response services (police, ambulance, hospital, etc.) will be notified by the OSIC immediately.
- If it can be conducted safely, the OSIC will direct personnel to move vital equipment/supplies from the fire path.
- Do not attempt to extinguish a fire involving explosives.
- Notify the SSHO and site supervisor.

Explosion

In the event of an explosion, all personnel evacuate, the OSIC requests the required support equipment and personnel, and the USACE and ATK representatives are notified. It is essential that the site be evacuated and no one allowed to re-enter until an ATK representative authorizes re-entry. The OSIC determines what actions are appropriate.

8.9.8.3 Inclement Weather

In the event of inclement weather [i.e., high winds, electrical storms, tornadoes, extremely hot weather (>100°F), or extremely cold weather (<0°F)], it may be necessary to cease operations and evacuate the site.

8.9.8.4 Spill Containment

A spill containment program will be implemented during all site activities that meet drum and container handling requirements in accordance with 29 CFR 1910.120. Hazardous substances and contaminated soils, liquids, and other residues also will be handled, transported, labeled, and disposed of in accordance with this regulation. If a spill occurs, Shaw will follow the *Spill Notification Procedures* in *Section 5.15.5* of this Work Plan and, if possible, implement controls to contain and isolate the spilled substance.

8.10 Personnel Training and Medical Surveillance Program

8.10.1 General

Work at RFAAP will be performed in accordance with the *RFAAP MWP* (URS, 2003). Section 8 of the MWP details the security and entry requirements for the installation. All Shaw employees, managers, supervisors, consultants, and subcontractors who perform field activities at RFAAP are required to have received the following:

- OSHA 1910.120 initial 40-hour training or OSHA 1910.120 annual 8-hour refresher training within the last year. In addition, 3 days of documented field experience under the direct supervision of a trained, experienced supervisor is required.
- Managers and supervisors directly responsible for site activities must complete an 8-hour supervisor training course in addition to the 40-hour training and 8-hour refresher course. Training certificates for all personnel (including subcontractor personnel) conducting site activities will be maintained in the Project File or Shaw's corporate safety and health file.
- An occupational medical surveillance examination (in compliance with OSHA 1910.120) within the last year, which demonstrates no restrictions for hazardous waste site work, and ability to wear a respirator.
- Site-specific safety and health training that specifically addresses the activities, procedures, monitoring, and equipment applicable to ongoing field activities.
- At least two members of the team are required to have first aid and CPR certification. These personnel will be on site with the team at all times.

8.10.2 Site-Specific Training

To ensure that all personnel understand the hazards associated with this specific project, the SSHO will conduct initial site-specific training for personnel before participating in the field activities. The SSHO will use the following outline for the initial training of personnel:

- Names of personnel and alternates responsible for site safety and health.
- Safety, health, and hazards present at the site.
- Contingency Plans Training.
- Hazard Communications Training.
- Use of PPE.
- Work practices by which the employee can minimize risks from hazards.
- Safe use of engineering controls and equipment on site.
- Medical surveillance requirements.
- Decontamination procedures.
- Emergency response plan.
- Spill containment.

8.10.2.1 Activity/Hazard Specific Training

Prior to initiating soil remediation activities, all personnel will receive additional training in lead awareness, arsenic awareness, vanadium awareness, and dioxin/furan awareness.

8.10.3 Daily Safety Meetings

Safety meetings/training will be held each morning on site at the daily safety meeting. This meeting will be conducted by the SSHO. Attendance is mandatory for all site personnel and will be documented in a log book. The safety and health considerations for the day's activities will be reviewed at this meeting. Additional training, Job Safety Analyses creation, and review of safety concerns will be conducted when circumstances dictate. The meeting will re-affirm safety issues, specific hazards, and emergency procedures, including:

- Notification procedures and phone numbers.
- Rally points and safe areas.
- Hospital and evacuation routes.
- Emergency equipment.

The SSHO will conduct tailgate safety meetings and new employee orientation at the beginning of each shift, whenever new personnel arrive at the site, as site conditions change, or as needed.

8.10.4 Medical Monitoring Program

Shaw employees who conduct field activities at SWMU 48 must participate in Shaw's medical surveillance program. Personnel performing site work must have received a medical baseline or follow-up examination within the past 12 months. A physician's statement declaring that each Shaw field team member is medically qualified to perform hazardous waste related activities, including medical qualification to wear a respirator, will be maintained on site and in the Shaw corporate safety and health files.

Subcontractor employees must participate in their employer's medical monitoring program consistent with 29 CFR 1910.120. The SSHO must ensure that all subcontractors participate in a medical monitoring program and that subcontractors provide appropriate documentation. Documentation will be maintained on site and should include a statement declaring that each subcontractor employee is medically qualified to perform hazardous waste site work, including medical qualification to wear a respirator.

8.11 General Safety Items

Additional safety items include the following:

- Safety and health audits will be conducted by the SSHO to ensure that all site activities are being performed in accordance with the SSHP, USACE requirements, OSHA regulations, Shaw procedures, and contract requirements.
- The SSHO will ensure that appropriate PPE is available for personnel and is used as directed in this SSHP. The SSHO will be responsible for ensuring that job site hazards are properly controlled to provide safe ingress and egress from the sites. Cones and high-visibility banner guard (when deemed necessary by the SSHO) will be used to control traffic and limit access to hazardous and restricted areas.
- A tailgate safety meeting will be conducted to discuss pertinent site safety topics at the beginning of each shift, whenever new personnel arrive at the job site, as site conditions change, and whenever otherwise deemed necessary. These meetings will be conducted by the SSHO, and all relevant information will be recorded in the site logbooks. Site personnel and visitors are required to attend these meetings. Proof of attendance will be documented. Necessary information from these meetings will be forwarded to the SSHO.
- Shaw and its subcontractors will emphasize compliance with state, local, and Installation motor vehicle laws, regulations, and safety guidelines as part of each daily safety

briefing. Special considerations, such as current or anticipated hazardous road conditions, will be addressed at the daily safety briefings.

- Emergency telephone numbers will be posted for the fire department, emergency medical response, and the nearest emergency medical clinic/hospital. These numbers are listed in this SSHP.
- At least one copy of this SSHP shall be available at each work site.
- Horseplay, practical joking, or any other actions that jeopardize safety will not be tolerated.
- Running is not permitted.
- Alcoholic beverages and non-medicinal drugs are not permitted at the project site. Personnel suspected of being under the influence of alcohol or drugs will be removed from the site.
- Radios (excepting two-way radios), tape players, or other forms of entertainment devices are prohibited during work.
- Legible and understandable precautionary labels shall be affixed prominently to containers of contaminated scrap, waste, debris, and clothing.
- Removal of contaminated soil from protective clothing or equipment by blowing, shaking, or any other means which disperse contaminants into the air is prohibited.
- Transportation and disposal of contaminated materials shall comply with all applicable local, state, and federal regulations. These items will be addressed by the generator, transporter, and disposer.
- Containers shall be moved only with the proper equipment and shall be secured to prevent dropping or loss of control during transport.
- Emergency equipment (including first aid equipment, emergency-use respirators, spill control materials, and fire extinguishers) shall be located in readily accessible locations.
- All trenching, shoring, and excavation work must comply with all federal OSHA rules and Shaw Procedure HS307.
- No food or beverages shall be present or consumed in the EZ. No tobacco products shall be present or used and cosmetics shall not be applied in the EZ.
- All personnel shall avoid contact with potentially contaminated substances. Walking through puddles or mud, kneeling on the ground, or leaning against drums shall be avoided.
- Monitoring equipment shall not be placed on potentially contaminated surfaces.

Field personnel must observe each other for signs of toxic exposure. Indications of adverse effects include, but are not limited to:

- Changes in complexion and skin discoloration.
- Changes in coordination.
- Changed in demeanor.

- Excessive salivation and papillary response.
- Changes in speech pattern.

Field personnel shall be cautioned to inform each other of non-visual effects of toxic exposure such as:

- Headaches or dizziness.
- Nausea.
- Blurred vision.
- Cramps.
- Irritation of eyes, skin, or respiratory tract.

9.0 CONTRACTOR QUALITY CONTROL PLAN

This CQCP describes the QC organization and program for IM actions at SWMU 48. The requirements and systems herein, are relevant and applicable to project work performed by Shaw and its subcontractors and suppliers. Chemical quality management aspects of this QC program are addressed in the QAPP.

The objective of this CQCP is to establish procedures to verify that the quality of work meets the applicable requirements of the contract, and is suitably well documented. Specifically, this plan:

- Identifies the qualifications, authority, duty, and responsibility of the CQC System Manager and staff.
- Establishes QC procedures for inspection and test activities, including the performance of 3-phase control, deficiency, and daily QC reporting.
- Defines project communication, documentation, and record keeping procedures.

References used for the development of this plan include USACE ER 1180-1-6: *Construction Quality Management* (30 September 95); USACE ER 1110-1-12: *Engineering and Design Quality Management* (1 June 93); and USACE ER 415-1-10: *Contractor Submittal Procedures* (15 April 97).

The sponsoring/monitoring agency for this project is the USACE, Baltimore District. Therefore, USACE's acceptance of this CQCP is required prior to the start of on-site operations under definable features of work listed in *Section 9.10* of this CQCP. Work outside these definable features is not to be performed without USACE documented approval.

Once accepted by the USACE, the distribution of plans, drawings, procedures, and instructions shall be controlled to ensure that the most recent revision is available for use at all locations where work is to be performed. Within the Shaw's project team, initial distribution will include the Program Manager, RFAAP Project Manager, SWMU 48 IM Task Manager, QC Manager, CQC System Manager, Site Superintendent, and subcontractors.

The USACE is to be notified by the CQC System Manager in writing a minimum of seven calendar days prior to any proposed changes to a USACE-accepted CQCP. Any revisions or changes to the accepted CQCP, CQC staff, or their responsibilities must be approved by the USACE prior to being implemented by the CQC System Manager or other project personnel.

Revisions to this plan will require the same level of review and approval as the original document.

9.1 Project Background

A detailed discussion of the project background was presented in the Organization and Technical Approach Plan (*Section 2.0*).

9.1.1 Project Scope of Work

The project scope of work and detailed approach for completion of the SWMU 48 IM was provided in the Organization and Technical Approach Plan (*Section 2.0*).

9.2 Project Organization

The quality related responsibilities and authority of the key members of the organization are outlined below. Additional QC staff may be added as necessary to meet QC requirements to complete the definable features of work. Changes in project management and QC personnel require USACE approval.

9.2.1 Project Manager

Mr. Jeffrey Parks, the Project Manager, reports to the Program Manager, Mr. Bob Culbertson. Mr. Parks is responsible for coordinating all activities performed by Shaw at RFAAP and for communicating with the USACE.

9.2.2 SWMU 48 IM Task Manager

Mr. Jeffrey Hillebrand, the SWMU 48 IM Task Manager, reports to the RFAAP Project Manager, Mr. Parks. Mr. Hillebrand is responsible for the quality and timeliness of all project activities, including those performed by subcontractors. Essentially, the Task Order Manager is responsible for task accomplishment, administration of all instructions, and on-site customer interface.

9.2.3 CQC System Manager/Site Superintendent

Mr. Steve Kritak is the designated CQC System Manager and Site Superintendent for this project. As Site Superintendent, Mr. Kritak reports to the SWMU 48 IM Task Manager regarding daily site operations. The Site Superintendent is responsible for supporting the implementation of the CQCP and efforts of the CQC Manager and his staff.

As CQC System Manager, Mr. Kritak will report to Mr. Charles Hunter, QC Manager, and will coordinate activities with the SWMU 48 IM Task Manager. As CQC System Manager, Mr. Kritak has authority to enforce the procedures defined in this CQCP. In alignment with this authority, Mr. Kritak has the authority to stop work, if necessary, to ensure that project activities comply with the requirements of this CQCP, the contract, and the Task Order. This authority applies equally to all project activities, whether performed by Shaw or its subcontractors and suppliers.

The CQC System Manager is responsible for planning and executing QC monitoring, inspection, and oversight of project operations to verify compliance with applicable requirements.

Specifically, the CQC System Manager is responsible for: 1) developing, implementing, and maintaining this CQCP and its related procedures; 2) planning and conducting preparatory, initial, follow-up, and final/completion inspections for each definable feature of work; 3) identifying quality deficiencies and verifying that appropriate corrective actions are implemented; 4) verifying that the requisite QC records, including submittals, are generated and retained as prescribed in this CQCP; and 5) verifying that subcontracted laboratories have appropriate USACE certifications and a documented QC program that complies with the applicable requirements of the contract and Task Order.

The CQC System Manager is to be physically on site whenever project-related fieldwork is in progress. If the CQC System Manager is to be absent from the site, with USACE approval, an alternately qualified CQC System Manager will be provided for USACE acceptance and assigned during the absence.

Mr. Kritak has successfully completed the USACE Quality Management Training Course for Contractors. Any alternate CQC System Manager must also complete this training prior to assignment.

9.2.4 Project Chemist

Eric Malarek, the Project Chemist, will be responsible for analytical sampling, reviewing results for acceptance, and ensuring analytical data is validated at the level required by the DQOs. The Project Chemist will be responsible for coordinating analysis and data package production with the laboratory. The Project Chemist will report to the SWMU 48 IM Task Manager and assist the CQC System Manager, as needed.

9.2.5 Subcontractors

Shaw will procure subcontractors for waste transportation and disposal and laboratory services from USACE certified laboratories.

9.3 Personnel Qualification and Training

Project staff shall be qualified to perform their assigned jobs in accordance with terms outlined by the LMARC contract. This will be accomplished by establishing and enforcing minimum qualification requirements for key positions, verifying initial and continued personnel proficiency, and implementing on-the-job training, as necessary.

9.3.1 Project Personnel

Shaw has established minimum qualification requirements for key positions on this project through review of contractual and other project-related requirements. The SWMU 48 IM Task Manager is responsible for reviewing personnel qualifications, and providing for any additional training required for this site. In the event that additional assignments are made for this project, the qualifications of assigned personnel are to be evaluated and documented. Project personnel are not to be assigned a position or job for which they do not meet the minimum qualifications.

Senior technical staff shall provide on-the-job training to newly-assigned technical staff related to their job requirements and techniques and with particular emphasis on problem prevention. Work performed by newly assigned staff is to be monitored by senior staff. When newly assigned personnel arrive, the individual's demonstrated proficiency to perform his or her assigned duties must be thoroughly documented prior to his or her release from senior staff monitoring. Training will be documented with training records maintained on file.

9.3.2 QC Personnel

QC personnel will be qualified to perform their assigned jobs. Minimum education and experience standards shall be in compliance with Shaw policies and procedures. Qualifications for key technical, management, and additional QC staff (if required) will be documented as outlined in the LMARC contract vehicle.

9.3.3 Subcontractors

Anticipated subcontractor organizations are identified in *Section 9.2.5* of this CQCP. The Project Manager is responsible for ensuring that subcontractors possess the requisite qualifications prior to procurement. Subcontractors to Shaw shall not subcontract their responsibilities on this project to a third party or organization without prior and written approval of the Shaw Project Manager. The Shaw Project Manager will ensure that each subcontractor agrees to comply with this CQCP or develops and implements a QC program that meets all contract requirements and is reviewed and accepted by Shaw and the USACE, prior to performing work.

9.3.4 Health and Safety Training

Health and safety training requirements for on-site project personnel have been established in accordance with OSHA requirements for hazardous site workers (29 CFR 1910.120) and Shaw policies and procedures. These training requirements are specified in the SSHP and are to be met before project personnel can begin site work. As a minimum, site workers and visitors who may encounter hazardous substances are to have completed the OSHA Hazardous Material Site Worker Training (40-hour initial training and 8-hour annual refreshers). Site managers are to have also completed the 8-hour Supervisor Training.

9.4 Letter of Authority

The letter of authority describes responsibilities and delegates the authority of the CQC System Manager. A copy of this letter will be furnished to the USACE and provided in **Appendix G**.

9.4.1 CQC System Manager

A letter of authority has been signed by the Shaw LMARC QC Manager and acknowledged by the designated CQC System Manager for this project. This letter describes the responsibilities of, and delegates authority to, this function, including the authority to stop work that is not in compliance with project requirements.

9.5 Submittal Management

The Project Manager has the sole responsibility for ensuring submittals fully comply with project requirements and shall establish and designate an individual to maintain the project Submittal Register. Submittal control is required to regulate the timely flow of materials and work, to ensure problem prevention, and to demonstrate that materials and work are in compliance with applicable requirements. Project submittal procedures are to be implemented as prescribed herein and in accordance with the project Submittal Register.

9.5.1 General Requirements

The Site Superintendent is responsible for submittal scheduling and tracking. The CQC System Manager is responsible for ensuring, through detailed review, that submittals, as well as the materials and the work they represent, are verified in full compliance with applicable requirements.

9.5.1.1 Project Submittals

Submittals are to be listed and tracked using USACE Engineering Form (ENG) 4288, Submittal Register. Submittals include deliverables generated on site or off site by Shaw, subcontractors, fabricators, manufacturers, suppliers, or purchasing agents. Procurement documents for subcontracted services and materials are to list the submittals required of the subcontractor. The CQC System Manager is to review the list to verify its completeness. The approved ENG 4288 becomes the scheduling document used to track and control submittals throughout the project. Submittals will be transmitted using form ENG 4025 with a unique tracking number assigned from the Submittal Register.

9.5.1.2 Project Records

The CQC System Manager is to establish and maintain an on-site project file in accordance with contract requirements. The purpose of this file is to maintain a complete set of all documents, reports, certifications, and other records that provide information on project plans, contract agreements, and project activities. The initial file will be structured to include a record copy of the following documents:

- Construction schedule and progress reports.
- Technical specifications, including addenda and modifications thereof.
- Change orders and other contract modifications.
- Engineer Field Orders.
- Manufacturer's certificates.
- Daily work activity summary reports, including:
  - Daily QC Report (including QC log).
  - Daily Health and Safety Report.
  - Daily Superintendent Report (including activity log).
  - Reports on any emergency response actions.
  - Test records.
  - Records of site work.
  - COC records.
  - Reports on any spill incidents.
  - Truck load tickets and shipping papers.
  - Laboratory results.
  - Records on quantities of soil treated.
  - Other items as required by the Contracting Officer's Representative.
- Conversation logs.
- Meeting minutes and agenda.
- Inspection logs and schedules.
- Photo documentation.
- Site maps.
- As-built drawings.

9.5.2 Submittal Scheduling

The Site Superintendent is to establish and maintain a project submittal schedule that reflects the status on ENG 4288. Submittal activities are to be incorporated into the construction schedule so that submittal progress can be tracked in conjunction with overall progress. Submittal schedules are to allow for evaluation, approval, procurement, and delivery prior to the preparatory phase and before the item is needed. The Site Superintendent is responsible for monitoring the progress of project submittals and keeping the Project Manager apprised. The submittal schedule is to be updated by the Site Superintendent on a weekly basis. Submittals covering component items that form a system or items that are interrelated are to be scheduled and submitted concurrently. Adequate time is to be allowed for required reviews and approvals.

9.5.3 Review of Plans and Specifications

During the preparatory phase for a construction feature of work, the Project Manager or his designee is responsible for reviewing the construction drawings and specifications and requesting clarification from the USACE, where necessary. The primary purposes of this review are to identify and resolve potential conflicts prior to initiating work operations. In the interest of minimizing adverse impacts on project schedules, this review is to be performed as early in the process as practical to allow sufficient time for evaluation and response. The Project Manager is responsible for ensuring that construction plans, drawings, and specifications 1) have been approved by the USACE for implementation on the particular feature of work; 2) are clear and complete; and 3) are executable, cost-effective, and practical. The review should include items such as identifying discrepancies between plans and specifications, assessing and verifying site conditions and restraints, verifying that proper allowances are made for maintenance space and access, etc.

9.5.4 Review and Approval of Submittals

Prior to client delivery or use, project submittals are to be reviewed and accepted by Shaw. The CQC System Manager certification and signature are required on each submittal. He is to review submittals prepared by Shaw, subcontractors, and suppliers for completeness and compliance with the specifications of the Task Order and contract. Submittals related to construction equipment or materials are to be reviewed for contractual compliance, including compliance with the *Buy American Act* (FAR 52.225-0005 and 52.225-15). Noncompliant submittals are to be returned to the originator for corrective action and re-submittal to the CQC System Manager.

Prior to submittal to the CQC System Manager for certification, technical documents (e.g., reports, plans, and engineering drawings) are to be reviewed by qualified staff. Although part of the QC process, technical reviewers may include but are not limited to the QC staff.

9.5.5 Documentation

In addition to the documentation requirements specified above, the following requirements apply to this project. The QC file is to be maintained by the CQC System Manager and is to be controlled as an integral component of the project files. Shop drawings, work orders, and change orders issued for remedial actions are to be provided to the CQC System Manager. It is the responsibility of the CQC System Manager to maintain this technical information and keep it current and recorded as it is revised. Technical information is not to be replaced or revised without receipt of a properly authorized change order or revision. Copies of purchase orders or subcontracts requiring inspection are to be provided to the CQC System Manager for receiving and recording purposes. Copies of required certifications received are to be maintained in the QC file and are to be submitted to the client in accordance with agreements made at the coordination meeting. Changes in submittal progress and QC activities related to submittals are to be summarized in the Daily QC Report.

9.6 Inspection Phases

The CQC System Manager is responsible for verifying compliance with this CQCP through implementation of the 3-phase control process. This process ensures that project activities comply with the approved plans and procedures. The specific QC monitoring requirements for the definable features of work for the SWMU 48 removal actions are discussed below. This section specifies the minimum requirements that must be met and to what extent QC monitoring must be conducted by the CQC System Manager.

9.6.1 Implementation of the 3-Phase Inspection Process

The CQC System Manager is to ensure that the 3-phase control process is implemented for each definable feature of work listed in *Section 9.10* of this CQCP, regardless of whether they are performed by Shaw or its subcontractors. Each control phase is important for obtaining a quality product. However, the preparatory and initial inspections are particularly invaluable in preventing problems. Production work is not to be performed on a definable feature of work until a successful preparatory and initial phase inspection have been completed.

9.6.1.1 Preparatory Phase Inspection

The CQC System Manager or designee will perform a Preparatory Phase Inspection prior to beginning each definable feature of work. The purposes of this inspection are to review applicable specifications and verify that the necessary resources, conditions, and controls are in place and compliant before the start of work activities. To conduct and document the inspection, the CQC System Manager shall use the Preparatory Inspection Checklist provided in **Appendix H**.

The CQC System Manager or designee will review work plans and operating procedures to ensure that they describe pre-qualifying requirements or conditions, equipment and materials, appropriate sequence, methodology, hold/witness points, and QC provisions. He is to verify that the required plans and procedures have been prepared and approved and are available to the field staff; field equipment is appropriate for its intended use, available, functional, and properly calibrated; staff responsibilities have been assigned and communicated; staff have the necessary knowledge, expertise, and information to perform their jobs; arrangements for support services (such as test laboratories) have been made; and prerequisite site work has been completed. As part of the Preparatory Phase Inspection, the CQC System Manager is to verify that lessons learned during previous similar work have been incorporated as appropriate into the project procedures to prevent recurrence of past problems.

Project staff must correct or resolve discrepancies between existing conditions and the approved plans/procedures identified by the CQC System Manager during a Preparatory Inspection. The CQC System Manager or designee must then verify that unsatisfactory and nonconforming conditions have been corrected prior to granting approval to begin work. Client notification is required at least 24 hours in advance. Results are to be documented in the preparatory inspection checklist and summarized in the Daily QC Report, which is provided in **Appendix H**.

9.6.1.2 Initial Phase Inspection

The CQC System Manager is to perform an Initial Phase Inspection the first time a definable feature of work is performed. To conduct and document the inspection, the CQC System Manager shall use the Initial Phase Inspection Checklist provided in **Appendix H**. The purposes of this inspection is to check preliminary work for compliance with procedures and specifications, establish the acceptable level of workmanship, and check for omissions and resolve differences of interpretation. The CQC System Manager, or his designee, is responsible for ensuring that discrepancies between site practices and approved specifications are identified and resolved. Initial inspection results are to be documented by the CQC System Manager and summarized in the Daily QC Report. Discrepancies between site practices and approved plans/procedures are to be resolved, and corrective actions for unsatisfactory and nonconforming conditions or practices are to be verified by the CQC System Manager or his designee, prior to granting approval to proceed. Client notification is required at least 24 hours in advance.

9.6.1.3 Follow-Up Phase Inspection

The CQC System Manager or designee will perform a Follow-Up Phase Inspection each day a definable feature of work is performed. The purpose is to ensure continuous compliance and the level of workmanship. To conduct and document these inspections, the CQC System Manager shall develop inspection checklists to accommodate the inspection of both routine and complex inspection activities. The CQC System Manager is responsible for on-site monitoring of the practices and operations taking place and verifying continued compliance with the specifications and requirements of the contract, Task Order, and approved project plans and procedures. He is also responsible for verifying that a daily health and safety inspection is performed and documented as prescribed in the project SSHP. Discrepancies between site practices and approved plans/procedures are to be reported, and corrective actions for unsatisfactory and nonconforming conditions or practices are to be verified by the CQC System Manager or his designee prior to granting approval to continue work. Follow-up inspection results are to be documented using a suitable checklist, as necessary, and summarized in the Daily QC Report.

9.6.1.4 Additional Inspections

Additional inspections performed on the same definable feature of work may be required at the discretion of the client or the CQC System Manager with approval by the client. Additional preparatory and initial inspections are generally warranted under any of the following conditions: unsatisfactory work, as determined by Shaw or the client; changes in key personnel; resumption of work after a substantial period of inactivity (e.g., 2 weeks or more); or changes to the project scope of work/specifications.

9.6.1.5 Completion/Acceptance Inspection

A Completion/Acceptance Inspection shall be performed, upon conclusion of the feature of work and prior to closeout, to verify that project requirements relevant to the particular feature of work are satisfied. Outstanding and nonconforming items are to be identified and documented on a punch list. As each item is resolved, it is to be so noted on the punch list. Client acceptance and closeout of each definable feature of work is a prerequisite to project closeout.

9.6.2 Inspection Procedures

9.6.2.1 Receiving and Storage

The CQC System Manager or designee is to inspect construction materials upon receipt and prior to use. Visual inspection criteria include identification, signs of damage or distortion, completeness, evidence of compliance with specifications, and associated documentation. Results of receiving inspections are to be documented and summarized in the Daily QC Report.

9.6.2.2 Off-Site Control

Source inspections at supplier facilities, if necessary, shall be performed to verify compliance with contract and Task Order requirements.

9.6.2.3 Material Certification

Copies of purchase orders or subcontracts requiring receiving inspection are to be provided to the CQC System Manager for scheduling inspection and record-keeping purposes. Copies of supplier certifications are to be maintained in the project QC file and made available to the USACE upon request or submitted in accordance with contract requirements.

9.6.2.4 Inspection of Workmanship

Standards for good workmanship shall be established and documented. The CQC System Manager shall discuss these standards during the preparatory phase meeting for each definable feature of work and verify the presence of good workmanship during each initial phase inspection, and follow-up phase inspection thereafter. Identified deficiencies are to be reported to the responsible organization and documented. Corrective actions are to be verified by the CQC System Manager and documented.

9.6.2.5 Surveillance of Subcontractor Operations

The CQC System Manager is responsible for performing monitoring, inspection, and oversight of project activities conducted by Shaw and its subcontractors. Deficiencies associated with subcontractor work are to be reported to the appropriate level of management for resolution.

9.6.3 Documentation of Inspections

The Shaw Inspection Schedule & Tracking Form (**Appendix H**) is to be used by the CQC System Manager for planning, scheduling, and tracking the progress of inspections for this project. The information on the form is to be kept up-to-date.

9.7 Testing

Testing will be performed as required to confirm that specifications are met. Testing in support of remediation activities generally includes on-site tests of items and materials, and off-site testing by laboratories, manufacturers, and suppliers.

9.7.1 Test Plan Application

Testing will be conducted and reported in accordance with project specifications, drawings, codes, standards, and procedures. The CQC System Manager and the subcontract laboratory will use this plan as a guide and checklist throughout the project. A preparatory meeting will be held for each definable feature of work where the testing and frequency of tests are to be reviewed. The QC staff is responsible for verifying that the tests are performed and that the results are summarized in and provided with the Daily QC report. Test failures will be documented on a Nonconformance Report (NCR) and tracked until such time as rework and re-testing can be performed and corrective action is verified.

9.7.2 Testing Procedures

The QC staff shall verify the proper selection of measuring and test equipment (M&TE) and verify that approved procedures and protocols are identified and available for use. QC shall also confirm that test personnel have a working knowledge of the test and instruments to be used. Upon satisfactory verification of the stated requirements, the test may proceed. Each reading is to be verified and documented by a member of the QC staff. As a minimum, test reports will reflect the date of performance, type of test conducted, the item tested, the procedure/protocol used (including revision), actual test results, identification of any M&TE used (including calibration status), identification and signature of the individual performing the test. Copies of test reports will be maintained in the project files and submitted to the USACE, as required.

9.7.3 Test Organizations

For environmental testing, the selected laboratory will be certified by the USACE Missouri River Division for environmental analysis for toxic materials using standard methods.

The CQC System Manager will verify the performance of sampling, sample handling, and shipping in accordance with the applicable sections of this plan. The sampling technicians will perform the required sampling. The Project Chemist will be responsible for ensuring analytical data is validated at the level required by the DQOs.

Data reports are to include sufficient information to verify the effectiveness and implementation of laboratory QC systems. Requisite information includes raw data, instrument printouts, preparation logs, calibration records, test results for associated QC samples, dilution factors, instrument settings, equations used in data reduction, and any observed deviations or problems.

9.7.4 M&TE Calibration and Maintenance

The selection, control, and use of M&TE shall be as specified within procedures and specifications. M&TE shall be calibrated or verified at specific intervals or prior to use, against measurement standards traceable to nationally recognized standards. M&TE shall be stored, handled, and maintained in accordance with the manufacturer's instructions. Records of these activities are to be generated by the individual performing the activity with copies provided to the CQC System Manager for retention in the project QC file. The Work Plan lists the M&TE for this project and provides calibration and maintenance responsibilities, schedules, and procedures.

9.7.5 Validation of Test Results

Prior to their use in decision-making, test data are to be reviewed and validated by the Project Chemist or his designee. Validation is to include:

- Verification that all required documentation was submitted.
- Verification that specified test procedures and conditions were followed.
- Review of QC data and comparison of achieved results against specified limits of acceptability.

9.7.6 Documentation of Testing

Test results are to be documented by the individual performing the test. Calibration and maintenance records associated with the M&TE are to be generated by the individual performing the activity. Documentation for calibration and maintenance of M&TE is to be made available to the USACE upon request.

Test results are to be retained in the project file and summarized in the Daily QC Report. These results will additionally be compiled into a report to the CQC System Manager that includes the name of the test, the items tested, test conditions and procedures, units of measurement, the resulting test data for all submitted samples (both passing and failing), and associated QC information (e.g., equipment calibration and maintenance, duplicate measurements, and use of certified reference standards). A copy of each test report is to be attached to the Daily QC Report.

9.8 Nonconformance Reporting & Corrective Action

The Shaw system for reporting deficiencies and implementing effective corrective action provides for two distinct reporting mechanisms which are procedurally addressed. The NCR shall be used for reporting and correcting deficient items and materials, and the Corrective Action Request (CAR) shall be used to report and correct programmatic deficiencies, negative quality trends, breakdowns in the quality program, and/or the more serious or significant deficiencies requiring management attention and action.

9.8.1 Identification and Control of Nonconforming Conditions

Any deficiency in characteristic, documentation, or procedure, which renders an item or material unsatisfactory or unacceptable, is required to be identified, reported, and corrected. The CQC System Manager will document item and material deficiencies using an NCR, following form instructions and those instructions delineated within Shaw SOP-Q-007; Nonconformance Reporting. The NCR form is provided in **Appendix H**. Each NCR will be logged within the NCR Tracking Log, and issued to the responsible organization for timely disposition and corrective action. Each NCR response shall identify one of the following four categories for disposition:

- Rework – The act of bringing the item into compliance with the original requirements.
- Repair – The act of making the item perform to its original requirements and function.
- Scrap – Removing the item from the project site for disposal.
- Use-As-Is – Permits the item to be utilized based on a documented and acceptable technical justification.

When possible, each NCR disposition will include the following within its corrective action:

- Identification of the cause.
- Steps taken to preclude recurrence.
- Date of disposition performance and corrective action completion.

Each NCR disposition and its corrective action will be verified by the CQC System Manager and documented by signature and date. This will include all re-inspection and re-testing, as appropriate.

NCR forms may be supplemented by completed checklists, photographs, sketches, drawings, or other renderings to assist in identifying the deficiency. All such data will become a part of the NCR and shall be maintained with the NCR on file.

9.8.2 Corrective Action Requests

In the case of a programmatic deficiency, or recurrence of a nonconforming condition (attributed to ineffective corrective action), the CQC System Manager will issue a CAR to the responsible organization. A CAR form is provided in **Appendix H**. The CAR will be processed in accordance with Shaw SOP-Q-008; Corrective Action Requests. The CAR is a document used to report deficiencies of a significant nature and shall be distributed to upper management for their attention and any subsequent action. The CAR is generally reserved for serious or major deficiencies and requires the responsible organization to:

- Take immediate corrective action to remedy the condition.
- Investigate and identify the root cause through analysis.
- Identify steps taken to preclude recurrence.
- Implement effective corrective action in a timely manner.

For each CAR, the responsible organization shall prepare and submit a formal response to the CQC System Manager for evaluation and acceptance, prior to the established due date. Failure to respond and/or provide effective corrective action will generally result in the issuance of a stop work order.

Each CAR corrective action will be verified by the CQC System Manager and documented. The completed CAR and any related documentation will be maintained in the project QC files.

9.9 Reports

The CQC System Manager is responsible for preparing and submitting the Daily QC Report to the USACE, the Site Superintendent for the project file, and providing concurrent courtesy copies to the Project Manager. The original and one copy of the Daily QC Report with attachments are to be submitted to the USACE on the first work day following the date covered by the report. All calendar days, including weekends and holidays, are to be accounted for throughout this project. As a minimum, one report is to be prepared and submitted for every continuous 7 days of no work.

As a primary component of the Daily Activity Summary Report, the Daily QC Report is to provide an overview of QC activities performed each day, including those performed for subcontractor and supplier activities. The QC reports are to present an accurate and complete picture of QC activities. They are to report both conforming and deficient conditions, and should be precise, factual, legible, and objective. Copies of supporting documentation, such as checklists and surveillance reports, are to be attached. The format to be used is provided in **Appendix H**.

A field QC log is to be maintained by the CQC System Manager and assigned to each member of the QC staff for use in documenting details of field activities during QC monitoring activities. At the end of each day, a copy of the log entries is to be attached to the Daily QC Report. The information in the QC log provides backup information and is intended to serve as a phone log and memory aide in the preparation of the Daily QC Report and in addressing follow-up questions that may arise.

Health and safety and QC staff input for the Daily QC Report is to be provided in writing to the CQC System Manager at a previously agreed upon time and place, generally no later than about 1 hour before normal close of business. For the sake of simplicity and completeness, the format for QC staff input should follow the same as for the Daily QC Report with only the relevant sections completed.

Each Daily QC Report is to be assigned and tracked by a unique number comprised of the Delivery Order number followed by the date expressed as DDMMYY. In the case of “no work day” reports, the report number is to comprise the Delivery Order, the last date covered, the number of days covered, and the initials “NW.” For example, DO #0025-110499 is the report for this delivery order related to site work performed on June 11, 2008, and DO #0025-290507-3NW is the report for this delivery order related to three no work days from July 27, 2008, through July 29, 2008. Copies of Daily QC Reports with attachments and QC logs no longer in use are to be maintained in the project QC file. Upon project closeout, all QC logs are to be included in the project QC file.

9.10 Definable Features of Work

Below, the definable features of work are identified and briefly described for the SWMU 48 IM action.

9.10.1 Soil Removal

9.10.1.1 Mobilization

This definable feature of work includes all pre-mobilization activities such as notifications and preparation of manifests; mobilization activities, mobilization of personnel, and mobilization of materials and equipment; and a kick-off/safety meeting to include a walk-through orientation of the removal action site, review of the work plan and removal action tasks, and review and acknowledgement of the SSHP (*Section 8.0*) by all site personnel.

9.10.1.2 Site Preparation

This definable feature of work includes all required activities associated with preparing the site for contaminated soil removal activities. This includes delineation of work and support zones, and installation of sediment and erosion control measures, if necessary.

9.10.1.3 Location of 2010 Test Pits

This definable feature of work includes all required activities associated with establishing excavation area boundaries at SWMU 48, and collecting discrete soil samples to determine the waste classification for contaminated sludge and soil.

9.10.1.4 XRF and Soil Confirmation Sampling

This definable feature of work includes all required activities associated with: 1) the excavation, transport, and disposal of contaminated soil from SWMU 48; 2) the collection of confirmation soil samples to ensure all contaminated soil has been removed; and 3) removal and disposal of fence around SWMU 48.

9.10.1.5 Backfill and Site Restoration

This definable feature of work includes all required activities associated with backfilling the site and restoring vegetation at SWMU 48.

9.10.1.6 Demobilization

This definable feature of work includes the removal of all equipment and materials from the jobsite and staging areas that were utilized during, or generated as a result of the soil removal activities at SWMU 48.

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