DEPARTMENT OF THE ARMY
US ARMY INSTALLATION MANAGEMENT COMMAND
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Received
MAR 29 2022
Land Division

Reply to Attention

Environmental Management Division

March 29, 2022

Mr. Stephen A. Cobb
Chief, Land Division
Alabama Department of Environmental Management
Post Office Box 301463
Montgomery, Alabama 36130-1463

Reference:

a. The Installation Restoration Program at Redstone Arsenal, Alabama, AMIM-REP-ER (EPA ID AL7 210 020 742).

b. Resource Conservation and Recovery Act Corrective Action Program at Redstone Arsenal, Alabama (EPA ID AL7 210 020 742).

c. Redstone Arsenal's Alabama Hazardous Wastes Management and Minimization Act Hazardous Waste Storage Facility/Thermal Treatment/Solid Waste Management Unit Corrective Action (AHWMMA) Permit dated July 19, 2021.

Dear Mr. Cobb:

This letter transmits the submittal of the Revision 1, Corrective Measures Implementation Work Plan, RSA-014S, Unlined Inactive Burn Trenches, Unit #2, US Army Garrison-Redstone, Madison County, Alabama for your review.

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to 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 fine and imprisonment for knowing violations."

Copies of this correspondence are being furnished to William Montgomery, Alabama Department of Environmental Management; Mr. Robert Pope, Superfund and Emergency Management Division USEPA Region 4, Mr. Cesar Zapata, Land, Chemicals and Redevelopment Division USEPA Region 4.

My point of contact for this request is Mr. Clint Howard, Environmental Restoration Branch, 256-842-3702 or email joseph.c.howard1.civ@mail.mil.

Sincerely,

Clint Howard

Clint Howard
Chief, Environmental Restoration Branch

Enclosure

Revision 1
Corrective Measures Implementation Work Plan
RSA-014S, Unlined Inactive Burn Trenches, Unit #2
Operable Unit 14
U.S. Army Garrison-Redstone
Madison County, Alabama
EPA ID No. AL7 210 020 742

Prepared for:

U.S. Army Engineering and Support Center
Huntsville Engineering and Support Center
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Huntsville, Alabama 35805

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11400 Parkside Drive, Suite 400
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Contract No. W912DY-17-D-0003
APTIM Project Number 501388
Delivery Order W912DY19F1116

March 2022

Revision 1
Corrective Measures Implementation Work Plan
RSA-014S, Unlined Inactive Burn Trenches, Unit #2
Operable Unit 14
U.S. Army Garrison-Redstone
Madison County, Alabama
EPA ID No. AL7 210 020 742

Certification

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 fine and imprisonment for knowing violations.

Kenneth J Hurley

Kenneth Hurley
Alabama PE No. 25249

3/29/2022
Date

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Executive Summary

Aptim Federal Services, LLC, on behalf of the U.S. Army Garrison–Redstone, has prepared this corrective measures implementation work plan for Redstone Arsenal, Madison County, Alabama, under the management of the U.S. Army Environmental Command. The U.S. Army Engineering and Support Center, Huntsville has contracted Aptim Federal Services, LLC under Contract Number W912DY-17-D-0003 to perform environmental remediation and restoration services within the Active Army Installation Restoration Program for Redstone Arsenal. All work will be performed in compliance with the Resource Conservation and Recovery Act Corrective Action program in accordance with Redstone Arsenal's hazardous waste permit (U.S. Environmental Protection Agency ID # AL7 210 020 742). In addition, all work shall comply with the Department of Defense, Department of Army, U.S. Army Corps of Engineers, Redstone Arsenal, and federal and state regulations and guidance, to include Interim Guidance and Data Item Descriptions. This corrective measures implementation work plan has been prepared to provide technical guidance for implementing soil corrective measures selected for Solid Waste Management Unit RSA-014S, Unlined Inactive Burn Trenches, Unit #2, in Operable Unit 14.

RSA-014 is located in the southern portion of RSA, within the RSA-151 groundwater unit. RSA-014 is located east of the Tennessee River and south of an embayment to the Tennessee river. The RSA-014 site was divided into two parcels, RSA-014 North (RSA-014N) and RSA-014 South (RSA-014S). RSA-014N surface media received a no-further-action decision during regulatory concurrence on the Resource Conservation and Recovery Act facility investigation report. The report recommended corrective measures for trichloroethene-contaminated surface soil within RSA-014S and that the chemicals of concern in groundwater present as commingled plumes under both RSA-014 parcels be addressed separately by the RSA-151 groundwater unit corrective measures.

The RSA-014 Resource Conservation and Recovery Act facility investigation defined the nature and extent of contamination and evaluated potential risks to current and future receptors and concluded that corrective measures are required to attain site closure. The Alabama Risk-Based Corrective Action Risk Management 2 evaluation identified trichloroethene in surface soil as a chemical of concern warranting action for the construction worker based on unacceptable risk due to ingestion of soil and potential inhalation of trichloroethene concentrations in ambient air volatilized from soil in a potential future construction area.

To address this identified problem, the Army has elected to perform corrective measures to manage the unacceptable risk by excavation and off-site disposal of trichloroethene-contaminated soil, which was a result of past Army activities conducted at RSA-014S. This corrective measures implementation work plan describes the correct measures necessary to support the removal of contaminated soil that poses unacceptable risk to the construction worker receptor at RSA-014S.

A cleanup goal of 1.3 milligrams per kilogram has been established and the corrective measures objective will be met if the confirmatory soil samples have trichloroethene concentrations less than or equal to the cleanup goal. The corrective measures involve excavation and off-site disposal of trichloroethene-contaminated soil followed by implementation of land-use controls. Land-use controls will be used to address the potential presence of munitions and explosives of concern items based on the designated “Moderate/High” unexploded ordnance probability for RSA-014S. All corrective measures activities conducted within the RSA-014S site boundary will be performed using unexploded ordnance personnel support based on the “Moderate/High” unexploded ordnance probability. Corrective measures activities are summarized in the following bullets:

- The projected excavation area at RSA-014S includes three areas totaling approximately 825 square feet where trichloroethene concentrations in soil exceed the cleanup goal. The approximate depth of excavations is 2 feet. The approximate volume of contaminated soil to be excavated is 80 loose cubic yards.

- All contaminated soils will be excavated, stockpiled, and characterized for waste disposal. If munitions and explosives of concern are discovered during the clearance of the corrective measures utilization areas or the excavation areas, they will be removed and disposed in accordance with the procedures herein.

- Confirmation soil samples will be collected after excavation to verify that trichloroethene concentrations along their respective excavation sidewalls and floor are below the cleanup goal.

- Waste characterization sampling will also be performed after stockpiling to acquire data that will be used to profile the waste for off-site disposal. The excavated soils at RSA-014S are expected to be managed as a nonhazardous waste and disposed in a Subtitle D landfill.

- The Army will establish a land-use control boundary, post signage requiring on-site unexploded ordnance support for site access and intrusive activity, conduct periodic inspections and submit inspection reports, and file a notice of environmental use restriction.

This corrective measures implementation work plan presents the specific activities necessary to ensure implementation of the corrective measures. These activities include procurement and subcontracting, mobilization, surface clearance of utilization areas and planned excavation areas, subsurface removal of munitions of explosive concern and munitions debris from the planned excavation areas, soil excavation, collection of confirmation and waste characterization samples, transportation and disposal of excavated soil, site restoration, and implementation of land-use controls.

The following plans and supporting documentation are included as appendices to this corrective measures implementation work plan:

- Alabama Department of Environmental Management Concurrence Letter for RSA-014 Resource Conservation and Recovery Act Facility Investigation Report
- Request for Redstone Resource Conservation and Recovery Act Permit Modification
- Corrective Measures Implementation Schedule
- Quality Assurance Project Plan
- Site-Specific Health and Safety Plan
- Investigation-Derived Waste Standard Operating Procedure 4.0
- Alabama Best Management Practices
- Construction Quality Assurance Plan
- Land-Use Controls
- Munitions Response Site Prioritization Protocol Tables
- Explosives Safety Submission
- Explosives Management Plan
- Support Plans
- Forms.

This work plan incorporates applicable elements of Redstone Arsenal's Hazardous Wastes Management and Minimization Act Hazardous Waste Storage Facility/Thermal Treatment/Solid Waste Management Unit Corrective Action Permit and the most recent edition of the Alabama Environmental Investigation and Remediation Guidance. This work plan is submitted to fulfill, in part, the requirements listed in Section VI.E of the Permit. As specified in Section VI.E.3 of the Permit, a request for permit modification is included as part of this plan.

1.0 Introduction

Aptim Federal Services, LLC (APTIM), on behalf of the U.S. Army Garrison–Redstone (hereinafter referred to as the Army), has prepared this corrective measures implementation (CMI) work plan for Redstone Arsenal (RSA), Madison County, Alabama, under the management of the U.S. Army Environmental Command. The U.S. Army Engineering and Support Center, Huntsville (CEHNC) has contracted APTIM under Contract Number W912DY-17-D-0003 to perform CMI at multiple (nine) sites at RSA under the Resource Conservation and Recovery Act (RCRA) Corrective Action program in accordance with RSA's Alabama Hazardous Wastes Management and Minimization Act Hazardous Waste Storage Facility/Thermal Treatment/Solid Waste Management Unit (SWMU) Corrective Action Permit (hereinafter referred to as the Permit) (U.S. Environmental Protection Agency [EPA] ID # AL7 210 020 742) (Alabama Department of Environmental Management [ADEM], 2021). This CMI work plan has been developed to provide technical guidance for implementing the soil corrective measures selected for SWMU RSA-014S, Unlined Inactive Burn Trenches, Unit #2, in Operable Unit (OU) 14.

This CMI work plan incorporates applicable elements of the Permit (ADEM, 2021) and the most recent edition of the Alabama Environmental Investigation and Remediation Guidance (AEIRG) (ADEM, 2017a). This CMI work plan is submitted to fulfill in part the requirements listed in Section VI.E of the Permit. As specified in Permit Section VI.E.3, the request for permit modification is included as part of this plan.

1.1 Purpose

The purpose of this CMI work plan is to describe the corrective measures selected for use at RSA-014S to address trichloroethene (TCE) in surface soil posing unacceptable risk to the construction worker receptor in a future construction area. The target level for TCE at a noncancer risk of hazard index (HI) of 1.0 is a concentration of 1.3 milligrams per kilogram (mg/kg) and is selected as the cleanup goal (CG) for the planned excavation as described further in Section 3.2.1. This CMI work plan also addresses potential munitions and explosives of concern (MEC) at the site. Since the UXO probability is "Moderate/High" for RSA-014S and only a limited MEC surface clearance and subsurface removal (excavation areas only) will be conducted during the corrective measures, the site cannot be released for unrestricted use. Land-use controls (LUC) will be implemented to prevent direct contact with potential MEC remaining within the site boundary.

The nature and extent of contamination was presented in the RCRA facility investigation (RFI) report (CB&I Federal Services LLC [CB&I], 2017) for RSA-014, which received concurrence from ADEM on September 21, 2017 (Appendix A). An Alabama Risk-Based Corrective Action (ARBCA) evaluation for human health and a screening-level ecological risk assessment (SLERA) were prepared for RSA-014 as part of the RFI report. The ARBCA evaluation concluded that TCE in surface soil at RSA-014S poses unacceptable risk to potential current and future construction workers but no chemicals in soil pose unacceptable human health risks to commercial workers or hypothetical future residential receptors and no threat to groundwater due to leaching and migration to the water table. The SLERA determined that chemicals present in surface soil at RSA-014S are not expected to pose a potential risk for adverse impacts to terrestrial plant or soil invertebrate communities and food chain receptors are unlikely to be impacted. No chemicals of concern (COC) were identified in surface media in the northern parcel (RSA-014N). Numerous COCs are present in groundwater as commingled plumes beneath both RSA-014N and RSA-014S and will be addressed on a more regional scale with the RSA-151 groundwater unit corrective measures.

This CMI work plan has been prepared to describe the technical approach and rationale for the activities that will be part of the selected corrective measures for RSA-014S.

1.2 Site Description

RSA-014 is located in the southern portion of RSA, within the RSA-151 groundwater unit. No buildings are located within the RSA-014 site boundaries. RSA-014 is located east of the Tennessee River and south of an embayment to the river (Figure 1-1). The RSA-151 groundwater unit underlying RSA-014 covers approximately 572 acres in the southern portion of RSA.

1.2.1 Site History

The original footprint for RSA-014 encompassed 9.8 acres that included and surrounded two former unlined burn trenches. Review of historical documents for the RSA-151 potential source area (PSA) investigation in 2004 identified an area north of the RSA-014 burn trenches, identified as 151-PS-04C, as possibly having been used as a disposal area for beryllium and small quantities of miscellaneous laboratory samples and production chemicals (Shaw Environmental, Inc. [Shaw], 2006). In 2009, based on agreement and recommendation from the Redstone Tier 1 Team, the 9.7-acre parcel north of RSA-014 was included as RSA-014N as part of the RSA-014 site. ADEM formally accepted the Army’s recommendation to add this north parcel (RSA-014N) to the RSA-014 site on October 8, 2010.

Operational history is provided below for each parcel, RSA-014N and RSA-014S. RSA-014N and RSA-014S are shown on Figures 1-2 and 1-3, respectively.

RSA-014N. The RSA-014 RFI report (CB&I, 2017) presents historical documentation from 1973 indicating an area north of the burn trenches at RSA-014S may have been used as a disposal area (designated Area U) primarily for beryllium, small quantities of miscellaneous laboratory samples, and production chemicals (e.g., energetic oxidizers) in the 1940s to 1950s. Site reconnaissance was conducted in 2013, prior to RFI sampling, to look for signs of trenching, mounding, areas of barren soil, or stressed vegetation; no evidence was found. Further, light detection and ranging data for this area also failed to identify any of the signature features typically seen at historical subsurface disposal areas (Figure 1-2). No evidence other than the 1973 documentation was found to support that this parcel was used as a disposal area. However, sampling was conducted to support the presence or absence of contamination as presented in the RFI report.

Figure 1-4 shows the current “Unlikely” chemical warfare materiel (CWM) probability and “Low” unexploded ordnance (UXO) probability for RSA-014N. The Army manages the UXO and CWM probabilities for RSA sites under the site access control (SAC) program (Army, 2012) until permanent corrective measures are in place.

RSA-014S. The RSA-014S site consists of the area including and surrounding two former burn trenches (referred to as north and south trenches) (CB&I, 2017) (Figure 1-3). During their use, the unlined, open trenches were approximately 150 to 200 feet long, 35 feet wide, and 6 to 12 feet deep. The trenches were reportedly used from the mid-1950s until 1991. The trenches were originally designed for disposal and burning of materials that included packaging and pallets used to ship munitions and contaminated metals (the metals reportedly were recovered for recycling). Some of the ash, residue, and metal debris remaining from burning activities conducted at the RSA-013 burn pads was disposed at the RSA-014S trenches. In 1984, the Army was made aware that propellant-contaminated solvents and explosives from Thiokol Corporation’s manufacturing and production areas were also disposed and burned in the trenches. Burning/disposal of propellant-contaminated solvents at these burn trenches was discontinued in 1984. From 1984 until 1991, materials such as nonhazardous propellant-contaminated materials (those materials containing less than 4 percent propellant) were disposed in the trenches at least once every 90 days. Diesel fuel and kerosene were reportedly used as starter materials. All burning and disposal activities ceased after 1991, and the trenches were filled and covered with clean fill. RSA-014S is fenced with 6-foot-high chain-link fencing with three-strand barbed wire along the top.

Based on contamination observed, it appears that an undocumented spill or leak of a drum of a TCE-based solvent occurred from the drum staging area adjacent to the northern trench at some time during its operational period. Elevated concentrations of TCE were found in three surface soil samples collected during the RFI. Discussion of the surface soil TCE data and its fate and transport in soil at RSA-014S are presented in Sections 2.2 and 2.3.5, respectively.

Figure 1-4 shows the current "Seldom" CWM probability and "Moderate/High" UXO probability for RSA-014S. The Army manages the UXO and CWM probabilities for RSA sites under the SAC program (Army, 2012) until permanent corrective measures are in place.

1.2.2 Site Topography

Topography in the vicinity of the two parcels is relatively flat, with ground elevations that range from approximately 556 to 566 feet above mean sea level within RSA-014N (Figure 1-2) and from approximately 565 to 580 feet above mean sea level within RSA-014S (Figure 1-3).

1.2.3 Climate

Climate is a primary component in the hydrologic cycle and water budget and an integral element of the hydrogeologic framework of a site. Seasonal and storm-related trends in temperature and rainfall influence surface water and groundwater flow conditions. Average annual rainfall at RSA is 52 inches and rainfall is the principal source of groundwater recharge, either directly through infiltration and percolation through the vadose zone (unsaturated overburden) or as runoff to streams, which may also recharge groundwater. On an annual basis, 75 to 90 percent of rainfall at RSA is lost to evapotranspiration (Shaw, 2003). Discounting runoff to surface water, 5 to 13 inches of rainfall remain available to recharge groundwater. Rainfall contributes to groundwater recharge primarily during the winter, when deciduous trees are leafless, reducing overall transpiration. With the onset of the growing season in April, temperatures increase dramatically, and most potential recharge is lost through evaporation and transpiration.

1.2.4 Ecology

RSA-014N is within the 100-year floodplain on land owned by the Tennessee Valley Authority and permitted for use by the Army. A stream runs through the northeast corner of RSA-014N and feeds an embayment of the Tennessee River located northwest of the site (Figure 1-1). A wetland complex consisting of palustrine forested and palustrine scrub/shrub wetlands associated with this stream is also located in the northeastern part of RSA-014N. The majority of RSA-014N is vegetated with mixed deciduous/coniferous forest. The southwest corner of RSA-014N, located within the fenced open burn (OB)/open detonation (OD) area, is primarily open grassland. The northeastern portion of RSA-014S is within the 100-year floodplain, but no water bodies or wetlands are located within the parcel. RSA-014S is approximately 60 percent mixed deciduous/coniferous forest and 40 percent open grassland, with the grasslands located mostly in the central and western portions of the site.

1.2.5 Geology

Discussions of regional stratigraphic and structural geology, surface and subsurface hydrology, and other physiographic and geographic topics are presented in the RSA-151 RFI report (APTIM, 2018) and the installation-wide work plan (IT Corporation, 2002).

Soil. The subsurface geologic setting beneath RSA-014N and RSA-014S includes overburden consisting of low-permeability, residual red, brown, and gray clay; silty clay; and silt. Intervals of chert and chert fragments increase with depth and represent residual deposits formed by in situ chemical weathering of chert nodules and layers within the limestone bedrock. Fluvial sediments (gravels, sands, silts, and clays) are also present in the subsurface due to the proximity of RSA-014 to the Tennessee River. The coarser-grained intervals likely represent fluvial channel deposits associated with the river.

The overburden or unconsolidated soil layer across most of RSA is called residuum because it formed from in situ chemical weathering of the underlying karstic limestone bedrock. This overburden layer consists mainly of clay and silty clay. It also includes varying amounts of residual chert fragments which were present within the parent limestone and have resisted chemical weathering because of their siliceous composition. The chert can be found scattered within the clay matrix as nodules or concentrated locally as near-horizontal layers within the soil.

Although there is little compositional variation within the overburden, the residuum does not transmit groundwater uniformly. Groundwater infiltration follows preferred pathways because zones of higher hydraulic conductivity developed during soil-forming processes. Preferred pathways within the overburden directly affect contaminant migration and distribution within the soil column.

Residual clay generally has low horizontal and vertical hydraulic conductivities. At a given location, a layer of chert within the clay may decrease vertical hydraulic conductivity and increase horizontal conductivity, while isolated nodules of chert may increase the vertical conductivity. Preferred groundwater flow pathways in the overburden also include macropores caused by rotting tree roots and burrowing animals.

Additionally, microfractures may be created within the clay during raveling, a process in which the clay slowly subsides as it is eroded and carried away by groundwater in bedrock fractures and conduits. Vertical movement of the soil caused by raveling or sloughing into fractures and conduits results in the development of microfractures in the overlying material. The microfractured clay soils have higher hydraulic conductivities than undisturbed clay and also act as preferred groundwater flow pathways.

Bedrock. Bedrock encountered during drilling operations completed at RSA-014 consists of limestones of the Mississippian-aged lowermost Monteagle Limestone or the uppermost Tuscumbia Limestone. The borehole drilling logs indicate depth to bedrock at RSA-014 ranges from approximately 43 to 86.8 feet below ground surface (bgs) in the vicinity of RSA-014N and 23.5 to 63 feet bgs at RSA-014S. The highly variable bedrock topography underlying RSA-014 is the product of in situ solutional weathering of the bedrock surface, forming deeply incised rock crevices, or cutters, and intervening pinnacles. This pinnacle-and-cutter topography is referred to as the "epikarst." The epikarst serves to facilitate hydraulic communication between the fractured and karstic bedrock and the saturated overburden.

Within RSA in general, large solution cavities have been observed in the subsurface in the Monteagle Limestone and upper Tuscumbia Limestone due to their massive thick bedding and "clean" limestone lithology. In contrast, the lower Tuscumbia and Fort Payne Formations consist of thin, interbedded dolomitic limestone, dolomite, and chert. Vertical fractures and high-angle fractures generally terminate at bed boundaries. Therefore, cavity heights are limited in intervals with thin bedding, and solution features tend to be wider than they are tall, although a few cavity heights observed in boreholes were up to 3 feet. Overall, the degree of karst development observed in the Fort Payne is lower than that observed in the Tuscumbia and occurs as solution-enlarged stylolites. In general, the lower Tuscumbia and Fort Payne have smaller cavities (usually less than a few tenths of 1 foot) that form along bedding planes and weathered stylolites.

1.2.6 Hydrogeology

Surface Water. A stream that feeds an embayment of the Tennessee River runs through the northeast corner of RSA-014N. There are no surface water bodies located within RSA-014S parcel boundary; however, a network of small, engineered drainage ditches is present throughout the area to facilitate storm water drainage off the OB/OD area. Both parcels are bounded by marshland to the east.

Groundwater. Groundwater is encountered within the overburden at RSA-014N at an average depth of 9.1 feet bgs. At RSA-014S, the average depth to groundwater is 13.6 feet bgs. Based upon groundwater depth to water measurements collected in February 2016, the primary direction of groundwater flow is to the north-northwest, toward the embayment to the Tennessee River northwest of RSA-014N (refer to Figure 1-4 in the RFI report [CB&I, 2017]).

1.3 Document Organization

This CMI work plan is organized into the following chapters:

- Chapter 1.0 presents the purpose and overview of the document and includes a brief site description, including the topography, climate, ecology, geology, and hydrogeology associated with the site.
- Chapter 2.0 presents additional background information about the site, including investigation history, the nature and extent of contamination, site risks, fate and transport, and the final conceptual site models (CSM).
- Chapter 3.0 describes the basis for the action, including the corrective measure objectives (CMO), the CGs, and a summary of the selected corrective measures.
- Chapter 4.0 describes the activities necessary for implementation of the corrective measures at the site.
- Chapter 5.0 describes the mechanisms to address foreseeable challenges that may arise during execution of the corrective measures described herein.
- Chapter 6.0 provides the references that contributed to the preparation of this CMI work plan.

The following plans and supporting documentation are included as appendices to this CMI work plan:

- Appendix A: ADEM Concurrence Letter for RSA-014 RFI Report
- Appendix B: Request for Redstone RCRA Permit Modification
- Appendix C: CMI Schedule
- Appendix D: Quality Assurance Project Plan (QAPP)
- Appendix E: Site-Specific Safety and Health Plan (SSHP)
- Appendix F: Investigation-Derived Waste Standard Operating Procedure 4.0
- Appendix G: Alabama Best Management Practices (BMP)
- Appendix H: Construction Quality Assurance Plan (CQAP)
- Appendix I: Land-Use Controls
- Appendix J: Munitions Response Site Prioritization Protocol (MRSPP) Tables
- Appendix K: Explosives Safety Submission (ESS)
- Appendix L: Explosives Management Plan
- Appendix M: Support Plans
- Appendix N: Forms.

2.0 Investigation Results

This chapter presents additional background information for RSA-014, including the investigation history, the nature and extent of contamination, the site risks, fate and transport, and the final CSMs.

2.1 Investigation and Remedial Action History

2.1.1 Investigation History

Environmental investigations relevant to the two RSA-014 parcels are listed below.

- Initial Army investigation (U.S. Army Environmental Hygiene Agency, 1986)
- Remedial investigation for Unit 2 (P.E. LaMoreaux & Associates, 1988)
- Interim RCRA Facility Assessment (A.T. Kearney, 1989)
- Identification and evaluation of potential SWMUs and areas of concern (Geraghty and Miller, Inc., [G&M], 1991)
- Phase I and II RFI at Unit 2 (G&M, 1992; 1993)
- Extraction well installation by Enserch Environmental (1994)
- RSA-013 groundwater treatment system (GWTS) construction and operation, various contractors, 1995-2000
- Supplemental investigation (Parsons Engineering Science, Inc., 1997)
- Soil vapor extraction (SVE) at northern trench, 1999-2000
- Supplemental remedial investigation (IT Corporation, 2000)
- OU-14 groundwater sampling (IT Corporation, 2000)
- RSA-151/152/156/157 PSA investigation (Shaw, 2006)
- RSA RCRA facility assessment (ADEM, 2008)
- RSA-014 RFI (CB&I, 2017)
- RSA-151 RFI (APTIM, 2018)
- OB/OD groundwater monitoring (APTIM, 2021 and subsequent annual updates).

A complete discussion of the previous site investigations is available in the RFI report for RSA-014 (CB&I, 2017).

2.1.2 Interim Remedial Actions

An SVE system was constructed within the northern burn trench during the summer 1998 through winter 1999 time frame and brought on line in January 1999. The SVE system was designed to recover residual volatile organic compounds (VOC) adsorbed in the soil within the trenches. To prevent the system from pulling in air from the surface, an impermeable geosynthetic liner was installed across the northern trench and expected SVE treatment area (Figure 1-3). Also, to enhance the ability of the system to remove VOCs from the soil, a horizontal dewatering well was installed beneath the northern trench and operated as part of the RSA-013 GWTS. The horizontal well/SVE system functioned to dewater the area under the trench and strip the VOCs adsorbed to the soils. When operational, the well with a 160-foot-long screen was capable of producing approximately 25 gallons of groundwater per minute from the overburden. Use of the SVE system was discontinued in October 2000 when the RSA-013 GWTS was shut down due to the discovery of perchlorate in the effluent. The horizontal well is currently being evaluated for use in a pilot study for collecting necessary chemical and hydrogeological data to support the design and construction of an in situ enhanced bioremediation recirculation system. This recirculation system is a significant component of the overburden groundwater remedy for the TCE and other solvent plumes under RSA-014 as part of the RSA-151 groundwater unit corrective measures study (HydroGeoLogic, Inc. [HGL], 2020).

2.2 Nature and Extent of Contamination Summary

The RFI (CB&I, 2017) evaluated sample data for usability and defined an appropriate data set for characterizing constituents at RSA-014, which consists of analytical results from the following:

<u>RSA-014N</u>

- Seven surface soil samples
- Thirteen subsurface soil samples
- Three surface water samples
- Three sediment samples
- Twenty groundwater samples from site monitoring wells

<u>RSA-014S</u>

- Fifty-nine surface soil samples
- Eighty-five subsurface soil samples

- Two soil vapor samples
- Thirty-one groundwater samples from site monitoring wells.

The samples were analyzed for one or more of the following: VOCs, semivolatile organic compounds (SVOC), metals, explosives, perchlorate, and chemical agent (CA) (mustard and lewisite)/breakdown products (thianes and thiodiglycol). The nature and extent of contamination in surface media and groundwater at RSA-014N and RSA-014S have been defined. Surface media is defined as surface soil, subsurface soil, surface water, sediment, and/or soil vapor as applicable.

Metals:

RSA-014S: All metals detected in surface and subsurface soil were determined to be naturally occurring except for one anomalous concentration of arsenic exceeding the background screening value (BSV) and the preliminary screening value (PSV) in surface soil. The arsenic exceedance is delineated by sample results that are background related or naturally occurring (Figure 3-1 in the RFI report [CB&I, 2017]).

RSA-014N: All metals detected in soil, surface water, and sediment were determined to be naturally occurring.

Groundwater: All metals in groundwater were determined to be naturally occurring except for two anomalous manganese concentrations exceeding the BSV and PSV. The manganese exceedances are delineated by concentrations that are naturally occurring (Figure 3-2 in the RFI report [CB&I, 2017]).

Volatile Organic Compounds:

RSA-014S: In surface soil, one concentration of tetrachloroethene (PCE) and three concentrations of TCE exceeded PSVs. The PSV exceedance for PCE in surface soil is delineated by locations that are below the PSV (Figure 3-4 in the RFI report [CB&I, 2017]). The three concentrations of TCE exceeding the PSV in surface soil are delineated by locations that are below the PSV (Figure 2-1). The source of the elevated TCE concentrations in surface soil is believed to be an undocumented spill or leak of a drum storing a TCE-based solvent near the northern trench during the site's operational period (Section 2.3.5). In subsurface soil, three concentrations of TCE exceeded the PSV but two of these exceedances were determined to represent a component of groundwater contamination due to each boring's topographic location and the sample depths (Figure 2-1).

RSA-014N: All VOCs detected in soil, surface water, and sediment were less than the PSVs.

Groundwater: Fourteen VOCs were detected in groundwater at concentrations exceeding PSVs; TCE exhibited the highest concentrations and the greatest frequencies of detection and exceedance. Each VOC groundwater exceedance has been delineated on an RSA-014 site scale or on the broader scale of the RSA-151 groundwater unit (Figures 3-5 through 3-17 in the RFI report [CB&I, 2017]).

Semivolatile Organic Compounds:

RSA-014S: All SVOC concentrations in surface and subsurface soil were below PSVs.

RSA-014N: All SVOCs detected in soil and surface water were less than the PSVs. SVOCs were not detected in sediment.

Groundwater: Seven SVOCs were detected in groundwater at concentrations above the PSVs; these exceedances have been delineated at the RSA-014 scale (Figure 3-18 in the RFI report [CB&I, 2017]).

Explosive Compounds:

RSA-014S: All explosive compounds in surface soil were detected at concentrations below the PSVs or were nondetect. No explosives were detected in subsurface soil.

RSA-014N: Explosives were not detected in soil, surface water, or sediment.

Groundwater: Eight explosives were detected in groundwater at concentrations above the PSVs. The explosive exceedances in groundwater have been delineated on either an RSA-014 scale or on the broader scale of the RSA-151 groundwater unit (Figure 3-19 in the RFI report [CB&I, 2017].

Perchlorate:

RSA-014S: Perchlorate was detected in soil at concentrations below the PSV with the exception of one perchlorate concentration in subsurface soil. This subsurface soil exceedance possibly represents a component of groundwater contamination due to the sample depth. The exceedance in subsurface soil is delineated by locations that were less than the PSV (Figure 3-20 in the RFI report [CB&I, 2017].

RSA-014N: Perchlorate was not detected in surface soil and was present at concentrations below the PSV in subsurface soil. There were no detections of perchlorate in surface water or sediment.

Groundwater: Perchlorate was detected in groundwater at concentrations above the PSV. The exceedances in groundwater are delineated on the RSA-151 groundwater unit scale (Figure 3-21 in the RFI report [CB&I, 2017]).

Chemical Agents/Agent Breakdown Products:

RSA-014S: Mustard was not detected in surface or subsurface soil samples. No agent breakdown products were detected in soil.

RSA-014N: Mustard was not detected in surface or subsurface soil samples. The agent breakdown product thiodiglycol was detected in surface soil and sediment samples at concentrations below the PSV. Agent breakdown products were not detected in surface water.

Groundwater: Three agent breakdown products (thiodiglycol, 1,4-dithiane, and 1,4-oxathiane) were detected in groundwater samples at low concentrations below the PSVs, where established.

2.3 Site Risk Summary

An ARBCA human health risk evaluation, which includes a vapor intrusion evaluation and a SLERA, were performed for RSA-014 (CB&I, 2017). Risks from exposure to potential MEC were identified based the "Moderate/High" UXO probability for RSA-014S. The probability for potential MEC at RSA-014N is Low. The site risks are summarized in Sections 2.3.1 through 2.3.4. The fate and transport evaluation is summarized in Section 2.3.5.

2.3.1 Current and Potential Future Land Use

According to the Installation Master Plan, land use surrounding RSA-014 is designated as Industrial Zone. RSA-014 is located in a Land Use District which is classified as the Buxton Road (S/W of Patton Road) in the southern portion of RSA. The primary missions include explosive operations and storage, range operations, and test areas (Army, 2013). Portions of RSA-014 lie within two ranges (R0701 Light Maneuver Area and R0702 OB/OD) and the OB/OD safety arc. Where practical, the Army has restricted entry into the RCRA SWMUs by fencing them and/or placing warning signs at key entry points in accordance with the SAC program (Army, 2012). RSA's SAC program (Army, 2012) was designed for, but not limited to, SWMUs that have not had a final remedy selection made. RSA-014S is fully enclosed by a 6-foot-high chain-link fence with three-strand barbed wire along the top. RSA-014S also lies within the secure RSA boundary. Site redevelopment (e.g., construction of parking lots, buildings, or other structures) is anticipated in the future consistent with industrial uses, but residential or daycare facilities are not anticipated. Hunting is not currently permitted within RSA-014S and hunting is not planned for this site area in the future. Current and future land use options have restrictions in the RSA Master Plan due to the "Moderate/High" UXO probability at RSA-014S.

2.3.2 Human Health ARBCA Evaluation

The human health risk assessment for RSA-014 was prepared and presented in the RSA-014 RFI report (CB&I, 2017) in accordance with the ARBCA guidance manual (ADEM, 2017b). RSA-014 was subdivided into two separate parcels (RSA-014N and RSA-014S) for the risk evaluations as described in Section 1.2.1. It consists of a three-tiered process: the preliminary screening level (PSL) evaluation (Tier 1); the Risk Management (RM) 1 evaluation (Tier 2); and the RM-2 evaluation (Tier 3). Note that the RM-1 evaluation is optional. It is typically not performed since RSA has an ADEM-approved installation-wide work plan (IT Corporation, 2002, Shaw, 2010a). Instead, the evaluation for RSA-014 proceeded directly from the PSL evaluation to the RM-2 evaluation. The PSL and RM-2 evaluations are described below.

Media of interest for RSA-014N were surface soil, shallow subsurface soil and groundwater; and for RSA-014S are surface soil, shallow subsurface soil, deeper subsurface soil, and groundwater. Surface media on the north and south parcels were evaluated separately; however, the analytical data for groundwater across both parcels were compiled into a single data set. In addition, analytical data are available for surface water in the stream that flows across the northeast corner of RSA-014N into an embayment of the Tennessee River. The risk from exposure to surface water was evaluated in the RSA-151 groundwater unit RFI report (APTIM, 2018) and was not included in the RSA-014 RFI (CB&I, 2017). The evaluation did not identify any COCs in surface water at RSA-014N posing unacceptable risk. Although sediment data were also available from the embayment, human exposure to sediment perennially under surface water generally does not contribute significantly to risk and does not require evaluation (EPA, 2014).

The PSL evaluation in the RSA-014 RFI consisted of a simple comparison of site concentrations with PSVs, which generally were the EPA (2014) regional screening levels (RSL), based on the lower of an individual excess lifetime cancer risk (IELCR) of 1E-6 and a noncancer HI of 0.1. In the case of groundwater, maximum contaminant levels were used as the PSVs, if available. Otherwise, tap water RSLs (EPA, 2014) were used. Residential PSVs were selected for the evaluation of this site in order to consider alternatives to attain unrestricted land use.

The PSL evaluation was conducted for all chemicals that are determined to be site related. Inorganics with maximum detected concentrations that do not exceed their BSVs or shown in a site-to-background evaluation to be naturally occurring are judged not to be site related and are not evaluated further. All other detected chemicals are initially identified as chemicals of potential concern (COPC) and site concentrations are compared to PSVs in the PSL evaluation. A COPC was identified as a COC if the maximum detected concentration is greater than a PSV.

The soil and groundwater COCs identified in the PSL evaluation were brought forward for evaluation in the cumulative risk assessment (RM-2 evaluation). No soil COCs were identified in RSA-014N soils, so RSA-014S soils and sitewide groundwater were evaluated in the RM-2 evaluation. Receptor scenarios evaluated in the cumulative risk assessment included a commercial worker (which includes a groundskeeper), a construction worker, and a hypothetical residential receptor. Groundwater was evaluated as if it were developed as a source of potable water in the future. Risks from exposure to groundwater were assessed even though groundwater use at this site is precluded now and in the future and nonpotable uses are managed by RSA's SAC program (Army, 2012) and the terms of the installation-wide groundwater interim record of decision (IROD) (Shaw, 2007).

A hypothetical future residential receptor was evaluated as required by ADEM (2017b) for future use without restrictions and to determine whether or not remedial measures and/or LUCs are warranted to achieve no further action status.

The ARBCA guidance (ADEM, 2017b) considers an IELCR of 1E-05 to be the target cumulative risk. The target cumulative noncancer hazard is an HI of 1.0. Estimated cumulative risks/hazards at or below these targets do not require additional action.

Cumulative IELCR and HI estimates for all receptor scenarios for RSA-014 are summarized in Table 2-1. This table shows IELCR and HI estimates for soil at RSA-014S, and groundwater at both RSA-014S and RSA-014N. The cumulative IELCR estimates for exposure to RSA-014S soil alone are less than the ADEM trigger level of 1E-05 for all receptors. The cumulative HI values are less than the trigger level of 1.0 for the commercial worker and the child resident but are above for the construction worker due to the presence of TCE. Specifically, RSA-014S soils may pose an unacceptable health risk during high-intensity, short-term exposures such as construction work due to inhalation of TCE in ambient air. Ingestion of TCE-contaminated surface soil during construction work is a minor contributor to the unacceptable risk. If groundwater is considered, the cumulative IELCR estimate is greater than 1E-05 for all receptors for both RSA-014N and RSA-014S. The cumulative HI for groundwater also exceeded 1.0 for all receptors.

Table 2-2 shows a summary of the RM-2 evaluation of human health for RSA-014. It shows the relevant COCs identified through the ARBCA evaluation that require action. As shown in Table 2-2, no relevant COCs were identified in RSA-014N soil. TCE was identified as a relevant COC in soil at RSA-014S for the construction worker. A large number of relevant COCs were identified for groundwater at RSA-014. Manganese, perchlorate, 5 explosive compounds (2,4,6 trinitrotoluene, 2,4-dinitrotoluene, 2,6-dinitrotoluene, 2-nitrotoluene, and RDX), 5 PAHs (1-

methylnaphthalene, benzo[a]anthracene, benzo[b]fluoranthene, dibenz[a,h]anthracene, and indeno[a,2,3-cd]pyrene), and 15 VOCs (Table 2-2) were identified as relevant COCs for groundwater for the residential receptor.

Vapor Intrusion Evaluation. The RFI report (CB&I, 2017) used the vapor intrusion evaluation methodology approved in the installation-wide work plan risk assessment supplements (Shaw, 2010a) and as updated based on current EPA guidance (EPA, 2015; 2018). For this evaluation, shallow subsurface soil gas samples were collected during the RFI and the risks were evaluated from exposure to actual soil gas, which is impacted both from VOCs in soil but more importantly from the VOCs in the dense nonaqueous-phase liquid concentration-level plume that is located beneath the southern trench at RSA-014S. Calculated attenuation factors were derived using site-specific soil and groundwater parameters and applied to the maximum soil gas concentrations of VOCs detected to derive calculated indoor air concentrations. These concentrations were compared to screening values calculated using the Vapor Intrusion Screening Level calculator. All detected VOCs in soil gas samples occurred at maximum concentrations less than screening values based on risks of 1E-6 or a hazard quotient of 1. Therefore, the RFI report concluded that VOCs in soil, soil gas, and groundwater at RSA-014 do not represent a source that would pose an unacceptable health threat to occupants from the vapor intrusion pathway in the event that buildings are erected on the site in the future. In addition, the OB/OD office (Building 8420) located west of RSA-014S was constructed in 2009 and contains a vapor barrier which was included to mitigate risk to occupants of this building from the presence of VOCs in RSA-151 groundwater beneath RSA-014 and surrounding sites.

2.3.3 Screening-Level Ecological Risk Assessment

A SLERA was completed for RSA-014N and RSA-014S as part of the RFI report (CB&I, 2017). The SLERA was conducted in accordance with the guidelines set forth in the ARBCA guidance manual (ADEM, 2017b), the RSA installation-wide work plan (IT Corporation, 2002), and the final SLERA supplements to the installation-wide work plan (Shaw, 2010a). A SLERA was performed in order to determine if the site is eligible for no-further-action status in accordance with ADEM requirements. Note that the SLERA evaluation relies on ecological screening values (ESV) rather than on the human health-based PSVs.

The surface soil data for this these two parcels were separately compared to relevant BSVs and ESVs. A weight-of-evidence (WOE) evaluation was completed to further evaluate the constituents identified in the initial screening. The WOE evaluation examined a number of lines of evidence in order to draw conclusions as to whether site-related constituents have the potential to pose hazards to ecological receptors.

The initial comparison of the detected constituent concentrations in RSA-014N surface soil to ESVs and BSVs identified magnesium and thiodiglycol as preliminary chemicals of potential ecological concern (COPEC) that required further evaluation. The WOE evaluation concluded concentrations of magnesium are likely to be naturally occurring and is a nutrient that is essential to growth and development of plants and animals. It was concluded that a community-level assessment was necessary for thiodiglycol; but a food chain assessment was not warranted as this chemical is not bioaccumulative.

Quantitative assessment of the potential effects of thiodiglycol in surface soil on terrestrial plant and invertebrate communities was not possible due to the lack of screening values for thiodiglycol in soil. However, a spatial analysis determined that approximately 11 percent of the area of RSA-014N (9.7 acres) had detectable concentrations of thiodiglycol. Because the area of soil potentially impacted by thiodiglycol is so small, thiodiglycol is unlikely to pose hazards to terrestrial invertebrate or terrestrial plant community segments that occur at RSA-014N. It was concluded that COPECs in surface soil at RSA-014N are unlikely to pose hazards to terrestrial invertebrate and plant communities or terrestrial food chain populations, and further evaluation of ecological hazards at RSA 014N is not warranted.

The screening-level hazard evaluation for surface soil at RSA-014S identified arsenic, cadmium, calcium, cobalt, copper, mercury, zinc, perchlorate, bis(2-ethylhexyl)phthalate, di-n-butyl phthalate, 1,1,1-trichloroethane (TCA), bromomethane, cis-1,2-dichloroethene (DCE), PCE, trans-1,2-DCE, and TCE as preliminary COPECs in surface soil that required further assessment. Based on the results of the screening evaluation and COPEC refinement, perchlorate, 1,1,1-TCA, bromomethane, cis-1,2-DCE, PCE, trans-1,2-DCE, and TCE warranted further evaluation for potential impacts to community-level receptors, but further assessment for food chain effects was not warranted because these constituents are not bioaccumulative. The screening evaluation and COPEC refinement also determined that arsenic, copper, bis(2-ethylhexyl)phthalate, and di-n-butyl phthalate warranted further evaluation for potential impacts to community-level receptors and food chain receptors.

The terrestrial invertebrate community-level assessment for RSA-014S soil showed that hazard quotients for bromomethane, PCE, and TCE are greater than 1.0 (suggesting the potential for effects), but a spatial analysis determined that these COPECs are detected at concentrations that exceeded their respective screening values in samples that represent 7 percent or less of the site. Therefore, due to the small area exhibiting concentrations of the COPECs that exceed their respective screening values (bromomethane, PCE, and TCE), it was concluded that they are unlikely to pose hazards to terrestrial invertebrate community segments at RSA-014S.

The terrestrial plant community level assessment showed that hazard quotients for most COPECs were less than 1; however, 1,1,1-TCA, bromomethane, cis-1,2-DCE, and trans-1,2-DCE in surface soil could not be assessed due to the lack of terrestrial plant screening values. A spatial analysis determined that approximately 7 percent or less of the site exhibited detectable concentrations of these COPECs in surface soil at RSA-014S; therefore, it was concluded that perchlorate, 1,1,1-TCA, bromomethane, cis-1,2-DCE, and trans-1,2-DCE are unlikely to pose hazards to terrestrial plant community segments at RSA-014S.

The food chain assessment results for RSA-014S showed that adverse impacts to local populations of food chain receptors from exposure to arsenic, copper, bis(2-ethylhexyl)phthalate, and di-n-butyl phthalate in surface soil at RSA-014S are not expected.

The results of the SLERAs for RSA-014 indicate that the COPECs in surface soil at RSA-014N and RSA-014S are unlikely to pose hazards to ecological receptor communities and/or populations, and further evaluation of ecological hazards from these COPECs at RSA-014S and RSA-014N is not warranted.

2.3.4 MEC Evaluation

A MEC investigation was not conducted at RSA-014S which is not within the Military Munitions Response Program (MMRP). However, the Army has assigned a “Moderate/High” UXO probability to this area based on its location within the OB/OD safety fan and the potential for UXO to have been disposed in the trenches. MEC has not been found at RSA-014S during the numerous field investigations conducted at this site; however, anomaly avoidance has been practiced during intrusive investigations. Although RSA-014 is a hazardous and toxic waste site and not a munitions response site (MRS) in the MMRP, an MRSPP score has been calculated as part of this CMI work plan (Appendix J) to evaluate the potential explosive hazards associated with conventional MEC, determine the relative risks posed by MEC at this site, and assist the Army in decision-making if LUCs should be implemented. The Army has provided unofficial guidance that sites with a MRSPP priority of 1 or higher require LUCs to protect site receptors (Appendix J, Table 29).

MRSPP. The MRSPP is a methodology developed by the U.S. Department of Defense (DoD) to assess the relative risks and assign a relative priority to MRSs (DoD, 2007). The MRSPP uses three modules to evaluate hazards associated with a site:

1) The Explosive Hazard Evaluation (EHE) module – This module evaluates the hazards associated with MEC (including UXO, discarded military munitions, and munitions constituents (MC) at high enough concentrations to pose an explosive hazard).

2) The Chemical Warfare Materiel Hazard Evaluation (CHE) module – This module addresses CWM and associated hazards.

3) Health Hazard Evaluation (HHE) module – This module examines risks associated with human and ecological exposures to MC and other contaminants that may be present at the site.

Module ratings are indicated by a letter "A" through "G," with "A" being the highest rating (highest priority) and "G" being the lowest rating (lowest priority). When a letter rating is not appropriate, an MRS may be assigned one of three alternative module ratings: Evaluation Pending, No Longer Required, or No Known or Suspected Explosive Hazard.

The MRS priority is determined by comparing the MRS ratings of the EHE, CHE, and HHE hazard evaluation modules. The approach is to assign an MRS priority based on the greatest potential hazards posed by UXO, discarded military munitions, or MC. Therefore, the MRS priority is the single highest priority of the three hazard evaluation modules. The priority assigned to an MRS may be one of eight numerical priorities, 1 through 8, or one of the three previously mentioned alternative MRS ratings. The MRS priority scale is such that the lowest numerical priority represents the highest potential hazard. Thus, a Priority 1 MRS contains the highest potential hazard, while a Priority 8 MRS contains the lowest potential hazard.

The results of applying the protocol to RSA-014S are as follows:

- EHE Module: E
- CHE Module: F
- HHE Module: B
- MRS Priority: 3.

The completed MRSPP tables are presented in Appendix J. Since the MRS priority is 1 or higher, LUCs are needed at RSA-014S to protect site receptors from the possibility of encountering MEC.

2.3.5 Contaminant Fate and Transport Summary

This section summarizes the fate of contaminants in the environment and their potential transport mechanisms at RSA-014 (CB&I, 2017). At RSA-014N and RSA-014S, the primary contaminant migration pathway is the dissolution of site-related chemicals from soil to form leachate and the subsequent transport to the water table resulting from the downward percolation of infiltrating rainfall. Overland transport of soil contaminants by wind or water is unlikely at RSA-014N and RSA-014S because the two parcels are relatively level and partially vegetated.

Constituents detected in soil samples associated with RSA-014N did not identify any chemical concentrations that exceeded RSA-specific soil screening levels. Therefore, it was concluded that soils at RSA-014N do not represent a leaching threat to groundwater. Based on concentrations of chemicals in soil at RSA-014S, seven constituents (arsenic, perchlorate, naphthalene, cis-1,2-DCE, methylene chloride, PCE, and TCE) were present in soil at concentrations exceeding the RSA-specific soil screening levels and were evaluated for the potential to leach from soil to groundwater at concentrations that would result in adverse impacts to groundwater. Of the seven constituents evaluated, none were determined to represent a current or future leaching threat to groundwater.

Elevated TCE concentrations above the PSV (0.41 mg/kg) were discovered in surface soil (0 to 1 foot bgs depth) during the 2014-2015 RFI at three locations east and southeast of the northern trench. The maximum detected concentration of TCE in soil equaled 44.8 mg/kg. The source of this TCE contamination appears to have been an undocumented spill or drum leak of a TCE-based solvent staged near the northern trench, presumably during the site's operational period.

Although the volatilization rate of TCE on the soil surface (within the top few inches) is rapid, if the TCE release migrated to shallow surface soil, for example below 6 inches, this would greatly increase the half-life of TCE in soil. As detailed in the fate and transport discussion of the Agency for Toxic Substances and Disease Registry (ATSDR) toxicological profile for TCE, TCE volatilization decreases with increased organic carbon content in soil (ATSDR, 2019). Soils at RSA, especially surficial soils, have a relatively high total organic carbon content for a clay-based soil (Shaw, 2011). In addition, desorption of TCE from inorganic mineral surfaces like those available in abundance in clay soils is much lower than predicted from sorption-desorption calculations. For these reasons, it is plausible that a TCE spill of relatively pure product to surface soils would have persisted in the deeper portion of the surficial soil layer at concentrations in the low part per million range.

2.4 Final Conceptual Site Model

The final CSMs were developed for RSA-014N and RSA-014S based on historical operations, site information, and soil and groundwater data collected in the RFI. The site-related contaminants included VOCs, SVOCs, explosives, perchlorate, metals, and CA/agent breakdown products. All potential site-related contaminants were included in the sample analyses during the RFI (CB&I, 2017).

The final CSMs for RSA-014N and RSA-014S are presented on Figures 2-2 and 2-3, respectively. The following describes the final CSMs for the two parcels at this site:

RSA-014N

- No contamination is present in site soils at concentrations above human health screening values.

- Exposure to site soils poses no unacceptable risks to human health receptors, ecological receptors, or the environment.

RSA-014S

- Soil and groundwater TCE contamination resulted from historical waste solvent disposal in the two trenches from Thiokol Corporation rocket motor development activities. Additionally, TCE-contaminated surface soil remains east-southeast of the northern trench from a suspected past surface spill/leak of a TCE-based solvent.

- TCE is present in site surface soil at concentrations that pose a health hazard to potential current and future construction workers.

- Exposure to contaminants in soils poses no unacceptable risks to commercial workers, residential receptors, ecological receptors, or the environment.

- Based on existing groundwater results, solvent disposed in the trenches has migrated to groundwater beneath the site. However, no source material remains in soil that could pose a continuing leaching threat to groundwater.

- MEC may be present based on a "Moderate/High" UXO probability and a MEC investigation/clearance has not been conducted.

2.5 RFI Conclusions

RSA-014N. No evidence was discovered at RSA-014N through site visits and RFI sampling to support purported historical disposal practices. The RSA-014N surface media do not pose unacceptable risks to potential human or ecological receptors and do not pose a leaching threat to groundwater. Thus, no further action is needed for surface media at RSA-014N, and ADEM was in agreement with the Army's no-further-action recommendation in the RFI report (CB&I, 2017). RSA-014N will not be addressed further in this CMI work plan.

RSA-014S. TCE in surface soil poses an unacceptable risk to a construction worker due to exposure to TCE in soil through the inhalation of ambient air and ingestion pathways, and corrective measures are required. No other chemical constituents in surface soil or subsurface soil pose unacceptable risks to any current or future receptors. Based on site history, the site's location adjacent to the OB/OD area, a "Moderate/High" UXO probability, and the fact that a MEC investigation/clearance has not been conducted, potential MEC may be present posing risks to site receptors.

Groundwater. Numerous COCs were identified in groundwater under both parcels at RSA-014 in the RFI. The Army recommended that corrective measures for COCs in groundwater be conducted with the corrective measures required for the RSA-151 groundwater unit. The Army has determined that because groundwater COCs found under RSA-014 are commingled throughout this region of the associated groundwater unit, they are best addressed on a broader scale than the surface media site level. ADEM agreed with this recommendation in their concurrence letter for the RSA-014 RFI report (CB&I, 2017). It should be noted that potable groundwater use under RSA-014 is precluded now and in the future and nonpotable uses are managed by RSA's SAC program according to the terms of the installation-wide groundwater IROD (Shaw, 2007).

3.0 Decision Summary

The RFI determined that an action is needed to address the unacceptable risk to construction workers from exposure to TCE in surface soil in a future construction area at RSA-014S.

3.1 Basis for the Action

The RFI report (CB&I, 2017) defined the nature and extent of contamination, evaluated potential risks to current and future receptors, and concluded that corrective measures are required at RSA-014S for the following:

- TCE-contaminated surface soil poses an unacceptable risk to potential current and future construction workers within a future construction area.

Corrective measures are needed to address the TCE-contaminated surface soil. Additionally, corrective measures are needed to prevent direct human contact with potential MEC associated with a “Moderate/High” UXO probability for RSA-014S.

3.2 Corrective Measure Objectives

The CMOs for RSA-014S are as follows:

- Prevent or reduce potential current and future construction worker exposure to TCE in surface soil such that no unacceptable hazard or risk is present.
- Prevent direct human contact with MEC.

The Army intends to achieve the CMOs for RSA-014S through the implementation of corrective measures.

3.2.1 Cleanup Goals for the Corrective Measures

CGs are relevant to alternatives that reduce concentrations, such as excavation and off-site disposal. ADEM (2017) considers a total (cumulative) IELCR of 1E-05 as the trigger level at which risk-based target levels must be developed to guide site management. RSA must use ADEM’s risk threshold as required under the Permit (ADEM, 2021).

For RSA-014S, TCE was identified as a COC requiring action in shallow soil for the construction worker. The RFI (CB&I, 2017) identified a risk-based target level for soil (RFI report Table D-27) for TCE for the construction worker of 1.3 mg/kg at an HI of 1.0, the ADEM cumulative limit. This value is selected as the CG for surface soil, as shown in Table 3-1. TCE concentrations from three surface soil samples (014S-HP012, 014S-SB002, and 014S-SB004) exceed the 1.3 mg/kg CG (Figure 3-1).

As stated in Section 3.2, one of the CMOs is to prevent direct human contact with MEC. This objective would be achieved by applying LUCs, and therefore CGs are not applicable for this objective.

3.2.2 Need for Corrective Measures

Because of the site history as a disposal area for solvents from historical disposal activities in trenches, TCE contamination remains in surface soil east and southeast of the northern trench. The RFI conducted at RSA-014 defined the nature and extent of contamination and concluded that further action is required at RSA-014S. The findings of the RFI indicate action is needed to address TCE-contaminated surface soil at three areas of RSA-014S (014S-HP012, 014S-SB002, and 014S-SB004). Action is also needed to address the potential for MEC at RSA-014S. Corrective measures are needed to attain cleanup standards as applicable and protect human health. No contaminant present in site soils was found to pose a leaching threat to groundwater or to populations or communities of ecological receptors.

3.2.3 Applicable Regulations

In considering corrective measures, various laws and regulations (state and federal) may apply. Consideration of applicable laws and regulations may affect the alternative evaluation and selection. Table 3-2 provides citations to specific laws and regulations that are applicable to selected corrective measures at RSA-014S.

3.2.4 Scope of the Corrective Measures

The overall strategy for cleanup at RSA has been presented to the regulatory agencies in two cleanup strategy documents, the Installation-Wide Groundwater Cleanup Strategy (Shaw, 2009a) and the Installation-Wide Strategy for Cleanup of Impacted Wetlands (Shaw, 2010b). These strategy documents have been designed to integrate groundwater units, surface media sites, and wetland areas by incorporating strategies (i.e., cleanup of surface media sites) to 1) ensure that the Army provides a systematic and uniform approach to investigating and remediating these areas to reach closure in an expeditious and fiscally responsible manner, and 2) ensure protection of potential receptors (i.e., implementation of the installation-wide groundwater LUCs) until final corrective measures result in COCs meeting the CGs where applicable. The scope of the corrective measures for RSA-014S is consistent with these strategies. The selected corrective measures for RSA-014S will address the unacceptable risks to the construction worker from TCE concentrations in ambient air in a future construction area. Without corrective measures, unacceptable risks would be present for potential current and future construction workers. The selected corrective measures will also provide protection for site workers who may need to access RSA-014S for ongoing groundwater corrective measures/monitoring or construction activities in this area and potentially encounter MEC.

3.3 Corrective Measures Evaluation and Selection

The contamination in surface soil is limited to a relatively small area of low concentrations of TCE; therefore, a focused CMS in accordance with EPA (1994) guidance was conducted for RSA-014S (APTIM, 2020). Although not part of the final CMS report for RSA-014S, ADEM has requested protection of potential receptors to MEC potentially present in the two disposal trenches from historical activity or from the site's location within the safety fan for the OB/OD units. The Army has added LUCs as a component of Alternative 2 to provide this necessary long-term protection.

3.3.1 Summary of the Corrective Measure Alternatives Evaluation

A typical comprehensive corrective action technology screening process was not required for the focused CMS for RSA-014S; instead, a presumptive corrective measure alternative (excavation and off-site disposal), along with the no-action alternative, were developed and evaluated in detail against a number of criteria, including technical feasibility, cost, effectiveness in cleaning up the contamination, and protection of human health and the environment. The no-action alternative was required to be retained in the evaluation process as a baseline for comparison purposes.

The two corrective measure alternatives are discussed below and were subjected to a detailed analysis in the focused CMS:

- ***Alternative 1***: No Action. Under the no-action alternative, no corrective measures would be taken to address the TCE-contaminated surface soil posing an unacceptable human health risk at RSA-014S and to address the potential for exposure to MEC. Because this alternative would not be protective of human health for the construction worker or for receptors who might encounter MEC, it is not considered a candidate for implementation but presents a baseline for the comparison of anticipated risk reduction and costs between other retained alternatives.

- ***Alternative 2***: Excavation and Off-Site Disposal and LUCs. TCE-contaminated soils at RSA-014S would be excavated and transported for disposal at an approved landfill. The excavation would then be backfilled with clean soil to complete site restoration. Due to the "Moderate/High" UXO probability, LUCs are needed in order to protect human receptors from risks posed by MEC which may be present at the site.

Because Alternative 2 is an effective technology, will achieve the CG, meets requirements as specified in the Army's guidance for the Defense Environmental Restoration Program (DoD, 2018), and ranks high or moderate in all evaluation criteria compared to Alternative 1 (no action), it was recommended as the preferred corrective measure alternative for soil at RSA-014S.

3.3.2 Selected Corrective Measures

The Army selected Alternative 2 as the corrective measure that most appropriately addresses the TCE-contaminated surface soil and LUCs to address the potential MEC at RSA-014S. The major components of the selected corrective measures include the following:

- Preparation of a CMI work plan through ADEM approval
- Site preparation including surface clearance of potential MEC items (utilization areas [e.g., ingress/egress areas, laydown areas, soil stockpile, etc.]), placement of erosion and storm water controls, vegetation/tree clearing as needed, utility clearance and marking, surveying and marking of proposed excavation areas, and protection of monitoring wells in the vicinity of excavation areas
- Surface clearance and subsurface removal for potential MEC items within planned excavation areas
- Removal of contaminated soils exceeding the CG of 1.3 mg/kg (approximately 80 loose cubic yards with 2-foot depth planned)
- Collection and analysis of soil confirmation samples to confirm that TCE concentrations remaining in soil are equal to or below the CG
- Collection of samples from excavated soil for waste characterization
- Transport of TCE-contaminated soil for final disposal at an approved off-site facility
- MEC and munitions debris (MD) disposal, if necessary
- Site restoration, including application of backfill and topsoil, and revegetation with approved grass mixtures
- LUCs to restrict site access and intrusive activity without on-site UXO support.

3.4 Request for Permit Modification

The RFI report for RSA-014 (CB&I, 2017) received concurrence from ADEM on September 21, 2017. A copy of the ADEM concurrence letter for the RFI report is included in Appendix A. The request for permit modification (Appendix B) accompanies this CMI work plan for RSA-014S and presents the supporting information, including all procedures necessary to implement and monitor the corrective measures for this site in accordance with Alabama Administrative Code (AAC) r. 335-14-8-.04(2). The inclusion of this request for permit modification meets requirements specified in Section VI.E.3 of the Permit.

4.0 Corrective Measures Implementation

This chapter provides an overview of the field activities planned to complete corrective measures at RSA-014S. Work presented in this chapter will be completed in accordance with the procedures outlined in this CMI work plan and other approved documentation as appropriate. All activities performed within the RSA-014S site boundary will be conducted using UXO escort and/or UXO support for surface clearance and subsurface removal activities as necessary. The proposed excavation areas are for removal of TCE-contaminated soil and are outside of the two disposal trenches where munitions may have been demilitarized and disposed during unsanctioned event(s), but the entire site boundary lies within the OB/OD safety arc.

While MEC is not expected to be present within the small areas and shallow depths planned for the corrective measure excavations located outside of the trenches, U.S. Army Corps of Engineers (USACE) (2004) EP 75-1-2, Munitions and Explosives of Concern (MEC) Support During Hazardous, Toxic, and Radioactive Waste (HTRW) and Construction Activities is applicable to this work by initially conducting a subsurface removal within the excavation areas to ensure that the removal of TCE-contaminated soil is performed with minimal potential of encountering MEC. All work will follow the Army-approved ESS for RSA-014S (Appendix K).

The general schedule for implementation of corrective measures at RSA 014S is provided in Appendix C. The schedule is approximate. The actual dates of implementation will depend on document review time, contracting, and field conditions encountered during the excavation and disposal activities. This area of RSA exhibits flooding during the months of higher rainfall from December to April. Where possible, the construction activities will be scheduled to be performed during the non-flooding season at RSA-014S to reduce the management of excess stormwater. Proposed excavation areas are shown on Figure 4-1.

4.1 General Scope

The general scope of work to be conducted with UXO escort and/or UXO support for surface clearance and subsurface removal as necessary includes the following:

- Mobilization/demobilization
- Surface clearance activities (select areas)
- Utility clearance and marking
- Installation of surface water and erosion controls

- Vegetation clearing
- Surveying and marking of proposed excavation areas
- Protection of monitoring wells located in the vicinity of excavation areas
- Surface clearance and subsurface removal at Planned Excavation Areas
- Excavation of contaminated soil and confirmation sampling and analysis
- Waste characterization sampling
- Transport and disposal of excavated soils as nonhazardous waste (Subtitle D landfill)
- MEC and MD disposal, if necessary
- Post signage and conduct initial fencing inspection using UXO escort if entry within site boundary is required
- Site restoration, including application of backfill and topsoil, and revegetation with approved grass mixtures
- Conduct annual routine LUC inspections, sign/fence repairs, and reporting.

The general scope of work not requiring UXO escort includes the following tasks:

- Establish LUC boundary
- Outline land use restrictions for this site in the RSA Property Master Plan
- Comply with requirements in AAC r. 335-5-1-.02(3)(a).

Communication and coordination during the CMI between the Army and APTIM and between the Army and ADEM will follow the protocol provided in the QAPP (Appendix D). In particular, APTIM will coordinate on-site work activities with the Army and the OB/OD schedule. RSA's community involvement plan (Dawson Technical, Inc., 2021)) provides the basis for communication between the Army and the public. As per the RCRA permitting process, public involvement will occur at least twice, including a public notice to be issued by the Army during the CMI work plan finalization process and in accordance with ADEM's permit modification notification.

4.1.1 Procurement and Subcontracting

The following subcontracted services and imported materials may be required for the completion of the project:

- Vegetation clearance
- Protection of existing monitoring wells

- Storm water erosion and sediment controls
- Surveying
- Excavation and site restoration
- Purchase/transportation of common fill and topsoil
- Analytical laboratory
- Transportation and disposal of contaminated soil
- Aggregate (crusher-run, riprap, and drainage stone)
- Erosion controls
- Seed, fertilizer, and mulch
- Heavy-duty plastic sheeting.

The following equipment may be utilized by subcontractors to complete field remediation activities:

- Excavator/backhoe to excavate contaminated soil

- Front-end loader/skid steer to consolidate soil and move fill material

- Steel-wheeled compactor for compaction of fill material

- Large-capacity water truck (or equivalent) for site dust control and hydration of import material for compaction

- Portable fuel tank (mounted on pickup truck).

Support equipment and materials will be procured through equipment and scientific supply vendors and shipped directly to the site. Support equipment includes portable storage, radios, relief stations, eyewash stations, sampling supplies and equipment, health and safety supplies and equipment (e.g., personal protective equipment, air monitoring equipment [e.g., dust monitor and photoionization detector]), and other miscellaneous supplies (e.g., wooden stakes, pin flags, and construction fencing materials).

4.1.2 Field Personnel

The following field personnel will likely be utilized to complete field remediation activities:

- Field construction quality control system manager

- Equipment operators

- Laborers

- UXO personnel (e.g., Senior Unexploded Ordnance Supervisor [SUXOS], Unexploded Ordnance Safety Officer [UXOSO]/UXO Quality Control Specialist [UXOQCS], and technicians).

The number and schedule of personnel will be developed during the project as required for completion.

The SUXOS, who acts as the safety observer, is responsible for the overall direction of the team and for radio communications. All non-UXO personnel working within the exclusion zone (EZ) will be escorted by one UXO Tech II, at a minimum, unless authorization to enter the EZ without UXO escort is approved by the UXOSO or Ordnance and Explosives Safety Specialist (OESS). Other workers may be present at the site, including escorted visitors and other subcontractors. These workers will not be authorized to enter the EZ when the Field Team is actively performing the excavation activity.

Only UXO-qualified personnel will handle MEC or material potentially presenting and explosive hazard (MPPEH). All project personnel will complete the Occupational Safety and Health Administration 40-hour training course, including the annual 8-hour refresher course for hazardous waste site workers, as required by the specific task. Additional site-specific training, in accordance with 29 Code of Federal Regulations (CFR) 1910.120; Engineer Manual (EM) 385-1-1, *Safety and Health Requirements* (USACE, 2014) and this CMI work plan, will be provided to all personnel on their initial mobilization. All UXO personnel will meet the requirements set forth in Technical Paper 18, *Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities* (U.S. Department of Defense Explosive Safety Board, 2020).

4.1.3 Quality Control Inspections for Field Activities

Inspections will be performed to determine compliance with this CMI work plan. The inspection criteria are included in the field audit checklists in the CQAP (Appendix H) and will be verified during inspection activities. Inspections may be performed and verified through visual observation, measurement of materials or equipment, examination of documentation/certification, evaluation of performance, or testing.

Inspections will be performed using a three-phase inspection method. Participants in the inspections typically include but are not limited to the task subcontractor, the project quality control manager, the regulatory representative, and the project health and safety representative. The preparatory inspection(s) are performed prior to start-up and will examine training, procedures, equipment and materials, work plans and documents, and overall readiness to perform work. Initial inspection(s) are performed when work begins on a particular feature of work and include an examination of the quality of workmanship and a review of control testing for compliance with work plan requirements. Follow-up inspection(s) are then performed to verify compliance with procedures. Follow-up inspections will ensure a continuation of quality and safety standards established during preparatory and initial inspections until completion of the definable work feature. Final follow-up inspection(s) will be conducted at the completion of the activity. The final follow-up inspection will be performed to ensure that the completed feature of work meets the work plan requirements. Any deficiencies noted during this inspection will be documented and a determination will be made as to the corrective actions necessary to mitigate the deficiency. All significant deficiencies will be corrected prior to completion of the activity. Records of inspections will be maintained in the project files. At a minimum, inspection files will include inspection reports/checklists, inspection responses, and any supporting documents, as well as applicable comments.

4.1.4 Daily Reports

The requirements for preparation and submittal of daily project documentation are outlined in the QAPP (Appendix D) and the CQAP (Appendix H). As indicated in the CQAP, the daily reports (including daily construction logs, etc.) will be provided to the APTIM Project Manager or designee during CMI activities. These reports will be submitted weekly to the CEHNC Contracting Officer's Representative/Project Manager and RSA. The report will include a running inventory of excavated material. Variances, inspection forms, survey data, and dig permits will be included in the project reporting (Section 4.12).

When field operations are being conducted, a daily status report will also be completed by the SUXOS (Appendix N). The report will include the following:

- Discussions of work progress
- Exposure data
- Problems encountered
- Any MEC or MD found and disposition.

The following events will be documented by the SUXOS and/or UXOSO:

- Chronological log of all significant daily events
- When and why work is stopped for safety reasons
- Health and safety violations or plan deviations.

4.1.5 Health and Safety Requirements

All personnel involved in the corrective measures will follow this CMI work plan, the ESS (Appendix K), and the installation-wide accident prevention plan (HGL, 2019a). Personnel will abide by the health and safety requirements presented in the SSHP prepared by APTIM for implementing the corrective measures (Appendix E).

4.2 Preliminary Activities

Preliminary activities include mobilization, surface clearance activities (select areas), fulfilling requirements for base access, surveying of excavation areas, utility marking and obtaining digging permits, establishing site control as needed, installation of storm water erosion and sediment controls, vegetation clearing, protection of existing monitoring wells, and establishment of soil stockpiles. All field personnel will follow this CMI work plan including the attached SSHP (Appendix E) and the QAPP (Appendix D). All preliminary activities will be conducted using UXO escort or UXO support (surface clearance activities).

4.2.1 Mobilization

Upon notice to proceed, APTIM will begin mobilization, including the deployment of personnel, equipment, subcontractors, and materials necessary to commence CMI activities at RSA-014S. After field mobilization, APTIM personnel will attend a preconstruction meeting and safety orientation to review the proposed approach and the sequencing of work to ensure that clear lines of communication are established. All necessary site-specific safety training will be conducted at this time.

Site preparations will be required prior to the establishment of site facilities such as soil stockpile areas, decontamination area, waste consolidation area, and a MEC collection point within the site boundary. The procedures presented in the ESS (Appendix K) will be used for establishing a MEC collection point. An instrument-aided surface clearance of these areas will be conducted by UXO personnel prior to setup as discussed in Section 4.2.2. All site setup and preparation operations will be conducted using UXO escort in accordance with EM 385-1-97 (USACE, 2013) and EP 75-1-2 (USACE, 2004).

4.2.2 Surface Clearance Activities

Prior to commencement of any preliminary corrective measures activities, UXO-qualified personnel will conduct an instrument-aided surface clearance of the planned areas for utilization (e.g., ingress/egress areas, laydown areas, soil stockpile, etc.). If an item is visibly encountered on the ground surface and identified as MEC, flagging will be placed adjacent to the item and all personnel will exit the site. The UXO team will assess the MEC item and determine the proper disposal in accordance with Section 4.4. If MD or cultural metal items (e.g., nail, wire, can, etc.) are observed at the surface and may interfere with the instrument readings, they will be removed from the surface and staged for subsequent disposition.

Should an anomaly be detected during instrument-aided surface clearance activities but is not visible to the UXO team member(s), flagging will be placed adjacent to the item. If this anomaly is not within the proposed contaminated soil excavation footprints, no further assessment of the anomaly will be conducted unless the anomaly location imposes site constraints on non-intrusive corrective measure activities (e.g., laydown area, equipment staging, and soil stockpiling). The UXO team will make a determination whether intended use of the area where an anomaly is detected would require anomaly investigation and removal. Should identification of the anomaly be determined as necessary for implementation of non-intrusive corrective measures, the UXO team will assess the anomaly in accordance with Section 4.3.

4.2.3 Access to Redstone Arsenal

Obtaining access to RSA requires registering at RSA Visitor's Center, located near Gate 9 on Rideout Road. Upon presentation of proper identification and completion of a background check, RSA will issue an installation access badge. Temporary passes may be required for some vehicles. Upon registration, personnel may access RSA through any of the gates in operation at RSA. Access to RSA is subject to change based upon security alerts or status (e.g., terrorist threat condition or force protection condition).

Military and government personnel may use current military (active, retired, or family) or federal government identification. Additional information can be obtained from the RSA Visitors Center located at Gate 9 at (256) 876-1122 or the Vehicle Registration Office at (256) 876-5770.

4.2.4 Location, Marking, and Surveying of Excavation Areas

A licensed land surveyor will be subcontracted to delineate the project work boundary and mark the excavation areas. The surveyor will locate these areas based on coordinates provided by APTIM and mark items in the field with highly visible wooden stakes, tape, or pin flags. Surveying methods will follow the procedures specified in the CQAP (Appendix H). The proposed excavation areas are shown on Figure 4-1 along with coordinates for the excavation boundaries.

4.2.5 Digging Permit and Utility Marking

In advance of any intrusive fieldwork, a job order request that describes the proposed activities will be submitted. This information is provided to RSA through a system that affords various RSA entities the opportunity to review the proposed activities and verify that impacts to RSA resources (e.g., natural, cultural, etc.) are properly managed. The job order request requires an active common access card and appropriate permissions to input the information into the system by the subcontractor. It could take a significant amount of time to obtain a common access card and permissions required for submittal. In addition, it may take several weeks to obtain approval of the job order request.

Prior to conducting any intrusive site activities, APTIM will coordinate with the appropriate RSA personnel to ensure that any underground utilities in the proposed excavation areas at RSA-014S are located and marked prior to beginning intrusive field activities. No utilities are expected to be identified in the RSA-014S excavation areas based on previous utility reviews during the RFI. The procedure requires notification by telephone ([256] 876-9881) requesting a work order for a digging permit within 14 days of intrusive activities.

The digging permit must be renewed every 30 days. To avoid temporary shutdown, APTIM will make a request for permit extension at least 1½ weeks prior to digging permit expiration for the extension to be granted.

4.2.6 Site Control

APTIM will use temporary construction fencing materials, barricades, and warning tape, as necessary, to delineate the site EZ, contamination reduction zone, and site support zone in compliance with their SSHP (Appendix E). Warning signs will be posted at conspicuous locations around the perimeter of the construction areas to discourage unauthorized entry. An equipment storage and material laydown area will be designated following the surface clearance tasks (Section 4.2.2).

4.2.7 Storm Water and Sediment Controls

Storm water management and erosion and sediment control will be provided in accordance with the Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Areas (Alabama Soil and Water Conservation Committee [ASWCC], 2018). A preliminary BMP layout is included on Figure 4-2. As the excavation at RSA-014S will be less than 1 acre in size, a National Pollutant Discharge Elimination System construction permit issued by the ADEM will not be required.

BMPs (surface stabilization, runoff conveyance, sediment control, stormwater management, etc.) will be used to divert clean water away from a disturbed site, minimize erosion and sedimentation, and prevent pollution of water and land at the site. Installation of temporary controls will be coordinated to maintain effective and continuous control of erosion and pollution. The primary erosion control techniques will be silt fencing and hay bales. Erosion control devices will be inspected at least once per week and following any accumulation of rainfall 0.75 inch or more within a 24-hour period. Sediment deposits will be manually removed from the silt fence after each qualifying rainfall event or when sediment reaches one-half of the barrier height. Removed sediment will be added to the contaminated soil for subsequent disposal. Repair of damaged erosion control devices and damaged areas around and beneath the devices will be initiated within 24 hours of report. Upon completion of the project, temporary erosion and sedimentation control devices will be removed and disposed of off site at the RSA construction and debris landfill. Appendix G provides details on the BMPs that may be used during implementation of the corrective measures.

To reduce the amount of soil transported onto paved roads by motor vehicles or runoff, stone pads with a filter fabric underlayment (construction exit pad) will be constructed at points of vehicular ingress or egress. The construction exit pads will be installed in locations shown on Figure 4-2 in accordance with ASWCC (2018) in Appendix G. New stone will be added as necessary at the site entrance to aid in removing soil from vehicle tires.

If deemed necessary based on site conditions, a temporary access road may be installed into the RSA-014S excavation area for use by over-the-road trucks hauling excavated soil to the Subtitle D landfill. The location of the temporary access road will be determined during mobilization activities. Fill material for the access road will be obtained from the approved off-site borrow source (Section 4.11.1). The access road may include compacted crushed rock as the final layer, if deemed necessary. The material used to construct the access road at RSA-014S will be spread on site during site restoration activities.

4.2.8 Vegetation Removal

APTIM will clear brush and other vegetation currently covering the excavation areas at RSA-014S as necessary in preparation for the soil removal action. This will include coordination with the RSA forester for potential removal of any commercial-quality trees. The remaining trees and brush will be cleared using manual and mechanical means (e.g., chainsaw, line trimmer, or heavy equipment). A preliminary vegetation clearance area is shown on Figure 4-2. A UXO escort (UXO Tech II at a minimum) will accompany all non-UXO personnel performing vegetation clearing activities.

A time-of-year restriction for clearing any tree with a diameter at breast height of 3 inches or greater was implemented at RSA to protect roost trees of the Indiana and the northern long-eared bats during the active season of April 1 through October 15. This time-of-year restriction may be altered to protect roost habitat during April 1 through October 15, with project specific consultation with the Alabama U.S. Fish and Wildlife Service (USFWS) Field Office. The time-of-year restriction may be waived if USFWS protocol surveys have been completed to verify absence.

If practical to implement on site, the cleared materials will be mulched and stockpiled for use during site restoration. Materials not used for site restoration will be disposed at the RSA construction and demolition landfill. This does not include material in contact with site soils; such materials (e.g., root wads) will be disposed in the same manner as the surrounding soil.

Should suspected or known MEC be encountered during vegetation clearing operations, it will be inspected by the on-site UXO personnel. The item(s) will be clearly marked (e.g., with cross-pin flags or caution tape) and its position annotated on the appropriate map. On-site UXO personnel will process the item as detailed in Section 4.4 and the ESS (Appendix K) prior to continuing vegetation clearance.

4.2.9 Existing Monitoring Well Protection

No existing monitoring wells are located with the three RSA-014S excavation areas (Figure 4-1). However, one monitoring well (P14-RS819) is located within the work zone for the excavation (Figure 4-2). Several other wells are located within the RSA-014S site. Monitoring wells within close proximity of the work zones at RSA-014S will be conspicuously marked in the field for protection during construction (i.e., safety fencing will be placed around the monitoring wells).

Although every attempt will be made to safeguard the existing monitoring wells, if a monitoring well is inadvertently damaged requiring abandonment, the well will be closed in accordance with an ADEM approved well closure plan (unless closed due to damage), Standard Operating Procedure (SOP) No. 21, *Monitoring Well and Borehole Abandonment* (Shaw, 2013; HGL, 2019b), and the AEIRG (ADEM, 2017a). Wells requiring closure and wells damaged as part of the corrective measure activities at RSA-014S will be replaced in kind. Documentation of the well closure activities will be included in the corrective measures report along with a request for a permit modification for any wells included in the groundwater monitoring program for RSA-151 corrective measures or the OB/OD area that require replacement.

If needed, any replacement monitoring wells will be installed following the completion of backfilling operations at RSA-014S. Well replacements would be limited to wells damaged or closed as part of excavation activities. Replacement wells would be installed in accordance with procedures outlined in SOP No. 17.0, *Monitoring Well Installation* (Shaw, 2013; HGL, 2019b). Currently, no replacement wells are planned for RSA-014S.

4.2.10 Stockpile Work Area

A soil stockpile work area will be established at RSA-014S for staging excavated contaminated soil prior to waste characterization and disposal and for staging of clean backfill from an off-site source, if necessary. The work area will be of sufficient size to hold the estimated 80 loose cubic yards of contaminated soil planned for excavation at RSA-014S. The contaminated soil will be stockpiled in a maximum of 200 cubic yard piles should more contaminated soil require excavation than the estimated 80 cubic yards. Clean backfill material will be stockpiled separately. The soil work area will be lined with heavy plastic sheeting and surrounded by a 1-foot-high berm to prevent runoff water and soil migration. A preliminary site layout including stockpile locations is shown on Figure 4-2.

4.3 Subsurface Removal in Support of Excavation Activities

A surface clearance within the proposed excavation areas will be conducted in accordance with Section 4.2.2. In order to reduce the potential for exposure to MEC during proposed excavation of TCE-contaminated soil, a subsurface removal as necessary will be conducted by the UXO team in the footprint of the proposed excavation areas in accordance with Section 6-7 of EP 75-1-2 (USACE, 2004). The excavation limits will be surveyed and staked prior to the start of subsurface removal activities as stated in Section 4.2.4.

The excavation footprint removal activities will include, but not be limited to the following:

- UXO personnel will provide MEC recognition, location, and safety functions and verify that all utility clearance permits are on-site.
- UXO personnel will physically review the excavation footprints and discuss visual observations and potential areas of concern.
- Conduct a subsurface survey using a hand-held magnetometer (or other applicable instrument) to identify and locate all anomalies within the three planned excavation footprints. All anomalies will be marked for subsequent intrusive investigation.
- UXO personnel will manually complete anomaly excavations of less than 1 foot. During subsurface activities, the UXO technicians will use a hand-held magnetometer (or other applicable instrument) to locate and pinpoint anomalies. The UXO technicians will carefully remove the overburden soil to expose and positively identify the source of a subsurface metallic anomaly.
- If the item is identified as MEC, the UXO team will determine whether the item is acceptable to move. After determining if an item is acceptable to move, the UXO team will determine the most expeditious route for safe movement of the MEC item to a MEC consolidation point. MEC may be moved for consolidation and disposal in accordance with the ESS (Appendix K). Items that cannot be safely moved will be blown in place using engineering controls, as necessary, as described in the ESS (Appendix K).
- After the probable source of the anomaly is identified and removed, validation of the process will be conducted using a hand-held magnetometer (or other applicable instrument). If validation is confirmed (i.e., no further anomaly detection), excavation proceed at the location to the target excavation depth (approximately 2 ft bgs) as detailed in Section 4.6.

4.4 MEC/MD Disposal

APTIM will be responsible for destroying MEC/MPPEH that is not transferred to the adjacent RSA OB/OD. Donor explosives may be stored in previously sited magazines provided by RSA in the 8200 Block area or procured using on-call explosives provider as discussed in the Explosives Management Plan (Appendix L) and ESS (Appendix K).

APTIM will be operating under a Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) Type 20 manufacturers license, and UXO personnel on site will be vetted by the ATF as employee possessors. The SUXOS will be the only person authorized to request donor explosives. Only UXO personnel who have been cleared as employee possessors by the ATF will be designated to receive explosives.

A detailed accounting of all MEC located at each excavation area will be made and maintained by the SUXOS. A log entry will be made for each MEC item indicating the item's identity, its explosive hazards, location (x, y, and z measurements), and final disposition. All MD excavated during removal activities will be removed from the site.

4.4.1 Area Notification/Evacuation Procedures

Prior to any detonation, a pre-established notification procedure detailed in the Communication Plan (Appendix M) will be initiated by the project team. As soon as it is determined that a detonation will be required, the SUXOS will initiate this procedure. The SUXOS will perform proper notifications in accordance with the RSA Explosive Safety Management Program (Army, 2018). Notifications will include the Mission Operations Control Center, U.S. Army Aviation and Life Cycle Missile Command Safety, OB/OD personnel, and the Public Affairs Office. The SUXOS will schedule the demolition to allow sufficient time to complete all notifications, approvals, and evacuations, as required.

4.4.2 Demolition Procedures

Demolition procedures will be conducted for MEC. No burn operations are anticipated. During demolition activities, the SUXOS will maintain overall control of the area. An EZ will be established around the demolition area according to the Minimum Separation Distance for intentional detonations stated in the ESS (Appendix K). Evacuation, if necessary, will be coordinated with tenant personnel. Only the SUXOS, OESS, UXO Demolition Team, and UXOSO/UXOQCS will be allowed within the EZ once the demolition operations have begun.

The UXOSO will ensure safe work practices are observed, and the UXO Demolition Team Leader will perform the necessary steps to safely dispose of the MEC. All demolition operations are expected to be performed during daylight hours. Special considerations will be made for nighttime demolition operations, if necessary. The following procedures will be followed for all demolition operations:

- Prior to conducting any demolition activities, the SUXOS will coordinate with RSA and CEHNC.
- The UXOSO will verify local weather conditions and verify that there is no potential for lightning in the demolition area.
- The SUXOS will notify emergency response agencies as far in advance as possible that disposal activities will take place. The SUXOS will ensure that the telephone number of the responding medical facility (Huntsville Emergency Medical Services, Inc.) is posted in the Accident Prevention Plan/Site Safety and Health Plan or is otherwise available to site personnel.
- Before beginning any explosive operations, a demolition operation briefing will be held for all personnel assigned to or working with disposal teams to review MEC demolition and emergency procedures.
- Installation utility maps will be checked for utilities within the vicinity of the demolition area.
- Donor explosives will be drawn from the explosive storage magazine or obtained from on-call explosives provider. The transportation vehicle will be loaded with the explosives and other required equipment.
- The UXO Demolition Team Leader will ensure that permission to detonate explosives and incendiaries has been obtained from the SUXOS.
- The SUXOS will be responsible for scheduling the detonations and ensuring that all project personnel are accounted for before disposal operations begin.
- The UXO Demolition Team Leader will then inspect the disposal shot and return to the safe firing point.
- Prior to initiation, the UXO Demolition Team Leader will ensure that personnel are stationed at the roadblocks, scan the EZ for personnel, and sound three distinct blasts on an air or vehicle horn. The UXO Demolition Team Leader will then scan the area again and initiate the demolition charge if all is clear. All roadblocks will be coordinated with RSA prior to implementation.
- Techniques described in EM 385-1-97, SOPs, and approved work plans will be used, as applicable, during all demolition operations.
- The MEC/MPPEH Disposal Log (Appendix N) will be completed for each disposal operation.

4.5 MEC/MD Records Management

APTIM will maintain a detailed accounting of all MEC and MD items encountered. Data from the removal operation activities will be entered in the Geographic information system (GIS) database and included in the CMI Report. The database will track all MEC recovered. Required forms are included in Appendix N.

Data collected regarding any found MEC items will include the standard official nomenclature, condition of the item, depth located, orientation of the item, location coordinates, and final disposition. The UXOQCS is responsible for the tracking, maintenance, and photographic records of all MEC recovered during the project. A digital photograph of each MEC item identified and significant/unusual items recovered during the CMI activities will be taken and entered into the GIS database.

MD will be tracked in the database by location, volume, or weight as well as the number and type of intact, inert munitions, if any are discovered. In addition, photographs of representative MD items will be collected. The items shall be documented in the CMI Report.

4.6 Excavation of Contaminated Soil and Confirmation Sampling and Analysis

Following completion of the surface clearance and subsurface removal activities as necessary within the planned excavation areas, the corrective measure consisting of excavation of TCE-contaminated soil will commence. The three proposed excavation areas (Areas 1 through 3) are shown on Figure 4-1 and the site layout is shown on Figure 4-2. At each area, the excavation limits will be surveyed and staked prior to the start of excavation. The depth of excavation at each area is planned as 2 feet based on the RFI findings. The dimensions of each excavation area are discussed below:

- Excavation Area 1 has approximate dimensions of 10 feet long by 10 feet wide (100 square feet). Approximately 7.4 bank cubic yards of soil will be generated from Area 1. Assuming a bulking factor of 1.3 from excavating, the disturbed or loose volume will be approximately 10 loose cubic yards.

- Excavation Area 2 has approximate dimensions of 10 feet long by 10 feet wide (100 square feet). Approximately 7.4 bank cubic yards (10 loose cubic yards) of soil will be generated from Area 2.

- Excavation Area 3 has approximate dimensions of 25 feet by 25 feet wide (approximately 625 square feet). Approximately 46 bank cubic yards (60 loose cubic yards) of soil will be generated from Area 3.

Continuous UXO Team Observation during Soil Excavation. The soil excavations for removal of TCE-contaminated soil within each of the three areas will be performed using a backhoe or excavator. The UXO team will continuously observe the soil as it is excavated. Should an item in the excavated soil or within the excavation be visually observed, the UXO personnel will identify the item in accordance with Section 4.3. Should initial visual observation conducted by UXO personnel determine that an item is cultural (i.e., wire, can, etc.), excavation will continue using the same protocol until the depth and lateral area is reached where confirmation soil samples for TCE from the sidewalls and floors are at or below the CG. Items found to represent MD will be managed as described in Section 4.4. However, should UXO personnel determine that an item encountered is potentially MEC, all work will stop, and personnel will exit the site while the UXO team makes their assessment and determines if a disposal action is required. Once the MEC item is properly removed and/or disposed of, excavation may continue. The excavations will extend to a proposed depth of 2 feet. No benching or shoring will be required at any of the three areas due to the shallow depths (2 feet). All excavations will be conducted in accordance with the Safety and Health Regulations for Excavations (Occupational Safety and Health Administration 29 CFR Part 1926 Subpart P). Although not anticipated at RSA-014S, excavations over 4 feet deep will be shored, sloped (1½:1, horizontal:vertical), or benched as required. Spoils will be placed a minimum of 3 feet from the edge of the excavation. Loose soil or rocks will be removed from the sides of excavation walls. Personnel will not enter any excavation over 4 feet deep that is not properly sloped or benched.

Confirmation Soil Sampling. Following completion of the excavations, confirmation soil samples will be collected within the excavation areas to ensure that the soil contaminant concentrations do not exceed the CG. The confirmation sampling design is statistically based and follows the guidelines set forth in (1) Section 9.6 of ADEM *General Soil Sample Collection Standard Operating Procedure (SOP) #2150, Rev. 1.1* (ADEM, 2018); (2) the August 13, 2010 guidance from ADEM, *In-situ Sampling for the Purposes of Waste Characterization/Disposal of Soil* (ADEM, 2010); and (3) Pacific Northwest National Laboratory (2012) *Visual Sample Plan* (Pacific Northwest National Laboratory, 2012).

The confirmation sample locations are shown on Figure 4-3. Confirmation samples will be collected on each sidewall at a maximum spacing of 50 feet between samples with a minimum of one sample per 50 square feet of sidewall area (Figure 4-4). A multipoint composite sample consisting of five aliquots using individual Terra Core™ samplers will be collected between a 0 to 2 foot depth from each sidewall. The aliquots will include a center point plus aliquots from the upper and lower left and right quadrants of the sidewall section. The depth interval may be adjusted if excavation depths change but will not exceed a maximum depth interval of 5 feet.

Confirmation samples will be collected from the floor of each excavation with a minimum of one sample per 2,500 square feet of floor area (maximum floor areas equal to 50- by 50-foot sections) (Figure 4-3). A multipoint composite sample consisting of five aliquots using individual Terra Core™ samplers will be collected from each excavation floor (Figure 4-5).

The Terra Core™ is a onetime use transfer tool, designed to easily collect soil samples and transfer them to an appropriate container(s) for in-field chemical preservation. For sampling each sidewall and floor, the laboratory will provide a 90 milliliter glass jar containing the appropriate amount of preservative (methanol) in accordance with Worksheet No. 20 in the QAPP (Appendix D). Sample collection logs will be filled out to document the sampling in accordance with SOP No. 1.0 (HGL, 2019b).

Confirmation samples will be collected using routine quality assurance/quality control sample frequencies (i.e., 10 percent field duplicates, 5 percent matrix spike/matrix spike duplicate). All sample containers, preservatives, and holding times will conform to the requirements specified in Worksheet No. 20 in the QAPP (Appendix D).

Confirmation samples will be sent to an off-site analytical laboratory for analysis of TCE (EPA Method 8260B) on a 5-day turnaround basis. Confirmation samples will be collected in accordance with the QAPP provided as Appendix D. Sample designations are shown in Worksheet No. 18 of Appendix D. If floor or sidewall confirmation sample results do not achieve the CGs for a particular excavation area, the excavation will be expanded as discussed in Section 5.1.

All analytical data generated from this project will be managed in accordance with the procedures specified in the QAPP, except only the final confirmation sample results will be validated. Sample documentation, custody, packaging, and shipping will follow the procedures specified in the QAPP. Custody will be maintained at all times by the APTIM sampling team prior to shipment to the analytical laboratory using typical chain-of-custody forms.

Soil Stockpiling. The excavated material will be temporarily stockpiled or staged prior to waste characterization sampling and off-site disposal. The excavated material will be staged on impervious material such as plastic sheeting and covered with waterproof material (i.e., tarpaulin or 10-mil plastic sheeting). Containment will control runoff, leaching, or fugitive dust emissions. Measures will be taken to prevent any surface runoff from entering into or washing away from the stockpile. The excavated areas will be adequately secured from the public and filled as soon as possible.

If necessary, dust at the site will be controlled with water using a water truck with hose and sprayers and mulch such as straw. Dry exposed areas will be misted with water until the surface is wet and repeated as needed. Visual observation will assure that water will be applied at rates so that runoff does not occur. In addition, all other equipment used at the site during operations will be operated in a manner that prevents further migration of contamination. Polymers, tackifiers, stabilizers, or chlorides will not be used for dust control. An action level of ½ the Occupational Safety and Health Administration particulate not otherwise specified threshold respirable fraction (2.5 milligrams per cubic meter) within or directly downwind of the work areas will be used to determine when dust suppression is needed. Dust levels will be monitored using a Data Ram PDR 1000 or equivalent real-time aerosol monitor.

4.7 Waste Characterization

Contaminated soils will be stockpiled as discussed in Section 4.6 during the excavation at RSA-014S. Up to 200 cubic yards may be included in a stockpile. Therefore, it is currently planned that one soil stockpile will be generated during the RSA-014S excavation (80 loose cubic yards). Grab samples will be collected from three exterior points of the stockpile from a depth between 0 and 2 feet. Two additional samples will be taken from the interior of the pile at a depth between 2 and 3 feet. The grab samples from the five points within each decision unit will be composited. A single sample using a Terra Core sampler will be collected for VOCs. Waste characterization samples will be sent to an off-site analytical laboratory for total VOCs, total characteristic leaching procedure (TCLP) VOCs, perchlorate, and explosives analyses. Stockpile samples will be collected in accordance with the QAPP provided as Appendix D. No additional quality assurance/quality control samples (other than the method-required batch quality control) will be required for the waste characterization samples.

Upon receipt of the analytical data, the waste characterization sample results will be compared to the regulatory levels for TCLP VOCs, total VOCs, perchlorate, and explosives. If the TCLP results indicate that the concentrations are below the RCRA regulatory criteria, the soil will be shipped to an off-site permitted Subtitle D landfill for disposal as nonhazardous special waste. If the TCLP results exceed limits, the wastes will be managed as hazardous waste and sent off site for treatment and disposal in accordance with federal and state regulations.

4.8 Remediation-Derived Waste Management

The management of excavated soils is discussed in Section 4.7. Waste transportation and disposal are discussed in Section 4.9. Other remediation-derived waste (RDW) generated during the CMI activities at RSA-014S is expected to include decontamination fluids and disposable personal protective equipment (PPE).

Solid RDW, liquid RDW, and PPE are examples of RDW that will be managed. All RDW will be containerized, labeled, and stored in compliance with the provisions of AAC r. 335-14 as applicable and as discussed in the AEIRG (ADEM, 2017a). PPE that is contaminated by site media will be disposed of with the contaminated waste stream (i.e., PPE generated during soil excavation will be disposed with the soil). PPE that is uncontaminated will be placed in trash bags and disposed in a dumpster as normal household trash. Other types of RDW, if generated, will be managed in accordance with Table 2 of Appendix G of AEIRG (ADEM, 2017a).

In determining whether to manage RDW as nonhazardous or hazardous, factors such as generator knowledge and real-time field measurements or observations will be considered. AAC r. 335-14-3.01(2) allows the use of generator knowledge in the hazardous waste determination process. Generator knowledge consists of an evaluation of the following four factors:

1. Process Knowledge – The site processes are evaluated to determine whether any activity might have generated a listed waste which still persists in soil or groundwater.

2. Past Management Practices – Investigation-derived wastes (IDW) resulting from various site investigation activities have been managed at RSA for over 20 years. Changes to regulations directing this management have been minor. The Army intends to follow management practices which have been accepted by ADEM during prior investigations.

3. Sampling Results from Past Waste Characterization Sampling – Historical waste characterization sampling may indicate whether future IDW or RDW is likely to be a nonhazardous waste or to have characteristics of a hazardous waste.

4. Sampling Results from Past Soil and Groundwater Sampling – Historical sampling results from soil and groundwater sampling may indicate whether future IDW or RDW is likely to be a nonhazardous waste or to have characteristics of a hazardous waste.

However, if the available generator knowledge from the four factors is inadequate to make an accurate determination, the waste will be tested according to the applicable methods set forth in Subpart C, 40 CFR 261 as specified in 40 CFR 262.11(d)(2).

Historical uses of RSA-014S indicated the primary COPCs are solvents, perchlorate, and explosives. Many of these compounds are regulated by RCRA. Therefore, detections, if present, could result in the generation of either a listed or a characteristic waste. TCE is a RCRA-regulated chemical, and IDW/RDW with TCE can be classified as a characteristic and/or a listed hazardous waste or may be nonhazardous. There are no known processes or available historical information for RSA-014S that would indicate any potential listed waste codes would apply to IDW/RDW.

Wastes will be containerized, labeled, and stored in compliance with the provisions of AAC r. 335-14 as applicable and as discussed in the AEIRG (ADEM, 2017a). Heavily soiled PPE will be drummed after use and subsequently disposed based on the analytical results of the waste characterization soil samples at RSA-014S.

For RDW considered to be nonhazardous using generator knowledge and field observations, and liquid waste will be containerized and stored on site pending sampling and analysis. Analytical testing and subsequent evaluations will be performed to determine if soil may be disposed of off site at a Subtitle D landfill. Sampling and analysis of RDW are discussed in Appendix D.

Any RDW determined to be hazardous will be managed and disposed of the waste as specified in SOP No. 4.0, *Investigation Derived Waste* (Appendix F). RDW believed to be hazardous will be containerized in 55-gallon drums or other suitable containers with tight-fitting lids or other covers. Presumed hazardous RDW will be labeled, moved to a satellite accumulation area or 90-day storage within 72 hours, or managed on site in a 90-day storage area, as specified in SOP No. 4.0. RDW will be disposed of as specified in SOP No. 4.0, *Investigation Derived Waste*.

A RCRA hazardous waste determination/evaluation is required by AAC r. 335-14-3-.01(2) and will be made utilizing waste identification criteria outlined in AAC r. 335-14-2-.01 through 335-14-2-.04. Process knowledge concerning listed waste and analytical results from soil and groundwater IDW or RDW samples will be used to determine whether the waste is nonhazardous, hazardous waste suitable for land disposal, or hazardous waste requiring treatment. Types of analyses are site specific but typically include TCLP VOCs, TCLP SVOCs, and TCLP metals. For RSA-014S, waste characterization analysis for soil will include target compound list (TCL) VOCs, TCLP VOCs, perchlorate, and explosives. Liquid RDW samples will be analyzed for TCL VOCs, perchlorate, and explosives. Wastes for which TCLP results exceed limits specified in AAC 335-14-2-.03, Table 1, will be managed as hazardous waste and sent off site for treatment and disposal in accordance with federal and state regulations.

For nonhazardous water RDW, possible management options include processing through RSA's sewage treatment plant or an appropriate RCRA-permitted facility. Examples of disposal practices for hazardous waste include disposal of solid (soil) hazardous waste at a disposal facility permitted to accept the waste based on the specific contaminants and concentrations in the soil. Treatment of the RDW hazardous liquids will be in accordance with ADEM regulations and the disposal facility permit. RSA will contact the EPA Region 4 off-site coordinator to ensure that any disposal facilities selected for RDW disposal do not have any operational or regulatory issues.

4.9 Waste Soil Transportation and Disposal

A licensed transportation and disposal subcontractor will be used to complete these activities. It is assumed that the soil will be disposed as special waste (nonhazardous) at a Subtitle D landfill. Transportation and disposal of the excavated waste will begin after approval by the selected waste disposal facility and ADEM or the applicable regulatory agency for the selected disposal facility (typically 4 to 6 weeks after receipt of Solid Waste Profile Sheet). Prior to transport, an RSA representative will review and sign the waste manifest.

During loading, APTIM will document the quantities of waste loaded onto the dump truck and facilitate the Bill of Lading or shipping paper documentation for the nonhazardous waste shipments. All hazardous waste sent off site for disposal shall be on a hazardous waste manifest and have a Land Disposal Restriction notification. Transportation will comply with all U.S. Department of Transportation regulations. APTIM will coordinate with the transporters so that the waste will be shipped to arrive on schedule at the landfill. APTIM will also receive written approval from the landfill (and ADEM, if required) prior to shipping waste to their facility. The landfill will provide APTIM with a certificate of disposal for each load received and processed.

4.10 Posting of Signage and Initial Inspection of Fencing

On-site UXO escort will be required should it be necessary for personnel to enter the site for the posting of signage and initial inspection of fencing. A total of 27 signs will be posted around the perimeter of RSA-014S as shown on Figure 4-6 noting that on-site UXO support is required for site access and intrusive activities, and approval must be obtained by the Chief, Installation Restoration Branch, within the Environmental Management Division. Figure 4-7 shows the proposed sign details. Minor text adjustments may be made to the signs based on input from RSA's safety office or other reviews or as needed to conform to the physical layout of the sign. The final verbiage used will be included in the CMI report for this site. The signs and lettering must be visible from a distance of 25 feet. The proposed area for LUCs where signs will be placed around the LUC area perimeter is shown on Figure 4-6. Twenty-seven signs are planned for placement around the LUC area boundary on an approximate 100-foot spacing consistent with signage spacing at other RSA sites closed with LUCs. The signs attached by metal brackets or similar will be placed on the existing fencing at an approximately 5-foot height from the base of the fence. The signs will be placed on the existing fencing around RSA-014S.

The fencing will be inspected to ensure that it provides adequate engineering controls as part of the site LUCs (Figure 4-6). A full site walk around the fencing perimeter will be conducted to ensure the fencing and fence posts have not been damaged to the extent that it could compromise the controls. A functioning lock will be checked for each gate.

4.11 Site Restoration and Demobilization

4.11.1 Backfilling and Site Restoration

Upon verification that the confirmation samples from an excavation area are below the relevant CG for that area, the excavation area will be backfilled until the area has been restored to its original grade. Approximately 80 cubic yards of fill material will be brought in from an approved off-site borrow source. As a contingency, representative samples of the borrow source material will be collected to confirm it is acceptable for use as backfill at the site, should an approved location not be available. The borrow material sampling, if required, will include one 5-point composite sample analyzed for TCL SVOCs, TCL pesticides/polychlorinated biphenyls, and target analyte list metals and one sample analyzed for TCL VOCs. Borrow samples will be collected in accordance with the QAPP provided as Appendix D.

The analytical results for target analyte list metals will be screened against BSVs and residential soil PSVs as supplemented by a site-to-background evaluation, if needed. Soil concentrations for VOCs, SVOCs, and pesticides/polychlorinated biphenyls will be screened against their respective residential soil PSVs to demonstrate that the material is acceptable for use. An existing borrow source may be utilized, if the borrow material sample collected previously meets the parameters listed above and this previous sample is still representative of the borrow soil that would be used at RSA-014S.

The backfill material will be dumped near the excavation area using a dump truck and placed in the excavation in lifts no greater than 1 foot high, with each lift compacted by the excavator prior to placement of the next lift. During backfilling, dust control will be implemented as discussed in Section 4.6. Once the area has been backfilled and compacted, clean topsoil will be placed over it. The disturbed area will then be seeded and mulched to promote revegetation and reduce the potential for soil erosion. Seed and mulch will be applied to all disturbed areas according to the ASWCC Permanent Seeding BMP (ASWCC, 2018) (Appendix G).

The applied grass mixture used will depend on the date scheduled for planting and the area planted. Refer to the Alabama Department of Transportation (ALDOT) Standard Specifications (ALDOT, 2018) Section 860.01 for seed mixture for Zone 1-Areas Subject to Frequent Mowing. Initial temporary planting of annual ryegrass is tentatively scheduled to occur in late fall to early winter (November and December). Permanent planting of Bermuda grass and white dutch clover is tentatively scheduled to occur in late spring to early summer (April and May).

A site inspection will be conducted approximately 4 weeks after the seeding to confirm the revegetation is successful. If revegetation is unsuccessful, the site will be reseeded until an adequate stand of vegetation is present. All temporary fencing, plastic sheeting, hay bales, wooden stakes, and other project-related items will be removed from the site and disposed in accordance with SOP No. 4.0, *Investigation Derived Waste* (Appendix F).

4.11.2 Equipment Decontamination

An area will be designated within the boundary of the work areas at RSA-014S, adjacent to vehicular ingress and egress areas, for equipment decontamination. A decontamination pad typically consists of a soil-bermed area covered with multiple layers of visqueen sheeting where gross contamination can be removed from equipment. The decontamination pad will contain a sump area or low area where wash water from pressure washing will drain to be pumped into a portable holding tank. Decontamination fluids will be sampled for TCL VOCs, perchlorate, and explosives. Decontamination fluids will be managed as discussed in Section 4.8. Settled soil within the sump will be disposed of with the excavated materials from RSA-014S.

Nondisposable sampling equipment will be decontaminated prior to beginning work at the site and prior to the collection of individual samples to prevent cross contamination and maintain the integrity of the environmental samples collected. All sampling equipment and injection equipment will be decontaminated in accordance with procedures specified in the RSA installation-wide quality assurance program plan (HGL, 2019b), which was prepared in accordance with Appendix E of the AEIRG (ADEM, 2017a).

4.11.3 Temporary Storm Water, Erosion Control, and Sediment Control Removal

Upon completion of site restoration activities, temporary erosion and sediment controls will be removed and disposed of off-site at the RSA construction and debris landfill or with the RDW from the excavation. The silt fence will remain in place until after the vegetation is established. When the silt fence is removed, the posts will be pulled from the ground and the remaining disturbed area will be reseeded. Excess soils will be removed from the silt fence and disposed of with the RDW from the excavation.

4.11.4 Demobilization

Personnel, equipment, and subcontractors will be demobilized from the project site after completion of remedial activities. A small crew and minimal equipment will be retained as required to remove surplus materials and clean staging areas.

Demobilization will primarily consist of disassembly, packing, and return of rented equipment to suppliers and travel for personnel back to their home offices.

4.12 Corrective Measures Implementation Reporting

A CMI report will be prepared in accordance with Section VIII.D of the Permit (ADEM, 2021) and AEIRG (ADEM, 2017a) as discussed in this section. If completion of the CMI requires more than 180 days, the Army will submit quarterly CMI progress reports in accordance with Section VIII.D.1 of the Permit. The CMI report will include the following:

a) A description of activities completed
b) As-built construction drawings presenting the final limits of soil excavations at each site and the locations of confirmation samples
c) Waste manifests indicating the handling of the excavated material that has been shipped off site to a certified disposal facility
d) Monitoring data (soil, air, dust, and water) collected for any reason during the construction period for the purposes of monitoring potential for human and ecological exposure
e) MEC/MD encountered during the corrective measures and disposition
f) Certification, prepared in accordance with AAC 335-13-8-02 (2)(d) by RSA and a registered professional engineer (State of Alabama), that the corrective measures required by the Permit are complete
g) Appendices consisting of site photographs, analytical reports, data validation documentation, and waste manifests.

4.13 Land-Use Controls

LUCs as implemented by a Notice of Environmental Use Restriction (NEUR) are required when an approved CMI allows a cleanup that will not result in remediation of the property or portions of the property to unrestricted use (Table 3-2 and Appendix I). The purpose of an NEUR is to ensure that risks to human health and/or the environment are properly managed by imposing activity and use restrictions on the applicable portions of the property and including these restrictions into the installation master plan. The Army will comply with the AAC r. 335-5-1-.02(3)(a) for the NEUR for RSA-014S.

4.14 Implementation of Land-Use Controls

LUCs will be implemented in accordance with AAC r. 335-5 (ADEM, 2019) to ensure that site access and intrusive activities conducted at RSA-014S remain protective of human health. The LUC boundary area is shown on Figure 4-6. Signs will be placed around the perimeter of the fenced LUC area including the fence access gates stating that on-site UXO support is required; a contact phone number will be provided for Army review and approval of requested tasks. Proposed specifications for the signs are presented on Figure 4-7 with any revisions to be managed as per Section 4.10. The following institutional controls will be implemented:

- A NEUR, in accordance with AAC r. 335-5-1-.02(3) (ADEM, 2019), will be developed that will restrict land use at RSA-014S and require inspection, maintenance, and repair of signage and fencing as well as on-site UXO support for access and intrusive site activities dependent upon location and activity. The NEUR will be included in the CMI report for this site. If the property is ever transferred out of federal control, the LUCs will be contained in an environmental covenant to be recorded on the property at the time of transfer.

- Incorporation of the NEUR into the RSA Real Property Master Plan as required by AAC r. 335-5-1-.02(3)(a)(1)(iv) (ADEM, 2019).

- Recording of the NEUR in the land records for the property, as required by AAC 335-5-1-.02(3)(a)(1)(iv) (ADEM, 2019).

The requirements of the NEUR are discussed in Section 4.14.2.

4.14.1 Survey Plat

In accordance with the Permit (ADEM, 2021), where land cannot be released for unrestricted use, RSA will submit a survey plat indicating the locations and dimensions of the land area included in the LUC boundary at RSA-014S in accordance with Section VIII.B.5 of the Permit. The survey plat shall be submitted to the Madison County Probate Judge's Office and to ADEM as part of the NEUR provided in the CMI report. This survey plat must be prepared and certified by a professional land surveyor registered in the state of Alabama and contain a prominently displayed note stating RSA's obligations to limit property to the specified restricted uses. The survey plat shall be maintained as described in the Permit until RSA can demonstrate to ADEM that the levels of hazardous constituents in all contaminated media are within limits appropriate for unrestricted land uses. A preliminary plan showing the areas to which LUCs will be applied is shown on Figure 4-6, with draft survey coordinates from the GIS database (latitude and longitude) of the corners of the LUC boundary.

4.14.2 Notice of Environmental Use Restriction

An NEUR is required when an approved CMI allows a cleanup that will not result in remediation of the property or portions of the property to unrestricted use. The purpose of an NEUR is to ensure that risks to human health and/or the environment are properly managed by imposing activity and use restrictions on the applicable portions of the property and making these restrictions a legal obligation until the NEUR is removed. The Army has determined that MEC may be encountered at RSA-014S as documented by a "Moderate/High" UXO probability for this area. The following restrictions will be imposed and enforced:

- The signs and site fencing will be inspected annually.

- On-site UXO support is required for site access and onsite intrusive activities.

A draft NEUR will be provided in the CMI report for this site for ADEM review and approval. Once the NEUR is approved, ADEM will execute and return the original document to RSA to be filed in the Madison County Probate Judge's Office within 30 days of receipt and no later than the submission of the survey plat. Certification that the NEUR was recorded with the Madison County Probate Judge's Office will be submitted to ADEM. This certification will include a copy of the NEUR and the document in which the notation was placed. RSA will maintain the NEUR until such time in the future that conditions can be demonstrated to ADEM's acceptance that the land can be released for unrestricted use. ADEM will be notified within 10 days after uses inconsistent with the NEUR are identified. Additionally, notice regarding any observed changes in use, identified proposed changes in use, applications for building permits, or proposals for site work inconsistent with the NEUR will be provided to ADEM as part of the annual monitoring report.

If the property is transferred to an owner that is not the federal government, an environmental covenant will be executed and filed at that time in accordance with AAC r. 335-5-1-.02(3)(a)(1)(i) (ADEM, 2019).

4.15 Ongoing Obligations and Responsibilities

4.15.1 Inspections and Repairs

Inspections will be conducted and documented on an annual basis as follows:

- Inspection of the fencing and signage around the LUC boundary to determine whether fencing is in good repair and signs are still present and legible.
- Repairs/replacements to the warning signs and fencing shall be completed on an as-needed basis to maintain access control and shall be initiated within 10 days of identifying the need for such repair/replacement.
- Ensure that site use remains for industrial use only and requirement for on-site UXO support is enforced.

The inspections will ensure long-term effectiveness of the LUCs for protection of site receptors. ADEM will be notified within 10 days after uses inconsistent with the NEUR are identified. If site entry is required, on-site UXO escort will be present for inspections and repairs. Coordination with OB/OD personnel will be required prior to conducting this activity.

4.15.2 Reporting

An annual inspection report will be submitted to ADEM. This report will document the inspections and identify the status of the NEUR and how any deficiencies or inconsistent uses have been addressed. The annual evaluation will address whether the use restrictions and controls referenced previously were communicated in the deed(s), the owners and state and local agencies were notified of the LUCs affecting the property and use of the property has conformed with such restrictions and controls. The report will include a copy of the inspection forms, any violations noted, and recommendations for any changes to the NEUR.

4.15.3 Notices

Notice shall be provided to ADEM in the annual monitoring report regarding any observed changes in use, any identified proposed changes in use, applications for building permits, or proposals for any site work inconsistent with the NEUR. RSA shall notify ADEM in advance of the proposed closing on any sale or other conveyance of any interest in any or all of the Property, in accordance with AAC r. 335-5-.02(3) (ADEM, 2019). If the property is transferred to an owner that is not the federal government, an environmental covenant will be executed and filed at that time in accordance with AAC r. 335-5-1-.02(3)(a)(1)(i) (ADEM, 2019).

5.0 Contingencies

The implementation of corrective measures is based on the best information currently available for RSA-014S. This chapter includes contingency plans to address different situations that could occur as part of this CMI. Any contingencies will be documented and included with the CMI report for the site.

5.1 Excavation Beyond Proposed Boundaries

The soil excavations at RSA-014S will proceed until the CG for TCE has been achieved. If an excavation is required to expand beyond where subsurface removal activities have occurred, a subsurface removal of the area(s) will be conducted prior to additional excavation of contaminated soil in accordance with Section 4.3. The following procedures will be followed for overexcavating sidewalls and floor samples:

- If the sidewall confirmation samples do not achieve the CG, the failing section will be expanded outward a minimum of one bucket width (approximately 3 feet) and resampled. The overexcavation process will continue until the CG has been achieved or further expansion of the excavation would compromise the geomembrane liner within the northern trench feature.
- If floor confirmation sample results do not achieve CG, the excavation will be expanded downward and resampled. Any downward extension of the excavation area will proceed in 1-foot increments (minimum) from the original depth for remediation. This process will proceed until CG has been achieved, the average water table has been reached, or groundwater begins to enter the excavation from the sidewalls or floor.

5.2 Excavation Sidewall Sloping

Although unlikely due to the shallow soil contamination, if APTIM determines that sidewall sloping or benching becomes necessary to achieve the CG in deeper soils, the soils removed for these purposes may be stockpiled separately from other site soils for potential use as backfill. These stockpiles will be sampled for TCE. If the results from this analysis are equal to or below CG, the soil may be used as backfill.

5.3 Excavation of Unknown Utilities

If unknown utilities are discovered or existing utilities are compromised during excavation, work will stop in that portion of the work area until the utilities are identified and either relocated or repaired by the utility company or other appropriate authorities. That evaluation will be performed by the Project Safety Officer in consultation with the Health and Safety Manager and the Army as appropriate. In the unlikely event that the utility impacts the removal of the shallow

TCE-contaminated soil, LUCs may be required for contaminated soils that are left in-place around the existing utility.

5.4 Excavation Dewatering

In the event that standing surface water and storm water inhibit excavation activities in this area of RSA during seasonal flooding, the water will be removed from the construction area by pumping. Storm water controls will be implemented to direct potential run-on away from the site. Water that has not come into contact with contaminated soil will be removed and discharged downgradient of the excavation. The discharged water will be directed through two silt fence barriers, or equivalent, to remove silt/sediment prior to leaving the project site. If the water does come into contact with contaminated soil, it will be pumped into a tank and sampled for disposal characterization. To prevent this contact, plastic sheeting may be used to cover excavated areas and prevent contact between storm water and potentially contaminated soil. Storm water would then be discharged prior to removing the plastic sheeting.

5.5 Saturated Soil Removal

Although unlikely, in the event contaminated soil becomes saturated in an excavation or stockpile area, the Site Manager will initiate measures to ensure that the soil can be prepared for transport and disposal. Those measures may include one or more of the following:

- Create an area within or adjacent to the affected area where excess water is allowed to drain and can then be collected.
- Mix saturated soil with dry soil (i.e., post waste characterization) ex situ prior to disposal.
- As a last resort, add absorbent to ensure no free liquids are present during transportation to the disposal facility.

5.6 Discovery of Subsurface Contaminant Sources

Although no subsurface contaminant sources are expected to be encountered during the RSA-014S excavation activities, subsurface piping, drains, or other undiscovered contaminant sources may be encountered. If any of these subsurface contaminant sources are encountered during the excavation, the feature will be handled in the following manner:

- If free liquid is found within the feature, it will be addressed as follows:
  - Small amounts will be mixed with dry soil from the excavation or an absorbent until no free liquid is visible.
  - Amounts too large for mixing/absorption will be removed, tested, and disposed of as a separate waste stream.

- Abandoned piping, drains, etc., that are within the excavation area will be excavated and staged along with the surrounding soil and disposed of in like manner with the surrounding soil.

- If a conduit extends outside the excavation and that boundary of the excavation has passed the CG, the conduit will be plugged with at least 2 feet of cement grout.

6.0 References

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ATTACHMENT 1

LIST OF ACRONYMS AND ABBREVIATIONS

List of Abbreviations and Acronyms
Redstone Arsenal, Madison County, Alabama

Acronym	Definition
µg/g	micrograms per gram
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
µmhos/cm	micromhos per centimeter
µS/cm	microsiemens per centimeter
$\mu g/m^3$	micrograms per cubic meter
ºC	degrees Celsius
ºF	degrees Fahrenheit
%D	percent difference
%R	percent recovery
1,1,2-TCA	1,1,2-trichloroethane
1,1-DCE	1,1-dichloroethene
1,2-DCE	1,2-Dichloroethene
2,4,5-T	2,4,5-trichlorophenoxyacetic acid
2,4,5-TP	2,4,5-trichlorophenoxypropionic acid
2,4-D	2,4-dichlorophenoxyacetic acid
2-ADNT	2-amino-4,6-dinitrotoluene
4-ADNT	4-amino-2,6-dinitrotoluene
AAC	Alabama Administrative Code
AAFES	Army and Air Force Exchange Service
AAP	Army Ammunition Plant
AB	ambient blank
ABLM	adult blood lead model
ABP	agent breakdown products
ABS	dermal absorption factor
ACAD	AutoCadd
ACGIH	American Conference of Governmental Industrial Hygienists
ACM	asbestos-containing material
ACSIM	Assistant Chief of Staff for Installation Management
ADAF	age-dependent adjustment factor
ADEM	Alabama Department of Environmental Management
ADPH	Alabama Department of Public Health
AEC	U.S. Army Environmental Command
AEDA	ammunition, explosives, and other dangerous articles
AEDB	Army Environmental Database
AEIRG	Alabama Environmental Investigation and Remediation Guidance
AEL	airborne exposure limit
AER	annual effectiveness report
AERMOD	American Meteorology Society/Environmental Protection Agency Regulatory Model
AET	apparent effects threshold
AF	soil-to-skin adherence factor
AFFF	Aqueous Fire Fighting Foam
AFS	air filtration system
AGC	advanced geophysical classification
AGS	Alabama Geographic Society
AHA	ammunition holding area
AHWMMA	Alabama Hazardous Wastes Management and Minimization Act
AIPH	Army Institute of U.S. Public Health
AL	Alabama
ALDOT	Alabama Department of Transportation
ALNHP	Alabama Natural Heritage Program
amb.	amber
AMCOM	U.S. Army Aviation and Missile Command
AMRDEC	Aviation and Missile Research, Development, and Engineering Center
amsl	above mean sea level (1988 North American Vertical Datum, NAVD 88)
ANOVA	Analysis of Variance
AOC	area of concern
AOI	area of investigation
AP	armor piercing
APEC	areas of potential ecological concern
APHC	U.S. Army Public Health Center
APT	armor-piercing tracer
APTIM	Aptim Federal Services, LLC
AR	Army Regulation
AR/COC	analysis request/chain of custody
ARAR	applicable or relevant and appropriate requirement
ARBCA	Alabama Risk-Based Corrective Action
AREE	area requiring environmental evaluation
ARFO	ammunition returned from overseas
Army	U.S. Army
AS	air sparging
ASCII	American Standard Code for Information Interchange
ASP	Ammunition Supply Point
ASR	archives search report
AST	aboveground storage tank
ASTM	American Society for Testing and Materials
ASV	alternative screening value
ASWCC	Alabama Soil and Water Conservation Committee
AT	averaging time; arsenic trichloride
ATF	Bureau of Alcohol, Tobacco, Firearms and Explosives
atm-m^3/mol	atmosphere cubic meters per mole
ATS	alternative treatment standard
ATT	Applied and Technical Training
ATSDR	Agency for Toxic Substances and Disease Registry
ATTN	attention
ATV	all-terrain vehicle
AUF	area use factor
AWARE	Associated Water and Air Resources Engineers, Inc.
AWBC	alternative water balance cover

List of Abbreviations and Acronyms
Redstone Arsenal, Madison County, Alabama

Acronym	Definition
AWQC	ambient water quality criteria
AWQS	ambient water quality standard
B	Analyte detected in laboratory or field blank at concentration greater than the reporting limit (and greater than zero)
BAF	bioaccumulation factor
$BAF_{soil\text{-}to\text{-}invert}$	soil-to-invertebrate bioaccumulation factor
BaOH	barium hydroxide
BAP	benzo(a)pyrene
BCF	bioconcentration factor
BCT	BRAC Cleanup Team
BCY	bank cubic yards
BDCM	bromodichloromethane
BCEE	bis(2-chloroethyl)ether
BEHP	bis(2-ethylhexyl)phthalate
BEM	Buried Explosion Module
BERA	baseline ecological risk assessment
BFB	bromofluorobenzene
BFE	base flood elevation
BFM	bonded fiber matrix
BG	Bacillus globigii
bgs	below ground surface
Bhate	Bhate Environmental Associates, Inc.
BHC	hexachlorocyclohexane
BHHRA	baseline human health risk assessment
BIM	basic information map
BIP	blow(n)-in-place
bkg	background
bls	below land surface
BMP	best management practice
BOD	biological oxygen demand
Bp	soil-to-plant biotransfer factors
BR	bedrock
BR-D	deep bedrock
BRAC	Base Realignment and Closure
BSAF	biota-to-sediment accumulation factors
BSC	background screening criterion
BSCRN	bottom of screen
BSV	background screening value
BTAG	Biological Technical Assistance Group
BTEX	benzene, toluene, ethyl benzene, and xylenes
BTOC	below top of casing
BTV	background threshold value
BW	body weight
BZ	breathing zone
C	ceiling limit value
C&D	Construction & Demolition
Ca	carcinogen
CA	chemical agent; corrective action
CAA	Clean Air Act
CAB	chemical warfare agent breakdown products
CACM	Chemical Agent Contaminated Media
$CaCO_3$	calcium carbonate
CAIS	chemical agent identification set
CalEPA	California Environmental Protection Agency
CAMU	corrective action management unit
CAP	corrective action plan; Contractor Acquired Property
CAR	corrective action request
CARA	Chemical, Biological, Radiological, Nuclear, and High-Yield Explosives (CBRNE) Analytical and Remediation Activity
CAS	Chemical Abstracts Service
CASE	Corrective Action System Effectiveness
CASNO	Chemical Abstract Service identification number
CASRN	Chemical Abstracts Service Registry Number
CB	chlorobenzene
CB&I	CB&I Federal Services LLC
CBC	Chemical and Biological Center
CBFM	collodial borescope flowmeter
CBMPP	construction best management practices plan
CBR	chemical, biological, and radiological
CBRN	chemical, biological, radiological, nuclear
CBRNE	Chemical, Biological, Radiological, Nuclear, and High-Yield Explosives
CBZ	chlorobenzene
CCAL	continuing calibration
CCB	continuing calibration blank
CCC	criterion continuous concentration
CCDC	Combat Capabilities Development Command
CCl_4	carbon tetrachloride
CCV	continuing calibration verification
CD	compact disk; Consent Decree
CDE	Chemical Defense Equipment
CDI	chronic daily intake
CDR	Contract Discrepancy Report
CDTF	Chemical Defense Training Facility
CEHNC	U.S. Army Engineering and Support Center, Huntsville
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERFA	Community Environmental Response Facilitation Act
CESAS	Corps of Engineers South Atlantic Savannah
CF	conversion factor
CFC	chlorofluorocarbon
CFDP	Center for Domestic Preparedness
CFR	Code of Federal Regulations

List of Abbreviations and Acronyms
Redstone Arsenal, Madison County, Alabama

Acronym	Definition
cfs	cubic feet per second
C_{fw}	contaminant concentration in fish from surface water
CG	phosgene (carbonyl chloride); cleanup goal
CGI	combustible gas indicator
ch	inorganic clays of high plasticity
CHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
CIH	Certified Industrial Hygienist
cis-1,2-DCE	cis-1,2-Dichloroethene
CK	cyanogen chloride
Cl	chloride, chlorinated
CLIN	contract line item number
ClO_4^-	perchlorate
CLP	Contract Laboratory Program
CLPILM	EPA CLP's prefix designation for the inorganic metals analysis statement of work
CLP M	EPA CLP's prefix designation for the mercury analysis statement of work
CM	corrective measure
cm	centimeter
cm/hour	centimeters per hour
cm^2	cubic centimeter
cm^2/second	square centimeters per second
cm^3/g	cubic centimeters per gram
CMA	U.S. Army Chemical Materials Activity; corrective measure alternative
CMC	criterion maximum concentration
CMD	corrective measures design
CMI	corrective measures implementation
CMICR	corrective measures implementation completion report
CMIP	corrective measures implementation work plan
CMO	corrective measure objective
CMS	corrective measures study
CMT	Continuous Multichannel Tubing
CN	chloroacetophenone
CNB	chloroacetophenone, benzene, and carbon tetrachloride
CNS	chloroacetophenone, chloropicrin, and chloroform
CO	carbon monoxide
CO_2	carbon dioxide
Co-60	cobalt-60
CoA	Code of Alabama
COAC	chemical of analytical concern
COC	when discussing chemicals, COC means chemical of concern; when discussing field paperwork, COC means chain of custody
COE	Corps of Engineers
COI	constituent of interest
Con	skin or eye contact
COPAC	chemical of potential analytical concern
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
COR	Contracting Officer's Representative
CP	communication plan; Competent Person
CPARS	Contractor Performance Assessment Reporting System
CPFF	cost plus fixed fee
CPOM	coarse particulate organic matter
CPSS	chemicals present in site samples
CPVC	chlorinated polyvinyl chloride
C_{pw}	chemical of potential ecological concern concentration in pore water
CQA	construction quality assurance
CQAP	construction quality assurance plan
CQCSM	Construction Quality Control System Manager
CRA	Conestoga-Rovers and Associates
CRDL	contract-required detection limit
CRL	certified reporting limit
CRP	community relations plan; compliance-related program
CRQL	contract-required quantitation limit
CRSA	Central Redstone Arsenal
CRZ	contamination reduction zone
CS	ortho-chlorobenzylidene-malononitrile
CSA	confirmation sampling activities
CSDWP	Comprehensive Site-Specific Demolition Work Plan
C_{sed}	chemical of potential ecological concern concentration in sediment from groundwater
CSEM	conceptual site exposure model
CSM	conceptual site model
CSP	chemical site plan
CSP	corrugated steel pipe
CSS	chemical safety submission
SCWGP	Construction Stormwater General Permit
CT	carbon tetrachloride
CTC	cost to completion
ctr.	container
CVAA	2-chlorovinylarsenous acid
C_w	contaminant concentration in water
CWA	when discussing chemicals, CWA means chemical warfare agent; when discussing laws, CWA means Clean Water Act
CWM	If used in the text of a document this acronym means chemical warfare materiel; if used in an analytical table which summarizes container requirements, this acronym means clear, widemouth container
CWS	Chemical Warfare Service
CX	dichloroformoxime
D	duplicate; duplicate contamination; when used as a validation qualifier, D means dilution
D2PC	Personal Computer Program for Chemical Hazard Prediction
DAD	average dermally absorbed dose
DAVS	detector-aided visual survey
D&I	detection and identification

List of Abbreviations and Acronyms
Redstone Arsenal, Madison County, Alabama

Acronym	Definition
DA	Department of the Army; diphenylchloroarsine
DA PAM	Department of the Army Pamphlet
DAAMS	Depot Area Air Monitoring System
DA_{event}	dermal dose absorbed per event
DAF	dilution-attenuation factor
DAF4	dilution-attenuation factor 4
DANC	decontamination agent, non-corrosive
DAP	diammonium phosphate
DASAF	Department of the Army Safety Office
DAVS	detector-aided visual survey
DBA	dibenz(a,h)anthracene
DBCP	1,2-dibromo-3-chloropropane
DBX	depth bomb explosive
DC	District of Columbia
DCA	dichloroethane
DCB	decachlorobiphenyl
DCE	dichloroethene
DCMA	Defense Contract Management Agency
DCQAP	data collection quality assurance plan
DD	Decision Document
DD	Department of Defense (form only)
DDD	dichlorodiphenyldichloroethane (this is an industry standard acronym for this chemical)
DDE	dichlorodiphenyldichloroethene (this is an industry standard acronym for this chemical)
DDESB	Department of Defense Explosives Safety Board
DDT	dichlorodiphenyltrichloroethane
DEH	Directorate of Engineering and Housing
DEHP	bis(2-ethylhexyl)phthalate
DEMIL	Demilitarization Areas
DEP	depositional soil
DERP	Defense Environmental Restoration Program
DES	Directorate of Environment and Safety
DF	dilution factor
DFTPP	decafluorotriphenylphosphine
DFOW	Definable Feature of Work
DGM	digital geophysical mapping
DHC	*Dehalococcoides* sp.
DI	deionized
DID	data item description
DIMP	di-isopropylmethylphosphonate
DL	detection limit
DLA	Defense Logistics Agency
DM	adamsite
DMBA	dimethylbenz(a)anthracene
DMM	discarded military munitions
DMMP	dimethylmethylphosphonate
DNAPL	dense nonaqueous-phase liquid
DNB	dinitrobenzene
DNBZ	dinitrobenzene
DNOC	4,6-dinitro-2-methylphenol
DNT	dinitrotoluene
DO	dissolved oxygen
DoD	U.S. Department of Defense
DODI	Department of Defense Instruction
DOJ	U.S. Department of Justice
DOT	U.S. Department of Transportation
DP	direct-push
DPDO	Defense Property Disposal Office
DPT	direct-push technology
DQCR	Daily Quality Control Report
DQO	data quality objective
DRMO	Defense Reutilization and Marketing Office
DRO	diesel range organics
DS	deep (subsurface) soil
DS2	Decontamination Solution Number 2
DSERTS	Defense Site Environmental Restoration Tracking System
DSMOA	Defense and State Memorandum of Agreement
DSN	Defense Switched Network
DSR	demolition and site restoration
DSS	data sufficiency summary
DTSC	Department of Toxic Substances Control
DU	decision unit
DUA	data usability assessment
DVD	digital versatile disc or digital video disc
DWEL	drinking water equivalent level
e.g.	for example
E3	Electromagnetic Environmental Effects
EB	equipment blank
EBS	environmental baseline study
EC_{20}	effects concentration for 20 percent of a test population
EC_{50}	effects concentration for 50 percent of a test population
EC	Emergency Coordinator
ECBC	Edgewood Chemical and Biological Center
Eco-RGRG	ecological risk-based remedial goal
Eco-SSL	ecological soil screening level
ECM	earth covered magazine
ED	exposure duration
EDD	electronic data deliverable
EDQL	ecological data quality level
EDS	explosive destruction system

List of Abbreviations and Acronyms
Redstone Arsenal, Madison County, Alabama

Acronym	Definition
EDTA	ethylenediaminetetracetic acid
EE/CA	engineering evaluation and cost analysis
EEL	estimated exposure level
EF	exposure frequency
EFR	enhanced fluid recovery
Eh	oxidation-reduction potential
ELAP	Environmental Laboratory Accreditation Program
Elev.	elevation
EM(1)	electromagnetic
EM(2)	Engineer Manual
EM31	Geonics Limited EM31 Terrain Conductivity Meter
EM61	Geonics Limited EM61 High-Resolution Metal Detector
EMI	electromagnetic induction
Empirical	Empirical Laboratories, LLC
EMSI/EL	Environmental Management Services, Inc./Environmental Laboratories
EMT	emergency medical technician
EOC	Emergency Operation Center
EOD	explosive ordnance disposal
EODT	explosive ordnance disposal team; EOD Technology, Inc.
EP	exit pathway
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
EPDS	Emergency Personnel Decontamination Station
EPIC	Environmental Photographic Interpretation Center
EPP	Environmental Protection Plan
EPRI	Electrical Power Research Institute
EPT	Ephemeroptera, Plecoptera, Trichoptera
EQ	EQ Environmental Quality Company
EQL	estimated quantitation limit
ER	equipment rinsate; USACE Engineer Regulation
ERA	ecological risk assessment
ERH	electrical resistive heating
ERIS	Environmental Restoration Information System
ER-L	effects range-low
ER-M	effects range-medium
ERMA	Environmental Remediation Services Multiple Award
ES	exposed site
ESA	ecologically sensitive area
ESB	Equilibrium Partitioning Sediment Benchmark
ESE	Environmental Science and Engineering, Inc.
ESL	ecological screening level
ESP	explosives site plan
ESMP	Endangered Species Management Plan; Explosives Safety Management Program
ESS	explosives safety submission
ESTCP	Environmental Security Technology Certification Program
ESV	ecological screening value
ET	exposure time
ET_{sw}	exposure time - surface water
EU	exposure unit
EUR	Environmental Use Restriction
EV	event frequency
E-W	east to west
Excel	Excel Geophysical Services
Exp.	Explosives
ExplorTech	ExplorTech, LLC
EXTOXNET	Extension Toxicology Network
Ey	Etowah silty clay loam
EZ	exclusion zone
FA	focus area
FA	fraction absorbed
FAC	facultative wetland
FACU	facultative upland
FACW	facultative wetland
FADL	Field Activity Daily Log
FAE	fuel-air explosive
FAR	Federal Acquisition Regulations
FAV	final acute value
FB	field blank
FBI	Family Biotic Index
FCM	food chain multiplier
FCSV	food chain screening value
FCV	final chronic value
FD	field duplicate
FDA	U.S. Food and Drug Administration
Fe^{+2}	ferrous iron
Fe^{+3}	ferric iron
FEC	fluid electrical conductivity
FedEx	Federal Express, Inc.
FEMA	Federal Emergency Management Agency
FFA	Federal Facilities Agreement
FFCA	Federal Facilities Compliance Act
FFE	field flame expedient
FFP	firm fixed price
FFS	focused feasibility study
FI	fraction of exposure; filtered
FID	flame ionization detector
FIFRA	Federal Insecticide, Fungicide, & Rodenticide Act
FLUTe	Flexible Liner Underground Technologies, Ltd. Co.
FM-ARNGTC	Fort McClellan Army National Guard Training Center

Acronym	Definition
FMDC	Fort McClellan Development Commission
FML	flexible membrane liner
f_{oc}	fraction organic carbon
FOIA	Freedom Of Information Act
FOMRA	Former Ordnance Motor Repair Area
FOST	Finding of Suitability to Transfer
Foster Wheeler	Foster Wheeler Environmental Corporation
FR	Federal Register
Frtn	fraction
FS	feasibility study
FSH	Fort Sam Houston
FSP	field sampling plan
FS smoke	sulfur trioxide and chlorosulfonic acid
ft	foot, feet
ft/day	feet per day
ft/ft	feet per foot
ft/yr	feet per year
ft^2	square feet
ft^2/day	square feet per day
FTA	Fire Training Area
FUP	fixed unit price
FWV	fieldwork variance
FY	fiscal year
g	gram
G&M	Geraghty and Miller, Inc.
g/cm^3	grams per cubic centimeter
g/m^2	grams per square meter
g/m^3	gram per cubic meter
G-856	Geometrics, Inc. G-856 magnetometer
G-858G	Geometrics, Inc. G-858G magnetic gradiometer
GA	tabun
GAC	granular activated carbon
GAF	General Aniline and Film; gastrointestinal absorption factor
gal	gallon
gal/min	gallons per minute
GB	sarin (isopropyl methylphosphonofluoridate)
GC	gas chromatograph
GC/MS	gas chromatograph/mass spectrometer
GCL	geosynthetic clay liner
GCMR	Geophysical Classification for Munitions Response
GCWD	Gulf Chemical Warfare Depot
GCWS	Gulf Chemical Warfare Service
GEAE	Generic Ecological Assessment Endpoint
GED	General Equivalency Diploma
GEDIT	gaseous electron donor injection technology
GFAA	graphite furnace atomic absorption
GIP	geophysical investigation plan
GIS	geographic information system
GNSS	Global Navigation Satellite System
GPCR	gas phase chemical reduction
gpm	gallons per minute
GPR	ground-penetrating radar
GPS	global positioning system
GRA	general response action
GRIM	Groundwater Responsibility Information Matrix
GRO	gasoline range organics
GS	ground scar
GSA	when discusing the federal government requirements, GSA means General Services Administration; when discussing geology, GSA means Geologic Survey of Alabama
GSE	Great Southern Engineering
GSR	green and sustainable remediation
GST	ground stain
GSV	geophysical systems verification
GUC	groundwater use control
GW	groundwater
GWDT	Groundwater Design Team
GWMZ	groundwater monitoring well, multizone
GWTR	groundwater monitoring well
H&S	health and safety
H_2O_2	hydrogen peroxide
H_2S	hydrogen sulfide
HA	hand auger; hazard assessment
HAL	Health Advisory level
HAMUST56	Huntsville Arsenal Mustard Plant 2, Lines 5 & 6
Harmon	Harmon Engineering Associates, Inc.
HAZMATCAD™	Hazardous Material Chemical Agent Detector
HAZWOPER	Hazardous Waste Operations and Emergency Response
HBESL	health-based environmental screening level
HC	mixture of hexachloroethane, aluminum powder, and zinc oxide (smoke producer)
HCE	hexchloroethane
HCl	hydrochloric acid
HD	distilled mustard (bis-[dichloroethyl]sulfide); hazard division
HDPE	high-density polyethylene
HE	high explosive
HEAST	Health Effects Assessment Summary Tables
HEAT	High Explosive Anti-Tank
HEPA	high-efficiency particulate air
HEGA	high-efficiency gas absorber

Acronym	Definition
Herb.	herbicides
HFD	hazardous fragment distance
HHAWQS	human health Alabama water quality standard
HHRA	human health risk assessment
HHRE	human health risk evaluation
HI	hazard index
HI_{COC}	total hazard index for a given relevant COC, for a given receptor added across all exposure routes for given source medium
Hi_{cum}	cumulative hazard index summed across chemicals and source media
HI_{TO}	total hazard index for a given target organ for a given receptor
Hm	hot measurement
HMW	high molecular weight
HMX	cyclotetramethylenetetranitramine; octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocane
HN	hydrogen mustard
HNC	hydrogen cyanide
HNO_3	nitric acid
HP	hydropunch
HPLC	high-performance liquid chromatography
HQ	hazard quotient
HQ_{COCi}	hazard quotient for the target organ of interest estimated for the ith COC
$'HQ_i$	hazard index for a given chemical summed across exposure routes and source media
$'HQ_{Ri}$	hazard quotient for the given chemical for exposure route i
HQ_{screen}	screening-level hazard quotient
hr	hour
HRR	Historical Records Review
HS	mustard
HSA	hollow-stem auger
HSB	Huntsville Spring Branch
HSDB	Hazardous Substances Data Bank
HSF	historic site feature
HSMR	Huntsville Spring Branch at Martin Road
HT	British Mustard
HTPB	hydroxy-terminated polybutadiene
HTRW	hazardous, toxic, and radioactive waste
HTW	hazardous and toxic waste
HUB	Historically Underutilized Business
HWCL	hazardous waste control limit
HWSA	Hazardous Waste Storage Area
HWSU	hazardous waste storage unit
HY	hydrostratigraphic unit
HYPN	hydropunch
Hz	hertz
I	out of control, data rejected due to low recovery
I-565	Interstate 565
IAP	Installation Action Plan
IATA	International Air Transport Authority
I-AVSS	instrument-aided visual surface sweep
IC	Incident Commander
ICAL	initial calibration
ICAM	improved chemical agent monitor
ICB	initial calibration blank
ICP	inductively coupled plasma
ICS	interference check sample
ICV	initial calibration verification
ID	identification; inside diameter
IDL	instrument detection limit
IDLH	immediately dangerous to life or health
IDM	investigative-derived media
IDQTF	Intergovernmental Data Quality Task Force
IDS	intrusion detection system
IDW	investigation-derived waste; investigative-derived waste
i.e.	that is (in other words)
IELCR	individual excess lifetime cancer risk
$IELCR_{coc}$	total individual excess lifetime cancer risk for a given relevant chemical of concern, for a given receptor added across all exposure routes for a given source medium
$'IELCR_{Cum}$	cumulative cancer risk for a given receptor summed across chemicals and source media
$'IELCR_{Ri}$	cancer risk for the given chemical in a given source medium for exposure route i
$'IELCR_T$	total cancer risk for the given chemical in a given source medium summed across exposure routes
$IELCR_{(Ti)}$	total cancer risk for chemical i in a given source medium summed across exposure routes
IEOC	Installation Emergency Operations Center
IERC	Installation Environmental Response Coordinator
IEUBK	Integrated Exposure Uptake Biokinetic
IF	ingestion factor; inhalation factor
IHF	interim holding facility
IIP	intrusive investigation plan
ILCR	incremental lifetime cancer risk
ILM	EPA CLP's prefix designation for the inorganic metals analysis statement of work for EPA contract laboratory program
IM	interim measure; isobutyl methacrylate
IMO	interim measure objective
IMU	inertial measurement unit
IM-AE	isobutyl methacrylate polymer AE
IMPA	isopropylmethyl phosphonic acid
in.	inch
Inc.	Incorporated
Ing	ingestion
Inh	inhalation
INT	interface
IOSC	Installation On-Scene Coordinator

List of Abbreviations and Acronyms
Redstone Arsenal, Madison County, Alabama

Acronym	Definition
IOU	integrator operable unit
IP	ionization potential
IPS	International Pipe Standard
IR	ingestion rate
IRAO	interim remedial action objective
IRAP-h	Industrial Risk Assessment Program-Human Health
IRDMIS	Installation Restoration Data Management Information System
IR_f	fish ingestion rate
'IR_{sw}	ingestion rate
IRFNA	inhibited red fuming nitric acid
IRIS	Integrated Risk Information System
IROD	interim record of decision
IRP	Installation Restoration Program
IRSL	industrial regional screening level
IS	incremental sampling
ISAB	in situ anaerobic bioremediation
ISBN	International Standard Book Number
ISCO	in situ chemical oxidation
ISCR	in situ chemical reduction
ISEB	in situ enhanced bioremediation
ISL	initial screening level
ISO	industry standard object
ISSC	Installation Support Services Contractor
ISTD	in situ thermal destruction
ISTT	in situ thermal treatment
IT	IT Corporation
ITEMS	IT Environmental Management System^{TM}
ITRC	Interstate Technology and Regulatory Council
IV	intervention value
IVS	instrument verification strip
IW	installation-wide
IWGW	installation-wide groundwater
IWGWMP	Installation-Wide Groundwater Monitoring Program
IWWP	installation-wide work plan
J	estimated concentration
J&E	Johnson and Ettinger
JD	jurisdictional determination
JOR	job order request
K	conductivity
KAPSDIDS	Kinetically Adjustable Pore Spaace Dilation Injection Delivery System
K_d	soil-water distribution coefficient
Kd_{bs}	bed sediment-sediment pore water partition coefficient
KeV	kilo electron volt
kg	kilogram
kg/m^3	kilograms per cubic meter
$KMnO_4$	potassium permanganate
KO	Contracting Officer
K_{oc}	organic carbon partioning coefficient
K_{ow}	octanol-water partition coefficient
K_p	permeability coefficient
kPa	kilopascal
kVA	kilovolt-ampere
L	if used as part of the units of measure, the acronym stands for "liter", if used as a chemical name, this acronym stands for lewisite
L/cm^3	liters per cubic centimeter
L/day	liters per day
L/kg/day	liters per kilogram per day
LANL	Los Alamos National Laboratory
lb	pound
LBP	lead-based paint
lbs/year	pounds per year
LC	liquid chromatography
LC_{50}	lethal concentration for 50 percent population tested
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LD_{50}	lethal dose for 50 percent population tested
LDD	lost, damage, or destruction
LEL	lower explosive limit
LF	Leaching Factor
LGAC	liquid-phase granular activated carbon
LiDAR	Light Detection and Ranging
LL	low level
LLC	limited liability company
LNAPL	light nonaqueous-phase liquid
LOAEL	lowest-observed-adverse-effects level
LOD	limit of detection
LOEC	lowest-observable-effect-concentration
LOQ	limit of quantitation
LSA	limited site assessment
LSV	leachate screening value
LTO	long-term operation
LTM	long-term management
LTV	leachate threshold value
LUC	land-use control
LUCAP	land-use control assurance plan
LUCER	land-use control effectiveness report
LUCIP	land-use control implementation plan
LWSV	liquid waste screening value

List of Abbreviations and Acronyms
Redstone Arsenal, Madison County, Alabama

Acronym	Definition
m	meter
m/year	meters per year
m/yr	meters per year
m/second	meters per second
m^3/hour	cubic meters per hour
m^3/kg	cubic meters per kilogram
MACOM	Major Command
MADEP	Massachusetts Department of Environmental Protection
MADL	minimum analytical detection limit
MAG	monitoring acceptance goal
MARB	Munitions Assessment Review Board
max	maximum
MB	method blank
MC	munitions constituents
MCDZ	McDonald Creek discharge zone
MCE	Maximum Credible Event
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MCPA	4-chloro-2-methylphenoxyacetic acid
MCPP	2-(2-methyl-4-chlorophenoxy)propionic acid
MCS	media cleanup standard
MD	munitions debris; Mahalanobis Distance
MDAS	Material Documented as Safe
MDC	maximum detected concentration
MDCC	maximum detected constituent concentration
MDEH	Material Documented as an Explosive Hazard
MDL	method detection limit
MEA	monoethanolamine
MEC	munitions and explosives of concern
MEE	methane, ethane, and ethene
MEP	Multiple Extraction Procedure
MeV	mega electron volt
MFD	maximum fragment distance
Mfp	Mississippian Fort Payne
mg	milligrams
mg/cm^2	milligrams per square centimeter
mg/cm^2/day	milligrams per square centimeter per day
mg/cm^2/event	milligrams per square centimeter per event
mg/day	milligrams per day
mg/kg	milligrams per kilogram
mg/kg-day	milligram per kilogram day
mg/kgbw/day	milligrams per kilogram of body weight per day
mg/L	milligrams per liter
mg/m^3	milligrams per cubic meter
mgal	million gallons
MGFD	munition with the greatest fragmentation distance
mh	highly plastic, inorganic silts, micaceous or diatomaceous fine, sandy or silt soils
MHz	megahertz
MI	multi-incremental
MICC	Mission & Installation Contracting Command
MIDAS	Munitions Items Desposition Action System
MiHPT	Membrane Interface Hydraulic Profile Tooling
min	minimum
MIMS	Munitions Information Management System
MINICAMS	miniature continuous air monitoring system
MIS	Management Information System; multiple incremental samples
mL	milliliter
mm	millimeter
MMAS	Mobile Munitions Assessment Systems
MMBtu/hr	million Btu per hour
MMCS	Missile and Munitions Command School
MM-CX	Military Munitions Center of Expertise
MMOA	mutagenic mode of action
MMRP	Military Munitions Response Program
Mn^{+4}	manganese
MNA	monitored natural attenuation
MnO_4-	permanganate ion
MNR	monitored natural recovery
MOA	Memorandum of Agreement
MOCA	4,4-methylene-bis(2-chloroaniline)
MOGAS	motor vehicle gasoline
MOUT	Military Operations in Urban Terrain
MP	Military Police
MPA	methyl phosphonic acid
MPC	maximum permissible concentration; measurement performance criteria
MPM	most probable munition
MPPEH	Material Potentially Presenting an Explosive Hazard
MPR	4.2-Inch Mortar Proofing Range
MPVE	multiphase vapor extraction
MQL	method quantitation limit
MQO	measurement quality objective
MR	molasses residue; munitions response
MRA	munitions response area
MRC	multiple round container
MRL	method reporting limit
MRL	minimal risk level
MRR	Materials Receiving Report
MRS	Munitions Response Site

List of Abbreviations and Acronyms
Redstone Arsenal, Madison County, Alabama

Acronym	Definition
MRSPP	Munitions Response Site Prioritization Protocol
MS	matrix spike
mS/cm	millisiemens per centimeter
mS/m	millisiemens per meter
MS/MSD	matrix spike/matrix spike duplicate
MSD	when discussing laboratory QC, MSD means matrix spike duplicate; when discussing explosives, MSD means minimum separation distance
MSFC	George C. Marshall Space Flight Center
msl	mean sea level
Mt	Mississippian Tuscumbia Limestone
MTBE	methyl tertiary butyl ether
M&TE	measurement and test equipment
mV	millivolts
MW	monitoring well
Na	sodium
N/A	not applicable
NA	not applicable
NAD	North American Datum
NAD83	North American Datum of 1983
$NaMnO_4$	sodium permanganate
NAPL	nonaqueous-phase liquid
NAS	National Academy of Sciences
NASA	National Aeronautics and Space Administration
NAVD 88	North American Vertical Datum, 1988 adjustment
NAVD88	North American Vertical Datum of 1988
NB	nitrobenzene
NBA	Northern Burial Area
NCEA	National Center for Environmental Assessment
NCP	National Contingency Plan
NCR	nonconformance report
NCRP	National Council on Radiation Protection and Measurements
ND	not detected
NDA	Northern Disposal Area
NDMA	n-nitrosodimethylamine
NDPA	n-nitroso-di-n-propylamine
NE	northeast
NELAP	National Environmental Laboratory Accreditation Program
NEPA	National Environmental Protection Act
NEW	net explosive weight
NFA	no further action
NFG	National Functional Guidelines
NFPA	National Fire Protection Agency
NG	National Guard
ng/L	nanograms per liter
NGB	National Guard Bureau
NGP	National Guardsperson
NGVD	National Geodetic Vertical Datum
Ni	nickel
NIC	notice of intended change
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NJDEP	New Jersey Department of Protection
NLM	National Library of Medicine
NLT	no later than
NMEA	National Marine Electronics Association
No.	number
NO_3^-	nitrate
NOAA	National Oceanic and Atmospheric Administration
NOAEL	no-observed-adverse-effects level
NOEC	no-observable-effect concentration
NONEL	non-electric
NOI	Notice of Intent
NOT	Notice of Termination
NP	nitropropyl
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPW	net present worth
NR	not requested
NRC	National Research Council
NRCC	National Research Council of Canada
NRHP	National Register of Historic Places
NRL	Naval Research Laboratory
NRT	near real time
ns	nanosecond
NS	not surveyed
N-S	north to south
NSA	New South Associates, Inc.
NT	nitrotoluene
nT	nanotesla
nT/m	nanoteslas per meter
NTCRA	Non-Time Critical Removal Action
NTIS	National Technical Information Service
NTP	National Toxicology Program
NTU	nephelometric turbidity unit
nv	not validated
NY DOH	New York State Department of Health
O&G	oil and grease
O&M	operation and maintenance
O_2	oxygen

List of Abbreviations and Acronyms
Redstone Arsenal, Madison County, Alabama

Acronym	Definition
O_3	ozone
OB/OD	open burn/open detonation
OBL	obligate
OCDD	octachlorodibenzo-p-dioxin
OD	outside diameter; other (nonmunitions) debris
OE	ordnance and explosives
OEC	Ordnance Explosives Center
OEHHA	Office of Environmental Health Hazard Assessment (of the California Environmental Protection Agency)
OESS	Ordnance and Explosives Safety Specialist
OGMS	Ordnance Guided Missile School
oh	organic clays of medium to high plasticity
OH·	hydroxyl radical
ol	organic silts and organic silty clays of low plasticity
OMEMS	Ordnance Munitions and Electronic Maintenance School
OP	organophosphorus; organochlorine pesticide
ORA	Operational Range Assessment
ORAP	Operational Range Assessment Program
Ord	Ordovician
ORP	oxidation-reduction potential
OSA	Open Storage Area
OSC	On-Scene Coordinator
OSD	overage/shortage/damage
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
OVA	organic vapor analyzer
OVB	overburden
OVB-S	shallow overburden
OVM	organic vapor monitoring
OVM-PID/FID	organic vapor meter-photoionization detector/flame ionization detector
OWS	oil/water separator
oz	ounce
P&T	pump and treat
PA	preliminary assessment; probability assessment
PA3	Plant Area 3, Incendiaries Manufacturing
PAED	Public Access Exclusion Distance
PAH	polynuclear aromatic hydrocarbon
PAL	preliminary action level
PARCCS	precision, accuracy, representativeness, comparability, completeness, and sensitivity
Parsons	Parsons Engineering Science, Inc.
Pb	lead
PBAA	polybutadiene acrylic acid
PBAN	polybutadiene/acrylic acid/acrylonitrile
PBC	performance-based contract
PBMS	performance-based measurement system
PC	permeability coefficient
PCA	tetrachloroethane
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo-p-dioxins
PCDF	polychlorinated dibenzofurans
PCE	tetrachloroethene
PCHL	2,3,4,5-6-pentachlorocyclohexanol
PCMIA	Personal Computer Memory Card International Association
PCP	pentachlorophenol
PCR	polymerase chain reaction
PCWM	Potential Chemical Warfare Materiel
PD	phenyldichloroarsine
PDA	Personal Digital Assistant
PDB	polyethylene diffusive bag sampler
PDF	Portable Document Format
PDS	Personnel Decontamination System; post-digestive spike
PDT	Project Delivery Team
PEC	probable effect concentration
PEF	particulate emission factor
PEL	permissible exposure limit
PELA	P.E. LaMoreaux and Associates, Inc.
PERA	preliminary ecological risk assessment
PERC	perchloroethene
PES	potential explosive site
Pest.	pesticides
PETN	pentaerythritol tetranitrate
PFAS	polyfluoroalkyl substance
PFO	palustrine forested wetland
PFOA	perfluorooctanoic acid
PFOS	perfluorooctyl sulfonate
PFT	portable flamethrower
PG	professional geologist
pg/g	picograms per gram
PgM	program manager
pH	measure of acidity/alkalinity; hydrogen ion activity (negative of the logarithm, base 10)
PHC	principal hazardous constituent
PID	photoionization detector
PIEZ	piezometer
PINS	portable isotopic neutron microscopy
PK	packer
PLS	Professional Land Surveyor
PLS	Professional (licensed) Land Surveyor
PM	project manager
PMC	Program Management Contract

List of Abbreviations and Acronyms
Redstone Arsenal, Madison County, Alabama

Acronym	Definition
PNMSCM	Product Manager for Non-Stockpile Chemical Materiel
PMP	Project Management Plan
PMTP	Program Management Team Plan
POC	point of contact
POL	petroleum, oils, and lubricants
POTW	publicly owned treatment works
POW	prisoner of war; palustrine open water
Powell	John Powell Chemical Company
PP	Proposed Plan
ppb	parts per billion
ppbv	parts per billion by volume
PPE	personal protective equipment
ppm	parts per million
ppmw	parts per million by weight
PPMP	Print Plant Motor Pool
PPRTV	provisional peer-reviewed toxicity values
ppt	parts per trillion
ppT	parts per thousand
PQL	practical quantitation limit
PR	potential risk
PRA	preliminary risk assessment
PRE	preliminary risk evaluation
PRG	preliminary remediation goal
PRO	petroleum range organics
PS	chloropicrin
PSA	potential source area
PSL	preliminary screening level
PSS	palustrine scrub shrub
PSSC	potential site-specific chemical
PSV	preliminary screening value
pt	peat or other highly organic silts
PT1	an incendiary mixture in munitions
PTFE	Polytetrafluoroethylene (Teflon)
PTMP	program team management plan
PTSM	principal threat source material
PVC	polyvinyl chloride
PWS	performance work statement
PZ	piezometer
QA	quality assurance
QA/QC	quality assurance/quality control
QAM	quality assurance manual
QAO	quality assurance officer
QAPP	quality assurance project plan
QASAS	Quality Assurance Specialist Ammunition Surveillance
QASP	Quality Assurance Surveillance Plan
QC	quality control
QCP	quality control plan
QCSM	Quality Control Site Manager
QCSR	quality control summary report
Q-D	quantity-distance
QL	quantitation limit
QP	Qualified Person
Q-Q	quantile-quantile
QSAR	quantitative structure-activity relationship
QSM	quality systems manual
QST	QST Environmental, Inc.
qty	quantity
Qual	qualifier
QuickSilver	QuickSilver Analytics, Inc.
R	when used as a validation qualifier, R means rejected; when used as a lab qualifier, R means resample; when used in text, R means retardation factor
R&A	relevant and appropriate
R^2	coefficient of determination
RA	remedial action
RAGS	Risk Assessment Guidance for Superfund
RA(O)	remedial action (operations)
RAO	remedial action objective
RAP	recommended action plan
RAR	remedial action report
RARE	Redstone Arsenal Rocket Engine
RASA	Redstone Arsenal Support Activity
RAWP	remedial action work plan
Raytheon	Raytheon Company
RBA	relative bioavailability
RBC	risk-based concentration
RBP	Rapid Bioassessment Protocol
RBRG	risk-based remedial goal
RBSC	risk-based screening concentration
$RBSC_I$	risk-based screening concentration for industrial soil
$RBSC_R$	risk-based screening concentration for residential soil
$RBSC_T$	risk-based screening concentration for tap water
RBTL	risk-based target level
$RBTL_{coc}$	risk-based target level for a given relevant COC, receptor, and source medium
RC	representative concentration; response complete
RC_{coc}	representative concentration of the relevant COC in the given medium
RCA	root cause analysis
RCMD	Recovered Chemical Materiel Directorate
RCRA	Resource Conservation and Recovery Act

List of Abbreviations and Acronyms
Redstone Arsenal, Madison County, Alabama

Acronym	Definition
RCRA CA	Resource Conservation and Recovery Act Corrective Action
RCWM	Recovered Chemical Warfare Materiel
RD	remedial design
RDECOM	U.S. Army Research, Development, and Engineering Command
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine; cyclotrimethylenetrinitramine; 1,3,5-trinitro-1,3,5-triazine (cyclonite); Royal Demolition Explosive
REAT	Regional Environmental Acquisition Tools
REC	Record of Environmental Consideration
REG	regular field sample
REL	recommended exposure limit; reference exposure level
RER	Record of Environmental Review
Rev	Revision
RF	response factor
RFA	request for analysis
RfC	reference concentration
RfD	reference dose
RFI	RCRA facility investigation
RFQ	request for quotation
RG	remedial goal
RGO	remedial goal option
RI	remedial investigation
RIP	remedy in place
RL	reporting limit
RM	risk management
RM-1	Risk Management-1
RM-2	Risk Management 2
RME	reasonable maximum exposure
RMP	risk management plan
Ro	Robertsville silt loam
ROD	Record of Decision
ROF	report of findings
ROI	radius of influence
ROP	Redstone Ordnance Plant
ROPS	roll over protection system
RPD	relative percent difference
RR	range residue
RRF	relative response factor
RRSE	Relative Risk Site Evaluation
RRSL	residential regional screening level
RS	prefix for groundwater monitoring well at Redstone Arsenal
RSA	Redstone Arsenal
RSD	relative standard deviation
RSL	Regional Screening Level
RSP	Redstone Arsenal spring
RTAP	Real-Time Analytical Platform
RTC	Redstone Test Center
RTECS	Registry of Toxic Effects of Chemical Substances
RTK	real-time kinematic
RTO	regenerative thermal oxidizer
RTOP	Request for Task Order Proposal
RTS	robotic total station
RTTC	Redstone Technical Test Center
Rust	Rust Environment and Infrastructure, Inc.
s/n	signal-to-noise ratio
SA	exposed skin surface area; source area
SAA	satellite accumulation area
SAC	site access control
SACIMS	Site Access Control Information Management System
SACP	Site Access Control Plan
SAD	South Atlantic Division
SAE	Society of Automotive Engineers
SAIC	Science Applications International Corporation
SAP	sampling and analysis plan
SAR	structure-activity relationship
SARA	Superfund Amendments and Reauthorization Act
SB	soil boring
SC	specific conductance
SCG	storage compatibility group
SCBA	self-contained breathing apparatus
Sch.	schedule
SCM	site conceptual model
SD	sediment
SDG	sample delivery group
SDS	safety data sheet
SDSW	sediment/surface water
SDWA	Safe Drinking Water Act
SDZ	surface danger zone
SED	Software Engineering Directorate
SEE	steam enhanced extraction
SF	cancer slope factor
SFSP	site-specific field sampling plan
SGF	standard grade fuels
Shaw	Shaw Environmental, Inc.
SHP	safety and health plan
SI	site inspection
SIC	sulfur-impregnated carbon
Sil	Silurian
SIM	Selective Ion Monitoring
SIR	secondary investigation report
SL	standing liquid

List of Abbreviations and Acronyms
Redstone Arsenal, Madison County, Alabama

Acronym	Definition
SLERA	screening-level ecological risk assessment
SLERAP	screening-level ecological risk assessment protocol
SM	sulfur monochloride
SMDP	Scientific Management Decision Point
SMF	smoke munitions filling
SMF 3	Smoke Munitions Filling Plant 3
SMP	site management plan
SNR	signal-to-noise ratio
SO_4	sulfate
SOD	soil oxidant demand
SOP	standard operating procedure
SOPP	standard operating project procedure
SP	submersible pump
SPA	single point anomaly
SPCC	system performance calibration compound
SPCS	State Plane Coordinate System
SPLP	synthetic precipitation leaching procedure
SPM	sample planning module
SPRG	spring
SQG	sediment quality guideline
SQRT	screening quick reference tables
SRA	streamlined human health risk assessment; saturated response area
SRB	sulfate-reducing bacteria
SRI	supplemental remedial investigation
SRM	standard reference material
SS	surface soil
SSC	site-specific chemical
SSHO	site safety and health officer
SSHP	site-specific safety and health plan
SSL	soil screening level
SSSL	site-specific screening level
SSTL	site-specific target level
SSPA	site-specific probability assessment
STB	supertropical bleach; site to background
STC	source-term concentration
STD	standard deviation
Std. units	standard units
STEL	short-term exposure limit
STP	sewage treatment plant
STL	Severn-Trent Laboratories
STT	sludge thickener tank
SU	sampling unit when used in a grid for incremental sampling; when used as a unit for pH, this acronym stands for standard unit
SUXOS	senior UXO supervisor
SV	screening value
SVE	soil vapor extraction
SVOC	semivolatile organic compound
SW-846	U.S. EPA's *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*
SW	surface water
SWCC	State of Alabama Soil and Water Conservation Committee
SWMU	solid waste management unit
SWTR	surface water
SZ	support zone
TA	test area
TAL	target analyte list
TAT	turn around time
TB	trip blank
TBC	to be considered
TBD	to be determined
TC	toxicity characteristic
TCA	trichloroethane
TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TCDF	tetrachlorodibenzofurans
TCE	trichloroethene
TCH	thermal conductive heating
TCL	target compound list
TCLP	toxicity characteristic leaching procedure
TCMX	tetrachloro-m-xylene
TCRA	time critical removal action
TDGCL	thiodiglycol
TDGCLA	thiodiglycol chloroacetic acid
TDS	total dissolved solids
TEA	triethylaluminum
TEC	threshold effect concentration
TeCA	1,1,2,2-tetrachloroethane
TEF	toxicity equivalency factor
TEGDN	triethylene glycol dinitrate
TEGN	triethylene glycoldinitrate
TEMP	temperature
TEMTADS	Time-Domain Electromagnetic Multisensor Tower Array Detection System
TEQ	toxic equivalency quotient
TERC	Total Environmental Restoration Contract
Tetryl	trinitrophenylmethylnitramine
TEU	Technical Escort Unit
THI	target hazard index
Thiokol	Thiokol Corporation
TIC	tentatively identified compound
TIR	thermal infrared survey
TLV	threshold limit value
TM	Technical Manual

List of Abbreviations and Acronyms
Redstone Arsenal, Madison County, Alabama

Acronym	Definition
TMP	temperature measuring point
TMPW	temporary groundwater monitoring well
TN	Tennessee
TNB	trinitrobenzene
TNT	trinitrotoluene
TO	task order
TOC	use top of casing when defining the well depth; use total organic carbon when defining a general chemistry parameter
TOI	target of interest
TOW	tube-launched, optically-tracked, wire-guided missile
TP	Technical Paper
TPH	total petroleum hydrocarbon
TPI	three-phase inspection
TPP	Technical Project Planning
TR	target cancer risk
TRADOC	U.S. Army Training and Doctrine Command
TRINITY	Trinity Analysis and Development Corp.
TRPH	total recoverable petroleum hydrocarbons
TRS	TRS Group Inc.
TRV	toxicity reference value
TSA	temporary storage area
TSCA	Toxic Substances Control Act
TSCRN	top of screen
TSDF	treatment, storage, and disposal facility
TSLC	target soil leachate concentration
TSS	total suspended solids
TTAP	treatment system tap (port)
TTZ	target treatment zone
Tu	Tupelo silt loam
TVA	Tennessee Valley Authority
TWA	time-weighted average
TXDOT	Texas Department of Transportation
TX-3	small rocket motor used for ballistics testing
U	not detected above reporting limit
U.S.	United States (of America)
UB	potential blank contamination
UCL	upper confidence limit
UCLM	upper confidence limit of the mean
UCR	upper certified range
UDMH	unsymmetrical dimethyl hydrazine
UF	uncertainty factor
UFP	Uniform Federal Policy
UIC	underground injection control
UJ	not detected, estimated due to data validation anomaly
UNEP	United Nations Environment Program
UNO	United Nations Organization
UPL	upper prediction limit; upland
UR	not detected; rejected due to data validation anomaly
URF	unit risk factor
USACE	U.S. Army Corps of Engineers
USACMLS	U.S. Army Chemical School
USAEC	U.S. Army Environmental Command
USAEHA	U.S. Army Environmental Hygiene Agency
USAESCH	U.S. Army Engineering Support Center, Huntsville
USAMPS	U.S. Army Military Police School
USAPHC	U.S. Army Public Health Command
USATCES	U.S. Army Technical Center for Explosive Safety
USATEU	U.S. Army Technical Escort Unit
USATHAMA	U.S. Army Toxic and Hazardous Material Agency
USC	United States Code
USCS	Unified Soil Classification System
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	underground storage tank
UTL	upper tolerance limit
UTM	Universal Transverse Mercatir
UTS	universal treatment standard
UTV	utility terrain vehicle
UXO	unexploded ordnance
UXOSP	unexploded ordnance sweep personnel
UXOQCS	UXO Quality Control Supervisor
UXOSO	UXO safety officer
V	vanadium
VC	vinyl chloride
VCE	Virtual Contracting Enterprise
VGIC	liquid-phase granular activated carbon
VI	vapor intrusion
VISL	vapor intrusion screening level
VOA	volatile organic analyte
VOC	volatile organic compound
VOH	volatile organic hydrocarbon
VP	soil vapor point
VQ	validation qualifier
vs	versus
VSI	visual site inspection
VSL	vapor screening level
VSP	Visual Sample Plan
VX	nerve agent (O-ethyl-S-[diisopropylaminoethyl]-methylphosphonothiolate)

List of Abbreviations and Acronyms
Redstone Arsenal, Madison County, Alabama

Acronym	Definition
WAC	Women's Army Corps
WBGT	wet bulb globe temperature
WDTA	Waste Disposal Trench Area
WNWR	Wheeler National Wildlife Refuge
WOE	weight of evidence
WP	white phosphorus
WPL	worker population limit
WPS	Waste Profile Sheet
WQC	water quality criteria
WRS	Wilcoxon rank sum
WS	watershed
WSA	Watershed Screening Assessment
WTP	water treatment plant
WWI	World War I
WWII	World War II
WWTP	wastewater treatment plant
X	Data collected in a manner that is now considered to be inconsistent with good scientific practice. These data are considered unusable. However, since these data exist in the database, additional definitive samples may be needed to verify the presence or absence of any positively detected result.
XRF	x-ray fluorescence
yd^3	cubic yards
ZVI	zero-valent iron

TABLES

Table 2-1

Summary of Receptor Cancer Risk and Noncancer Hazard for Chemicals of Concern
Reasonable Maximum Exposure
RSA-014S Corrective Measures Implementation Work Plan
Redstone Arsenal, Madison County, Alabama

CANCER RISK

Receptors	Total Soil IELCR	Groundwater IELCR	CUMULATIVE RISK SOIL	CUMULATIVE RISK SOIL AND GROUNDWATER
Industrial Receptors:				
Commercial Worker	1.8E-06	6.1E-02	1.8E-06	6.1E-02
Construction Worker	8.9E-07	2.7E-03	8.9E-07	2.7E-03
Hypothetical Residential Receptors:				
Child Resident [a]	6.6E-06	5.3E-02	6.6E-06	5.3E-02
Adult Resident [a]	2.3E-06	1.1E-01	2.3E-06	1.1E-01
Lifetime Resident [a]	8.9E-06	1.7E-01	8.9E-06	1.7E-01

NONCANCER HAZARD

Receptors	Total Soil HI	Groundwater HI	CUMULATIVE HI SOIL	CUMULATIVE HI SOIL AND GROUNDWATER
Industrial Receptors:				
Commercial Worker	0.028	7400	0.028	7400
Construction Worker	6.6	8200	6.6	8200
Hypothetical Residential Receptors:				
Child Resident [a]	0.45	26000	0.45	26000

[a] Risk associated with the hypothetical residential receptor; child and adult resident risk are summed to estimate the cancer risk for the lifetime resident.
Noncancer hazard estimates are based on the hypothetical child resident only.
HI - Hazard index.
IELCR - Individual excess lifetime cancer risk.

Table 2-2

Conclusions of the ARBCA RM-2 Evaluation
RSA-014S Corrective Measures Implementation Work Plan
Redstone Arsenal, Madison County, Alabama

Receptors	Exposure to Soil [a]	Relevant COCs in Soil	Exposure to Soil and Groundwater [a]	Relevant COCs for Exposure to Groundwater [b]
RSA-014 NORTH				
Commercial Worker	√	(None)	X	Manganese Perchlorate 2,4-Dinitrotoluene 2,6-Dinitrotoluene 2-Nitrotoluene 1-Methylnaphthalene Dibenz(a,h)anthracene 1,1,1-Trichloroethane 1,1,2,2-Tetrachloroethane 1,1,2-Trichloroethane 1,1-Dichloroethene 1,2-Dichloroethane Benzene Chlorobenzene Chloroform cis-1,2-Dichloroethene Methylene chloride Tetrachloroethene Toluene Trichloroethene Vinyl chloride
Construction Worker	√	(None)	X	Manganese Perchlorate 2,6-Dinitrotoluene 1,1,1-Trichloroethane 1,1,2,2-Tetrachloroethane 1,1,2-Trichloroethane 1,1-Dichloroethene 1,2-Dichloroethane Benzene Chlorobenzene Chloroform cis-1,2-Dichloroethene Methylene chloride Tetrachloroethene Toluene Trichloroethene Vinyl chloride

Table 2-2

Conclusions of the ARBCA RM-2 Evaluation
RSA-014S Corrective Measures Implementation Work Plan
Redstone Arsenal, Madison County, Alabama

Receptors	Exposure to Soil [a]	Relevant COCs in Soil	Exposure to Soil and Groundwater [a]	Relevant COCs for Exposure to Groundwater [b]
Hypothetical Resident	√	(None)	X	Manganese Perchlorate 2,4,6-Trinitrotoluene 2,4-Dinitrotoluene 2,6-Dinitrotoluene 2-Nitrotoluene RDX 1-Methylnaphthalene Benzo(a)anthracene Benzo(b)fluoranthene Dibenz(a,h)anthracene Indeno(1,2,3-cd)pyrene 1,1,1-Trichloroethane 1,1,2,2-Tetrachloroethane 1,1,2-Trichloroethane 1,1-Dichloroethane 1,1-Dichloroethene 1,2-Dichloroethane Benzene Chlorobenzene Chloroform cis-1,2-Dichloroethene Methylene chloride Tetrachloroethene Toluene Trichloroethene Vinyl chloride

Conclusions of the ARBCA RM-2 Evaluation
RSA-014S Corrective Measures Implementation Work Plan
Redstone Arsenal, Madison County, Alabama

Receptors	Exposure to Soil [a]	Relevant COCs in Soil	Exposure to Soil and Groundwater [a]	Relevant COCs for Exposure to Groundwater [b]
RSA-014 SOUTH				
Commercial Worker	√	(None)	X	Manganese Perchlorate 2,4-Dinitrotoluene 2,6-Dinitrotoluene 2-Nitrotoluene 1-Methylnaphthalene Dibenz(a,h)anthracene 1,1,1-Trichloroethane 1,1,2,2-Tetrachloroethane 1,1,2-Trichloroethane 1,1-Dichloroethene 1,2-Dichloroethane Benzene Chlorobenzene Chloroform cis-1,2-Dichloroethene Methylene chloride Tetrachloroethene Toluene Trichloroethene Vinyl chloride
Construction Worker	X	Trichloroethene	X	Manganese Perchlorate 2,6-Dinitrotoluene 1,1,1-Trichloroethane 1,1,2,2-Tetrachloroethane 1,1,2-Trichloroethane 1,1-Dichloroethene 1,2-Dichloroethane Benzene Chlorobenzene Chloroform cis-1,2-Dichloroethene Methylene chloride Tetrachloroethene Toluene Trichloroethene Vinyl chloride

Table 2-2

Conclusions of the ARBCA RM-2 Evaluation
RSA-014S Corrective Measures Implementation Work Plan
Redstone Arsenal, Madison County, Alabama

Receptors	Exposure to Soil [a]	Relevant COCs in Soil	Exposure to Soil and Groundwater [a]	Relevant COCs for Exposure to Groundwater [b]
Hypothetical Resident	√	(None)	X	Manganese Perchlorate 2,4,6-Trinitrotoluene 2,4-Dinitrotoluene 2,6-Dinitrotoluene 2-Nitrotoluene RDX 1-Methylnaphthalene Benzo(a)anthracene Benzo(b)fluoranthene Dibenz(a,h)anthracene Indeno(1,2,3-cd)pyrene 1,1,1-Trichloroethane 1,1,2,2-Tetrachloroethane 1,1,2-Trichloroethane 1,1-Dichloroethane 1,1-Dichloroethene 1,2-Dichloroethane Benzene Chlorobenzene Chloroform cis-1,2-Dichloroethene Methylene chloride Tetrachloroethene Toluene Trichloroethene Vinyl chloride

Notes:

√ Cumulative cancer risk and noncancer hazard were found to be acceptable.

X Cumulative cancer risk and noncancer hazard were found to be unacceptable.

[a] Risk conclusions exclude metals found to be naturally occurring.

[b] Chemicals with maximum detected concentrations below their maximum contaminant levels are not included as COCs from exposure to groundwater.

COC - Chemical of concern.
RM-2 - Risk-Management-2.

Table 3-1

RSA-014S Soil Cleanup Goals
RSA-014S Corrective Measures Implementation Work Plan
Redstone Arsenal, Madison County, Alabama

COC Requiring Action RSA-014 South	Construction Worker Soil CG (mg/kg)	Basis
Trichloroethene	1.3	Risk[a]

Notes:

CG - Cleanup goal.

COC - Chemical of concern.

mg/kg - milligrams per kilogram.

RFI - Resource Conservation and Recovery Act facility investigation.

[a] CG is based on a risk-based target level at HI of 1.0 (Table D-27 in RSA-014 RFI Report [CB&I, 2017]).

Table 3-2

Federal and State Regulations Applicable to RSA-014S Soil Corrective Measures
RSA-014S Corrective Measures Implementation Work Plan
Redstone Arsenal, Madison County, Alabama

Standard, Requirement, or Criterion	Requirement	Applicability	Comments
Federal			
Standards Applicable to Generators of Hazardous Waste, 40 CFR Part 262	Establishes standards for generators of hazardous waste under RCRA. Specifies requirements for hazardous waste packaging, labeling, manifesting, record keeping, and accumulation time.	Applicable	Applicable if soil containing TCE is determined to be hazardous.
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, 40 CFR Part 264.13(a)(1)	Must obtain a detailed chemical and physical analysis on a representative sample of the waste(s).	Applicable	Applicable if soil containing TCE is determined to be hazardous.
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, 40 CFR Part 264.170-179	Management of hazardous waste in containers	Applicable	Applicable if soil containing TCE is determined to be hazardous.
RCRA Act, 40 CFR Part 266 Subpart M (Military Munitions Rule)	Regulates storage and transportation of recovered military munitions in accordance with DoD Explosive Safety Board standards.	Potentially applicable	The rule would apply if removal activities resulted in the discovery of MEC, which is possible based on the UXO probability at RSA-014S.
State			
Alabama Identification and Listing of Hazardous Waste, ADEM 335-14-3	Establishes standards for generators of hazardous waste including, identification, accumulation, transport, and reporting.	Applicable	Applicable if soil containing TCE is determined to be hazardous.
Alabama Solid Waste Act, Code of Alabama, Title 22, Chapter 27	Establishes sitewide program to provide for the safe management of nonhazardous wastes.	Applicable	Nonhazardous waste is expected to be generated, transported, or disposed as part of the corrective measure activities.
Alabama Solid Waste Management Regulations, ADEM 335-13-1 through 335-13-8	Establishes minimum criteria for the processing, recycling, transportation, and disposal of solid wastes and the design, location, and operation of solid waste disposal facilities.	Applicable	Nonhazardous waste is expected to be generated, transported, or disposed as part of monitoring or corrective measure activities.
Alabama Uniform Environmental Covenants Program, ADEM 335-5-1-.03(r)	Establishes the requirements for environmental use restrictions on federal facility property.	Applicable	The use of LUCs is considered to be likely for this site.
Alabama Wellhead Protection Program, ADEM 335-7-12	Establishes requirements for the closure or abandonment of groundwater monitoring or extraction wells.	Potentially applicable	Although no monitoring wells are planned to be abandoned during the corrective measures, if a well is damaged during the corrective measures it may have to be abandoned/replaced.

ADEM - Alabama Department of Environmental Management.

CFR - Code of Federal Regulations.

LUC - Land-use control.

MEC - Munitions and explosives of concern.

RCRA - Resource Conservation and Recovery Act.

TCE - Trichloroethene.

FIGURES

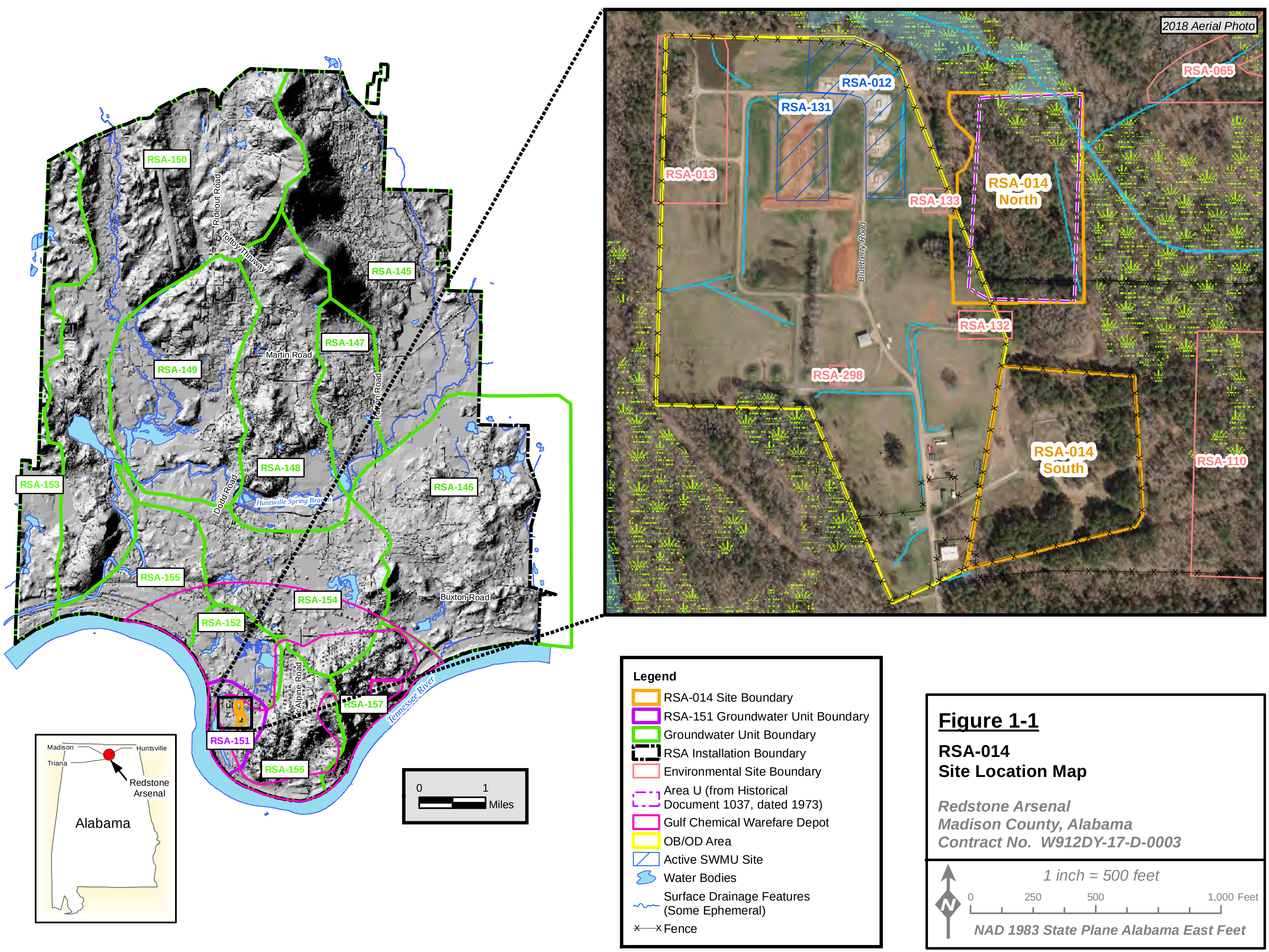

Figure 1-1

RSA-014
Site Location Map

Redstone Arsenal
Madison County, Alabama
Contract No. W912DY-17-D-0003

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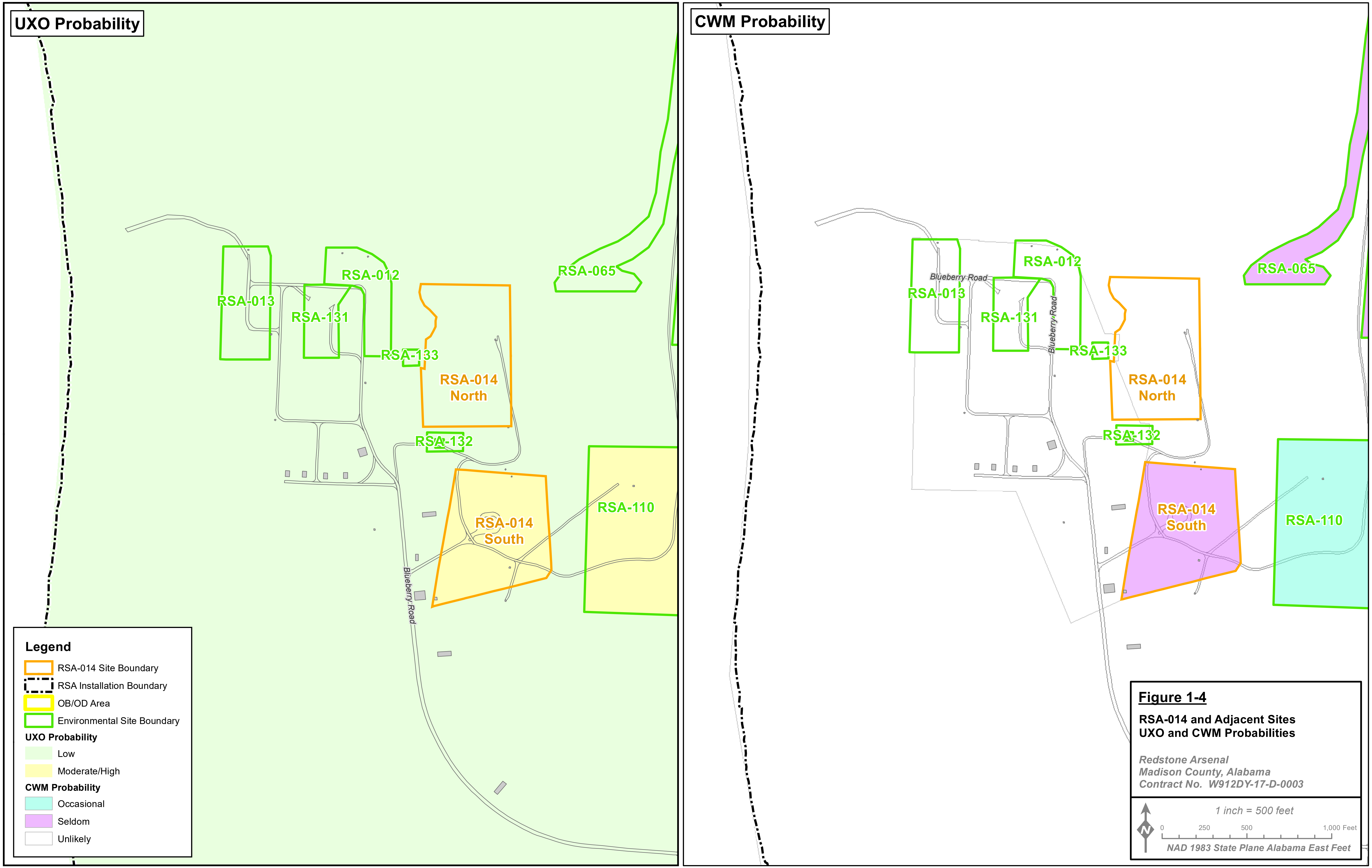

Figure 1-4

RSA-014 and Adjacent Sites UXO and CWM Probabilities

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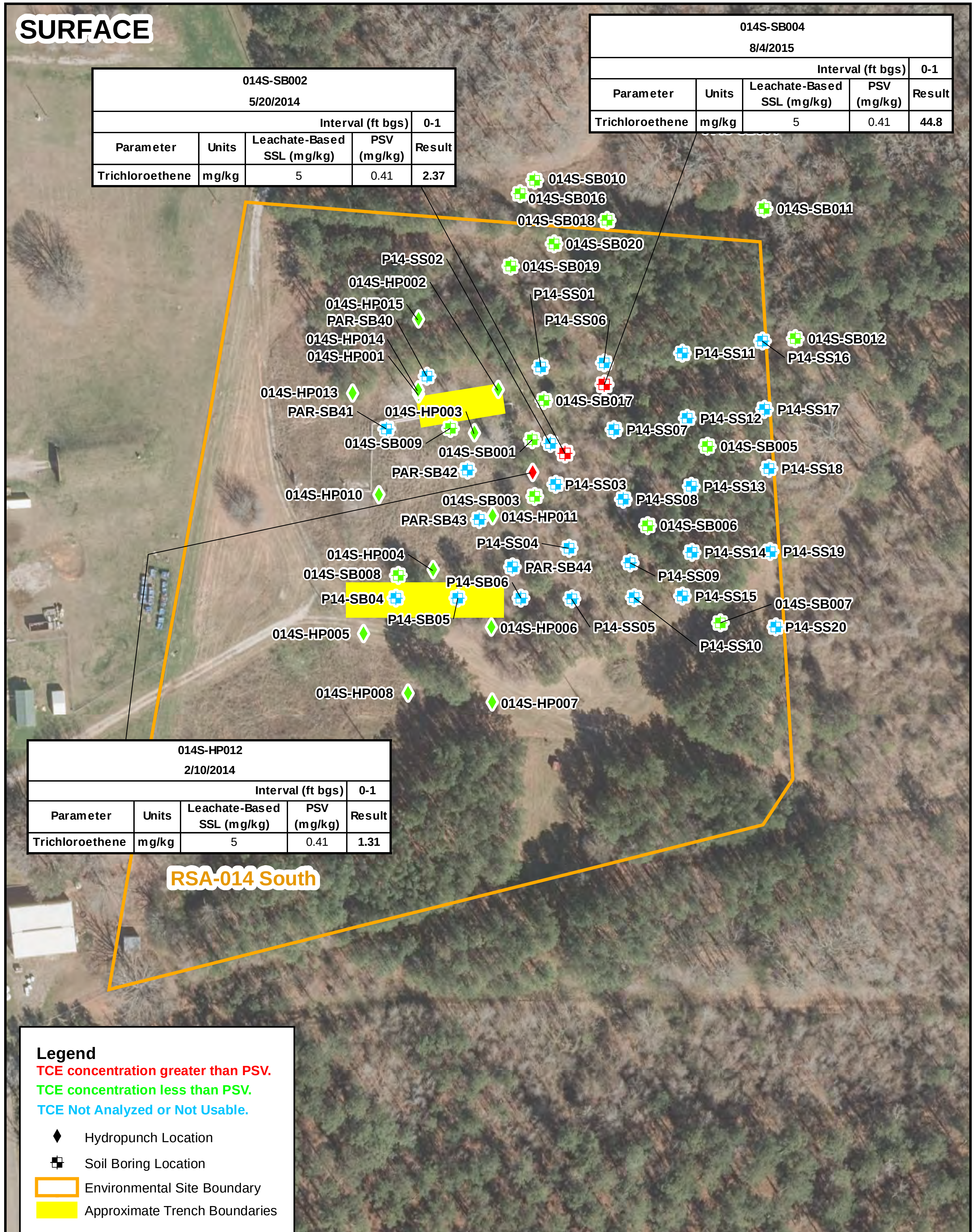
SURFACE



014S-SB002
5/20/2014

Parameter	Units	Leachate-Based SSL (mg/kg)	PSV (mg/kg)	Result
			Interval (ft bgs)	0-1
Trichloroethene	mg/kg	5	0.41	2.37

014S-SB004
8/4/2015

Parameter	Units	Leachate-Based SSL (mg/kg)	PSV (mg/kg)	Result
			Interval (ft bgs)	0-1
Trichloroethene	mg/kg	5	0.41	44.8

014S-HP012
2/10/2014

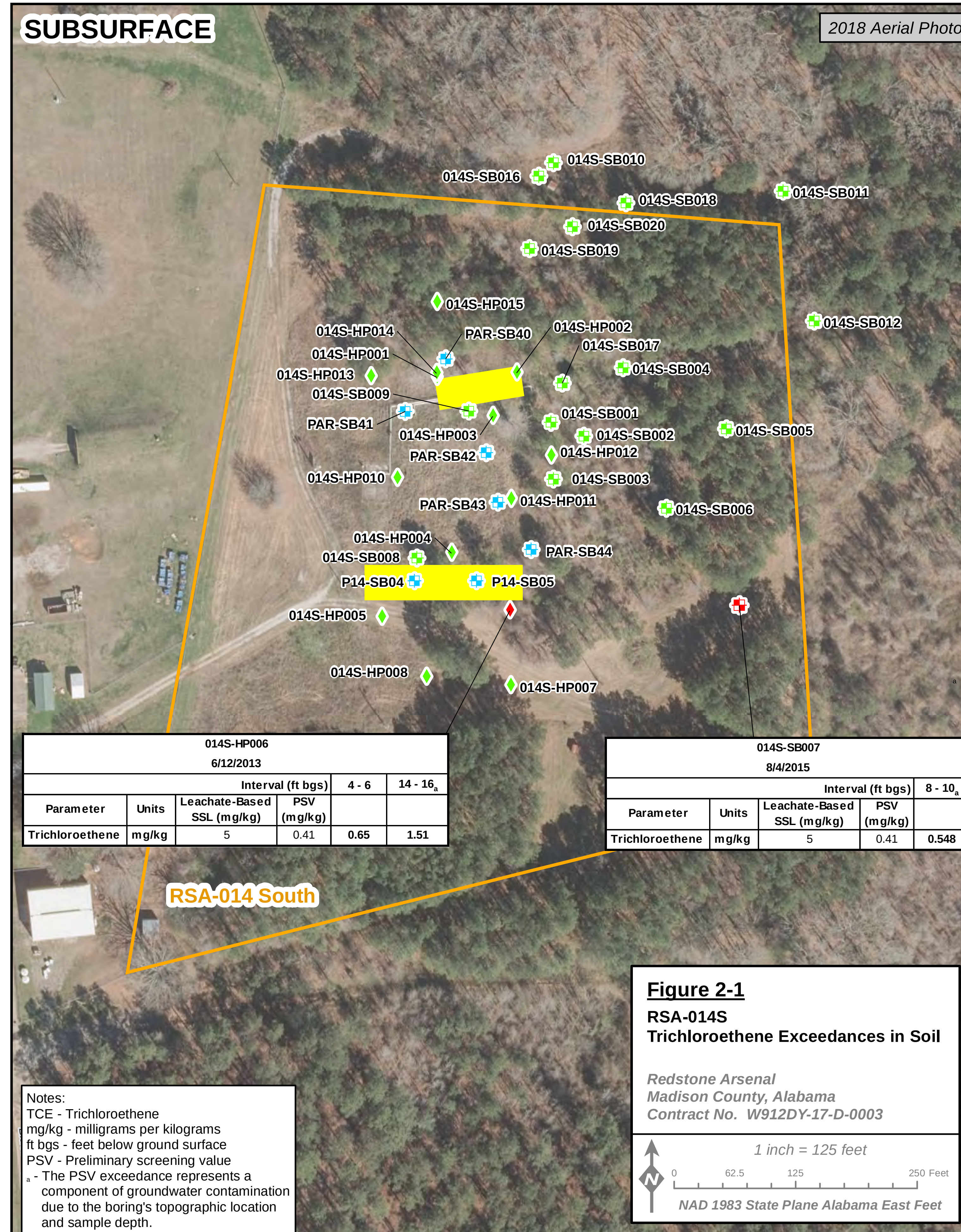
Parameter	Units	Leachate-Based SSL (mg/kg)	PSV (mg/kg)	Result
			Interval (ft bgs)	0-1
Trichloroethene	mg/kg	5	0.41	1.31

Legend

TCE concentration greater than PSV.
TCE concentration less than PSV.
TCE Not Analyzed or Not Usable.
Hydropunch Location
Soil Boring Location
Environmental Site Boundary
Approximate Trench Boundaries

SUBSURFACE

2018 Aerial Photo



014S-HP006
6/12/2013

Parameter	Units	Leachate-Based SSL (mg/kg)	PSV (mg/kg)		
			Interval (ft bgs)	4 - 6	14 - 16[a]
Trichloroethene	mg/kg	5	0.41	0.65	1.51

014S-SB007
8/4/2015

Parameter	Units	Leachate-Based SSL (mg/kg)	PSV (mg/kg)	
			Interval (ft bgs)	8 - 10[a]
Trichloroethene	mg/kg	5	0.41	0.548

Notes:
TCE - Trichloroethene
mg/kg - milligrams per kilograms
ft bgs - feet below ground surface
PSV - Preliminary screening value
[a] - The PSV exceedance represents a component of groundwater contamination due to the boring's topographic location and sample depth.

Figure 2-1
RSA-014S
Trichloroethene Exceedances in Soil

Redstone Arsenal
Madison County, Alabama
Contract No. W912DY-17-D-0003

1 inch = 125 feet
0 62.5 125 250 Feet
NAD 1983 State Plane Alabama East Feet

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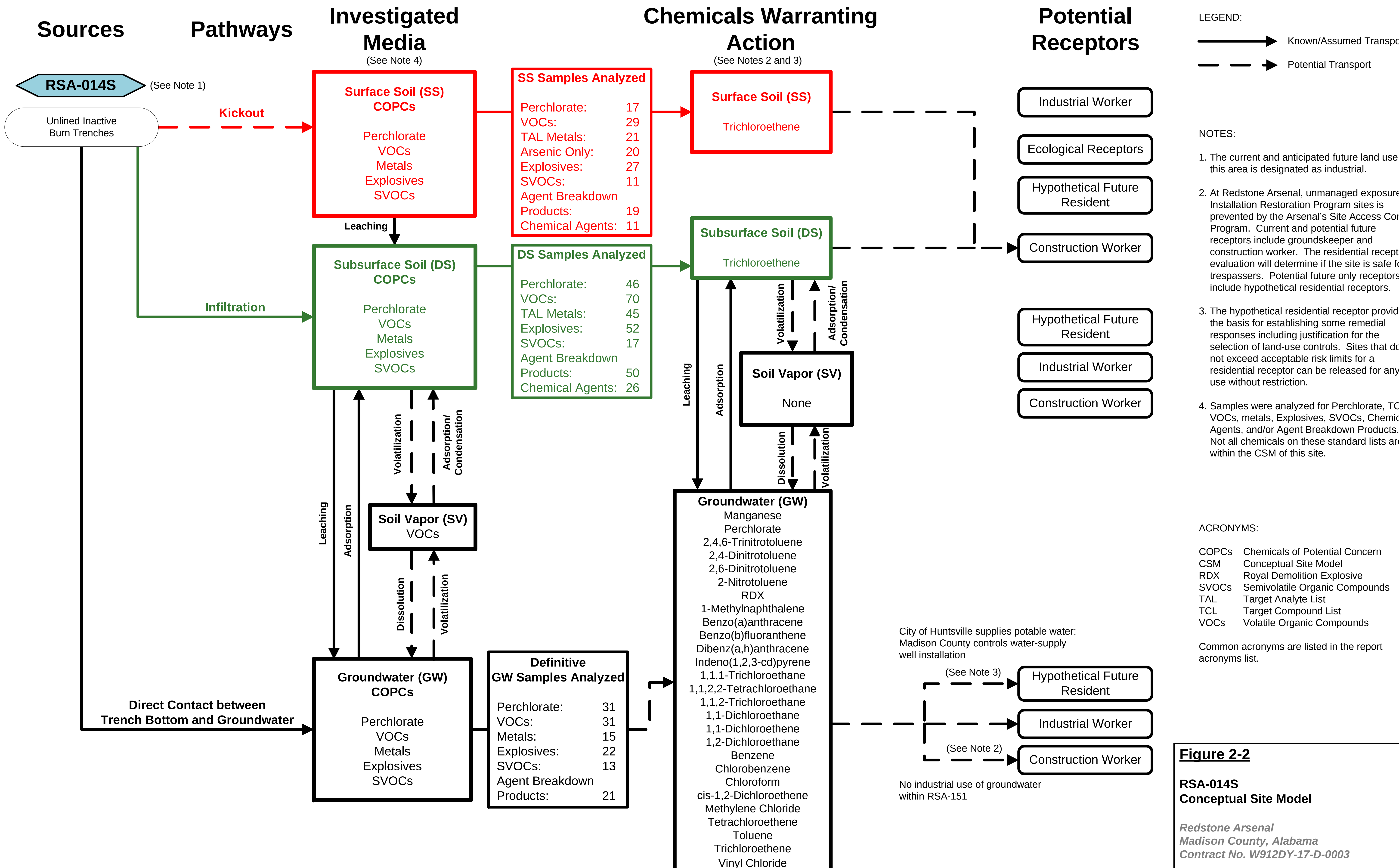

NOTES:

1. The current and anticipated future land use of this area is designated as industrial.
2. At Redstone Arsenal, unmanaged exposure to Installation Restoration Program sites is prevented by the Arsenal's Site Access Control Program. Current and potential future receptors include groundskeeper and construction worker. The residential receptor evaluation will determine if the site is safe for trespassers. Potential future only receptors include hypothetical residential receptors.
3. The hypothetical residential receptor provides the basis for establishing some remedial responses including justification for the selection of land-use controls. Sites that do not exceed acceptable risk limits for a residential receptor can be released for any use without restriction.
4. Samples were analyzed for Perchlorate, TCL VOCs, metals, Explosives, SVOCs, Chemical Agents, and/or Agent Breakdown Products. Not all chemicals on these standard lists are within the CSM of this site.

ACRONYMS:

COPCs	Chemicals of Potential Concern
CSM	Conceptual Site Model
RDX	Royal Demolition Explosive
SVOCs	Semivolatile Organic Compounds
TAL	Target Analyte List
TCL	Target Compound List
VOCs	Volatile Organic Compounds

Common acronyms are listed in the report acronyms list.

Figure 2-2

RSA-014S
Conceptual Site Model

Redstone Arsenal
Madison County, Alabama
Contract No. W912DY-17-D-0003

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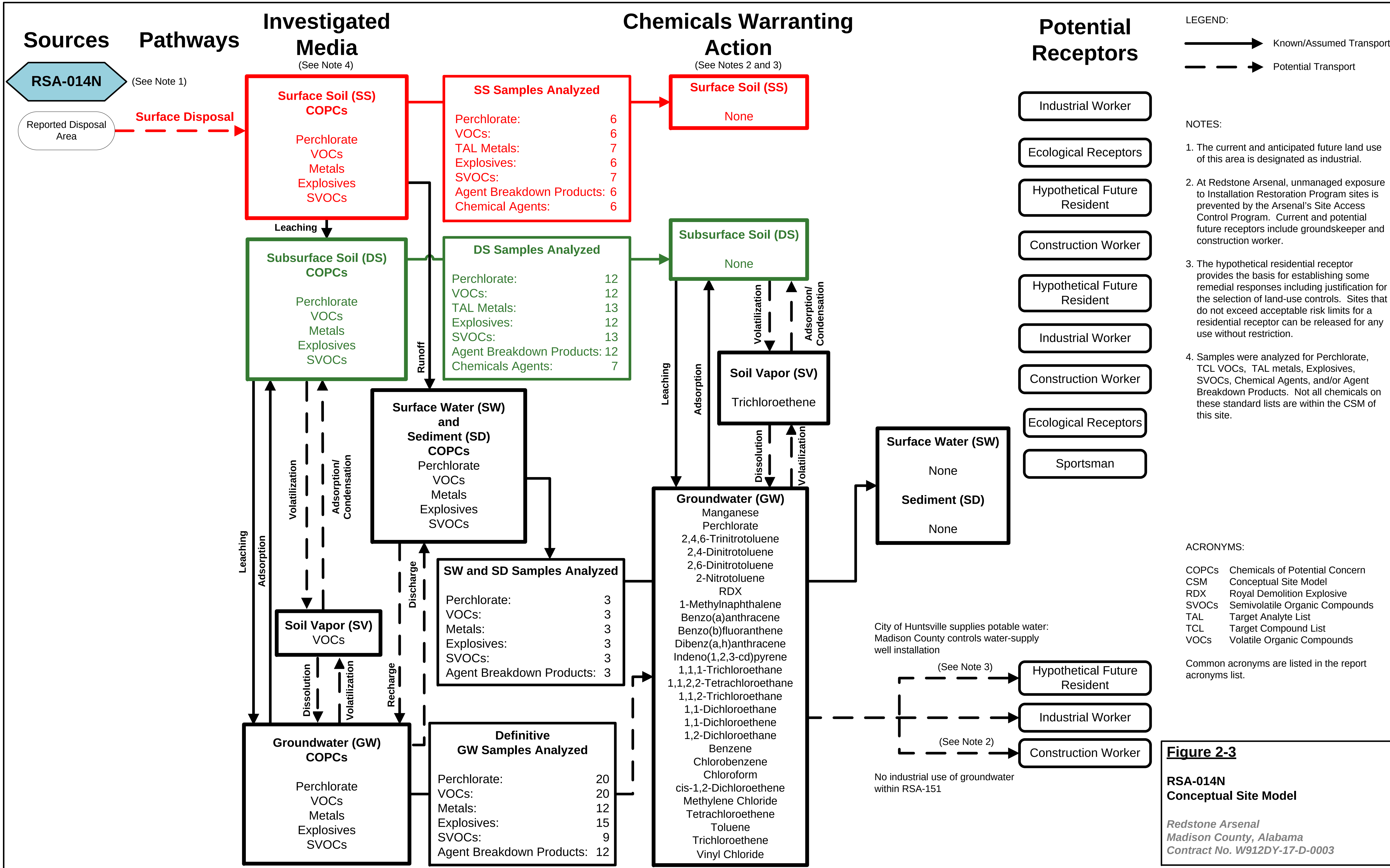
B. Hodges



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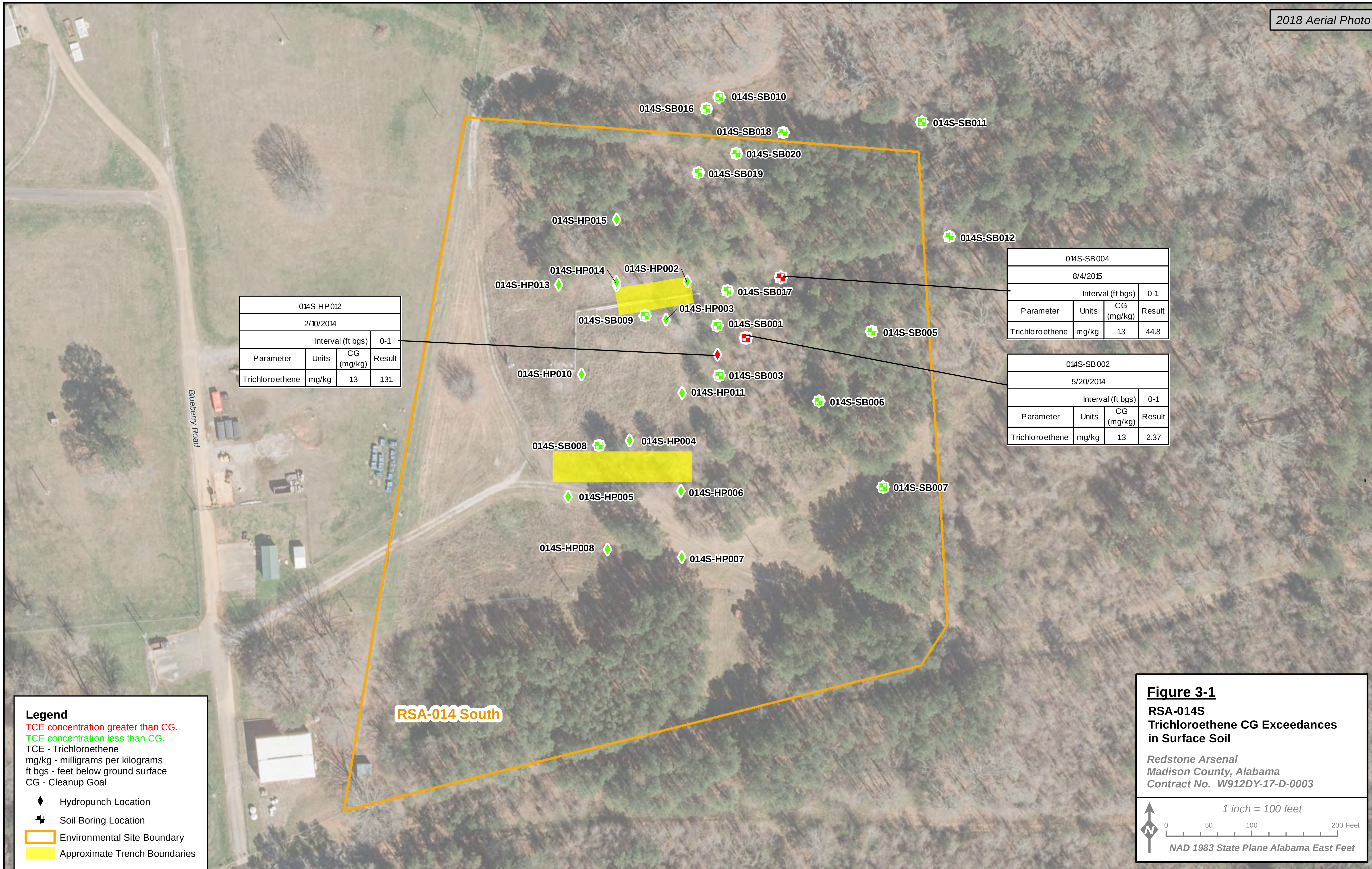


014S-HP012			
2/10/2014			
Interval (ft bgs)			0-1
Parameter	Units	CG (mg/kg)	Result
Trichloroethene	mg/kg	13	131

014S-SB004			
8/4/2015			
Interval (ft bgs)			0-1
Parameter	Units	CG (mg/kg)	Result
Trichloroethene	mg/kg	13	44.8

014S-SB002			
5/20/2014			
Interval (ft bgs)			0-1
Parameter	Units	CG (mg/kg)	Result
Trichloroethene	mg/kg	13	2.37

Figure 3-1

RSA-014S
Trichloroethene CG Exceedances in Surface Soil

Redstone Arsenal
Madison County, Alabama
Contract No. W912DY-17-D-0003

Area 1	
Easting	Northing
406085.37	1481082.86
406095.37	1481082.86
406095.37	1481072.86
406085.37	1481072.86

Area 2	
Easting	Northing
406119.00	1481103.22
406129.00	1481103.22
406129.00	1481093.22
406119.00	1481093.22

Area 3	
Easting	Northing
406151.91	1481181.37
406176.91	1481181.37
406176.91	1481156.37
406151.91	1481156.37

Legend

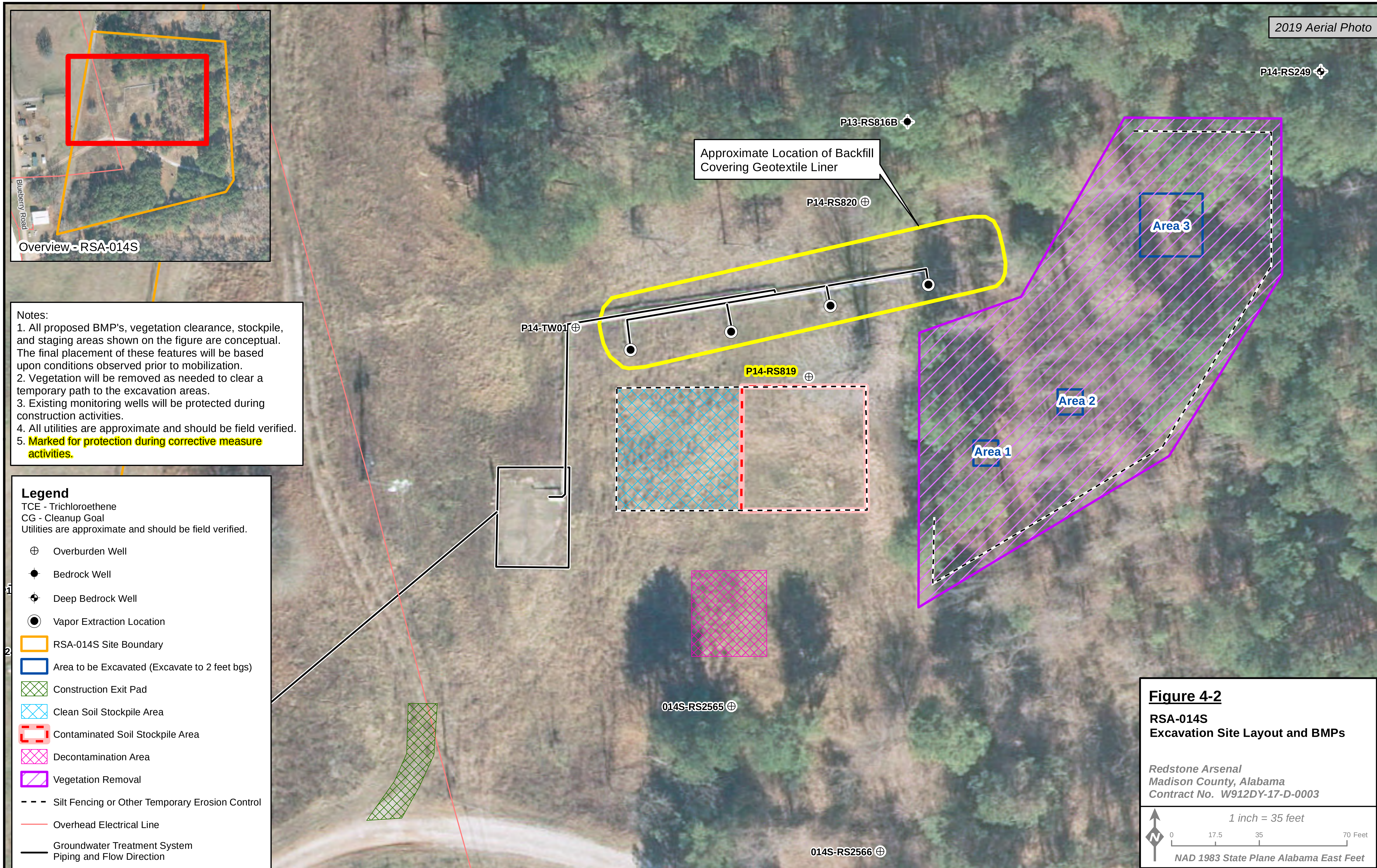
TCE - Trichloroethene
CG - Cleanup Goal
Utilities are approximate and should be field verified.

- Overburden Well
- Bedrock Well
- Deep Bedrock Well
- TCE exceeds CG (1.3 mg/kg)
- TCE does not exceed CG
- Area to be Excavated (Excavate to 2 feet bgs)
- Vapor Extraction Location
- Overhead Electrical Line
- Groundwater Treatment System Piping and Flow Direction

Figure 4-1

RSA-014S
Proposed Soil Excavation Areas

Redstone Arsenal
Madison County, Alabama
Contract No. W912DY-17-D-0003



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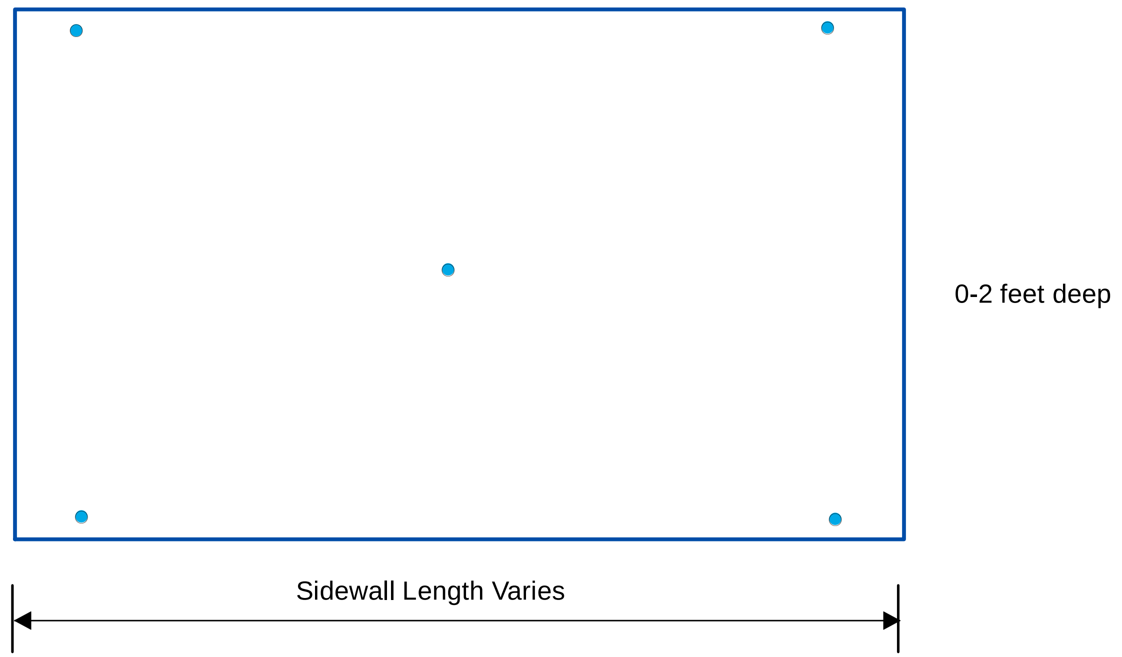

Legend

Aliquot

Note:
A minimum of one composite sample will be collected for every 50 linear feet of sidewall.

Figure 4-4

RSA-014S
Excavation Sidewall Confirmation Sampling Approach

Redstone Arsenal
Madison County, Alabama
Contract No. W912DY-17-D-0003

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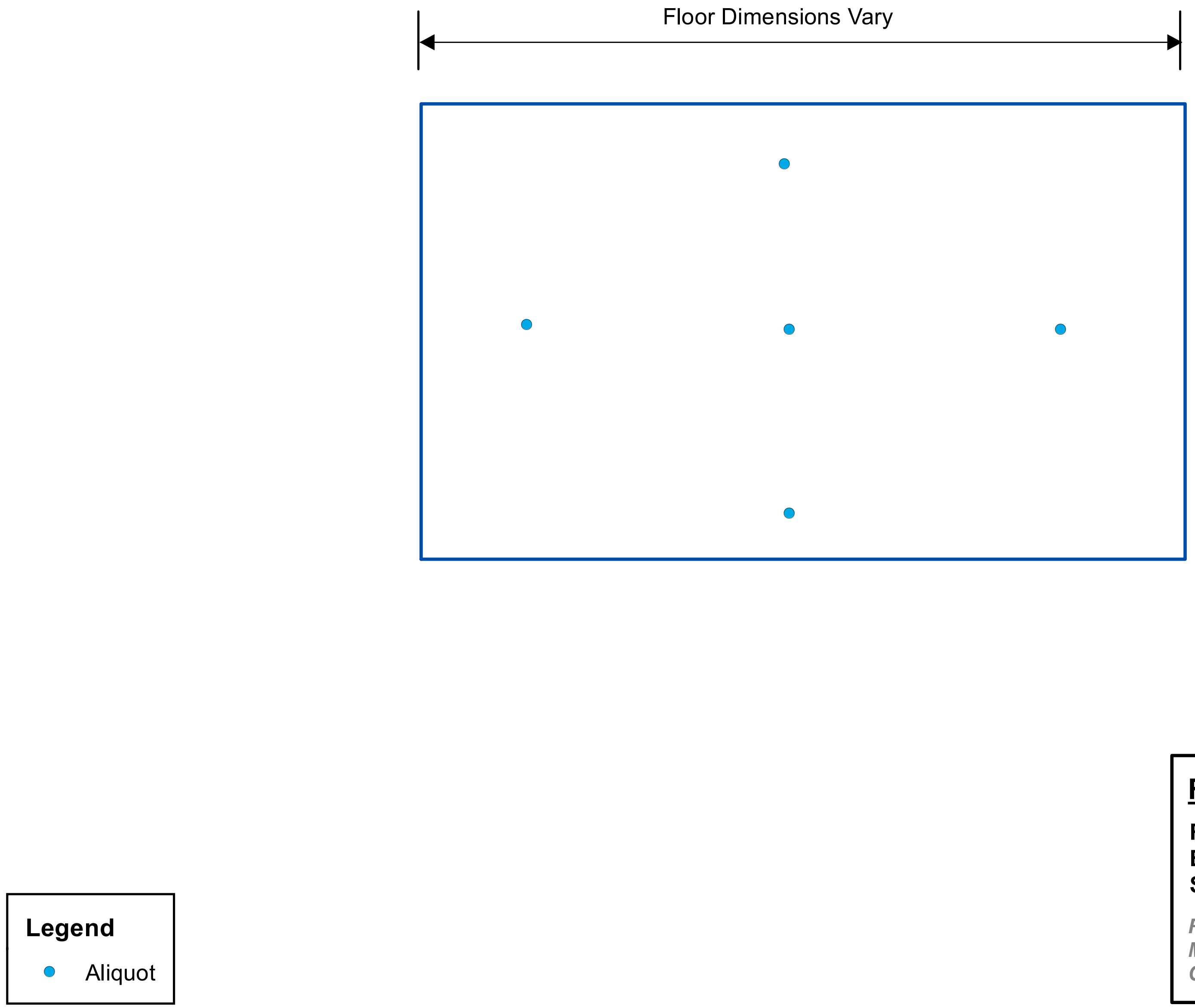

Figure 4-5

RSA-014S
Excavation Floor Confirmation Sampling Approach

Redstone Arsenal
Madison County, Alabama
Contract No. W912DY-17-D-0003

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LUC Corner	Latitude	Longitude
1	34.568863	-86.664979
2	34.568763	-86.663219
3	34.567245	-86.663092
4	34.567115	-86.663193
5	34.566634	-86.665425

Land-Use Sign		
Number	Latitude	Longitude
1	34.568843	-86.664983
2	34.568846	-86.664669
3	34.568827	-86.664337
4	34.568808	-86.664006
5	34.568789	-86.663672
6	34.56877	-86.663341
7	34.568588	-86.663205
8	34.568315	-86.663182
9	34.568041	-86.663158
10	34.567766	-86.663134
11	34.567491	-86.663112
12	34.567216	-86.663115
13	34.567077	-86.66337
14	34.567007	-86.663692
15	34.566938	-86.664015
16	34.566868	-86.664339
17	34.566798	-86.664663
18	34.566729	-86.664985
19	34.566659	-86.665308
20	34.56681	-86.665391
21	34.567081	-86.665339
22	34.567352	-86.665286
23	34.56748	-86.665259
24	34.567754	-86.665203
25	34.568027	-86.665146
26	34.5683	-86.665089
27	34.568573	-86.665036

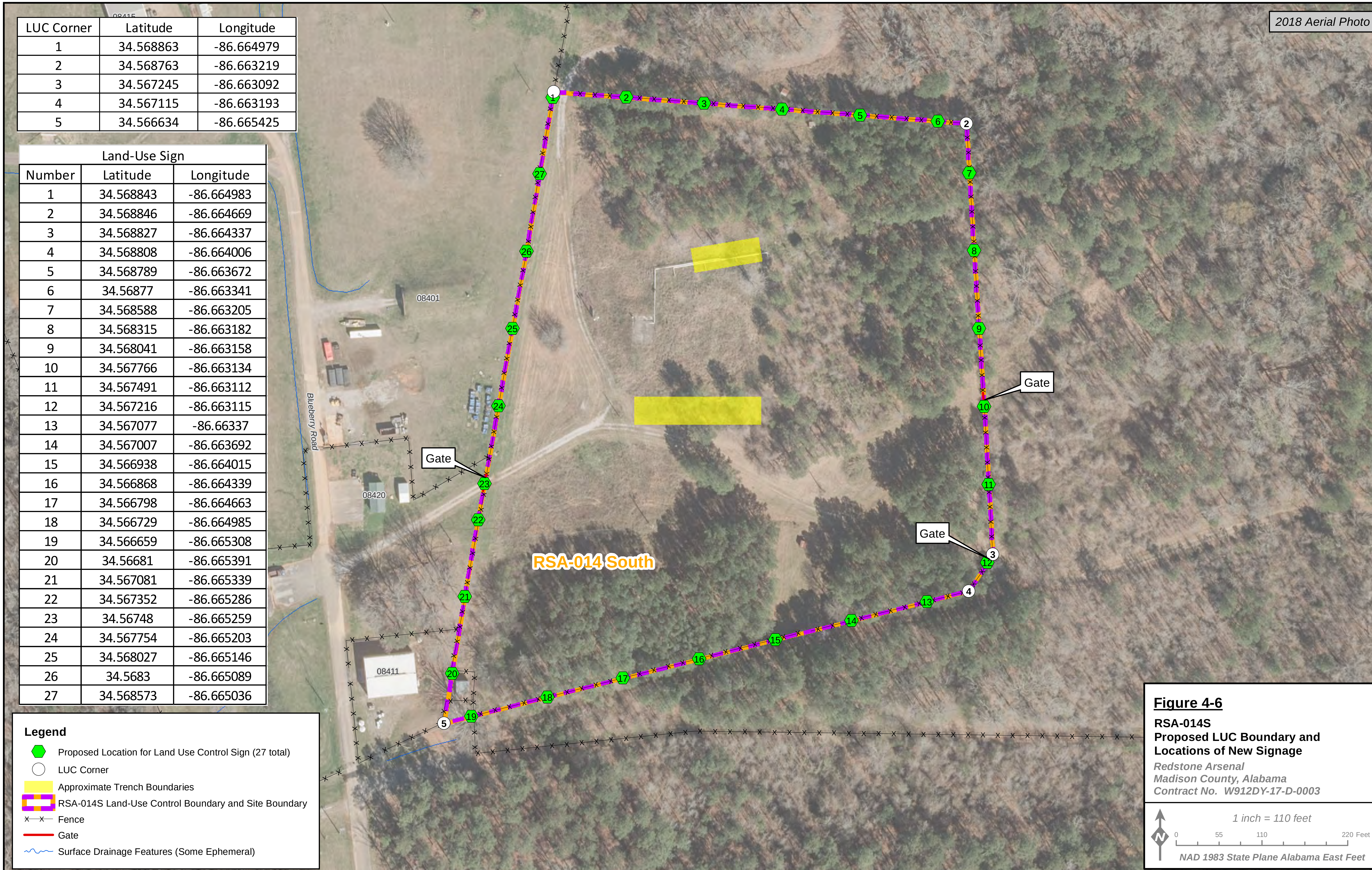
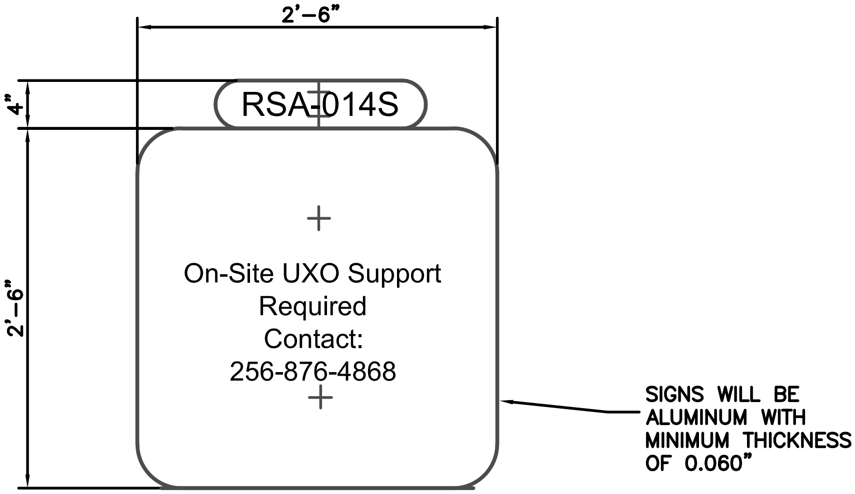


Figure 4-6

RSA-014S
Proposed LUC Boundary and Locations of New Signage

Redstone Arsenal
Madison County, Alabama
Contract No. W912DY-17-D-0003

Document Path: F:\Projects\Redstone_MEGA\GIS_Documents\Project_Maps\RSA_014\CMIP_Aug2021\RSA_014_Prop_LUC_New_Signage.mxd



RSA-014S Land-Use Control Sign

SCALE: ¾"=1'-0"

1 0 3 FEET

<u>FIGURE 4-7</u>
RSA-014S
LAND-USE CONTROL SIGN

Redstone Arsenal
Madison County, Alabama
Contract No. W91ZLK-13-D-0018-0003

APPENDIX A

ADEM CONCURRENCE LETTER FOR RSA-014 RFI REPORT

LANCE R. LEFLEUR
DIRECTOR

Alabama Department of Environmental Management
adem.alabama.gov
1400 Coliseum Blvd. 36110-2400 ■ Post Office Box 301463
Montgomery, Alabama 36130-1463
(334) 271-7700 ■ FAX (334) 271-7950

KAY IVEY
GOVERNOR

September 21, 2017

CERTIFIED MAIL # 91 7199 9991 7037 0311 0976

Mr. Terry Hazle, Director
Directorate of Environmental Management
DEPARTMENT OF THE ARMY
Installation Restoration Division
(AMSAM-RA-DEM-IR)
US Army Aviation and Missile Command
Building 4488
Redstone Arsenal, AL 35898

Re: **ADEM Concurrence Letter:**
Revision 1, RCRA Facility Investigation Report, RSA-014, Unlined Inactive Burn Trenches Unit #2, Operable Unit 14, dated August 2, 2017
Redstone Arsenal, Madison County, Alabama
DSMOA Site No 535-223-5545
Facility ID No: AL7 210 020 742

Dear Mr. Hazle:

The Alabama Department of Environmental Management (ADEM or the Department) has completed the review of the aforementioned document received on August 3, 2017. Based on its review, the Department has determined that all comments on the previous version of this document have been resolved and concurs with the recommendation for No Further Action at this time for the surface media at RSA-014 North and corrective measures to be performed for the surface media at RSA-014 South. With respect to the groundwater under the entire site for RSA-014, the Department concurs with the recommendation for corrective measures to be performed as part of the RSA-151 groundwater unit.

Since the findings of this RFI Report indicate action is needed for chemicals of concern (COCs) in the surface media at RSA-014 South and for COCs in groundwater under the entire site for RSA-014, a Corrective Measures Implementation (CMI) plan to address this action is required. In accordance with Permit Condition VI.E.2., the CMI plan must be completed within 120 calendar days following notification from the Department that a CMI Plan is required. Therefore, RSA should submit a CMI Plan to address the surface media for RSA-014 within 120 calendar days of receipt of this letter. The corrective measures to address the groundwater under RSA-014 should be addressed as a part of the CMI Plan for RSA-151.

ADEM will move RSA-014 to Table VI.6 (Sites requiring a corrective measures implementation work plan) and list it as requiring corrective measures for COCs in the surface media as a part of RSA-014 and for COCs in the groundwater as a part of RSA-151. All of these changes will be incorporated into the facility's Alabama Hazardous Wastes Management and Minimization Act (AHWMMA) permit as part of the next permit modification.

If you have any questions on this matter, please contact Krishna Morrissette of the Facilities Engineering Section via e-mail at kmorrissette@adem.alabama.gov or at (334) 394-4335.

Sincerely,

Jason Wilson, Chief
Governmental Hazardous Waste Branch
Land Division

JW/KMM

cc: Clint Howard, Redstone Arsenal
Jason T. Wilson, ADEM
Kelley Hartley, ADEM (email)
Salee Downey, Redstone Arsenal (email)
Brian Roberson, NASA MSFC
Ashley T. Mastin, ADEM
Michelle Thornton, US EPA Region IV (email)
Robert Morris, US EPA Region IV (email)

APPENDIX B

REQUEST FOR REDSTONE RCRA PERMIT MODIFICATION

REQUEST FOR REDSTONE RCRA PERMIT MODIFICATION
RSA-014S, UNLINED INACTIVE BURN TRENCH, UNIT #2
OPERABLE UNIT 14
U.S. ARMY GARRISON – REDSTONE
MADISON COUNTY, ALABAMA
March 2022

B1.0 Introduction

As specified in Section VI.E.3 of the U.S. Army Garrison–Redstone's (hereinafter referred to as the Army) Alabama Hazardous Wastes Management and Minimization Act Hazardous Waste Storage Facility, Thermal Treatment, Solid Waste Management Unit Corrective Action Permit (Alabama Department of Environmental Management [ADEM], 2021), a request for permit modification is to be submitted along with a corrective measures implementation (CMI) work plan. The Army has been directed to include this request for permit modification in an appendix to the CMI work plan. Therefore, this request for modification to the Permit has been prepared for Solid Waste Management Unit RSA-014, Unlined Inactive Burn Trench Unit #2, Operable Unit 14 at Redstone Arsenal (RSA) in Madison County, Alabama. The Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) report for RSA-014 (CB&I Federal Services LLC [CB&I], 2017) received concurrence from ADEM on September 21, 2017. The Army has prepared the CMI work plan and is ready to implement corrective measures for soil at the southern parcel of RSA-014 (RSA-014S).

As part of the RFI report, the Army requested that ADEM move this site from Table VI.2 to Table VI.6 in the Permit and list it as requiring corrective measures for soil and groundwater. ADEM subsequently moved RSA-014 to Table VI.6 in Permit Modification No. 11 (ADEM, 2018) as requiring action for soil and groundwater. The groundwater action is part of the RSA-151 groundwater unit corrective measures and is not part of the RSA-014S soil corrective measures. As specified in Section VI.E.3 of the Permit, this modification will serve to incorporate the proposed remedy, including all procedures necessary to implement and monitor the final corrective measures for this site, into the Permit in accordance with Alabama Administrative Code r. 335-14-8-.04(2).

B2.0 Facility and Site Description

RSA is located in the southwestern portion of Madison County, which is in the northern portion of Alabama (Figure 1-1 in the CMI work plan). RSA is a U.S. Army facility that encompasses approximately 38,300 acres of land, all of which are either owned or controlled by the Army.

Development within RSA has largely centered on the historical production (and later disposal) of conventional and chemical munitions and, more recently, development and testing of missiles and rockets. These processes have produced chemical wastes since operations began in the early 1940s.

RSA-014, Unlined Inactive Burn Trenches Unit #2, is located in the southwestern portion of RSA and overlies the RSA-151 groundwater unit (Figure 1-1 in the CMI work plan). RSA-014 is located east of Blueberry Road and southwest of an embayment of the Tennessee River. The site is located just east of the active open burn (OB)/open detonation (OD) area (Figure 1-1 in the CMI work plan). The OB/OD area includes active sites RSA-012 (Active Open Burn Pans [OB]) and RSA-131 (Active Open Detonation Area [OD]).

RSA-014 consists of two noncontiguous parcels identified as RSA-014 North (RSA-014N) and RSA-014 South (RSA-014S). RSA-014N occupies approximately 9.7 acres (Figure 1-2 in the CMI work plan) and RSA-014S occupies approximately 9.8 acres (Figure 1-3 in the CMI work plan) for a total of approximately 19.5 acres. No habitable buildings are or have been located within either parcel.

RSA-014N. Historical Army documentation from 1973 suggested that RSA-014N may have been used as a disposal area for beryllium, small quantities of miscellaneous laboratory samples, and production chemicals (e.g., energetic oxidizers) in the 1940s to 1950s. Site reconnaissance was conducted in 2013 prior to the RFI to look for signs of trenching, mounding, areas of barren soil, or stressed vegetation; no evidence indicating that RSA-014N was a former disposal area was found during the reconnaissance or during review of historical aerial photographs or light detection and ranging data. Sampling was conducted during the RFI to confirm the presence or absence of contamination.

RSA-014S. The RSA-014S parcel consists of two former burn trenches (referred to as north and south trenches) (Figure 1-3 in the CMI work plan). During their use from the mid-1950s to 1991, the unlined, open trenches were approximately 150 to 200 feet long, 35 feet wide, and 6 to 12 feet deep. The trenches were designed for disposal and burning of packaging and pallets used to ship munitions and contaminated metals (the metals reportedly were recovered for recycling). Diesel fuel and kerosene were reportedly used as starter materials for the burning of the materials. Some of the ash, residue, and metal debris from the burn pads at the nearby RSA-013 site was disposed at the RSA-014S trenches. Additionally, unsanctioned burning and disposal of propellant-contaminated solvents and explosives from Thiokol Corporation's manufacturing and production areas occurred in the trenches until 1984. All burning and disposal activities ceased after 1991, and the trenches were filled and covered with clean fill.

The RSA-014N and RSA-014S parcels lie within the boundary of the former Gulf Chemical Warfare Depot, which operated from 1942 to 1947 for receipt, storage, and shipment of chemical agents, bulk chemicals, munitions, decontaminating equipment, and protective materials. Aerial photographs during this time frame show roads through both parcels and possible open staging areas in RSA-014S due to its location near the designated Toxic Gas Yards (e.g., RSA-110).

B3.0 Investigative History

Environmental investigations relevant to RSA-014 are listed below.

- Initial Army investigation (U.S. Army Environmental Hygiene Agency, 1986)
- Remedial investigation for Unit 2 (P.E. LaMoreaux & Associates, 1988)
- Interim RCRA Facility Assessment (A.T. Kearney, Inc., 1989)
- Identification and evaluation of potential solid waste management areas and areas of concern (Geraghty and Miller, Inc., 1991)
- Phase I and II RFI at Unit 2 (Geraghty and Miller, Inc., 1992; 1993)
- Extraction well installation by Enserch Environmental, 1994
- RSA-013 groundwater treatment system construction and operation, various contractors, 1995-2000
- Supplemental investigation (Parsons Engineering Science, Inc., 1997)
- Supplemental remedial investigation (IT Corporation, 2000)
- Comprehensive groundwater sampling (IT Corporation, 2000)
- RSA-151/152/156/157 potential source area investigation (Shaw Environmental, Inc. [Shaw], 2006)
- RSA RCRA facility assessment (ADEM, 2008)
- RSA-151 RFI (Aptim Federal Services, LLC [APTIM], 2018)
- RSA-014 RFI (CB&I, 2017)
- RSA-151 corrective measures study (CMS) report (HydroGeoLogic, Inc., 2020)

- RSA-014 CMS report (APTIM, 2020a)
- OB/OD groundwater monitoring (APTIM, 2021 and subsequent annual updates)

Further details of the investigations are presented in the RSA-014 RFI report (CB&I, 2017). The RFI received concurrence from ADEM on September 21, 2017. The RSA-014N usable data set includes analytical results from 7 surface soil samples, 13 subsurface soil samples, 3 surface water samples, 3 sediment samples, and 20 groundwater samples from site monitoring wells. The RSA-014S usable data set includes analytical results from 59 surface soil samples, 85 subsurface soil samples, 2 soil vapor samples, and 31 groundwater samples from site monitoring wells. The samples were analyzed for metals, volatile organic compounds (VOC), semivolatile organic compounds (SVOC), explosive compounds, perchlorate, and chemical agents/breakdown products. The nature and extent of contamination in soil and groundwater at RSA-014N and RSA-014S have been defined.

B4.0 Scope of the Corrective Measures for RSA-014

The overall strategy for cleanup at RSA has been presented to the regulatory agencies in two cleanup strategy documents, the *Installation-Wide Groundwater Cleanup Strategy* (Shaw, 2009a) and the *Installation-Wide Strategy for Cleanup of Impacted Wetlands* (Shaw, 2010a). These strategy documents have been designed to integrate groundwater units, surface media sites, and wetland areas by incorporating strategies (i.e., cleanup of surface media sites) to 1) ensure that the Army provides a systematic and uniform approach to investigating and remediating these areas to reach closure in an expeditious and fiscally responsible manner, and 2) ensure protection of potential receptors (i.e., implementation of the installation-wide groundwater land-use controls [LUC]) until final corrective measures result in chemicals of concern (COC) meeting the cleanup goals (CG) where applicable. The scope of the corrective measures for RSA-014S is consistent with these strategies. The selected corrective measures for RSA-014S will address the unacceptable risk to the potential current and future construction workers from trichloroethene (TCE) concentrations in surface soil within a future construction area. Without corrective measures, unacceptable risks would be present for potential current and future construction workers. No corrective measures are required for RSA-014N. Corrective measures are required for numerous COCs present as commingled plumes in groundwater under both RSA-014 parcels and will be addressed by the regional RSA-151 groundwater unit corrective measures. The selected corrective measures will also provide protection for site workers who may need to access RSA-014S for ongoing groundwater corrective measures/monitoring or construction activities in this area and potentially encounter munitions and explosives of concern (MEC).

B5.0 Site Characteristics

This chapter provides general information on the site characteristics of RSA-014 and identifies the components of the conceptual site models (CSM) for the site. Further discussion of the site characteristics is included in the RFI report (CB&I, 2017).

Topography in the vicinity of the two RSA-014 parcels is relatively flat, with ground elevations that range from approximately 556 to 566 feet above mean sea level within RSA-014N (Figure 1-2 in the CMI work plan) and from approximately 565 to 580 feet above mean sea level within RSA-014S (Figure 1-3 in the CMI work plan). RSA-014N is within the 100-year floodplain, on land owned by the Tennessee Valley Authority and permitted for use by the Army. A stream runs through the northeast corner of RSA-014N and feeds an embayment of the Tennessee River located northwest of the site (Figure 1-1 in the CMI work plan). A wetland complex consisting of palustrine forested and palustrine scrub/shrub wetlands associated with this stream is also located in the northeastern part of RSA-014N. The majority of RSA-014N is vegetated with mixed deciduous/coniferous forest. The southwest corner, located within the fenced OB/OD area, is primarily open grassland. The northeastern portion of RSA-014S is within the 100-year floodplain, but no water bodies or wetlands are located within the parcel (Figure 1-1 in the CMI work plan). RSA-014S is approximately 60 percent mixed deciduous/coniferous forest and 40 percent open grassland, with the grasslands located mostly in the central and western portions of the site.

Based on direct-push technology and auger refusal depths observed during intrusive fieldwork, overburden thickness ranges from approximately 43 to 86.8 feet in the vicinity of RSA-014N and from approximately 23.5 to 63 feet at RSA-014S. The average depth to groundwater is 9.10 feet below ground surface (bgs) at RSA-014N and 13.56 feet bgs at RSA-014S. The primary direction of groundwater flow across both parcels is to the north-northwest, toward the embayment to the Tennessee River northwest of RSA-014N.

The current unexploded ordnance (UXO) and chemical warfare materiel (CWM) probability ratings for RSA-014N are “Low” and “Unlikely.” The current UXO and CWM probability ratings for RSA-014S are “Moderate/High” and “Seldom.” The probabilities are shown on Figure 1-4 in the CMI work plan. The Army manages the current UXO and CWM probabilities under the site access control (SAC) program (Army, 2012), Master Planning (Army, 2013), and UXO construction support (Army, 2018) until permanent corrective measures are in place.

Conceptual Site Model. The final CSM includes the following main components:

RSA-014N

- No contamination is present in site soils at concentrations above human health screening values.
- Exposure to site soils poses no unacceptable risks to human health receptors, ecological receptors, or the environment.

RSA-014S

- Soil and groundwater TCE contamination resulted from historical waste solvent disposal in the two trenches from Thiokol Corporation rocket motor development activities. Additionally, TCE-contaminated surface soil remains east-southeast of the northern trench from a suspected past surface spill/leak of a TCE-based solvent presumably during the site's operational period.
- TCE is present in site surface soil at concentrations that pose a health hazard to potential current and future construction workers.
- Exposure to contaminants in soils poses no unacceptable risks to commercial workers, residential receptors, ecological receptors, or the environment.
- Based on existing soil and groundwater results, solvent disposed in the trenches has migrated to groundwater beneath the site. However, no source material remains in soil that could pose a continuing leaching threat to groundwater.
- MEC may be present based on a "Moderate/High" UXO probability and that a MEC investigation/clearance has not been conducted.

B6.0 Investigative Results

The RSA-014 RFI report (CB&I, 2017) evaluated the analytical results from all usable soil samples (RSA-014N and RSA-014S), sediment and surface water samples (RSA-014N only), and groundwater samples (evaluated as single unit for RSA-014N and RSA-014S) samples. All results are summarized in this section. However, only a figure for the TCE preliminary screening value (PSV) exceedances in soil, which is the subject of the corrective measures at RSA-014S, is included in the CMI work plan. All other soil and groundwater contaminant figures can be found in the RSA-014 RFI report (CB&I, 2017). The nature and extent of contamination results indicate the following:

Metals:

RSA-014S: All metals detected in surface and subsurface soil were determined to be naturally occurring except for one anomalous concentration of arsenic exceeding the background screening value (BSV) and the PSV in surface soil. The arsenic exceedance is delineated by sample results that are background related or naturally occurring.

RSA-014N: All metals detected in soil, surface water, and sediment were determined to be naturally occurring.

Groundwater: All metals in groundwater were determined to be naturally occurring except for two anomalous manganese concentrations exceeding the BSV and PSV. The manganese exceedances are delineated by concentrations that are naturally occurring.

Volatile Organic Compounds:

RSA-014S: In surface soil, one concentration of tetrachloroethene (PCE) and three concentrations of TCE exceeded PSVs. All exceedances of the PSV for PCE and TCE in surface soil are delineated by locations that are below PSVs. The source of the elevated TCE concentrations in surface soil is believed to be an undocumented spill or leak of a drum storing a TCE-based solvent some time during the site's operational period. In subsurface soil, three concentrations of TCE exceeded the PSV but two of these exceedances were determined to represent a component of groundwater contamination due to each boring's topographic location and the sample depths. Figure 2-1 in the CMI work plan presents the TCE concentrations in surface and subsurface soil above the PSV.

RSA-014N: All VOCs detected in soil, surface water, and sediment were less than the PSVs.

Groundwater: Fourteen VOCs were detected in groundwater at concentrations exceeding PSVs; TCE exhibited the highest concentrations and the greatest frequencies of detection and exceedance. Each VOC groundwater exceedance has been delineated on an RSA-014 site scale or on the broader scale of the RSA-151 groundwater unit.

Semivolatile Organic Compounds:

RSA-014S: All SVOC concentrations in surface and subsurface soil were below PSVs.

RSA-014N: All SVOCs detected in soil and surface water were less than the PSVs. SVOCs were not detected in sediment.

Groundwater: Seven SVOCs were detected in groundwater at concentrations above the PSVs; these exceedances have been delineated at the RSA-014 scale.

Explosive Compounds:

RSA-014S: All explosive compounds in surface soil were detected at concentrations below the PSVs or were nondetect. No explosives were detected in subsurface soil.

RSA-014N: Explosives were not detected in soil, surface water, or sediment.

Groundwater: Eight explosives were detected in groundwater at concentrations above the PSVs. The explosive exceedances in groundwater have been delineated on either an RSA-014 scale or on the broader scale of the RSA-151 groundwater unit.

Perchlorate:

RSA-014S: Perchlorate was detected in soil at concentrations below the PSV with the exception of one perchlorate concentration in subsurface soil. This subsurface soil exceedance possibly represents a component of groundwater contamination due to the sample depth. The exceedance in subsurface soil is delineated by locations that were less than the PSV.

RSA-014N: Perchlorate was not detected in surface soil and was present at concentrations below the PSV in subsurface soil. There were no detections of perchlorate in surface water or sediment.

Groundwater: Perchlorate was detected in groundwater at concentrations above the PSV. The exceedances in groundwater are delineated on the RSA-151 groundwater unit scale.

Chemical Agents/Agent Breakdown Products:

RSA-014S: Mustard and lewisite were not detected in surface or subsurface soil samples. No agent breakdown products were detected in soil.

RSA-014N: Mustard was not detected in surface or subsurface soil samples. The agent breakdown product thiodiglycol was detected in surface soil and sediment samples at concentrations below the PSV. Agent breakdown products were not detected in surface water.

Groundwater: Three agent breakdown products (thiodiglycol, 1,4-dithiane, and 1,4-oxathiane) were detected in groundwater samples at low concentrations below the PSVs, where established.

B7.0 Land and Resource Use

Current and Future Land Use. According to the Installation Master Plan, RSA-014 is located in an area designated as Industrial Zone, representing Range Operations, Explosive Operations, Storage, Test Areas, Open Space, and Buffer Zones. Both parcels lie adjacent to the

OB/OD area, with the southwest corner of RSA-014N falling within the OB/OD area (Figure 1-2 in the CMI work plan). Where practical, the Army has restricted entry into the RCRA solid waste management units by fencing them and/or placing warning signs at key entry points in accordance with the SAC program (Army, 2012). RSA-014S is currently fenced with 6-foot-high chain-link fencing with three-strand barbed wire along the top (Figure 1-1 in the CMI work plan). Both land parcels lie within the secure RSA boundary. Site redevelopment (e.g., construction of parking lots, buildings, or other structures) is anticipated in the future consistent with industrial uses, but residential or daycare facilities are not anticipated. Hunting is not currently permitted within RSA-014, and hunting is not planned for this site area in the future. Current and future land use options have restrictions in the RSA Master Plan due to the "Moderate/High" UXO probability at RSA-014S.

Current Groundwater Use. Groundwater under RSA-014 is not currently used for human consumption or any nonpotable purposes. RSA's installation-wide groundwater interim record of decision (IROD) (Shaw, 2007) and LUC remedial design (Shaw, 2009b) as implemented by the Army's SAC program (Army, 2012) prevent the current use of groundwater for potable purposes and ensure that any nonpotable uses of groundwater are reviewed and evaluated by the Army prior to being allowed.

Future Groundwater Use. Future use of groundwater under RSA-014 is possible. However, under the provisions of RSA's installation-wide groundwater IROD (Shaw, 2007) and the Army's SAC program (Army, 2012), future groundwater resources beneath RSA-014 and elsewhere on RSA may not be developed for potable purposes, and groundwater withdrawals for nonpotable uses must be managed until remedies are selected in the final decision documents for the various groundwater units within RSA, including the RSA-151 groundwater unit. In the meantime, as part of the Permit, ADEM has required that the Army perform annual monitoring of wells located within the RSA perimeter (ADEM, 2021). This annual monitoring will allow the Army and ADEM both to assess the rate of long-term groundwater recovery and ensure protection for residents living outside of the boundary of RSA (APTIM, 2020b and subsequent annual updates).

B8.0 Site Risks

An Alabama Risk-Based Corrective Action (ARBCA) human health risk evaluation and a screening-level ecological risk assessment (SLERA) are summarized in Sections B8.1 and B8.2. The MEC and fate and transport evaluations are summarized in Sections B8.3 and B8.4, respectively. Further detail is presented in the RFI report (CB&I, 2017).

B8.1 Human Health Risk

Receptors under current and future site use of RSA-014 consist of a commercial worker and a construction worker. A residential receptor is included in the risk assessment as a potential hypothetical future receptor. It is not anticipated that RSA-014 will be developed for residential use. Although Army risk regulations, policy, and guidance are to only evaluate those receptors that are actually at a site or that could reasonably be anticipated to occur, the risk assessment includes a residential use scenario only to comply with the Alabama Environmental Investigation and Remediation Guidance (ADEM, 2017a) and ARBCA guidance (ADEM, 2017b). In the Permit, ADEM requires that these guidance documents and approved risk assessment work plans (IT Corporation, 2002; Shaw, 2010b) be adhered to during environmental investigations and evaluations. RSA is legally mandated to comply with the Permit. At RSA, the hypothetical residential scenario is included in the Risk Management (RM)-2 human health risk assessment (HHRA) in order to determine whether a site is eligible for unrestricted use as defined in Alabama Administrative Code 335-5-1-.03(r) or support the use of LUCs as a component of the selected remedy. Therefore, risks to a residential site user receptor were assessed in this RM-2 HHRA.

All receptors were evaluated for exposure to soil and groundwater. Evaluation of groundwater exposure was conducted for the hypothetical development as a potable source. There is no current potable use of groundwater at RSA-014. An installation-wide groundwater IROD (Shaw, 2007) was instituted to prevent potable use and provide management control over nonpotable uses of all groundwater beneath RSA. RSA's SAC program was designed to be used at sites that have not had final remedy selection made (Army, 2012). The IROD is interim in nature and is not a final remedy. In order to design the final remedy, which may include LUCs, the potable use must be considered.

RSA-014N. No COCs were identified in RSA-014N soils. Although surface water and sediment samples were collected from the stream located in the northeastern corner of RSA-014N, the data from these samples were assessed in the RSA-151 groundwater unit RFI (APTIM, 2018) and not reassessed in the RSA-014 RFI (CB&I, 2017). The results of the RSA-151 RFI risk assessment concluded that constituents in surface water pose no unacceptable health threat to humans exposed in a recreational wading scenario. The analytical results from the sediment samples were not evaluated in the RSA-151 RFI risk assessment because exposure to sediment perennially covered with water is generally considered to be insignificant (EPA, 2002). No further evaluation of soil, surface water, or sediment within RSA-014N was required.

RSA-014S. Arsenic, perchlorate, benzo(a)pyrene, PCE, and TCE were identified as COCs in RSA-014S total soil and evaluated further in the RM-2 cumulative risk assessment.

Groundwater. Manganese, perchlorate, 10 explosive compounds, 7 polynuclear aromatic hydrocarbons (PAH), and 15 VOCs in groundwater (groundwater under RSA-014N and RSA-014S was evaluated as a single unit) were identified as COCs because their maximum detected concentrations exceed their PSVs. Barium, mercury, nickel, two SVOCs, and three VOCs were identified as COCs in groundwater only because they have maximum contaminant levels. The COCs in RSA-014 groundwater under both parcels were further evaluated in the RM-2 cumulative risk assessment.

RM-2 Cumulative Risk Assessment – RSA-014S and Groundwater. The ARBCA guidance (ADEM, 2017b) considers an individual excess lifetime cancer risk (IELCR) of 1E-05 to be the target cumulative risk. The target noncancer threshold is a hazard index (HI) of 1.0. Estimated cumulative risks/hazards at or below these target levels do not require additional action. The cumulative IELCR and HI estimates for RSA-014S are summarized in Table 2-1 in the CMI work plan. The conclusions of the RM-2 cumulative risk assessment, COCs requiring action in soil, and significant contributors to unacceptable risk in groundwater are summarized in Table 2-2 in the CMI work plan. The cumulative IELCR did not exceed 1E-05 for any of the receptor scenarios for exposure to RSA-014S soil. The cumulative HI did not exceed the threshold level of 1.0 for the commercial worker or hypothetical residential receptor. However, the cumulative HI for the construction worker exceeded the threshold of 1.0 due largely to the inhalation of TCE. TCE for the construction worker scenario was identified as the only COC in soil requiring action. The cumulative IELCR for exposure to groundwater hypothetically developed as a potable source exceeded the ADEM target level of 1E-05 for all receptors. Similarly, the cumulative HI for exposure to groundwater exceeded the threshold level of 1.0 for all receptors. A large number of COCs requiring action were identified for groundwater under RSA-014. Manganese, perchlorate, 5 explosive compounds (2,4,6-trinitrotoluene, 2,4-dinitrotoluene, 2,6-dinitrotoluene, 2-nitrotoluene, and RDX), 5 PAHs (1-methylnaphthalene, benzo[a]anthracene, benzo[b]fluoranthene, dibenz[a,h]anthracene, and indeno[1,2,3-cd]pyrene), and 15 VOCs were identified as COCs requiring action for groundwater for the residential receptor.

Vapor Intrusion Evaluation. The RFI report (CB&I, 2017) used the vapor intrusion evaluation methodology approved in the installation-wide work plan risk assessment supplements (Shaw, 2010b) and as updated based on current EPA guidance (EPA, 2015; 2018). For this evaluation, shallow subsurface soil gas samples were collected during the RFI and the risks were evaluated from exposure to indoor air concentrations of VOCs derived from the soil gas sample results. Soil gas results reflect both VOC vaporization in soil and dissolved phase groundwater but more importantly VOCs vaporizing from the dense nonaqueous-phase liquid concentration-level plume that is located beneath the southern trench at RSA-014S. Calculated attenuation factors were derived using site-specific soil and groundwater parameters and applied to the maximum soil gas concentrations of VOCs detected to derive calculated indoor air concentrations. These concentrations were compared to screening values calculated using the Vapor Intrusion Screening Level calculator. All detected VOCs in soil gas samples occurred at maximum concentrations less than screening values based on risks of 1E-6 or a hazard quotient of 1. Therefore, the RFI report concluded that VOCs in soil, soil gas, and groundwater at RSA-014 do not represent a source that would pose an unacceptable health threat to occupants in the event that buildings are erected on the site in the future.

B8.2 Ecological Risk

The SLERA for RSA-014 (CB&I, 2017) was conducted in accordance with the guidelines set forth in the ARBCA guidance manual (ADEM, 2017b), the RSA installation-wide work plan (IT Corporation, 2002), and the final SLERA supplements to the installation-wide work plan (Shaw, 2010b). A SLERA was performed in order to determine if the site is eligible for no further action in accordance with ADEM requirements. Note that the SLERA evaluation relies on ecological screening values (ESV) rather than on the human-health based PSVs.

RSA-014N. Surface soil data for RSA-014N were compared to their respective BSVs (as applicable) and ESV. Comparison of surface soil data to their respective ESVs and BSVs identified magnesium and thiodiglycol as preliminary chemicals of potential ecological concern (COPEC) that required further evaluation. All of the other constituents detected in surface soil at RSA-014N were detected at concentrations less than their respective ESVs and/or BSVs and considered to pose negligible ecological hazards.

The COPEC refinement process concluded that no further evaluation was warranted for magnesium in surface soil at RSA-014N because concentrations of magnesium are considered background related and magnesium is a nutrient that is essential to growth and development of plants and animals and is easily regulated by most organisms.

The COPEC refinement process concluded that thiodiglycol warranted further evaluation for potential impacts to community-level receptors, but further assessment for food chain effects was not warranted because it is not bioaccumulative. Quantitative assessment of the potential effects of thiodiglycol in surface soil on terrestrial plant and invertebrate communities was not possible due to the lack of screening values for thiodiglycol in soil. Because the area of soil potentially impacted by thiodiglycol is so small (approximately 11 percent of the area of RSA-014N), thiodiglycol is unlikely to pose hazards to terrestrial invertebrate or terrestrial plant community segments that occur at RSA-014N. The small size of the impacted area at this site (less than 3 acres) and the absence of special status species or habitats result in an insufficiency of ecological resources to warrant ecological concerns. The results of the SLERA indicate that no ecological hazards are present. Further evaluation of ecological hazards at RSA-014N is not warranted.

RSA-014S. Surface soil data for RSA-014S were compared to their respective BSVs (as applicable) and ESVs. Comparison of surface soil data to their respective BSVs and ESVs identified arsenic, cadmium, calcium, cobalt, copper, mercury, zinc, perchlorate, bis(2-ethylhexyl)phthalate, di-n-butyl phthalate, 1,1,1-trichloroethane, bromomethane, cis-1,2-dichloroethene (DCE), PCE, trans-1,2-DCE, and TCE as preliminary COPECs in surface soil that required further assessment. All of the other constituents detected in surface soil at RSA-014S were detected at concentrations less than their respective ESVs and/or BSVs and determined to pose negligible ecological hazards.

Based on the results of the screening evaluation and COPEC refinement, perchlorate, 1,1,1-trichloroethane, bromomethane, cis-1,2-DCE, PCE, trans-1,2-DCE, and TCE warranted further evaluation for potential impacts to community-level receptors, but further assessment for food chain effects was not warranted because these constituents are not bioaccumulative. The screening evaluation and COPEC refinement also determined that arsenic, copper, bis(2-ethylhexyl)phthalate, and di-n-butyl phthalate warranted further evaluation for potential impacts to community-level receptors and food chain receptors.

The results of the community-level (terrestrial invertebrate and terrestrial plant) assessment for RSA-014S concluded that the small size of the impacted area at this site (less than 3 acres) and the absence of special status species or habitats result in an insufficiency of ecological resources to warrant ecological concerns. The calculated hazard quotients for food chain receptors based on the maximum detected concentrations and lowest-observed-adverse-effects level-based food chain screening values were less than 1.0 for arsenic, copper, bis(2-ethylhexyl)phthalate, and di-n-butyl phthalate. These results indicate that adverse impacts to local populations of food chain receptors from exposure to arsenic, copper, bis(2-ethylhexyl)phthalate, and di-n-butyl phthalate in surface soil at RSA-014S are not expected. The results of the SLERA indicate that no ecological hazards are present. Further evaluation of ecological hazards at RSA-014S is not warranted.

B8.3 MEC Evaluation

A MEC investigation was not conducted at RSA-014S, which is not within the Military Munitions Response Program. However, the Army has assigned a "Moderate/High" UXO probability to this area based on its location within the OB/OD safety fan and the potential for UXO to have been disposed in the trenches. MEC has not been found at RSA-014S during the numerous field investigations conducted at this site; however, anomaly avoidance has been practiced during intrusive investigations.

Although RSA-014 is a hazardous and toxic waste site and not a munitions response site (MRS) in the Military Munitions Response Program, a Munitions Response Site Prioritization Protocol (MRSPP) score has been calculated as part of the CMI work plan (Appendix J) to evaluate the potential explosive hazards associated with conventional MEC, determine the relative risks posed by MEC at this site, and assist the Army in decision-making if LUCs should be implemented. The Army has provided unofficial guidance that sites with MRSPP scores of 1 or greater require LUCs to protect site receptors.

MRSPP. The MRSPP is a methodology developed by the U.S. Department of Defense (DoD) to assess the relative risks and assign a relative priority to MRSs (DoD, 2007). The MRSPP uses three modules to evaluate hazards associated with a site:

1) The Explosive Hazard Evaluation (EHE) module – This module evaluates the hazards associated with MEC (including UXO, discarded military munitions, and munitions constituents [MC] at high enough concentrations to pose an explosive hazard).

2) The Chemical Warfare Materiel Hazard Evaluation (CHE) module – This module addresses CWM and associated hazards.

3) Health Hazard Evaluation (HHE) module – This module examines risks associated with human and ecological exposures to MC and other contaminants that may be present at the site.

Module ratings are indicated by a letter "A" through "G," with "A" being the highest rating (highest priority) and "G" being the lowest rating (lowest priority). When a letter rating is not appropriate, an MRS may be assigned one of three alternative module ratings: Evaluation Pending, No Longer Required, or No Known or Suspected Explosive Hazard.

The MRS priority is determined by comparing the MRS ratings of the EHE, CHE, and HHE hazard evaluation modules. The approach is to assign an MRS priority based on the greatest potential hazards posed by UXO, discarded military munitions, or MC. Therefore, the MRS priority is the single highest priority of the three hazard evaluation modules. The priority assigned to an MRS may be one of eight numerical priorities, 1 through 8, or one of the three previously mentioned alternative MRS ratings. The MRS priority scale is such that the lowest numerical priority represents the highest potential hazard. Thus, a Priority 1 MRS contains the highest potential hazard, while a Priority 8 MRS contains the lowest potential hazard.

The results of applying the protocol to RSA-014S are as follows:

- EHE Module: E
- CHE Module: F
- HHE Module: B
- MRS Priority: 3.

The completed MRSPP tables are presented in Appendix J. Since the MRS score is 1 or greater, LUCs are needed at RSA-014S to protect site receptors from the possibility of encountering MEC.

B8.4 Contaminant Fate and Transport

At RSA-014, the primary contaminant migration pathway is dissolution of site-related chemicals from soil to form leachate and the subsequent transport to the water table resulting from the downward percolation of infiltrating rainfall. Overland transport of soil contaminants by wind or water is unlikely at RSA-014 because the site is relatively level and partially vegetated.

A contaminant migration assessment for RSA-014 was conducted for the two separate parcels, RSA-014N and RSA-014S. Constituents detected in soil samples associated with RSA-014N did not identify any chemical concentrations that exceeded RSA-specific soil screening levels. Therefore, it was concluded that soils at RSA-014N do not represent a leaching threat to groundwater. Based on concentrations of chemicals in soil at RSA-014S, seven constituents (arsenic, perchlorate, naphthalene, cis-1,2-DCE, methylene chloride, PCE, and TCE) were evaluated for the potential to leach from soil to groundwater at concentrations that would result in adverse impacts to groundwater. Of the seven constituents evaluated, none were determined to represent a current or future leaching threat to groundwater (CB&I, 2017).

Elevated concentrations of TCE were observed in surface soil samples only with a maximum detected concentration of 44.8 milligrams per kilogram (mg/kg). Although the volatilization rate of TCE on the soil surface (within the top few inches) is rapid, if the TCE release migrated to shallow surface soil, for example below 6 inches, this would greatly increase the half-life of TCE in soil. As detailed in the fate and transport discussion of the Agency for Toxic Substances and Disease Registry (ATSDR) toxicological profile for TCE, TCE volatilization decreases with increased organic carbon content in soil (ATSDR, 2019). Soils at RSA, especially surficial soils, have a relatively high total organic carbon content for a clay-based soil (Shaw, 2011). In addition, desorption of TCE from inorganic mineral surfaces like those available in abundance in clay soils is much lower than predicted from sorption-desorption calculations. For these reasons, it is plausible that a TCE spill of relatively pure product to surface soils would have persisted in the deeper portion of the surficial soil layer at concentrations in the low part per million range.

B9.0 Objectives of the Corrective Measures and Cleanup Goals

The RFI conducted at RSA-014 defined the nature and extent of contamination and concluded that former operations resulted in TCE-contaminated surface soil within RSA-014S that poses an unacceptable risk to current and future construction workers if construction is conducted at this site. Site soils within RSA-014S do not pose an unacceptable risk to the groundskeeper, hypothetical residential receptors, or ecological receptors or a leaching threat to groundwater. No COCs were identified in soil, surface water, or sediment at RSA-014N, and this parcel received ADEM concurrence for no further action (CMI work plan Appendix A). COCs in groundwater under both parcels also received ADEM concurrence for performing corrective measures as part of the RSA-151 groundwater unit (CMI work plan Appendix A). Additionally, corrective measures are needed to address the “Moderate/High” UXO probability for RSA-014S.

The corrective measure objectives (CMO) for RSA-014S are as follows:

- Prevent or reduce potential current and future construction worker exposure to TCE in surface soil such that no unacceptable hazard or risk is present.
- Prevent direct human contact with MEC.

CGs are relevant to alternatives that reduce concentrations, such as excavation and off-site disposal. ADEM (2017a) considers a total (cumulative) IELCR of 1E-05 as the trigger level at which risk-based target levels must be developed to guide site management. RSA must use ADEM’s risk threshold as required under the Permit (ADEM, 2021).

For RSA-014S, TCE was identified as a COC requiring action in shallow soil for the construction worker. The RFI (CB&I, 2017) identified a risk-based target level for soil (RFI report Table D-27) for TCE for the construction worker of 1.3 mg/kg at an HI of 1.0, the ADEM cumulative limit. This value is selected as the CG for soil, as shown in Table 3-2 in the CMI work plan. TCE concentrations from three surface soil samples (014S-HP012, 014S-SB002, and 014S-SB004) exceed the 1.3 mg/kg CG (Figure 3-1 in the CMI work plan).

As stated previously, one of the CMOs is to prevent direct human contact with MEC. This objective would be achieved by applying LUCs, and therefore CGs are not applicable for this objective.

B10.0 Description and Comparison of Alternatives

The contamination in surface soil is limited to three relatively small areas of concentrations of TCE exceeding the CG; therefore, a focused CMS report (APTIM, 2020a) was prepared for RSA-014S in accordance with EPA (1994) guidance. A typical comprehensive corrective action technology screening process is not required for the focused CMS for RSA-014S; instead, a presumptive corrective measure alternative (excavation and off-site disposal), along with the no-action alternative, were developed and evaluated in detail against a number of criteria, including technical feasibility, cost, effectiveness in cleaning up the contamination, and protection of human health and the environment. The no-action alternative is required to be retained in the evaluation process as a baseline for comparison purposes. Although not part of the final CMS report for RSA-014S, ADEM has requested protection of potential receptors to MEC potentially present in the two disposal trenches from historical activity or from the site's location within the safety fan for the OB/OD units. Since MEC has not been found at RSA-014S to date, an action to conduct a MEC investigation and removal is not needed. The Army has added LUCs as a component of Alternative 2 to provide this necessary long-term protection.

The two corrective measure alternatives are discussed below and were subjected to a detailed analysis in the focused CMS:

- ***Alternative 1:*** No Action. Under the no-action alternative, no corrective measures would be taken to address the TCE-contaminated surface soil posing an unacceptable human health risk at RSA-014S and the potential for MEC. Because this alternative would not be protective of human health for the construction worker or for receptors who might encounter MEC, it was not considered a candidate for implementation but presented a baseline for the comparison of anticipated risk reduction and costs between other retained alternatives.

- ***Alternative 2:*** Excavation and Off-Site Disposal and LUCs. TCE-contaminated soils at RSA-014S would be excavated and transported for disposal at an approved landfill. The excavation would then be backfilled with clean soil to complete site restoration. Due to the "Moderate/High" UXO probability, LUCs are needed in order to protect human receptors from risks posed by MEC which may be present at the site.

Because Alternative 2 is an effective technology, will achieve the CG, meets requirements as specified in the Army's guidance for Defense Environmental Restoration Program (DoD, 2018), and ranks high or moderate in all evaluation criteria compared to Alternative 1 (no action), it was recommended as the preferred corrective measure alternative for soil at RSA-014S.

B11.0 Selected Corrective Measure

Alternative 2 was selected as the most appropriate corrective measure alternative to address TCE-contaminated surface soil and LUCs to address the potential MEC at RSA-014S. The major components of the selected corrective measures include the following:

- Preparation of a CMI work plan through ADEM approval.
- Site preparation including surface clearance of potential MEC items (utilization areas [e.g., ingress/egress areas, laydown areas, soil stockpile, etc.]), placement of erosion and storm water controls, vegetation/tree clearing as needed, utility clearance and marking, surveying and marking of proposed excavation areas, and protection of monitoring wells in the vicinity of excavation areas
- Surface clearance and subsurface removal for potential MEC items within the planned excavation areas
- Removal of contaminated soils exceeding the CG of 1.3 mg/kg (approximately 80 loose cubic yards with 2-foot depth planned)
- Collection and analysis of soil confirmation samples to confirm that TCE concentrations remaining in soil are equal to or below the CG
- Collection of samples from excavated soil for waste characterization
- Transport of TCE-contaminated soil for final disposal at an approved off-site facility
- MEC and munitions debris disposal, if necessary
- Site restoration, including application of backfill and topsoil, and revegetation with approved grass mixtures
- Implementation of LUCs to restrict site access and intrusive activity without proper on-site UXO construction support including posting of signage and initial fencing inspection; outline land use restrictions in RSA Property Master Plan; conduct annual LUC inspections, sign/fence repairs, and reporting; and comply with requirements in Alabama Administrative Code r. 335-5-1-02(3)(a).

Following a surface clearance and subsurface removal of potential MEC at the planned excavation areas, TCE-contaminated soil will be excavated and disposed off site at an approved landfill. This alternative involves the excavation of three areas, one area of 100 square feet around sample point 014S-HP012, a second area of 100 square feet around soil boring 014S-

SB002, and a third area of approximately 625 square feet around sample boring 014S-SB004 for a total soil volume of 80 loose cubic yards. TCE concentrations in surface soil (i.e., 0 to 1 foot bgs) at these sample locations exceed the CG of 1.3 mg/kg (CMI work plan Figure 4-1). For the three areas, the planned excavation depth is 2 feet bgs, given an overexcavation depth of 1 foot into subsurface soil. The excavated areas would be backfilled with clean fill from an approved borrow area and topsoil, sloped to drain, and revegetated to minimize erosion. The Army will submit a draft Notice of Environmental Use Restriction (NEUR) with ADEM as part of the CMI report. Once finalized, this NEUR will restrict land use to industrial and require inspection, maintenance of signage and fencing, and require on-site UXO construction support during site access and intrusive activities. The NEUR is incorporated into the RSA Master Plan and in the land records for the property in accordance with Alabama Administrative Code 335-5-.02(3)(a)(1)(iv) (ADEM, 2019).

The corrective measures in Alternative 2 address the soil contamination in a manner that is cost-effective and would be protective of the construction worker, and they provide the best balance of trade-offs among the other corrective measures alternatives with respect to the evaluation criteria. The implementation of LUCs for MEC protects future site receptors to potential MEC at the site. Alternative 2 meets the four general ADEM standards for corrective measures (overall protection of human health and the environment, attainment of media cleanup standards, control of sources of the release, and compliance with standards for management of wastes).

B12.0 Public Involvement

Public participation requirements specified under Alabama Administrative Code r. 335-14-8-.08(6) will be met during the permit modification process for the RSA-014 corrective measure. In addition, the Army will inform the public of the proposed RSA-014 corrective measure in a newspaper announcement in local newspapers.

B13.0 Conclusions

This request for permit modification presents the supporting information needed to allow ADEM to modify the Permit, in accordance with Alabama Administrative Code r. 335-14-8-.04(2), with respect to cleanup status at RSA-014. As part of the RFI report, the Army requested that ADEM move this site from Table VI.2 to Table VI.6 in the Permit and list it as requiring corrective measures for soil and groundwater. ADEM subsequently moved RSA-014 to Table VI.6 in Permit Modification No. 11 (ADEM, 2018) as requiring action for soil and groundwater.

B14.0 References

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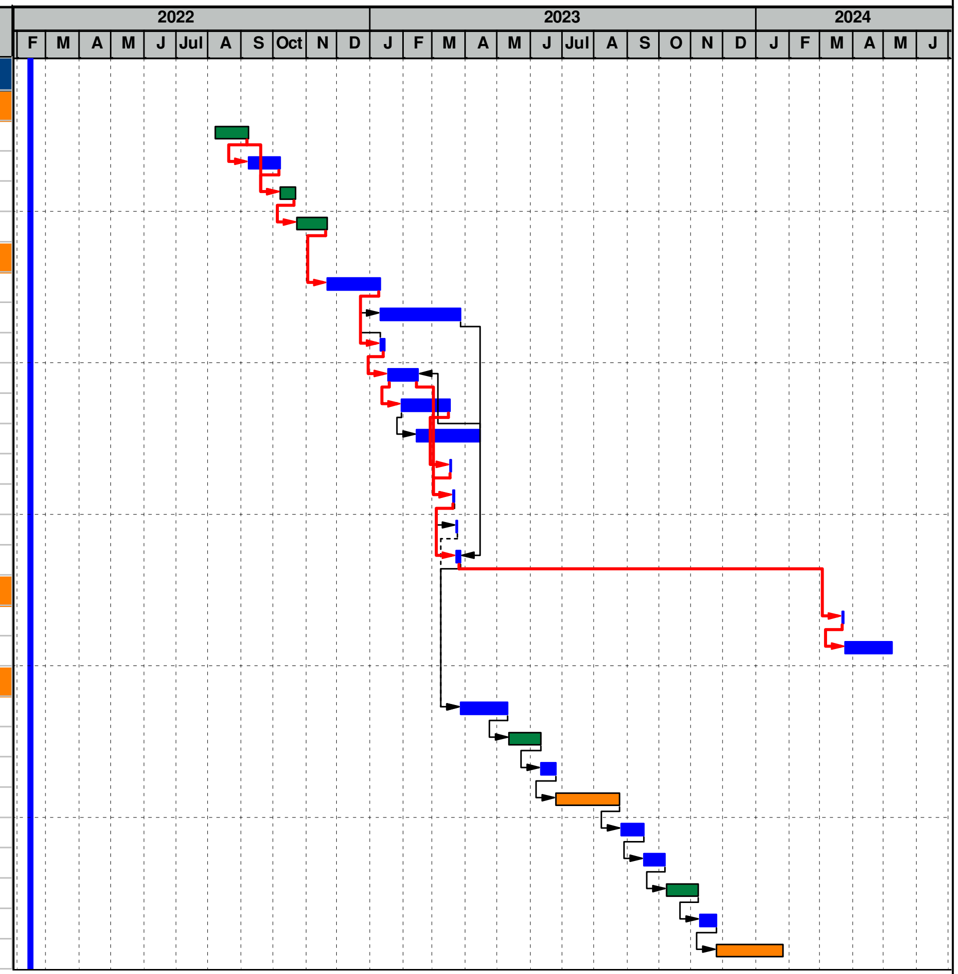
APPENDIX C

CORRECTIVE MEASURES IMPLEMENTATION SCHEDULE

RSA-014S Corrective Measures Implementation *

Activity Name	OD	Start	Finish
RSA-014S Corrective Measures Implementation	640	08-Aug-22	08-May-24
RSA-014 CMIP CMI Contracting	106	08-Aug-22	21-Nov-22
Army Request for Bids	30	08-Aug-22*	07-Sep-22
Contractor Proposal Preparation	30	08-Sep-22	07-Oct-22
Army Bid Evaluation	15	08-Oct-22	22-Oct-22
Army Award Contract for CMI	30	23-Oct-22	21-Nov-22
RSA-014 CMIP CMI Construction	145	22-Nov-22	15-Apr-23
CMI Procurement Package	45	22-Nov-22	10-Jan-23
CMI Fieldwork Oversight and Onsite UXO Support	74	11-Jan-23	27-Mar-23
Mobilization, Vegetation Clearance, Surveying, BMP Installation	5	11-Jan-23	15-Jan-23
Excavation of Contaminated Soil/Debris	30	17-Jan-23	15-Feb-23
Confirmation Sampling and Laboratory Analysis	45	31-Jan-23	17-Mar-23
CMI Data Management and Data Validation	60	14-Feb-23	15-Apr-23
Loadout and Off-site Disposal of Contaminated Soil	2	18-Mar-23	19-Mar-23
Backfill	3	20-Mar-23	22-Mar-23
Install LUC Signs and inspect fencing	2	23-Mar-23	24-Mar-23
Site Restoration and Demobilization	5	23-Mar-23	27-Mar-23
RSA-014 CMI LUC Inspections	47	23-Mar-24	08-May-24
LUC Inspection with on-site UXO Support **	2	23-Mar-24	24-Mar-24
LUC Inspection Report	45	25-Mar-24	08-May-24
RSA-014 CMIP CMI Report	295	28-Mar-23	26-Jan-24
CMI Report, Rev 0 - Army	45	28-Mar-23	11-May-23
Army Review CMI Report, Rev 0	30	12-May-23	11-Jun-23
Submittal of CMI Report, Rev 0 to ADEM-EPA	14	12-Jun-23	25-Jun-23
Regulatory Review CMI Report, Rev 0	60	26-Jun-23	25-Aug-23
Response to Regulatory Comments CMI Report, Rev 0	21	26-Aug-23	16-Sep-23
Prepare and Submit CMI Report, Rev 1 to Army	21	17-Sep-23	07-Oct-23
Army Review CMI Report - Rev 1	30	08-Oct-23	07-Nov-23
Submittal of CMI Report, Rev 1 to ADEM-EPA	14	08-Nov-23	24-Nov-23
Regulatory Review CMI Report, Rev 1	60	25-Nov-23	26-Jan-24



* Start Date dependant on Permit Modification following ADEM concurrence on Corrective Measure Implementation Work Plan

** Inspections continue on an annual basis until such time that the Army demonstrates to ADEM's satisfaction that no residual munitions and explosives of concern remain in the subsurface.

Corrective Measures Contract...
Army
ADEM

Data Date: 14-Feb-22

APPENDIX D

QUALITY ASSURANCE PROJECT PLAN

Appendix D

Quality Assurance Project Plan
for the
Corrective Measures
RSA-014S
U.S. Army Garrison-Redstone
Madison County, Alabama
U.S. EPA ID No. AL7 210 020 742

Contract Number W912DY-17-D-0003
Delivery Order No. W912DY-19-F-1116

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March 2022

List of Quality Assurance Project Plan Worksheets

List of Attachments

D1.0 Introduction

This quality assurance project plan (QAPP) has been prepared to guide the conduct of corrective measures for RSA-014S. This QAPP is an appendix to the corrective measures implementation (CMI) work plan for RSA-014S. This QAPP has been prepared as a site-specific plan under the *Final Revision 4 Installation-Wide Uniform Federal Policy Quality Assurance Program Plan, U.S. Army Garrison-Redstone, Madison County, Alabama* (HydroGeoLogic, Inc., 2019) or most recent version.

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Worksheet Nos. 1 and 2: Title and Approval Page

Site Name/Project Name	Redstone Arsenal, Madison County, Alabama/Huntsville MEGA
Site Location	RSA-014, Unlined Inactive Burn Trenches, Unit #2
Site Number/Code	RSA-014
Operable Unit (OU)	OU-14
Contractor Name	Aptim Federal Services, LLC (APTIM)
Contract Number	W912DY-17-D-0003
Contract Title	Corrective Measures Implementation at Multiple Sites, Redstone Arsenal
Delivery Order	W912DY-19-F-1116
Guidance used to prepare site-specific plan	Aptim Federal Services, LLC (APTIM), 2020, *Revised Final Focused Corrective Measures Study Report, RSA-014, Unlined Inactive Burn Trenches, Unit #2, Operable Unit 14, U.S. Army Garrison-Redstone, Madison County, Alabama*, Prepared for U.S. Army Engineering and Support Center, Huntsville, April. Aptim Federal Services, LLC (APTIM), 2018, *Statement of Basis/Decision Document, RSA-014, Unlined Inactive Burn Trenches, Unit #2, Operable Unit 14, U.S. Army Garrison-Redstone, Madison County, Alabama*, Prepared for Mission & Installation Contracting Command, June. CB&I Federal Services LLC (CB&I), 2017, *Revision 1 RCRA Facility Investigation Report, RSA-014, Unlined Inactive Burn Trenches, Unit #2, Operable Unit 14, U.S. Army Garrison-Redstone, Madison County, Alabama*, Prepared for Mission & Installation Contracting Command, August. Intergovernmental Data Quality Task Force, 2005, *Uniform Federal Policy for Quality Assurance Project Plans.* IT Corporation (IT), 2002a, *Draft Installation-Wide Work Plan, Revision 2, Redstone Arsenal, Madison County, Alabama,* prepared for the U.S. Army Corps of Engineers, Savannah District, June. Shaw Environmental, Inc. (Shaw), 2010, *Installation-Wide Work Plan, Final Appendices B, C, D, E, F, Redstone Arsenal, Madison County, Alabama*, September. U.S. Army Corps of Engineers, 2015, Technical Guidance for Military Munitions Response Action, Engineer Manual 200-1-15, 30 October. U.S. Department of Defense (DoD), 2019, *Quality Systems Manual for Environmental Laboratories* Version 5.3, May.

Worksheet Nos. 1 and 2: Title and Approval Page

	U.S. Environmental Protection Agency (EPA), 2014, *National Functional Guidelines for Superfund Inorganic Data Review*, EPA 540-R-013-001, August U.S. Environmental Protection Agency (EPA), 2014, *EPA National Functional Guidelines for Superfund Organic Methods Data Review*, EPA 540-R-014-002, August.
Regulatory Program	Resource Conservation and Recovery Act (RCRA), ADEM Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), EPA Region 4
Approval Entities	U.S. Army Garrison – Redstone; U.S. Army Engineering and Support Center, Huntsville (CEHNC); Alabama Department of Environmental Management (ADEM)
Work Plan	☒ Corrective Measures Implementation ☐ Generic Field Sampling Plan
Dates of Scoping Session	June 11, 2020 (see Attachment D-1)
Dates and Titles of SFSP Documents Written for Previous Site Work (if applicable)	References for documents used to prepare the CMI Work Plan are included in Chapter 6.0 of the CMI Work Plan.
Organizational Partners (stakeholders) and Their Connection with Lead Organization	U.S. Army Garrison-Redstone – Site manager for RSA-014 and point of contact with regulators. CEHNC – Oversees APTIM's performance under this contract. ADEM – State regulator overseeing RSA environmental and remediation activities. EPA, Region 4 – Federal regulator overseeing RSA environmental and remediation activities.
Data Users	CEHNC, Project/Task Leads, Engineering, support personnel, U.S. Army Garrison-Redstone, ADEM, EPA Region 4

Worksheet Nos. 1 and 2: Title and Approval Page

The below signatures indicate the representatives of the subject organizations have reviewed this RSA-014S-specific QAPP and concur with its implementation as written.

Review:

Vicki Graves | 03/31/2022

Vicki Graves
APTIM Project Chemist

Date

Approval:

Donnie C. Burton
Digitally signed by Donnie C. Burton
Date: 2022.03.31 14:37:24 -04'00'

03/31/2022

Don Burton, PE
APTIM Project Manager

Date

ROESKE.ASHLEY.ELIZABETH.1277832069
Digitally signed by ROESKE.ASHLEY.ELIZABETH.1277832069
Date: 2022.03.31 14:51:51 -05'00'

Ashley Roeske
USACE Project Manager/
Contracting Officer Representative

Date

Worksheet Nos. 3 and 5: Project Organization and QAPP Distribution

CMIP Recipients	Title	Organization	Telephone Number	E-mail Address
Ashley E. Roeske	Contracting Officer Representative	U.S. Army Engineering & Support Center, Huntsville	256-895-1429	Ashley.E.Roeske@usace.army.mil
Clint Howard	Chief Installation Restoration Branch	U.S. Army Garrison - Redstone	256-842-3702	joseph.c.howard1.civ@mail.mil
Bob Gorman	Army Site Task Manager	U.S. Army Garrison - Redstone	256-348-1812-	Robert.p.gorman10.civ@mail.mil
TBD	Lead Remedial Project Manager	ADEM	TBD	TBD
Dr. Heather McDonald, PE	Technical Manager	U.S. Army Engineering & Support Center, Huntsville	256-895-1892	Heather.B.Mcdonald@usace.army.mil
Don Burton, PE	Project Manager	APTIM	865-207-1394	Don.burton@aptim.com
Dennis Seymore	Senior Scientist	APTIM	865-414-6073	Dennis.seymore@aptim.com
Emily Davis	Regulatory Specialist	APTIM	717-737-1049	Emily.davis@aptim.com
Tricia Felt	Corporate Quality Management Director	APTIM	303-741-7426	Tricia.felt@aptim.com
Brian Rhodes	Project QA/QC Manager/Quality Control Site Manager (QCSM)	APTIM	256-714-4200	Brian.rhodes@aptim.com
Vicki Graves	Project Chemist	APTIM	865-310-6773	Vicki.graves@aptim.com
Gail Cooley	Site Technical Lead	APTIM	865-556-1967	Gail.cooley@aptim.com
Ken Hurley, PE	Project Engineer	APTIM	865-560-7831	Kenneth.hurley@aptim.com

Notes:

TBD – To be determined.

Copies of the corrective measures implementation work plan which contains the QAPP will be distributed to the individuals above.

One controlled hard copy of the corrective measures implementation work plan which contains the QAPP will be maintained in the field trailer as a reference for field workers. The field team members are required to be familiar with their applicable contents through required reading and the sign-off acknowledgement sheet. The QCSM will be the owner of the field copy and standard operating procedures (SOP) and will be responsible to ensure that it is current and that all field sampling personnel have read the work controlling documents and have signed the acknowledgement form.

Worksheet Nos. 3 and 5: Project Organization and QAPP Distribution

Acknowledgement Form

Project Personnel	Title	Telephone Number	Signature	Date CMI Work Plan Read

The individuals who sign above are certifying they have read the applicable sections of the Quality Assurance Project Plan and the corrective measures implementation (CMI) work plan. Upon completion, please forward the original signed form, with all columns completed, to the Corporate Quality Management Director.

Worksheet No. 4, 7, and 8: Personnel Qualifications and Sign-off Sheet

Name	Title	Organizational Affiliation	Responsibilities	Minimum Required Qualifications/Specialized Training/Certifications	Signature/ Date
Ashley Roeske	Contracting Officer Representative	CEHNC	Designate environmental coordinators for Contract No. W912DY-17-D-0003, Delivery Order (DO) W912DY-19-F-1116. Represent the Army's interests in the coordination and implementation of the DO for which they are responsible.	Specified by Army Corp of Engineers requirements	
Bob Gorman	Army Site Manager	U.S. Army Garrison - Redstone	Responsible for the coordination and implementation of the site-specific corrective measure tasks associated with RSA-014, including all technical and regulatory issues.	Specified by Army requirements	
Don Burton, PE	Project Manager	APTIM	Primary POC for coordination with Redstone Arsenal leadership, AEC, CEHNC, regulators, and stakeholders. Plans/administers RSA's assigned corrective measures, including IAP/CTC. Develops and oversees execution of the strategic plan. Responsible for performance, cost/schedule control, estimating, quality, safety in accordance with PWS, PMP, contract requirements, and applicable laws/regulation. Approves staff assignments and oversees PMs on DO. Responsible for monthly progress and cost reporting and change management in response to RSA's mission needs.	(1) A college degree in business, engineering, construction management, geology, chemistry, or related field. (2) Professional registration, in their respective field, if appropriate. (3) Fifteen years experience in Program Management for other contracts and programs, with a minimum of 7 years working experience in Environmental Remediation sites for contracts and programs of similar size and complexity, and oversight of project managers and project teams.	

Worksheet No. 4, 7, and 8: Personnel Qualifications and Sign-off Sheet

Name	Title	Organizational Affiliation	Responsibilities	Minimum Required Qualifications/Specialized Training/Certifications	Signature/ Date
Dennis Seymore	Senior Scientist	APTIM	Primary POC for technical coordination of Redstone Arsenal Contract No. W912DY-17-D-0003, Delivery Order W912DY-19-F-1116 activities. Oversees the activities of all APTIM personnel; ensures compliance with the scope of work and environmental activities and controls project consistency. Additional responsibilities include review and approval of the CMI Work Plan including the QAPP, Health and Safety Plan, and other project-specific attachment and plans; assignment of duties to project staff, including orientation of staff to project needs and requirements; and evaluation of training needs for the project staff. Provides budget and schedule control; reviews any subcontractor work and approves subcontract invoices; establishes the project record management system; ensures that major project deliverables are reviewed for technical accuracy and completeness before release; and ensures that QAPP requirements are satisfied. Provides the Army with an alternative POC for the RSA Contract No. W912DY-17-D-0003, Delivery Order W912DY-19-F-1116 activities.	(1) A college degree in engineering, construction management, geology, chemistry, or related field. (2) Professional registration, in their respective field, if appropriate. (3) Ten years experience in technical leadership for other contracts/programs with a minimum of 7 years working experience in Environmental Remediation sites of similar complexity and scope.	
Ken Hurley, PE	Senior Engineer	APTIM	Provides engineering direction for corrective measures design and provides PE certification of the CMIP.	(1) A college degree in engineering (2) Professional registration in engineering. (3) Ten years experience in engineering leadership for other contracts/programs with a minimum of 7 years working experience in Environmental Remediation sites of similar complexity and scope.	

Worksheet No. 4, 7, and 8: Personnel Qualifications and Sign-off Sheet

Name	Title	Organizational Affiliation	Responsibilities	Minimum Required Qualifications/Specialized Training/Certifications	Signature/ Date
Emily Davis	Regulatory Specialist	APTIM	Single POC responsible for coordination with Army on regulatory issues. Determines applicable regulatory requirements; ensures compliance; negotiates proposed remedies with regulators; determines ARARs, evaluates alternative cleanup methods; and supports Army in resolving legal, regulatory, and policy concerns.	(1) An advanced college degree in law, engineering, public administration, construction management, geology, chemistry, or related field. (2) Professional registration, in their respective field, if appropriate. (3) Ten years experience in regulatory requirements for other contracts/programs with a minimum of 7 years working experience in Environmental Remediation sites, to include innovative approaches to regulatory and technical challenges such as successful experience in developing technical impracticability waivers.	
Tricia Felt	Corporate Quality Management Director	APTIM	The Corporate Quality Management Director for the RSA Contract No. W912DY-17-D-0003, Delivery Order W912DY-19F-1116 activities is responsible for ensuring the overall project quality. The Corporate Quality Management Director coordinates with the technical managers of the project team to evaluate status, procedures, and nonconformances from a quality program standpoint. Other responsibilities may include the following:	(1) A college degree in engineering, construction management, geology, chemistry, or related field and professional registration. (2) Professional registration, in their respective field, if appropriate. (3) A minimum of 5 years Quality Assurance/Control experience, with a minimum of 3 years in Environmental Remediation projects.	

Worksheet No. 4, 7, and 8: Personnel Qualifications and Sign-off Sheet

Name	Title	Organizational Affiliation	Responsibilities	Minimum Required Qualifications/Specialized Training/Certifications	Signature/ Date
Tricia Felt (Continued)	Corporate Quality Management Director	APTIM	• The Corporate Quality Management Director gathers and coordinates corporate resources and references in the areas of quality improvement, corrective action (CA) control, and quality systems auditing for the project. • Reviews quality-related tasks in the detailed site-specific plans. • Provides project-specific training in QA/QC matters to contractor personnel, as needed, identified, or requested by the PM. • Acts as the QCSM, if required.	.	
Brian Rhodes	QCSM	APTIM	Reports directly to the Corporate Quality Management Director on all matters within the scope of the project QC program and is responsible for the overall management of the QC program on and off site, including field sampling and characterization, construction, and consulting engineering activities. Duties of the QCSM include but are not limited to the following: • Serves as primary contact for project quality matters and actively identifies and responds to QA/QC needs. Resolves problems and answers requests for guidance or assistance. • Implements project-specific QAPP. • Actively tracks the progress of quality tasks in the QAPP and consults periodically with the Program Manager and PM on quality-related issues. • Prepares and submits QC reports as required to the PM as well as to the corporate QA management. • Approves field CAs prior to implementation.	BS in environmental science or related field plus 5 years experience in quality assurance	

Worksheet No. 4, 7, and 8: Personnel Qualifications and Sign-off Sheet

Name	Title	Organizational Affiliation	Responsibilities	Minimum Required Qualifications/Specialized Training/Certifications	Signature/ Date
Brian Rhodes (continued)			• Verifies that the subcontractor performs appropriate CAs for all APTIM nonconformances and interfaces with the analytical data coordinator or chemist on all quality issues and concerns associated with the subcontracted laboratory, including subcontractor-performed CAs. • Ensures that performance and system inspections are performed. • Ensures that necessary CAs are taken for incidents of nonconformance. • Assists in the implementation of CAs to prevent recurrence of any problems. • If significant adverse conditions exist, implements a CA Request in accordance with APTIM policies and Corporate Quality Management Director oversight. • Assists on training and orientation of field staff regarding task-specific and IW plans. • Conducts performance and systems inspections. • Identifies and reports nonconforming items or activities. • Initiates recommended CA. • Verifies implementation of CA. • Monitors subcontractors on and off site. • Certifies submittal documents. • Prepares all QC reports as required by contract specifications. • Notifies the Corporate Quality Management Director of conditions adverse to quality which cannot be resolved at the project level.		

Worksheet No. 4, 7, and 8: Personnel Qualifications and Sign-off Sheet

Name	Title	Organizational Affiliation	Responsibilities	Minimum Required Qualifications/Specialized Training/Certifications	Signature/ Date
Brian Rhodes	Site-Specific Health and Safety Officer	APTIM	Evaluates the health and safety aspects of the on-site tasks to ensure that activities are performed in a safe manner. Coordinates with Task Managers to complete health and safety work plan addenda for each major task work plan and works with on-site personnel to achieve compliance with the applicable health and safety plans. May have additional duties assigned by the PM.	BS in environmental science or related field plus 5 years experience in safety	
Vicki Graves	Project Chemist	APTIM	Works with the project team in formulating plans and approaches and help to assess sampling, analytical, and QA/QC requirements for each project task. Helps to ensure consistency of approach among the various tasks regarding these areas. Reviews analytical data and assists in the interpretation and use of sampling and analytical QA/QC data. Works together with the laboratory PM, laboratory QA Manager, and APTIM's Corporate Quality Management Director to identify and resolve analytical issues and nonconformances and participates in project and laboratory audits. In addition, the Project Chemist or designee: • Interfaces with the laboratory contact to ensure the laboratory is aware of the project data quality objectives, program goals, and analytical QA/QC objectives • Communicates with the laboratory contact concerning the schedule of sample shipments and the shipment contents, including QC samples. Based on this information, provides status tracking of sample shipments to project management • Reviews all laboratory data before those data are transferred to permanent storage. Reports to other project participants via electronic deliverable	BS/BA in chemistry or equivalent 5 years or more experience that includes QA/QC, environmental investigation design, field sampling, field/laboratory analysis, data review, or data management	

Worksheet No. 4, 7, and 8: Personnel Qualifications and Sign-off Sheet

Name	Title	Organizational Affiliation	Responsibilities	Minimum Required Qualifications/Specialized Training/Certifications	Signature/ Date
Vicki Graves (Continued)	Project Chemist	APTIM	• Interfaces with the Data Users, Task Managers, Field Sampling Lead, Sample Coordinator, Data Manager, and Laboratory PM for analytical requirements • Defines methods and procedures used to achieve desired data quality, and ensures the laboratory is aware of the project data quality objectives, program goals, and analytical QA/QC objectives. Monitors laboratory deliverables for completeness and accuracy • Assists in identifying and resolving any technical or quality issues regarding sample collection and analysis and interfaces with the laboratory QA Manager to resolve any nonconformances or quality issues • Ensures that all sample planning tables are distributed to the laboratory contact, and the sample collection coordinator • Communicates with the laboratory contact to schedule bottle and sample shipments between the field and the laboratory, including QC samples • Provides status tracking of sample shipments to project management • Reviews and/or validates all data based on data quality indicators • Ensures data loaded into the database are accurate and complete • Works with the Sample Coordinator and the analytical laboratory to ensure the complete and accurate transfer of samples and information from the field into the laboratory • Receives and reviews analytical data and verifies receipt of analytical data from the laboratory in hard copy and electronic formats.		

Worksheet No. 4, 7, and 8: Personnel Qualifications and Sign-off Sheet

Name	Title	Organizational Affiliation	Responsibilities	Minimum Required Qualifications/Specialized Training/Certifications	Signature/ Date
Don Dill	Data Validation Lead	APTIM	Reviews data against method requirements and project acceptance criteria, loads data into the appropriate database as defined in task project requirements, and performs completeness and accuracy checks on flagged data that do not meet performance objectives.	BS in chemistry, environmental science, or related field or AS plus 5 years experience; plus certification in data validation or 2 years experience using/or reviewing data for each method reviewed	
Annette Hough	Data Manager	APTIM	Loads data and information into APTIM's database and checks for errors, requests data corrections, maintains the integrity of the database, and reports data and information as requested from data users. Prepares and submits the electronic database deliverables via the Project Chemist.	AS or BS in computer science plus 2 years experience in database management or 5 years experience in database management. Supervision is required if experience is less than 2 years.	
Brandi Hodges	Geographic Information System Data Manager	APTIM	Oversees GIS efforts for the project, including Web-based GIS product.	A minimum of 5 years GIS database management experience, with a minimum of 3 years in Environmental Remediation projects.	
Becky Vandergriff	Admin Record/ Document Control	APTIM	Ensures that all the Administrative Records are adequately maintained.	A minimum of five (5) years Document Control experience, with a minimum of three (3) years in Environmental Remediation projects.	

Resumes to be located on line and/or in the project files in APTIM's office.

ADEM – Alabama Department of Environmental Management.
AEC – Army Environmental Center.
APTIM – Aptim Federal Services, LLC
AS – Associate of Science.
BA – Bachelor of Arts.
BS – Bachelor of Science.
CA – Corrective action.
CEHNC – U.S. Army Engineering and Support Center, Huntsville.
CMI – Corrective measures implementation.
CTC – Cost-to-complete.
DO – Delivery order.
EPA – U.S. Environmental Protection Agency.
GIS – Geographic Information System.
IAP – Installation Action Plan.
IW – Installation-wide.

Worksheet No. 4, 7, and 8: Personnel Qualifications and Sign-off Sheet

PM – Project manager.
PMP – Project management plan.
POC – Point of contact.
PWS – Performance work statement.
QA/QC – Quality assurance/quality control.
QAPP – Quality Assurance Project Plan.
QCSM – Quality Control Site Manager.
RL – Reporting limit.
RSA – Redstone Arsenal.

Worksheet No. 6: Communication Pathways and Procedures

Communication Drivers	Responding Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Point of Contact with CEHNC Ashley Roeske	APTIM Project Manager	Don Burton	865-207-1394	All documents and information are forwarded to the CEHNC by the APTIM Project Manager, or designee.
Point of Contact with Army Bob Gorman	APTIM Project Manager	Don Burton	865-207-1394	All documents and information are forwarded to the Army by the APTIM Project Manager, or designee.
Point of Contact with U.S. Environmental Protection Agency (EPA) Robert Pope	APTIM Project Manager	Don Burton	865-207-1394	All documents and information are forwarded to EPA by the APTIM Project Manager, or designee.
Point of Contact with Alabama Department of Environmental Management (ADEM) TBD	APTIM Project Manager	Don Burton	865-207-1394	All documents and information are forwarded to ADEM by the APTIM Project Manager, or designee.
Project Management and Technical Issues	APTIM Senior Scientist	Dennis Seymore	865-414-6073	Maintains communication with all project and task technical lead personnel and communicates with the APTIM Project Manager (PM), at minimum, during the weekly project status meeting and as circumstances require.
Changes to Project Documents and Forms	APTIM Document Control	Becky Vandergriff	865-560-7800	Maintains revision control for all project documents and forms and oversees project documents and records management. All change requests are submitted to Document Control through principal document authors. Documents are issued document revision numbers and uploaded to the Administrative Record for the Project. All document revision slip pages or revised forms are provided to the document/form owner within 10 days following identification of the change.
Changes to quality assurance project plan (QAPP)	APTIM QCSM	Brian Rhodes	256-714-4200	Any field change requests, variance requests, or deviations are communicated to the APTIM Corporate Quality Management Director or designee and the APTIM Project Chemist. If a permanent change needs to be implemented, the APTIM QCSM will make the change within 5 days. The APTIM QCSM or designee is responsible for implementing a tracking system (i.e., Variance Tracking Log, Nonconformance Report [NCR] Tracking Log, Corrective Action [CA] Tracking Log, etc.).
Changes to QAPP	APTIM Project Chemist	Vicki Graves	865-310-6773	If the site-specific QAPP needs modification, the Project Chemist will coordinate with the APTIM Corporate Quality Management Director or designee to take appropriate action. If the QAPP is modified, it is submitted for regulatory review and approval.
Field Activities	APTIM Field QA/QC Manager	Brian Rhodes	256-714-4200	Daily field activities are summarized on weekly reports and posted for distribution.
Temporary Change Requests	APTIM QCSM	Brian Rhodes	256-714-4200	Requests to make temporary changes to field or other procedures are submitted to the APTIM Corporate Quality Management Director, who forwards to the APTIM Technical Lead and appropriate individuals for input and approval.

Worksheet No. 6: Communication Pathways and Procedures

Communication Drivers	Responding Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Data Requests and Reporting	APTIM Data Manager	Annette Hough	865-560-7829	All requests for data are directed to the Project Chemist, who forwards to the Data Manager for processing. The Project Chemist reviews data prior to release.
Data Reporting – Electronic Deliverable	APTIM Data Manager	Annette Hough	865-560-7829	The Data Manager ensures that electronic deliverable submittals are prepared and submitted on a regular basis.
Database Issues	APTIM GIS Manager	Brandi Hodges	865-963-6455	All issues relating to operation or maintenance of the GIS database or equivalent database are directed to the GIS Manager, including requests for access and special reporting formats, such as data to support the GIS.

ADEM – Alabama Department of Environmental Management.
CA – Corrective action.
CEHNC – U.S. Army Engineering and Support Center, Huntsville
DL – Detection limit.
EPA – U.S. Environmental Protection Agency.
GIS – Geographic Information System.
NCR – Nonconformance report.
PM – Project Manager.
QA – Quality assurance.
QAPP – Quality Assurance Project Plan.
QC – Quality control.
QCSM – Quality Control Site Manager.
SOP – Standard Operating Procedure.
TBD – To be determined.

Worksheet No. 9: Project Planning Session Summary

Project Title: Multiple Sites Corrective Measures **Project Contract/Delivery Order:** W912DY-17-D-0003/W912DY-19-F-1116 **Project Manager**: Don Burton, PE	**Site Name(s)**: RSA-014/Redstone Arsenal **Site Location**: Madison County, Alabama
Date of Session: June 11, 2020 **Scoping Session Purpose:** See Attachment D-1	

Name	Title	Affiliation	Phone #	E-mail Address
Ashley Roeske	Contracting Officer Representative	CEHNC	256-895-1429	ashley.e.roeske@usace.army.mil
Dr. Heather McDonald, PE	Technical Manager	CEHNC	256-895-1392	Heather.b.mcdonald@usace.army.mil
Michael D'Auben	Chemist	CEHNC	TBD	Michael.J.D'Auben@usace.army.mil
Kenny Jones	Health and Safety	CEHNC	TBD	Kennard.e.jones@usace.army.mil
Jennifer Graham	Physical Scientist (Environmental)	AEC	210-466-1406	Jennifer.L.Graham10.civ@mail.mil
Bob Gorman	Site Manager	RSA	256-348-1812	Robert.p.gorman10.civ@mail.mil
Kel Morrissette	Lead Remedial Project Manager	ADEM	334-394-4335	kmorrissette@adem.alabama.gov
Jason Wilson	Chief, Governmental Hazardous Waste Branch, Land Division	ADEM	334-271-7789	JTWilson@adem.alabama.gov
Daniel Arthur	Lead, Facilities Engineering Section	ADEM	TBD	Daniel.arthur@adem.alabama.gov
Don Burton, PE	Project Manager	APTIM	865-207-1394	don.burton@aptim.com
Emily Davis	Regulatory Specialist	APTIM	717-737-1049	Emily.davis@aptim.com
Dennis Seymore	Senior Scientist	APTIM	865-414-6073	dennis.seymore@aptim.com
Gail Cooley	Site Technical Lead	APTIM	865-556-1967	gail.cooley@aptim.com
Ray Clark	Engineer	APTIM	865-560-7799	Ray.clark@aptim.com

ADEM – Alabama Department of Environmental Management.
AEC – Army Environmental Center.
CEHNC – U.S. Army Engineering and Support Center, Huntsville.
RSA – Redstone Arsenal.
TBD – Ashley Roeske can provide contact information, if needed.
See RSA-014 CMIP Scoping Session Memorandum for the scoping session held on June 11, 2020 in Attachment D-1.

Worksheet No. 10: Conceptual Site Model

Corrective measures are required to address elevated concentrations of TCE in surface soil posing an unacceptable risk to potential current and future construction workers primarily due to the potential inhalation of TCE concentrations in ambient air in a future construction area. Corrective measures are also required to prevent direct contact with potential MEC. The CMI work plan provides the site description, history, and environmental setting (Section 1.2); investigations conducted and results (Sections 2.1 and 2.2); human health and ecological risk results, and land use considerations, and MEC evaluation (Section 2.3); and the final conceptual site model (Section 2.4). Background site maps are included in the CMI work plan.

Worksheet No. 11: Project/Data Quality Objectives

Chapter 3 of the corrective measures implementation (CMI) work plan provides the decision summary for the corrective measures at RSA-014S, including objectives of the corrective measures, cleanup goals (CG), and the need for the corrective measures. The project quality objectives are presented below.

Step 1. State the Problem

- The Resource Conservation and Recovery Act facility investigation (RFI) concluded that TCE in surface soil at RSA-014S poses unacceptable risks to the construction worker. Elevated concentrations of numerous chemicals of concern (COC) present in groundwater as commingled plumes will be addressed on a regional basis with the RSA-151 groundwater unit. These problems are a result of former Department of Defense (DoD) activities.
- Based on the current CWM (Seldon) and UXO (Moderate/High) probability ratings, restrictions to the site (access) and intrusive restrictions will remain.
- Removal of TCE in surface soil above the CG at RSA-014S is required to reduce the potential unacceptable exposure for the construction worker.
- COCs in groundwater under RSA-014 require corrective measures; groundwater cleanup will be the responsibility of the RSA-151 groundwater unit.

Step 2. Identify the Goal of the Study

- Elevated concentrations of TCE present in soil above the CG have been identified as requiring corrective measures to address unacceptable risks to human health for potential current and future construction workers during inhalation of ambient air within a future construction area.

Step 3. Identify Informational Inputs

- Table VI.6 of Redstone Arsenal's Alabama Hazardous Wastes Management and Minimization Act (AHWMMA) Permit indicates that a CMI work plan is required for RSA-014 soil (RSA-014S only) and groundwater (groundwater responsibility of RSA-151).
- Review of historical documents indicating that site was used to burn and dispose propellant-contaminated solvents, packaging and pallets used to ship munitions, and contaminated metals in two disposal trenches, each approximately 150 to 200 feet long, 35 feet wide, and 6 to 12 feet deep.
- Results of the existing investigations.
- Results of the UXO probability.
- The conceptual site model (CSM) for RSA-014S.
- Existing quality control (QC) and quality assurance (QA) records of data quality checks.

Step 4. Define the Boundaries of the Study

- Study boundaries for the COC in soil (TCE) have been defined in the RFI, which was conducted in accordance with the Department's Alabama Environmental Investigation and Remediation Guidance (AEIRG).
- MEC is potentially present within the study boundaries.

Worksheet No. 11: Project/Data Quality Objectives

- Based on site history and existing data collected, the current site boundary includes historical site features and structures.
- These historical site features and structures have been identified as release points for potential contaminants.
- Potential locations where releases of TCE may be present have been defined.
- Corrective measures will be conducted for elevated TCE concentrations in soil until the confirmatory sample results are less than or equal to the CG. The CG has been established in the corrective measures study and will be summarized in the CMI work plan. Corrective measures will also be implemented for potential MEC at the site.

Step 5. Develop the Analytic Decision Approach

- The corrective measures will include confirmatory soil sampling in accordance with the Department's AEIRG for analysis of TCE to determine the effectiveness of the selected alternative.
- If review of the confirmatory soil sampling data indicates the CGs have not been achieved, additional soil removal will be implemented to meet the CGs.
- If review of the confirmatory soil sampling data indicates the CGs have been achieved, no further soil removal will be conducted, as the stated corrective measures objectives will be met.
- The corrective measures include establishment of land-use controls based on the current UXO probability of "Moderate/High" for the site.

Step 6. Specify Performance or Acceptance Criteria

- Selected definable features of work and tasks will achieve the performance criteria specified in the CMI work plan and supporting documents
- Soil samples collected will be analyzed by an Environmental Laboratory Accreditation Program (ELAP) certified subcontracted laboratory for the COC (TCE).
- Analytical results generated by off-site laboratories will be evaluated using procedures outlined in the QAPP portion of the CMI work plan to ensure they are suitable for final decision making.
- Soil sample results will be reviewed by the APTIM Project Chemist or as delegated and by the CEHNC Chemist.
- Analytical results from waste characterization samples will be submitted to the off-site disposal facility to adequately classify waste materials and meet the applicable waste profile package requirements for disposal.

Step 7. Develop/Optimize the Plan for Obtaining Data

- Only qualified personnel will perform corrective measures activities.
- Requirements of the CMI work plan will be subjected to QC and QA reviews.

Worksheet No. 11: Project/Data Quality Objectives

AEIRG - Alabama Environmental Investigation and Remediation Guidance
AHWMMA - Alabama Hazardous Wastes Management and Minimization Act.
AEIRG – Alabama Environmental Investigation and Remediation Guidance.
CG – Cleanup goal.
CMI – Corrective measures implementation.
CMS – Corrective measures study.
COC – Chemical of concern.
DOD – U.S. Department of Defense.
ELAP - Environmental Laboratory Accreditation Program
QA – Quality assurance.
QC – Quality control.

Worksheet No. 12: Measurement Performance Criteria

Table 12-1– Measurement Performance Criteria – Compound (Matrix)

Matrix	Soil				
Analytical Group	Volatile Organic Compounds (VOCs)				
Concentration Level	Low				
Sampling Procedure SOP	**Analytical Method/SOP**	**Data Quality Indicators**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
Soil: SOP 6.0	SW8260C / VO004	Overall Precision	RPD ≤ 20% when detected in both samples ≥ sample-specific LOQ	Field Duplicates	S
		Analytical Precision (laboratory)	RPD ≤ 20%	Laboratory Sample Duplicates	A
		Analytical Accuracy/Bias (laboratory)	Analyte-specific (QSM)	Laboratory Control Samples	A
		Analytical Accuracy/Bias (matrix interference)	Analyte-specific (QSM)	Matrix Spike Duplicates	S&A
		Overall accuracy/bias (contamination)	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	Equipment Blanks	S
		Sensitivity	Laboratory compliance with DoD QSM 5.3 guidance for updating DL, LOD, and LOQ values	LOQ verification sample (spiked at LOQ)	A
		Completeness	See Worksheet No. 34	See Worksheet No. 34	

REMEDIATION-DERIVED WASTE

Worksheet No. 12: Measurement Performance Criteria

Table 12-2– Measurement Performance Criteria – Compound (Matrix)

Matrix	Soil				
Analytical Group	Explosives				
Concentration Level	Low				
Sampling Procedure SOPP	**Analytical Method/SOP**	**Data Quality Indicators**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
Soil: SOP 6.0	SW8330B/ SV010	Overall Precision	RPD ≤ 20% when detected in both samples ≥ sample-specific LOQ	Field Duplicates	S
		Analytical Precision (laboratory)	RPD ≤ 20%	Laboratory Sample Duplicates	A
		Analytical Accuracy/Bias (laboratory)	Analyte-specific (QSM)	Laboratory Control Samples	A
		Analytical Accuracy/Bias (matrix interference)	Analyte-specific (QSM)	Matrix Spike Duplicates	S&A
		Overall accuracy/bias (contamination)	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	Equipment Blanks	S
		Sensitivity	Laboratory compliance with DoD QSM 5.3 guidance for updating DL, LOD, and LOQ values	LOQ verification sample (spiked at LOQ)	A
		Completeness	See Worksheet No. 34	See Worksheet No. 34	

Worksheet No. 12: Measurement Performance Criteria

Table 12-3– Measurement Performance Criteria – Compound (Matrix)

Matrix	Soil				
Analytical Group	**Perchlorates**				
Concentration Level	**Low**				
Sampling Procedure SOPP	**Analytical Method/SOP**	**Data Quality Indicators**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
Soil: SOP 6.0	6850 / HPLC06	Overall Precision	RPD ≤ 20% when detected in both samples ≥ sample-specific LOQ	Field Duplicates	S
		Analytical Precision (laboratory)	RPD ≤ 15%	Laboratory Sample Duplicates	A
		Analytical Accuracy/Bias (laboratory)	Analyte-specific (QSM)	Laboratory Control Samples	A
		Analytical Accuracy/Bias (matrix interference)	Analyte-specific (QSM)	Matrix Spike Duplicates	S&A
		Overall accuracy/bias (contamination)	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	Equipment Blanks	S
		Sensitivity	Laboratory compliance with DoD QSM 5.3 guidance for updating DL, LOD, and LOQ values	LOQ verification sample (spiked at LOQ)	A
		Completeness	See Worksheet No. 34	See Worksheet No. 34	

Worksheet No. 13: Secondary Data Uses and Limitations

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
Data collected during and prior to the RFI (CB&I, 2017).	CB&I Federal Services LLC (CB&I), 2017, *Revision 1 RCRA Facility Investigation Report, RSA-014, Unlined Inactive Burn Trenches, Unit #2, Operable Unit 14, U.S. Army Garrison-Redstone, Madison County, Alabama*, August.	Refer to Section 2.1 in the CMI Work Plan	Previous data collected for this site were reviewed in Chapter 3 and Table 3-1 of the RFI for usability in the corrective measures.	All usable data brought forward for the CMI work plan have been validated; therefore, no restrictions on data use have been identified.

Data Limitations and Actions from Usability:

After all data evaluations are completed, any limitations on the use of data will be known to the planning team and will be considered during decision making for the corrective measures planning.

Worksheet Nos. 14 and 16: Project Tasks and Schedule

The project tasks are presented in Chapter 4 of the RSA-014S corrective measures implementation work plan and the construction quality assurance plan (Appendix H). Appendix C in the corrective measures implementation plan contains the project schedule.

Worksheet No. 15: Reference Limits and Evaluation Tables

Worksheet No. 15-3-1 – Soil Volatile Organic Compounds (VOC)					
Matrix: Soil **Analytical Group: VOC - SW8260B** **Concentration: Low**	CAS Number	Redstone-Specific Soil PSV [a] ca - 1 x 10^{-6}; nc - HI = 0.1 (ug/kg)	Laboratory-Specific[a]		
Analyte			DL (ug/kg)	LOD (ug/kg)	LOQ (ug/kg)
TCL VOCs					
Trichloroethene (TCE)	79-01-6	4.10E+02	19	50	100

[a] Detection Limit (DL), Limit of Detection (LOD), and Limit of Quantitation (LOQ).

[a]The preliminary screening value (PSV) is from EPA, 2021, *Regional Screening Levels for Chemical Contaminants at Superfund Sites*, Mid-Atlantic Risk Assessment, May.
ca - Carcinogen.
nc – Noncarcinogen; HI – Hazard index.
µg/kg – Micrograms per kilogram.

REMEDIATION-DERIVED WASTE

Worksheet No. 15: Reference Limits and Evaluation Tables

Worksheet No. 15-3-2– Investigation-Derived Waste (IDW) Solid Volatile Organic Compounds (VOC)					
Matrix: Solids TCLP **Analytical Group: VOC – 1311/SW8260C** **Concentration: Low**	CAS Number	RCRA TCLP Limit (µg/L)	Laboratory-Specific		
Analyte			DL (mg/L)	LOD (mg/L)	LOQ (mg/L)
TCLP VOCs					
1,1-Dichloroethene (1,1-DCE)	75-35-4	700	0.0004	0.0010	0.0020
1,2-Dichloroethane (EDC)	107-06-2	500	0.00024	0.0006	0.0010
2-Butanone (Methyl ethyl ketone; MEK)	78-93-3	200,000	0.0026	0.006	0.010
Benzene	71-43-2	500	0.0004	0.0010	0.0020
Carbon Tetrachloride	56-23-5	500	0.0003	0.0006	0.0010
Chlorobenzene	108-90-7	100,000	0.0003	0.0006	0.0010
Chloroform	67-66-3	6,000	0.0003	0.0006	0.0010
Tetrachloroethene (PCE; PERC)	127-18-4	700	0.00027	0.0006	0.0010
Trichloroethene (TCE)	79-01-6	500	0.0003	0.0006	0.0010
Vinyl Chloride (VC)	75-01-4	200	0.00014	0.00030	0.00060

Worksheet No. 15: Reference Limits and Evaluation Tables

Worksheet No. 15-3-3– Remediation-Derived Waste (RDW) Solid Volatile Organic Compounds (VOC)

Matrix: Soil **Analytical Group: VOC - SW8260B** **Concentration: Low**	CAS Number	Laboratory-Specific		
Analyte		DL (ug/kg)	LOD (ug/kg)	LOQ (ug/kg)
1,1,1-Trichloroethane (1,1,1-TCA)	71-55-6	16	50	100
1,1,2,2-Tetrachloroethane	79-34-5	21	50	100
1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113; Freon 113)	76-13-1	30	50	200
1,1,2-Trichloroethane	79-00-5	12	50	100
1,1-Dichloroethane (1,1-DCA)	75-34-3	7	25	50
1,1-Dichloroethene (1,1-DCE)	75-35-4	21	50	100
1,2,4-Trichlorobenzene	120-82-1	17	50	100
1,2-Dichlorobenzene	95-50-1	15	50	100
1,2-Dichloroethane (EDC)	107-06-2	22	50	100
1,2-Dichloropropane	78-87-5	26	50	100
1,3-Dichlorobenzene	541-73-1	14	25	50
1,4-Dichlorobenzene	106-46-7	15	50	100
2-Butanone (Methyl ethyl ketone; MEK)	78-93-3	400	1000	2000
2-Hexanone (Methyl butyl ketone; MBK)	591-78-6	200	500	1000
4-Methyl-2-pentanone (Methyl isobutyl ketone; MIBK)	108-10-1	180	500	1000
Acetone	67-64-1	400	1000	2000
Benzene	71-43-2	11	25	50
Bromodichloromethane (Dichlorobromomethane; DBCM)	75-27-4	14	25	50
Bromoform	75-25-2	60	100	200
Bromomethane	74-83-9	90	200	400
Carbon Disulfide	75-15-0	40	100	200

Worksheet No. 15: Reference Limits and Evaluation Tables

Worksheet No. 15-3-3– Remediation-Derived Waste (RDW) Solid Volatile Organic Compounds (VOC)				
Matrix: Soil **Analytical Group: VOC - SW8260B** **Concentration: Low**	CAS Number	Laboratory-Specific		
Analyte		DL (ug/kg)	LOD (ug/kg)	LOQ (ug/kg)
Carbon Tetrachloride	56-23-5	14	25	100
Chlorobenzene	108-90-7	10	25	50
Chloroethane	75-00-3	30	50	100
Chloroform	67-66-3	16	50	100
Chloromethane	74-87-3	30	50	100
cis-1,2-Dichloroethene (cis-1,2-DCE)	156-59-2	27	50	100
cis-1,3-Dichloropropene	10061-01-5	14	25	50
Dibromochloromethane	124-48-1	40	100	200
Dichlorodifluoromethane	75-71-8	50	100	200
Ethylbenzene	100-41-4	11	25	50
Methyl Tertiary Butyl Ether (MTBE)	1634-04-4	16	50	100
Methylene Chloride, or Dichloromethane	75-09-2	60	100	400
Styrene	100-42-5	16	50	100
Tetrachloroethene (PCE; PERC)	127-18-4	11	25	50
Toluene	108-88-3	16	50	100
trans-1,2-Dichloroethene (trans-1,2-DCE)	156-60-5	14	25	50
trans-1,3-Dichloropropene	10061-02-6	40	100	200
Trichloroethene (TCE)	79-01-6	19	50	100
Trichlorofluoromethane	75-69-4	40	100	200
Vinyl Chloride (VC)	75-01-4	19	50	100
Xylenes (Total)	1330-20-7	25	50	100

DL - Detection Limit LOD - Limit of Detection LOQ - Limit of Quantitation mg/kg - Milligrams per kilogram.

Worksheet No. 15: Reference Limits and Evaluation Tables

Worksheet No. 15-3-4– Remediation-Derived Waste (RDW) Solid Explosives				
Matrix: Soil **Analytical Group: Explosives - SW8330A** **Concentration: Low**	CAS Number	Laboratory-Specific		
Analyte		DL (mg/kg)	LOD (mg/kg)	LOQ (mg/kg)
1,3,5-Trinitrobenzene	99-35-4	0.05	0.15	0.30
1,3-Dinitrobenzene	99-65-0	0.03	0.10	0.20
2,4,6-Trinitrophenylmethylnitramine (Tetryl)	479-45-8	0.06	0.15	0.30
2,4,6-Trinitrotoluene (TNT)	118-96-7	0.05	0.10	0.20
2,4-Dinitrotoluene (DNT)	121-14-2	0.06	0.15	0.30
2,6-Dinitrotoluene	606-20-2	0.06	0.15	0.30
2-Amino-4,6-dinitrotoluene	35572-78-2	0.03	0.10	0.20
2-Nitrotoluene (ONT)	88-72-2	0.03	0.10	0.20
3-Nitrotoluene	99-08-1	0.04	0.10	0.20
4-Amino-2,6-dinitrotoluene	19406-51-0	0.05	0.10	0.20
4-Nitrotoluene (PNT)	99-99-0	0.06	0.15	0.30
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	0.06	0.15	0.30
Nitrobenzene	98-95-3	0.05	0.10	0.20
Nitroglycerin	55-63-0	0.12	0.30	0.60
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	0.05	0.10	0.20
Pentaerythritol tetranitrate (PETN)	78-11-5	0.12	0.30	0.60
Nitroguanidine (separate analysis)	556-88-7	0.06	0.12	0.25
Nitrocellulose (separate analysis)	9004-70-0	33	100	200

DL - Detection Limit LOD - Limit of Detection LOQ - Limit of Quantitation mg/kg - Milligrams per kilogram.

Worksheet No. 15: Reference Limits and Evaluation Tables

Worksheet No. 15-3-5– Remediation-Derived Waste (RDW) Solid Perchlorates				
Matrix: Soil **Concentration: Low**	CAS Number	Laboratory-Specific		
Analyte		DL (mg/kg)	LOD (mg/kg)	LOQ (mg/kg)
Perchlorate	14797-73-0	0.001	0.002	0.004

DL - Detection Limit LOD - Limit of Detection LOQ - Limit of Quantitation mg/kg - Milligrams per kilogram.

Worksheet No. 17: Sampling Design and Rationale

Soil confirmation sampling and rationale for the planned excavations at RSA-014S are presented in Section 4.6 and Figure 4-3 through 4-5. of the CMI Work Plan.

Worksheet No. 18: Sampling Locations and Methods

Sample Location	Sample Designation	Sample Depth (ft bgs) (a)	QA/QC Sample Designation		Analytical Suite
			FD*	MS/MSD*	
RSA-014S Confirmation Sample Excavation Area 1					
014S-EX1-EW01	014S-EX1-EW01-DS-ABH0191-REG	0-2			Trichloroethene
014S-EX1-NW01	014S-EX1-NW01-DS-ABH0192-REG	0-2	014S-EX1-NW01-DS-ABH0193-FD		Trichloroethene
014S-EX1-WW01	014S-EX1-WW01-DS-ABH0194-REG	0-2			Trichloroethene
014S-EX1-SW01	014S-EX1-SW01-DS-ABH0195-REG	0-2		014S-EX1-SW01-DS-ABH0195-MS/MSD	Trichloroethene
014S-EX1-FS01	014S-EX1-FS01-DS-ABH0196-REG	2-3			Trichloroethene
RSA-014S Confirmation Sample Excavation Area 2					
014S-EX2-EW01	014S-EX2-EW01-DS-ABH0197-REG	0-2			Trichloroethene
014S-EX2-NW01	014S-EX2-NW01-DS-ABH0198-REG	0-2			Trichloroethene
014S-EX2-WW01	014S-EX2-WW01-DS-ABH0199-REG	0-2	014S-EX2-WW01-DS-ABH0200-FD		Trichloroethene
014S-EX2-SW01	014S-EX2-SW01-DS-ABH0201-REG	0-2		014S-EX2-SW01-DS-ABH0201-MS/MSD	Trichloroethene
014S-EX2-FS01	014S-EX2-FS01-DS-ABH0202-REG	2-3			Trichloroethene
RSA-014S Confirmation Sample Excavation Area 3					
014S-EX3-EW01	014S-EX3-EW01-DS-ABH0203-REG	0-2			Trichloroethene
014S-EX3-NW01	014S-EX3-NW01-DS-ABH0204-REG	0-2			Trichloroethene
014S-EX3-WW01	014S-EX3-WW01-DS-ABH0205-REG	0-2	014S-EX3-WW01-DS-ABH0206-FD		Trichloroethene
014S-EX3-SW01	014S-EX3-SW01-DS-ABH0207-REG	0-2		014S-EX3-SW01-DS-ABH0207-MS/MSD	Trichloroethene
014S-EX3-FS01	014S-EX3-FS01-DS-ABH0208-REG	2-3			Trichloroethene
RSA-014S RDW Stockpile Soil Sample					
014S-STCKPILE01	014S-STCKPILE01-SO-ABH9023-REG	NA			TCL VOCs, TCLP VOC, Perchlorate, Explosives
RSA-014S Contingency Clean Soil Borrow Sample Location					
014S-BORROW1	014S-BORROW1-SO-ABH9025-REG	NA	014S-BORROW1-SO-ABH9026-FD	014S-BORROW1-SO-ABH9025-MS/MSD	TCL VOCs, TCL SVOCs, TCL Pesticides/PCBs, TAL Metals

Worksheet No. 18: Sampling Locations and Methods

*The MS/MSD locations are subject to change due to field conditions. Project chemist will be notified and data base updated accordingly.

Sampling SOP Reference (HGL, 2019)

SOP 1.0, Field Documentation; SOP 2.0, Collection and Field Screening of Soil Samples; SOP 3.0, Field Equipment Decontamination

SOP 4.0, Investigative Derived Waste, SOP 6.0, Subsurface Soil Sampling.

SOP 15.0, Non-Hazardous Sample Handling, Packaging, and Shipping; SOP 22.0, Description of Geologic Materials.

Worksheet No. 19: Analytical SOP Requirements Table

Sample Container, Preservation, and Holding Time Requirements						
Matrix	**Analytical Group**	**Laboratory Analytical and Preparation Method/SOP**	**Sample Container Quantity and Type**	**Sample Volume**	**Sample Preservation**	**Sample Holding Time**
Soil	Volatiles - VOCs	5035/8260C - VO004	2 40-mL VOC vials		Methanol, Cool 0°C to 6°C	365 days to extraction / 365 days to analysis

REMEDIATION-DERIVED WASTE

Worksheet No. 19: Sample Containers, Preservation, and Hold Times

Matrix	Analytical Group	Laboratory Analytical and Preparation Method/SOP	Sample Container Quantity and Type	Sample Volume	Sample Preservation	Sample Holding Time
Soil	TCLP VOCs	1311/5030/8260C – PR003, VO004	1 – 4 oz. glass jar; Teflon®-lined cap		Zero headspace, Cool 0°C to 6°C	14 days to leaching / 14 days to analysis
Soil	Perchlorate	6850 - HPLC06	1 – 4 oz. glass; Teflon®-lined cap		Cool 0°C to 6°C	28 days to extraction / 28 days to analysis
Soil	Explosives	8330B – SV010	1 4-oz Amber Gl		Cool 0°C to 6°C	14 days to extraction / 40 days to analysis

RDW – Remediation -Derived Waste.
SOP - Standard Operating Procedure.
TCLP - Toxicity Characteristic Leaching Procedure.
VOC - Volatile Organic Compound.

Worksheet No. 20: Field Quality Control Sample Summary

	Analytical Method	Matrix	Total Number of Samples	FD	MS	MSD	Equip. Rinsate (1/event)	Trip Blank (1/cooler)	TAT Needed[a]	Sample Container/Preservation Requirements[b]	Holding Time	Total Number of Containers
RSA-14S Confirmation Samples Excavation Area 1												
Trichloroethene	5035A/8260C	Soil	5	1	1	1	0	0	5 Days	5 Terracores in Methanol-90 ml vial	14 days	40
RSA-14S Confirmation Samples Excavation Area 2												
Trichloroethene	5035A/8260C	Soil	5	1	1	1	0	0	5 Days	5 Terracores in Methanol-90 ml vial	14 days	40
RSA-14S Confirmation Samples Excavation Area 3												
Trichloroethene	5035A/8260C	Soil	5	1	1	1	0	0	5 Days	5 Terracores in Methanol-90 ml vial	14 days	40
RSA-14S RDW Stockpile Soil Sample												
TCL VOCs	5035A/8260C	Soil	1	0	0	0	0	0	5 Days	2 Terracores in Methanol	14 days	3
TCLP VOCs	1311/5030B/8260C	Soil	1	0	0	0	0	0	5 Days	4 oz jar	14 days TCLP extraction; 7 days prep; 40 days analysis	1
Perchlorate	6850	Soil	1	0	0	0	0	0	5 Days	4 oz jar; headspace required	28 days	1
Explosives	8330	Soil	1	0	0	0	0	0	5 Days	4 oz jar	14 days extraction; 40 days analysis	1
RSA-14S Contingency Borrow Soil Sample												
TCL VOCs	5035/8260C	Soil	1	1	1	1	0	0	5 Days	2 Terracores in Methanol	14 days	12
TCL SVOCs	3540C/8270D	Soil	1	1	1	1	0	0	5 Days	4-oz jar	14 days extraction; 40 days analysis	4
TCL Pesticides	3540C/8081B	Soil	1	1	1	1	0	0	5 Days	4-oz jar	14 days extraction; 40 days analysis	4

Worksheet No. 20: Field Quality Control Sample Summary

	Analytical Method	Matrix	Total Number of Samples	FD	MS	MSD	Equip. Rinsate (1/event)	Trip Blank (1/cooler)	TAT Needed[a]	Sample Container/Preservation Requirements[b]	Holding Time	Total Number of Containers
TCL PCBs	3540C/8082A	Soil	1	1	1	1	0	0	5 Days	4-oz jar	14 days extraction; 40 days analysis	4
TAL Metals	3050B/6010C/7471A	Soil	1	1	1	1	0	0	5 Days	4-oz jar	6 Months; Mercury - 28 days	4

[a] Sample deliverables should include a Level IV, CLP-like data package and EDD for all samples with the exception of IDW samples that require certificates of analysis and EDD only.

[b] All samples should be cooled to 4 degrees Celsius in conjunction with preservation requirements noted prior to shipment to the laboratory.

Worksheet No. 21: Field Standard Operating Procedures

The following SOPs from the IW QAPP will be followed during the conduct of the RSA-014S corrective measures.

Reference Number	Title, Revision Date and/or Number	Equipment Type	Comments
01	Installation-Wide Quality Assurance Program Plan Volume II, Rev. 4 December 2019 (or as updated)	As specified in each SOP	List of the SOPs for field activities is presented in IW-UFP-QAPP Volume II and provided below.
02	EPA SW-846 Update III Method 5035A, Draft Revision 1, July 2002	Terra Core samplers	NA
03	EPA Quartering Method, EISOPQAM, Revised November 2001 (EPA, 2001)	Composite samples only	NA
SOP 1.0	Field Documentation Rev. 4 December 2019	NA	The objective of SOP 1.0 is to establish the minimum documentation requirements for personnel performing field activities at RSA.
SOP 2.0	Collection and Field Screening of Soil Samples Rev. 4 December 2019	Terra Core samplers, hand auger, direct-push sampler	SOP 2.0 establishes guidelines and procedures for use by field personnel in collection and field screening of hand-augered, grab, and sleeve-lined split- spoon soil samples from surface or subsurface soils, or sediments.
SOP 3.0	Field Equipment Decontamination Rev. 4 December 2019	Decon supplies, deionized water, detergent and potable water	The objective of SOP 3.0 is to describe the proper methods for decontaminating downhole and sampling equipment used to perform field investigations.
SOP 4.0	Investigation-Derived Waste Rev. 4 December 2019	NA	SOP 4.0 establishes specific management practices for the in-process handling and subsequent disposition of environmental media generated as a result of investigation and removal actions.
SOP 6.0	Subsurface Soil Sampling Rev. 4 December 2019	Hand augers, Shelby tubes, and split- spoon samplers	The objective of SOP 6.0 is to establish guidelines and procedures for use by field personnel in the collection and documentation of subsurface soil samples for physical and chemical analysis from the unconsolidated zone (at a depth of 1 foot or greater below ground surface). Subsurface soils also include those first soils encountered directly under paved or covered surfaces, such as slabs.
SOP 11.0	Field Generated Records Management Rev. 4 December 2019	NA	SOP 11.0 establishes the methods and responsibilities associated with the management of field-generated program and delivery order records.
SOP 15.0	Non-Hazardous Sample Handling, Packaging, and Shipping Rev. 4 December 2019	NA	SOP 15.0 establishes guidelines and procedures for field personnel to use in the packaging and shipping of environmental samples for chemical and physical analysis. This SOP only applies to the packaging and shipping of low-concentration environmental samples.

Worksheet No. 21: Field Standard Operating Procedures

Reference Number	Title, Revision Date and/or Number	Equipment Type	Comments
SOP 20.0	Drilling Unconsolidated Materials Rev. 4 December 2019	Hydropunch, hollow-stem auger, or rotosonic drill rigs	SOP 20.0 establishes guidelines and requirements drilling unconsolidated materials at RSA. Soil borings, piezometers, and monitoring wells are commonly installed at RSA during environmental work. Several drilling techniques are available but only the most commonly used methods are presented in this SOP. The selection of a drilling method is made based on the desired outcome of the drilling and knowledge of site conditions. The most common methods used at RSA include hydropunch, hollow-stem auger, and rotosonic methods for drilling in unconsolidated materials.
SOPP 21.0	Monitoring Well and Borehole Abandonment Rev. 4 December 2019	Casing splitter, grout, tremie pipe	SOP 21.0 establishes guidelines and procedures for field personnel to use in the supervision of borehole or soil boring abandonment and groundwater monitoring well abandonment (destruction) activities. Additional specific borehole and well abandonment procedures and requirements will be provided in the site-specific plan.
SOP 22.0	Description of Geologic Materials Rev. 4 December 2019	Munsell soil color chart, grain size chart, percentage chart, USCS classification chart	SOP 22.0 specifies the requirements for the description of soil and rock encountered during investigations at RSA.
SOP 23.0	Preparation and Control of Procedures Rev. 4 December 2019	NA	SOP 23.0 provides instructions for the development, issuance, and maintenance of field investigative, quality control, and record management SOPs for RSA. This procedure is applicable to all personnel responsible for the development and use of these procedures. The objective of this procedure is to ensure that all SOPs are developed, issued, and maintained in a consistent manner with all required information.
SOP 24.0	Field Equipment Calibration Rev. 4 December 2019	Manufacturers' calibration guides	SOP 24.0 establishes guidelines and procedures for use by field personnel at RSA for the calibration of field equipment. The performance of proper calibration procedures will result in reliable field data. The general guidelines for calibration apply to all mechanical and/or electronic measurement equipment used in the field.
SOP 28.0	Munitions and Explosives of Concern (MEC) Anomaly Avoidance Support Rev. 4 December 2019	Various geophysical instruments	SOP 28.0 describes surface and subsurface anomaly avoidance procedures and techniques to be used while conducting munitions response and hazardous, toxic or radioactive waste-related activities during investigation, design, and remedial actions.
SOP 29.0	Vegetation Removal Rev. 0 December 2019	Hand operated and mechanical vegetation removal tools and equipment	SOP 29.0 describes the procedures for field personnel to conduct vegetation removal operations.
SOP 33.0	MPPEH Inspection and Management Rev. 0 December 2019	Storage containers	SOP 33.0 describes procedures for handling MPPEH, including inspection, management, safety, security, and chain of custody certification during munitions response activities.
SOP 34.0	Subsurface Utility Avoidance Rev. 0 December 2019	Utility service location equipment	SOP 34.0 establishes the minimum requirements for avoiding damage to subsurface utilities from unintentional contact with powered equipment.

Worksheet No. 21: Field Standard Operating Procedures

Reference Number	Title, Revision Date and/or Number	Equipment Type	Comments
SOP 39.0	Stop Work Order Notice for Quality Related Issues Rev. 4 December 2019	NA	SOP 39.0 describes the process and responsibilities for issuing, resolving, and verifying acceptable responses/actions for Stop Work Orders associated with quality-related items.
SOP 40.0	Receiving Inspection Rev. 2 December 2019	NA	SOP 40.0 describes the process and responsibilities for the performance and documentation of receipt inspection of quality affecting items.
SOP 41.0	Inspection Rev. 3 December 2019	NA	SOP 41.0 describes the methods and responsibilities for performing and documenting inspections on project work activities and materials to ensure compliance with established requirements.
SOP 42.0	Surveillance Rev. 3 December 2019	NA	SOP 42.0 provides instructions for performing and documenting the surveillance of project activities and functional areas. Surveillance generally includes the observation of real-time activities and/or the review of supporting documentation.
SOP 43.0	Nonconforming Reporting Rev. 3 December 2019	NA	SOP 43.0 establishes the system for initiating, processing, and controlling nonconforming items, services, or activities to include disposition and corrective actions.
SOP 44.0	Corrective Action Rev. 3 December 2019	NA	SOP 44.0 defines the requirements for identifying and processing a Corrective Action Request.
SOP 45.0	Quality Audits Rev. 3 December 2019	NA	SOP 45.0 establishes the requirement for a comprehensive system of planned and documented internal quality audits to verify the effectiveness of the Quality Management Program.

1 NA – Not applicable.
2 USCS – Unified Soil Classification System.

Worksheet No. 22: Field Equipment Calibration, Maintenance, Testing, and Inspection

Measurement Quality Objective	Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	Calibration Reference
Ongoing instrument function test	Organic Vapor Monitor or Photoionization Detector	Daily calibration before use with 100 parts per million isobutylene gas	As required by manufacturer specifications	Screen for VOCs.	Check all sensors and battery charge.	At beginning of work activity before use	Within ±10% of calibration gas	If calibration not within ±10%, repeat or tag as "out of calibration – do not use."	APTIM Field Lead	Manufacturer's Instrument Operating and Calibration Manual
Ongoing instrument function test	Lower Explosive Limit Meter/ Oxygen Meter	Daily calibration before use with 100 parts per million methane gas	As required by manufacturer specifications	Screen for combustible gases and oxygen levels.	Check all sensors and battery charge.	At beginning of work activity before use	Within ±10% of calibration gas	If calibration not within ±10%, repeat or tag as "out of calibration – do not use."	APTIM Field Lead	Manufacturer's Instrument Operating and Calibration Manual
Ongoing instrument function test	Hand-Held Metal Detection Instrument	Calibrate in accordance with manufacturer's requirements. Check sensitivity against surrogate verification strip- surrogates to mimic 75 percent of the metal footprint of a 60-millimeter mortar.	As required by manufacturer specifications	Detection of ferrous MEC anomalies	Check all sensors, cables, and battery charge if applicable. Check for proper instrument response by screening known metal object.	At beginning of work activity before use	Meets specification Instrument must respond to known metal object. Instrument must detect all three surrogates in verification strip.	RCA/CA	UXO Field Lead	Manufacturer's Instrument Operating and Calibration Manual

Worksheet No. 22: Field Equipment Calibration, Maintenance, Testing, and Inspection

All equipment used by APTIM requiring regular maintenance and calibration (i.e., measurement and test equipment [M&TE]) will be stored at APTIM's facility. APTIM maintains a sufficient number of backup M&TE, as well as spare parts, if repair is needed to maintain the project schedule. M&TE will be maintained and calibrated in accordance with the manufacturer's specification as noted in the SOPs. M&TE that requires annual off-site calibration will be inspected monthly to ensure that calibration does not lapse. All M&TE in which calibration has expired, does not pass required calibration, or suffers damage while in active use will be removed from the inventory and tagged as "out of service" to prevent inadvertent use. The defective M&TE will not be allowed back in service until repaired or recalibrated against nationally recognized standards. The site manager is responsible to assign a person to manage the inventory of all consumables to ensure adequate inventory for the completion of the specific task.

Additional equipment, tools, and supplies required for use during the task-specific activity are provided in detail in the SOPs. Any required tools, equipment, and/or supplies that are not listed in the SOPs will be identified in this worksheet and incorporated in the site-specific task or project work plan. The APTIM site manager or designee will be responsible for assuring that there is an adequate amount of consumable supplies, materials, and spare parts for the completion of the task or will have access to a location in which supplies or materials may be procured in a reasonable period of time so that there will be no adverse effect on the project schedule.

All turnkey subcontractors will be responsible for managing and maintaining adequate supplies of consumables and available inventory of spare parts.

ISO – Industry standard object.
M&TE – Measurement and test equipment.
SOP – Standard operating procedure.
VOC – Volatile organic compound.

Worksheet No. 23: Analytical SOP References Table – Laboratory

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix / Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
PR002 Rev 3.2	TCLP/SPLP Extraction, Volatile Fraction (ZHE)	Definitive	TCLP	Extraction Vessel	CT Laboratories	N
VO004 Rev 3	Analysis of Volatile Organic Compounds by GC/MS (8260C)	Definitive	Solids/Organics	GC-MS	CT Laboratories	N
SV010 Rev 5.1	Explosives by Modified Method 8330B	Definitive	Organics	HPLC	CT Laboratories	N
HPLC06 Rev 8	Perchlorate Method 6850/331.0	Definitive	Solids/Inorganics	HPLC-MS	Microbac	N

GC/MS – Gas chromatography/mass spectrometry.
SPLP – Synthetic precipitation leaching procedure.
TCLP - Toxicity Characteristic Leaching Procedure.

Worksheet No. 24: Analytical Instrument Calibration Table - Laboratory

Instrument	Calibration Procedure*	*Frequency of Calibration*	*Acceptance Criteria*	Corrective Action	Person Responsible for Corrective Action	SOP Reference
GC/MS	Tuning	Prior to ICAL and at the beginning of each 12-hour period	Specific ion criteria of BFB or DFTPP from method.	Retune instrument and verify. Rerun affected samples. Flagging criteria are not appropriate.	Analyst/Supervisor	SV006 SV007 VO002 VO004
	ICAL – For all analytes, a minimum of five points must be used for linear regression, six points for second order regression	ICAL prior to sample analysis	Each analyte and surrogate must meet one of the three options below: Option 1: RSD for each analyte ≤15%. Option 2: linear least squares regression for each analyte: r2 ≥0.99. Option 3: non-linear least squares regression (quadratic) for each analyte: r2 ≥0.99 (minimum six-point).	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL. Flagging criteria are not appropriate.	Analyst/Supervisor	
	Second Source Calibration Verification (ICV)	Once after each ICAL	All project analytes within ±20% of true value.	Correct problem, then repeat breakdown checks.	Analyst/Supervisor	
	Retention Time Window Position Establishment	Once after each ICAL for each analyte and surrogate	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	Analyst/Supervisor	
	Evaluation of RRT	With each sample	RRT of each target analyte within ±0.06 RRT units.	Correct problem, then rerun ICAL. Flagging criteria are not appropriate.	Analyst/Supervisor	
	CCV	Daily prior to sample analysis for 12-hour analysis period; at the end of the analytical batch run	All reported analytes and surrogates ±20% of true value. All reported analytes and surrogates ±50% for end of analytical batch CCV.	If analyte exceeds with a positive bias and is nondetect, results will be qualified. Detected analytes and analytes with negative bias will be requested for qualification/narration with client. If client approval is not received, correct problem, then rerun CCV. If that fails, repeat ICAL. Reanalyze all samples since last acceptable CCV. If reanalysis cannot be performed, data must be qualified and explained in the case narrative.	Analyst/Supervisor	

BFB –1-Bromo-4-fluorobenzene.
CCB - Continuing Calibration Blank.
CCV - Continuing Calibration Verification.
DFTPP –Decafluorotriphenylphospine.
GC/MS – Gas chromatography/mass spectrometry.
ICAL - Initial Calibration.
ICV - Initial Calibration Verification.
RRT – Relative Retention Time.
SOP - Standard Operating Procedure.

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Worksheet No. 24: Analytical Instrument Calibration Table - Laboratory

Instrument	Calibration Procedure*	*Frequency of Calibration*	*Acceptance Criteria*	Corrective Action	Person Responsible for Corrective Action	SOP Reference
LC/MS/MS (Perchlorate)	Tuning	Prior to ICAL	Ions should be within +/- 0.3 m/z of masses 83, 85 and 89	Retune instrument. Reanalyze tuning solutions.	Analyst/Supervisor	HPLC06
	ICAL	As needed; when CCV out of criteria	Minimum 5 point calibration Linear regression - correlation coefficient >0.995	Correct problem then repeat ICAL	Analyst/Supervisor	
	Second Source Calibration (ICV)	After ICAL, prior to beginning a sample run	< 15% drift	Correct problem.then rerun ICV. If rerun fails, repeat ICAL.	Analyst/Supervisor	
	Continuing calibration verification (CCV)	Daily and after every 10 sample injections	< 15% drift	Correct problem. Rerun CCV. If rerun fails, reanalyze all samples since last successful CCV.	Analyst/Supervisor	
	Interference check	At least one ICS must be analyzed daily	< 30% drift	Correct problem. Reanalyze ICS and all samples.	Analyst/Supervisor	
HPLC / 8330B, LAB SOP	Initial Calibration (ICAL)	At instrument setup and after ICV or CCV failure, prior to sample analysis. Minimum of 5 levels for linear and 6 levels for quadratic.	ICAL must meet one of the three options below: Option 1: RSD for each analyte ≤ 15%; Option 2: linear least squares regression for each analyte: r2 ≥ 0.99; Option 3: non-linear least squares regression (quadratic) for each analyte: r2 ≥ 0.99.	Correct problem then repeat ICAL. No samples may be run until ICAL has passed.	Analyst / Supervisor	SV018 Rev 2.1, SV010 Rev 5.0
HPLC / 8330B, LAB SOP	Initial Calibration Verification (ICV)	Once after each ICAL, analysis of a second source standard prior to sample analysis.	All reported analytes and surrogates within ± 20% of true value.	Correct problem. Rerun ICV. If that fails, repeat ICAL. No samples will be analyzed until the problem has been corrected.	Analyst / Supervisor	SV018 Rev 2.1, SV010 Rev 5.0

Worksheet No. 24: Analytical Instrument Calibration Table - Laboratory

Instrument	**Calibration Procedure***	***Frequency of Calibration***	***Acceptance Criteria***	**Corrective Action**	**Person Responsible for Corrective Action**	**SOP Reference**
HPLC / 8330B, LAB SOP	Continuing Calibration Verification (CCV)	Before sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All reported analytes and surrogates within ± 20% of the true value.	Recalibrate, and reanalyze all affected samples since the last acceptable CCV; or Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.	Analyst / Supervisor	SV018 Rev 2.1, SV010 Rev 5.0

BFB –1-Bromo-4-fluorobenzene.
CCB - Continuing Calibration Blank.
CCV - Continuing Calibration Verification.
DFTPP –Decafluorotriphenylphospine.
GC/MS – Gas chromatography/mass spectrometry.
HPLC – High-performance liquid chromatography.
ICAL - Initial Calibration.
ICV - Initial Calibration Verification.
LC- Liquid chromatorgraphy
RRT – Relative Retention Time.
SOP - Standard Operating Procedure.

Worksheet No. 25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
GC/MS	Replace septa, clean injection port, clip column, check auto sampler, clean source	VOC	Detector, injection port, column, autosampler	As needed	Must meet initial and/or continuing calibration criteria	Repeat maintenance activity or remove from service	Lab Section Supervisor	VO004

GC/MS –Gas Chromatography/Mass Spectrometry.
VOC -Volatile Organic Compounds.

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Worksheet No. 25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
HPLC	Fill solvent bottles, change precolumn, column frits, flush column, clean pump head	Explosives & Propellants	Autosampler, column flow, detector, column and associated parts	As needed	Must meet initial and/or continuing calibration criteria	Repeat maintenance activity or remove from service	Lab Section Supervisor	SV018, SV010
LC/MS/MS	Clean turbo spray, interface, nebilizer, curtain plate	Perchlorates	Monitor gas supply pressure, HPLC system pressure, check for leaks	Prior to calibration check and/or as necessary	Acceptable calibration	Correct problem and repeat calibration	Analyst / Supervisor	HPLC06

Worksheet Nos. 26 and 27: Sample Handling, Custody, and Disposal

Table 26-1: Sample Handling, Custody, and Disposal

Sample Collection, Packaging, and Shipment (Field)
Sample Collection (Personnel/Organization): TBD
Sample Packaging (Personnel/Organization): TBD
Coordination of Shipment (Personnel/Organization): TBD
Type of Shipment/Carrier: UPS/FedEx
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Jodi Serstad, Elaine Bender / CT Laboratories
Sample Custody and Storage (Personnel/Organization): Jodi Serstad / CT Laboratories
Sample Preparation (Personnel/Organization): Organics: Jennifer Hagar, Metals: Brianna Martin-Meise / CT Laboratories
Sample Determinative Analysis (Personnel/Organization): Organics: Jim Yoder, Raj Nair, Adam Zurfluh, Jill Van Daalwyk; VOCs: Randy Digmann, Teisha Grundahl, Dan Scott; Metals: Nora Lea Henn, Matthew Szymanski / CT Laboratories; John Richards, Craig Smith / Microbac; Heather Patterson, Matt Cash / Cape Fear Analytical
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): 60 days from receipt
Sample Extract/Digestate Storage (No. of days from extraction/digestion): 3 months from sample digestion/extraction
SAMPLE DISPOSAL
Personnel/Organization: Jodi Serstad / CT Laboratories
Number of Days from Analysis: Minimum 30 days after final report sent to client; unless there is a written request to hold them longer.

Note: Samples will be collected, shipped and received by the contract laboratory under strict chain-of-custody procedures.
TBD – To be determined.

Worksheet Nos. 26 and 27: Sample Handling, Custody, and Disposal

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory):

Procedures to ensure the custody and integrity of the samples begin at the time of sampling and continue through transport, sample receipt, preparation, analysis and storage, data generation and reporting, and sample disposal. Records concerning the custody and condition of the samples are maintained in field and laboratory records.

APTIM shall maintain chain-of-custody (COC) records for all field and field quality control (QC) samples. A sample is defined as being under a person's custody if any of the following conditions exist: (1) it is in their possession, (2) it is in their view after being in their possession, (3) it was in their possession and they locked it up, or, (4) it is in a designated secure area.

Samples collected in the field shall be transported to the laboratory or field-testing site as expeditiously as possible. When a 0-6 degrees Celsius requirement for preserving the sample is indicated, the samples shall be packed in ice or with reusable gel-type ice packs to keep them cool during collection and transportation. Samples shall be placed in coolers for transit, with custody seals attached to document any unauthorized opening of the coolers. Sample jars will not have individual custody seals. During transit, it is not always possible to rigorously control the temperature of the samples. As a general rule, storage at low temperature is the best way to preserve most samples. If the temperature of the samples upon receipt exceeds the temperature requirements, the exceedance shall be documented in laboratory records and discussed with APTIM. The decision regarding the potentially affected samples shall also be documented.

Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal):

Once the samples reach the laboratory, they shall be checked against information on the analysis request (AR)/COC form for anomalies. The condition, temperature, and appropriate preservation of samples shall be checked and documented on the COC form. Checking an aliquot of the sample using pH paper is an acceptable procedure except for volatile organic compounds, where an additional sample is required to check preservation. The occurrence of any anomalies in the received samples and their resolution shall be documented in laboratory records. All sample information shall then be entered into a tracking system, and unique analytical sample identifiers shall be assigned. A copy of this information shall be reviewed by the laboratory for accuracy. Sample holding time tracking begins with the collection of samples and continues until the analysis is complete. Holding times for methods required routinely for this work are specified in Worksheet No. 19. Samples not preserved or analyzed in accordance with these requirements shall be resampled and analyzed at no additional cost to the government. Subcontracted analyses shall be documented with the COC form. Procedures ensuring internal laboratory COC shall also be implemented and documented by the laboratory. Specific instructions concerning the analysis specified for each sample shall be communicated to the analysts. Analytical batches shall be created, and laboratory QC samples shall be introduced into each batch.

While in the laboratory, samples shall be stored in limited-access, temperature-controlled areas. Samples for volatile organics determination shall be stored separately from other samples, standards, and sample extracts. Samples shall be stored after analysis until disposed of in accordance with applicable local, state, and federal regulations. Disposal records shall be maintained by the laboratory.

SOPs describing sample control and custody shall be maintained by the laboratory.

Worksheet Nos. 26 and 27: Sample Handling, Custody, and Disposal

Sample Identification Procedures: All samples shall be uniquely identified, labeled, and documented in the field at the time of collection in accordance with the SOP 15.0, *Non-Hazardous Sample Handling, Packaging, and Shipping*.
COC Procedures: The following information concerning the sample shall be documented on the COC form: Unique sample identification Date and time of sample collection Source of sample (including name, location, and sample type) Designation of matrix spike/matrix spike duplicate Preservative used Analyses required Name of collector(s) Pertinent field data (pH, temperature, etc.) Serial numbers of custody seals and transportation cases (if used) Custody transfer signatures and dates and times of sample transfer from the field to transporters and to the laboratory or laboratories Bill of lading or transporter tracking number (if applicable).

Examples of COC records, sample labels, and custody seals are included in Attachment 2 of the Installation-Wide Quality Assurance Program Plan (HGL, 2019 or most recent).

Worksheet No. 28: Analytical Quality Control and Corrective Action

Matrix: Soil/Aqueous/TCLP
Analytical Group: Organics
Analytical Method/SOP: VOCs 8260C

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/position of person responsible for corrective action	Project-Specific Measurement Performance Criteria
Method Blank (MB)	One per preparatory batch of 20 or fewer samples of similar matrix.	No analytes detected > ½ LOQ or > 1/10 amount measured in any sample or 1/10 the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	Correct problem. If required, re-prep and reanalyze MB and all samples processed with the contaminated blank	Analyst/Group Leader	Same as QC Acceptance Limits.
Laboratory Control Sample (LCS)	One per preparatory batch of 20 or fewer samples of similar matrix.	DoD QSM Version 5.3 LCS limits are used, if available. Otherwise, in-house control limits are used for any compounds not specified in QSM 5.3. In-house control limits may not be greater than ± 3 times the standard deviation of the mean LCS recovery.	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available	Analyst/Group Leader	Same as QC Acceptance Limits.
Matrix Spike (MS)	One per preparatory batch of 20 or fewer samples of similar matrix.	DoD QSM Version 5.3 LCS limits are used, if available. Otherwise, in-house control limits are used for any compounds not specified in QSM 5.3. In-house control limits may not be greater than ± 3 times the standard deviation of the mean LCS recovery.	Examine project-specific requirements. Contact the client as to additional measures to be taken. If MS results are outside the limits, data shall be evaluated to determine source(s) of difference (i.e., matrix effect or analytical error)	Analyst/Group Leader	Same as QC Acceptance Limits.
Matrix Spike Duplicate (MSD) or Matrix Duplicate (MD)	One per preparatory batch of 20 or fewer samples of similar matrix.	DoD QSM Version 5.3 LCS limits used for a MSD, if available. Otherwise, in-house control limits used for any compounds not specified in QSM 5.3. In-house control limits may not be greater than ± 3 times standard deviation of the mean LCS recovery MSD or MD: RPD of all analytes ≤ 20% (between MS and MSD or sample and MD).	Examine the project-specified requirements. Contact the client as to additional measures to be taken The data shall be evaluated to determine the source of difference	Analyst/Group Leader	Same as QC Acceptance Limits.

Worksheet No. 28: Analytical Quality Control and Corrective Action

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/position of person responsible for corrective action	Project-Specific Measurement Performance Criteria
Internal Standards (IS)	Every field samples, standard and QC sample	Retention time within ± 10 seconds from retention time of the midpoint standard in the ICAL; IS areas within -50% to +100% of ICAL midpoint standard..	Inspect mass spectrometer and GC for malfunctions and correct problem. Reanalysis of samples analyzed while system was malfunctioning is mandatory	Analyst/Group Leader	Same as QC Acceptance Limits.
Surrogates	All field and QC samples.	QC acceptance criteria specified by the project, if available; otherwise DoD QSM Version 5.3 limits are used.	Correct problem, then re-prep and reanalyze all failed samples for all 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.	Analyst/Group Leader	Same as QC Acceptance Limits.

DoD – U.S. Department of Defense.
ICAL – Internal calibration.
IS – Internal standard.
LCS – Laboratory control sample.
LOQ – Limit of quantification.
MB – Method blank.
MD – Matrix duplicate.
MS – Matrix spike.
MSD – Matrix spike duplicate.
QC – Quality control.
QSM – Quality systems manual.

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Worksheet No. 28: Analytical Quality Control and Corrective Action

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/position of person responsible for corrective action	Project-Specific Measurement Performance Criteria
Method Blank (MB)	One per preparatory batch of 20 or fewer samples of similar matrix.	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater.	Correct problem. If required, reprep and reanalyze MB and all samples processed with the contaminated blank.	Analyst/Group Leader	Same as QC Acceptance Limits.
Laboratory Control Sample (LCS)	One per preparatory batch of 20 or fewer samples of similar matrix.	DoD QSM LCS limits used if available. Otherwise, in-house control limits used for compounds not specified in QSM 5.3. In-house control limits may not be > ± 3 times the standard deviation of the mean LCS recovery.	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.	Analyst/Group Leader	Same as QC Acceptance Limits.
Matrix Spike (MS)	One per preparatory batch of 20 or fewer samples of similar matrix.	DoD QSM LCS limits used if available. Otherwise, in-house control limits used for compounds not specified in QSM 5.3. In-house control limits may not be > ± 3 times the standard deviation of the mean LCS recovery.	Examine the project-specific requirements. Contact the client as to additional measures to be taken. If MS results are outside limits, data shall be evaluated to determine source(s) of difference (i.e., matrix effect or analytical error).	Analyst/Group Leader	Same as QC Acceptance Limits.
Matrix Spike Duplicate (MSD) or Matrix Duplicate (MD)	One per preparatory batch of 20 or fewer samples of similar matrix.	DoD QSM LCS limits are used for MSD, if available. Otherwise, in-house control limits are used for any compounds not specified in QSM 5.0. In-house control limits may not be > ± 3 times the standard deviation of the mean LCS recovery. MSD or MD: RPD of all analytes ≤ 30% (between MS & MSD or sample & MD).	Examine the project-specified requirements. Contact the client as to additional measures to be taken. The data shall be evaluated to determine the source of difference.	Analyst/Group Leader	Same as QC Acceptance Limits.
Surrogates	All field and QC samples.	QC acceptance criteria specified by the project, if available; otherwise DoD QSM Version 5.3 limits are used.	Correct problem, then reprep and reanalyze all failed samples for all 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.	Analyst/Group Leader	Same as QC Acceptance Limits.

Worksheet No. 28: Analytical Quality Control and Corrective Action

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/position of person responsible for corrective action	Project-Specific Measurement Performance Criteria
Confirmation of positive results (second column)	All positive results must be confirmed (except for single column methods such as Thiodiglycol where confirmation is not an option or requirement)	Calibration and QC criteria for second column are the same as for initial or primary column analysis. Results between primary and secondary column RPD ≤ 40%.	N/A.	Analyst/Group Leader	Same as QC Acceptance Limits.

DoD – U.S. Department of Defense.
LCS – Laboratory control sample.
LOQ – Limit of quantification.
MB – Method blank.
MD – Matrix duplicate.
MS – Matrix spike.
MSD – Matrix spike duplicate.
QC – Quality control.
QSM – Quality systems manual.

Worksheet No. 29: Project Documents and Records

The following list represents the anticipated documents and records that will be prepared during the course of corrective measures. This list may not be all inclusive and will be revised with additions and deletions for each document prepared for the site-specific task. At the conclusion of the list, information is provided that describes records management and the procedure for obtaining additional detailed information.

Sample Collection Documents and Records	On-Site Analysis Documents and Records	Off-Site Analysis Documents and Records	Data Assessment Documents and Records	Health and Safety
CMI Work Plan Field Activity Daily Log Boring Log Sample Collection Log Sample logging and tracking software AR/COC Drum/Container Sampling Log Drum/Container Inventory Log Sampling Reports Variance Request	Field Activity Daily Log Sample Collection Log Air Monitoring Data Equipment Calibration Receipt Equipment Calibration Logs Visual Classification – Soil Photo Documentation and Tracking Log Daily Construction Log	APTIM AR/COC Laboratory SDG Report Preliminary Data and Draft Analytical Reports Sample Receipt Forms Data Validation Reports Final Data Packages and Final Analytical Report Electronic Data Deliverables	Data Review Checklists QCSR Telephone Logs Corrective Action Reports Laboratory QA Plan Environmental Laboratory Accreditation Program	Accident Prevention Plan Project-specific Safety and Health Plan Project Environmental Safety and Health Plan and Sign-off Sheet Munitions and Explosives of Concern Guidance for Environmental and Construction Activities Daily Safety Meeting Daily Activity Hazard Analysis Equipment Calibration Receipt Equipment Calibration Logs Health and Safety Activity Reports and Documentation Training Records Accident Reports Lessons Learned

Worksheet No. 29: Project Documents and Records

Administrative	Permits	Quality	Project Management	Technical
Memos Incoming Correspondence Outgoing Correspondence Correspondence from Others Telephone Conversation Logs Meeting Notes – Internal Meeting Notes – External Project Related Emails	Excavation Permits Right-of-Entry Permits Construction Permits Overhead Utility Clearance Permit Underground Utility Clearance Permit Underground Utility Variance	Management Assessment Reports – Internal Independent Assessment Reports – Internal Receipt Inspection Checklist Preparatory Inspection Checklist Initial Inspection Checklist Follow-up Inspection Checklist Nonconformance Report and Tracking Log Variance Report and Tracking Log Site QC Reports	Project Schedule Project Budget Work Breakdown Structure Contract Change Request Project Activity Reports Project Summary/Status Report Invoices Insurance	Corrective Measures Implementation Work Plan Decision Documents Project Reports Surveys Drawings and Checklists/Check Prints As-Built Drawings Corrective Measures Reports Operation and Maintenance Manuals

AR/COC – Analysis Request/Chain of Custody.
CMI – Corrective measures implementation.
QA – Quality assurance.
QC – Quality control.
QCSR – Quality control summary report.
SDG - Sample delivery group.

Record-Keeping, Archival, and Retrieval Requirements

Record-keeping, archival, and retrieval requirements will be conducted in accordance with APTIM SOPs.

Field Records Generation

Field records generation will be in accordance with APTIM SOPs.

Worksheet No. 29: Project Documents and Records

Record Archival and Retrieval Procedures for Field Information

Record archival and retrieval procedures for field information will be specified in APTIM SOPs.

Location of Study Records, Reports, and Formal Documents

Program Repository. The program repository will be maintained in accordance with APTIM SOPs and Army contractual requirements.

Administrative Record. The Administrative Record will be maintained in accordance with APTIM SOPs and Army contractual requirements.

Record Retention Time Procedures

At the close of this delivery order, all documents and records will be managed in accordance with contractual requirements which specify that records be transferred to the Army.

Note: The Office of Information Resource Management requirements are not applicable to this project since RSA is not a fund-led site.

Additional Record-Keeping, Archival, and Retrieval Procedures for Electronic Data

Additional record-keeping, archival, and retrieval procedures for electronic data will be conducted in accordance with APTIM SOPs.

Data Handling Equipment and Data Compiling and Analysis

Laboratory analytical data will be processed in a manner that ensures project requirements are being met. Data handling equipment and data compiling and analysis will be in accordance with APTIM SOPs.

Computer Hardware and Software

APTIM will provide hardware and software commensurate with contract specifications for this project.

As the data are made available for usability, APTIM will utilize various software packages to determine if the data quality objectives have been met and to map, analyze, and disseminate spatial data.

Ensuring Database Accuracy

APTIM will ensure database accuracy in accordance with the project contract.

Worksheet No. 30: Analytical Services Table

Matrix	Analytical Group	Sample Locations/ ID Numbers	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization (Name and Address, Contact Person and Telephone Number)	Backup Laboratory/Organization (Name and Address, Contact Person and Telephone Number)
Soil	Volatiles - VOCs		VO004 Rev 3	21 calendar days	CT Laboratories LLC Eric Korthals, Project Manager 1230 Lange Court Baraboo, WI 53913 608.356.2760	CT Laboratories LLC Ceress Berwanger, President 1230 Lange Court Baraboo, WI 53913 608.356.2760

REMEDIATION-DERIVED WASTE

Worksheet No. 30: Analytical Services Table

Matrix	Analytical Group	Sample Locations/ ID Numbers	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization (Name and Address, Contact Person and Telephone Number)	Backup Laboratory/Organization (Name and Address, Contact Person and Telephone Number)
Soil	TCLP VOCs		VO004 Rev 3	21 calendar days	CT Laboratories LLC Eric Korthals, Project Manager 1230 Lange Court Baraboo, WI 53913 608.356.2760	CT Laboratories LLC Ceress Berwanger, President 1230 Lange Court Baraboo, WI 53913 608.356.2760
Soil	Explosive		SV010 Rev 5.1	21 calendar days	CT Laboratories LLC Eric Korthals, Project Manager 1230 Lange Court Baraboo, WI 53913 608.356.2760	CT Laboratories LLC Ceress Berwanger, President 1230 Lange Court Baraboo, WI 53913 608.356.2760
Soil	Perchlorates		HPLC06 Rev 8	21 calendar days	Microbac Laboratories Stephanie Mossberg, Project Manager 158 Starlite Drive Marietta, OH 45750 740.373.4071	Microbac Laboratories Jacqueline Parsons, Project Manager 158 Starlite Drive Marietta, OH 45750 740.373.4071

Worksheet Nos. 31, 32, and 33: Assessments and Corrective Action

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings (Title and Organizational Affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CA) (Title and Organizational Affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (Title and Organizational Affiliation)
Management Assessments	Based on project management request	Internal	APTIM	Don Burton, Project Manager, APTIM	Don Burton, Project Manager, APTIM	Don Burton, Project Manager, APTIM	Don Burton, Project Manager, APTIM
Independent Assessments	Based on project management request	External	TBD	TBD	Don Burton, Project Manager, APTIM	Don Burton, Project Manager, APTIM	Don Burton, Project Manager, APTIM
Receipt Inspections	As required	Internal	APTIM	Brian Rhodes, Quality Control Site Manager (QCSM), APTIM	Don Burton, Project Manager, APTIM	Don Burton, Project Manager, APTIM	Don Burton, Project Manager, APTIM
Laboratory Audits and Inspections	Every two years (in accordance with U.S. Department of Defense [DoD] Environmental Laboratory Accreditation Program [ELAP] requirements) if determined necessary to confirm DoD ELAP accreditation audits or for other reasons	External	TBD	Don Burton, Project Manager, APTIM or designee	CT Lab Project Manager Eric Korthals	CT Lab Project Manager Eric Korthals	Vicki Graves, Project Chemist, APTIM
Quality Control Summary Report	Each analytical definable feature of work	Internal	APTIM	Vicki Graves, Project Chemist, APTIM	Not applicable (NA)	NA	NA

Worksheet Nos. 31, 32, and 33: Assessments and Corrective Action

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings (Title and Organizational Affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CA) (Title and Organizational Affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (Title and Organizational Affiliation)
Field Inspections	Annually	Internal	Army	Bob Gorman, Site Manager, RSA, Dr. Heather McDonald, PE, Technical Manager, CEHNC or designees	Bob Gorman, Site Manager, RSA, Dr. Heather McDonald, PE, Technical Manager, CEHNC or designees	Bob Gorman, Site Manager, RSA, Dr. Heather McDonald, PE, Technical Manager, CEHNC or designees	Bob Gorman, Site Manager, RSA, Dr. Heather McDonald, PE, Technical Manager, CEHNC or designees
Preparatory Inspections/ meetings	Task kick-off	Internal	APTIM/Army	Don Burton, Project Manager, APTIM, Brian Rhodes, QCSM, APTIM, Bob Gorman, Site Manager, RSA, Dr. Heather McDonald, PE, Technical Manager, CEHNC	Don Burton, Project Manager, APTIM	Brian Rhodes, QCSM, APTIM	Don Burton, Project Manager, APTIM
Initial Inspections	Task as required	Internal	APTIM/Army	Don Burton, Project Manager, APTIM, Brian Rhodes, QCSM, APTIM, Bob Gorman, Site Manager, RSA, Dr. Heather McDonald, PE, Technical Manager, CEHNC	Don Burton, Project Manager, APTIM	Brian Rhodes, QCSM, APTIM	Don Burton, Project Manager, APTIM

Worksheet Nos. 31, 32, and 33: Assessments and Corrective Action

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings (Title and Organizational Affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CA) (Title and Organizational Affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (Title and Organizational Affiliation)
Follow-Up Inspections	Task as required	Internal	APTIM/Army	Don Burton, Project Manager, APTIM, Brian Rhodes, QCSM, APTIM, Bob Gorman, Site Manager, RSA, Dr. Heather McDonald, PE, Technical Manager, CEHNC	Don Burton, Project Manager, APTIM	Brian Rhodes, QCSM, APTIM	Don Burton, Project Manager, APTIM
Final Inspections	Task completion	Internal	APTIM/Army	Don Burton, Project Manager, APTIM, Brian Rhodes, QCSM, APTIM, Bob Gorman, Site Manager, RSA, Dr. Heather McDonald, PE, Technical Manager, CEHNC	Don Burton, Project Manager, APTIM	Brian Rhodes, QCSM, APTIM	Don Burton, Project Manager, APTIM

TBD – To be determined.

Worksheet Nos. 31, 32, and 33: Assessments and Corrective Action

Table 31-1 Guidance on Audits and Inspections

Assessment and Audit Frequency Technical inspections and assessments shall be conducted during initial stages of fieldwork to identify and correct problems as quickly as possible. Independent assessments will be performed in response to project management requests. Laboratory audits may be conducted by the APTIM personnel every two years in accordance with the frequency required by the U.S. Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP) if they are deemed necessary to confirm DoD ELAP accreditation audits. More frequent audits may be deemed necessary based on laboratory data quality performance, reporting, or other related issues that could arise over the course of the contract. The laboratory audit will include all sample analysis procedures that will be performed by the laboratory being audited. The Quality Assurance (QA) Manager or Project Manager (PM) may conduct audits at a greater frequency than indicated in Worksheet No. 31. Successful DoD ELAP audits are needed to demonstrate environmental testing laboratories are compliant with the DoD Quality Systems Manual, Version 5.3 (DoD, 2019) or the most current version.
Management Assessments and Independent Assessments Management assessments and independent assessments may be used to review sample collection, handling, analysis, and documentation procedures. Assessment results are used to evaluate a system's ability to produce data that fulfill program objectives and to identify any areas requiring corrective actions (CA). Inspections are routine qualitative reviews of the overall sampling or measurement system or may have a narrow focus, such as a follow-up inspection, while assessments provide an overall examination of the measurement system. Assessment and inspection records are reviewed by the QA Manager or designated staff to determine whether data will fulfill the program objectives. Additional inspections or reviews for designated methods may be conducted, or additional information may be requested if data quality problems are indicated. **Management Assessments** Management assessments may be conducted at the request of the Site Operations Manager, PM, or other employees in management authority. Management assessments are informal reviews of work progress, functionality, adherence to policies and procedures, compliance with requirements, or effectiveness of implementation. They provide the basis for follow-up inspections or independent assessments whenever deficiencies are indicated. All observations are documented, and any recommendations or CAs are submitted to the QA Manager for tracking, implementation, additional review (if required) and completion. **Independent Assessments** Independent assessments may be conducted at the request of the PM or by personnel who have the authority and organizational independence to provide an unbiased review of the system or procedure. When performed, a detailed checklist will be used for each procedure or system reviewed and will contain items that delineate the critical aspects of the procedure under review. All observations are documented, and the checklist is submitted with a written assessment and recommendations to the QA Manager, PM, Army Contracting Officer's Representative (COR), representatives of the audited organization, and others as appropriate. The information and any CA documentation also will be summarized and included in program reports.

Worksheet Nos. 31, 32, and 33: Assessments and Corrective Action

Field Inspections
The field inspections are on-site, qualitative reviews of a sampling or analysis system. Inspections are conducted, preferably at the beginning of the sampling task, by the Project Manager or designee, field lead, or a designated qualified technical staff member who has the authority to act independently of the project staff. Critical items for field inspections include:

- Calibration procedures and documentation for field instruments
- Documentation in field logbooks and on sampling data sheets
- Document control
- Equipment decontamination procedures
- Sample collection, storage, and transportation procedures
- Chain-of-custody procedures for sample documentation and for transfer to a laboratory
- Work instructions.

The checklist for each inspection will contain detailed questions regarding the critical items requiring yes/no answers and comments. A debriefing session will be held for all participants to discuss any inspection results and to discuss any required CA. The reviewer then completes the inspection and submits a report, including observations of strengths and deficiencies and any recommendations for improvements. Detailed checklists will be provided for each final version of the site-specific field sampling plans.

Inspections for Field Activities
Inspections will be performed on materials or services to determine compliance with contractual, planning, and other requirements. Criteria will be established prior to the inspection and will be based on project specifications, requirements, code specifications, and product acceptability and conducted in accordance with the SOPs. Acceptance criteria will be adequate for the activity and will be verified during inspection activities. Inspection may be performed and verified through visual observation, measurement of materials or equipment, examination of documentation/certification, evaluation of performance, or testing. Inspection forms must be developed based on the definable features of work described in the CMI work plan.

Inspections may be performed using the three-phase inspection method. The preparatory inspections will be performed prior to start-up and will examine training, procedures, equipment and materials, work plans and documents, and overall readiness to perform work. Initial inspections will be performed when work begins on a particular feature of work and will include an examination of the quality of workmanship and a review of control testing for compliance with contract and work plan requirements. Follow-up inspections will be performed to verify compliance with procedures and will ensure the continuation of quality and safety standards established during preparatory and initial inspections until completion of the definable work feature. Final follow-up inspections will be conducted at the completion of each task. Participants in this inspection may include QA (U.S. Army Garrison-Redstone and CEHNC) and QC (APTIM). The final follow-up inspection will be performed to ensure that the completed feature of work meets contract requirements. Any deficiencies noted during this inspection will be documented, and a determination will be made as to the CAs that may be necessary to mitigate the deficiency. All significant deficiencies must be corrected prior to turnover.

Records of inspections will be maintained in the project files. At a minimum, inspection files will include inspection reports/checklists, inspection responses, any supporting documents, and applicable client comments.

Worksheet Nos. 31, 32, and 33: Assessments and Corrective Action

Receipt Inspections

Standard APTIM procurement procedures will be used to obtain supplies and consumables. These procedures are initiated by the task manager, field coordinator, or other technical lead personnel and then forwarded to project management and procurement personnel for approval and supplier contact. In the request for supplies, the requestor must provide specifications of the material, including any required certifications of purity or QC level. Sample supplies and consumables must be inspected upon receipt to verify that they meet these specifications and that any required manufacturer's documentation is present and retained for the APTIM project files in accordance with the SOPs. Any damaged, unsealed, or used equipment (unless adequately cleaned and returned to service) will not be accepted.

For items that may come in contact with the sampled matrix or sampling device, assurances should be made, through adequate receipt inspection, that such materials are not contaminated. They must remain sealed or be adequately decontaminated before field use. Examples include decontamination water, chemical reagents, in-line water filters, sample bottles and jars, sampling probes/instruments, bailers, soil spoons, or augers.

Performance and System Audits

Scheduled project/laboratory audits will be performed, as project activities allow, to review and evaluate the adequacy of field activities and laboratory performance and to ascertain if the QAPP is being completely and uniformly implemented. The Project Manager or designee is responsible for requesting and establishing an audit team. Biennial audits may be supplemented by additional audits for one or more of the following reasons:

- Significant changes are made in field or laboratory protocols.
- It is necessary to verify that a CA has been taken on a nonconformance reported in a previous audit.
- Audit is requested by the PM.

The objectives of performance and systems audits are 1) to verify that the QAPP developed for this project is being implemented according to the specified requirements, 2) to assess the effectiveness of the plan, 3) to identify nonconformances, and 4) to verify that identified deficiencies are corrected. Upon discovery of any significant deviation from the QAPP, the Project Chemist and Project Manager or designee shall be informed of the nature and extent of the deviation. A nonconformance will be documented and a CA will be taken to remedy the deviation.

Assessment Findings and Corrective Action

All observations and assessment findings will be documented, and the checklist will be submitted with a written assessment and recommendations, including any required or recommended CAs to the Project Manager or designee, PM, CEHNC COR, representatives of the audited organization, and others as appropriate. The information and any CA documentation also will be summarized and included in program reports. The U.S. Environmental Protection Agency and other regulatory agencies shall be notified of any significant CAs by the U.S. Army Garrison-Redstone.

References:

U.S. Department of Defense (DoD), 2019, ***Quality Systems Manual for Environmental Laboratories***, Version 5.3, May (or most current version).

Worksheet Nos. 31, 32, and 33: Assessments and Corrective Action

Nonconformance Documentation

Complex field investigation, remediation, sampling, and analysis tasks are sometimes subject to nonconformances. A nonconformance is defined as an unplanned deviation that occurs during the implementation of a task that cannot usually be corrected until after it has occurred. Nonconformance activities may include using unapproved methods, not following procedures specified in the QAPP or CMI work plan or substituting unapproved materials or equipment to perform an activity. Nonconforming supplies may also include suspect and counterfeit items. All nonconformance activities and/or material must go through a cycle of being identified, documented, assessed, corrected, and reported in accordance with APTIM's nonconformance procedure. The steps described in APTIM's guidelines are critical in handling nonconformances as they are encountered.

The identification of a nonconformance is the responsibility of every person assigned to the project. This responsibility is incorporated into each person's understanding of his or her tasks, as assigned by the supervisor or task leader, and each person's function on the project. As individuals perform their duties on the project, they must constantly be aware of the scope of the activity and recognize when a deviation from the planned activity has occurred or is occurring. After recognizing the deviation, they must take action by informing the Project Manager and documenting in writing (using the Nonconformance Report [NCR] form) the specifics of what occurred. The site Quality Control (QC) Officer will maintain a status log of open and closed nonconformances. The log will also serve as the basis for numbering each discrepancy and tracking it through closure.

Satisfactory resolution of nonconformances must be verified by the site QC Officer. Nonconformances are not to be closed until the required corrective and preventative actions have been completed to the satisfaction of the site QC Officer or until long-term CAs have been established and implemented. Nonconformances will be monitored until the action is verified as complete and closed as documented on the NCR.

Nonconformances and associated documentation will be documented in the project file and referenced and discussed in the final task report.

Variance Documentation

Variances are similar to nonconformances with respect to how they are defined, resolved, and documented. The primary difference is the timing of the occurrence of the deviation. A variance can be identified prior to implementation of a task, while a nonconformance is generally not identified until the task is in progress or complete. Therefore, with a variance, alternative techniques, modified methods, or a change in task and data quality objectives can be considered. Substitute data, alternate success criteria, or even the deletion of data points may be contemplated after gathering information on the reason for the deviation and examining the intended use of the data as planned. Project variances will be subject to the same stepwise process of identification, documentation, assessment, correction, and reporting as nonconformances.

The project variance ensures key information is recorded by the personnel who identify variances, review the documentation, assess the impact on task objectives, and consider alternative strategies for corrective action.

Variances will be documented in the project file and will be referenced and discussed in the final task report.

Worksheet Nos. 31, 32, and 33: Assessments and Corrective Action

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Time Frame of Notification [1]	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Organization) [2]	Time Frame for Response
Management Assessments	Nonconformance Report (NCR)[3, 4]	Steve Moran, Program Manager, APTIM; Don Burton, Project Manager, APTIM; Dennis Seymore, Senior Scientist, APTIM	5 Days	Corrective Action Request (CAR)	Steve Moran, Program Manager, APTIM; Don Burton, Project Manager, APTIM; Dennis Seymore, Senior Scientist, APTIM	30 Days
Independent Assessments	NCR[3, 4]	Don Burton, Project Manager, APTIM; Tricia Felt, Corporate Quality Assurance (QA)/Quality Control (QC) Director, APTIM; Dennis Seymore, Senior Scientist, APTIM	5 Days	CAR	Steve Moran, Program Manager, APTIM; Don Burton, Project Manager, APTIM	30 Days
Receipt Inspections	NCR[3, 4]	Dennis Seymore, Senior Scientist, APTIM; Brian Rhodes, Quality Control Site Manager (QCSM), APTIM; Tricia Felt, Corporate Quality Management Director, APTIM	Not Applicable (NA)	Item will be rejected and returned to vendor, repaired, or used as-is.	Don Burton, Project Manager, APTIM; Tricia Felt, Corporate Quality Management Director, APTIM; Brian Rhodes, QCSM, APTIM; Dennis Seymore, Senior Scientist, APTIM	NA
Laboratory Audits and Inspections	NCR[3, 4]	Steve Moran, Program Manager, APTIM; Don Burton, Project Manager, APTIM	NA	CAR	Don Burton, Project Manager, APTIM; Brian Rhodes, QCSM, APTIM; Vicki Graves, Project Chemist, APTIM; Tricia Felt, Corporate Quality Management Director, APTIM	NA
Quality Control Summary Report (QCSR)	QCSR	Vicki Graves, Project Chemist, APTIM; APTIM Data Users	NA	NA	NA	NA
Field Inspections	NCR[3, 4]	Dennis Seymore, Senior Scientist, APTIM; Don Burton, Project Manager, APTIM; Brian Rhodes, QCSM, APTIM; Tricia Felt, Corporate Quality Management Director, APTIM	NA	CAR	Don Burton, Project Manager, APTIM; Brian Rhodes, QCSM, APTIM; Tricia Felt, Corporate Quality Management Director, APTIM	NA

Worksheet Nos. 31, 32, and 33: Assessments and Corrective Action

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Time Frame of Notification [1]	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Organization) [2]	Time Frame for Response
Preparatory Inspections/ Meetings	NA (Preparatory Inspection is a meeting to determine if all parties are prepared for task)	Don Burton, Project Manager, APTIM; Brian Rhodes, QCSM, APTIM; Dennis Seymore, Senior Scientist, APTIM; Gail Cooley, Site Technical Lead, APTIM	NA	NA	NA	NA
Initial Inspection	NCR[3, 4]	Don Burton, Project Manager, APTIM; Brian Rhodes, QCSM, APTIM; Tricia Felt, Corporate Quality Management Director, APTIM; Dennis Seymore, Senior Scientist, APTIM	5 days	CAR, based on the severity of the nonconforming action, service, or item.	Steve Moran, Program Manager, APTIM; Don Burton, Project Manager, APTIM; Tricia Felt, Corporate Quality Management Director, APTIM	30 days
Follow-up Inspections	NCR[3, 4]	Don Burton, Project Manager, APTIM; Brian Rhodes, QCSM, APTIM; Tricia Felt, Corporate Quality Management Director, APTIM; Dennis Seymore, Senior Scientist, APTIM	5 days	CAR, based on the severity of the nonconforming action, service, or item.	Steve Moran, Program Manager, APTIM; Don Burton, Project Manager, APTIM; Tricia Felt, Corporate Quality Management Director, APTIM	30 days
Final Inspections	NCR[3, 4]	Dennis Seymore, Senior Scientist, APTIM; Don Burton, Project Manager, APTIM; Brian Rhodes, QCSM, APTIM; Tricia Felt, Corporate Quality Management Director, APTIM	5 days	CAR, based on the severity of the nonconforming action, service, or item.	Steve Moran, Program Manager, APTIM; Don Burton, Project Manager, APTIM; Tricia Felt, Corporate Quality Management Director, APTIM	30 days

[1] If a nonconforming item or activity is of a nature severe enough to affect the project scope, cost, safety, or the environment, project management shall be notified immediately. An NCR shall be issued within 48 hours following the identification.

[2] The name of individuals(s) receiving the corrective action response will be based on the nature of the CAR or severity of the deviation and the availability of the subject matter expert.

Note: EPA and ADEM will be notified of significant corrective actions.

[3] Copies of all NCRs need to be directed to the APTIM Project Manager and APTIM Corporate Quality Management Director, depending upon the severity of the nonconforming action or item.

[4] Nonconformance reporting will be conducted in accordance with APTIM's guidelines which establish the system for initiating, processing, and controlling nonconforming items, services, or activities to include disposition and CAs.

Worksheet Nos. 31, 32, and 33: Assessments and Corrective Action

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
Field Activity Daily Log	Daily	Daily	Dennis Seymore, Sr. Scientist, APTIM or Brian Rhodes, QCSM, APTIM	Tricia Felt, Corporate Quality Management Director or Designee, APTIM
Daily Construction QC Report- Subcontracted	Daily	Daily	Dennis Seymore, Sr. Scientist, APTIM or Brian Rhodes, QCSM, APTIM	Tricia Felt, Corporate Quality Management Director or Designee, APTIM
Daily Construction QC Report- Self Performed	Daily	Daily	Dennis Seymore, Sr. Scientist, APTIM or Brian Rhodes, QCSM, APTIM	Government entity to be determined for specific sites as described in Document Submission Requirements and Distribution Procedures, Rev. 57
Weekly Construction QC Report	Weekly	Weekly	Dennis Seymore, Sr. Scientist, APTIM or Brian Rhodes, QCSM, APTIM	Don Burton, Project Manager, APTIM and other staff as designated by the Project Manager
RSA Small Working Group Teleconference	Weekly	Not applicable	Don Burton, Project Manager, APTIM	Small working group
Laboratory QA Audit Report	Once every two years if determined necessary to confirm DoD ELAP accreditation audits or as required by situation or circumstance	No later than 30 days after the audit	Tricia Felt, Corporate Quality Management Director, APTIM or Designee	Don Burton, Project Manager, APTIM
Laboratory QA Report	When significant plan deviations result from unanticipated circumstances	Immediately	Eric Korthals, CT Laboratories, LLC Project Manager	Vicki Graves, Project Chemist, APTIM; Don Burton, Project Manager, APTIM
Three Phase Inspection Checklist	As needed	As needed	Dennis Seymore, Sr. Scientist, APTIM or Brian Rhodes, QCSM, APTIM	Tricia Felt, Corporate Quality Management Director, APTIM; Project Central Files

Worksheet Nos. 31, 32, and 33: Assessments and Corrective Action

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
Readiness Review checklist	Completed prior to each field effort	A minimum of two weeks prior to start of field work	Don Burton, Project Manager, APTIM or Designee	Tricia Felt, Corporate Quality Management Director, APTIM
Field Variance	As needed	Prior to executing the definable feature of work	Responsible Party Army POC Dennis Seymore, Senior Scientist, APTIM; Don Burton, Project Manager, APTIM; Subject Matter Expert as needed	Don Burton, Project Manager, APTIM and other staff as designated by the Project Manager; Tricia Felt, Corporate Quality Management Director, APTIM; Project Central Files
Nonconformance Report	As needed	As needed	Responsible Party Dennis Seymore, Senior Scientist, APTIM Don Burton, Project Manager, APTIM Subject Matter Expert as needed	Don Burton, Project Manager, APTIM and other staff as designated by the Project Manager; Tricia Felt, Corporate Quality Management Director, APTIM; Project Central Files
Corrective Action Implementation Report	As needed	As defined in the report	Responsible Party Dennis Seymore, Senior Scientist, APTIM Don Burton, Project Manager, APTIM Subject Matter Expert as needed	Don Burton, Project Manager, APTIM; Tricia Felt, Corporate Quality Management Director, APTIM; Project Central Files
Internal Audit Reports	As needed	No later than 30 days after the audit	APTIM Auditors	Dennis Seymore, Senior Scientist, APTIM Tricia Felt, Corporate Quality Management Director, APTIM Don Burton, Project Manager, APTIM
Data Quality Assessment (Note: Data quality assessment is performed in the QCSR)	QCSR report results will be included in the Corrective Measures Implementation Report.	See publication date for corrective measures implementation report in the corrective measures implementation work plan schedule.	Vicki Graves, Project Chemist, APTIM or Designee	Don Burton, Project Manager, APTIM; Ashley Roeske, CEHNC COR; Bob Gorman, Army POC

DoD – U.S. Department of Defense.
ELAP – Environmental Laboratory Accreditation Program.
POC – Point of contact.
QC – Quality control.
QCSM – Quality control site manager.
QCSR – Quality control summary report.
QA – Quality assurance.

Worksheet No. 34: Data Verification and Validation Inputs

Verification Input	Description	Internal/External	Responsible for Verification (Name, Organization)
COC and Shipping Forms	Upon receipt of samples, COC forms and shipping documentation will be reviewed by the laboratory for verification against the sample coolers they represent. The COC form will be signed by all parties having custody of samples, with the exception of commercial carriers.	External	Eric Korthals, CT Laboratories, LLC Project Manager
Field Records	All field records, including AR/COC, field activity logs, well development logs, and sample collection logs, will be verified for completeness.	Internal	APTIM Quality Control Site Managers (QCSM) Vicki Graves, APTIM Project Chemist
Laboratory Data	All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal.	External	Eric Korthals, CT Laboratories, LLC Project Manager
Laboratory Data	All laboratory data packages will be verified for content upon receipt.	Internal	Vicki Graves, APTIM Project Chemist
Data Input/Verification	Verified information will be entered into EQuIS or a similar database.	Internal	Annette Hough, APTIM Data Coordinator
Data Input/Verification	EDDs will be loaded into EQuIS or a similar database and self-verified, based on input information.	Internal	Annette Hough, APTIM Data Manager
Data Qualifiers and Use Codes	Following entry of automated data review, data validation qualifiers, and Use Codes, a hard copy validation QC table will be printed and verified against the original data validation checklists.	Internal	Don Dill, APTIM Data Validation Lead
Data Completeness Summary	Data validation information will be reviewed and the number of valid data points will be determined.	Internal	Don Dill, APTIM Data Validation Lead

AR – Analysis request.
COC – Chain of custody.
EDD – Electronic data deliverable.
QC – Quality control.

Data Reduction and Review of Field Activities

Data collected during the field activities will be reviewed by checking the procedures used and comparing the data to previous measurements. The field coordinator or sampling coordinator will be responsible for checking all field samples to verify that sample collection and field measurement protocols have been observed. These checks will include:

- Use of standard operating project procedures
- Calibration method and frequency
- Quality control bottle lot number
- Data and time sampled
- Preservation method
- Sample team members
- Receiving laboratory
- Chain-of-custody number
- Airbill number.

Worksheet No. 34: Data Verification and Validation Inputs

Data Validation Activities

Sample data are validated by the APTIM validation team using the Environmental Protection Agency's (EPA) *Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review* (EPA, 2008) and *Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review* (EPA, 2010) for guidance prior to 2015. Beginning in 2015, validation is performed using the U.S. Department of Defense (DoD) General Validation Guidelines (DoD, 2018) and the DoD Quality Systems Manual, Version 5.3 (DoD, 2019) or latest revision for analytical specific criteria. EPA Region 3 *Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses* (EPA, 1994) and *Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (EPA, 1993) are applied during the blank evaluation portion of the validation activities. Specific quality control criteria are identified in Quality Assurance Program Plan Worksheets No. 12 and No. 28, respectively; analytical methods and laboratory standard operating procedures are applied to all sample results. For those analytical methods not addressed by the validation guidelines, the evaluation is based on the published method requirements, laboratory-specific standard operating procedures, and technical judgment following the logic of the Contract Laboratory Program validation guidelines for data qualification.

References:

U.S. Department of Defense (DoD), 2019, ***Quality Systems Manual for Environmental Laboratories***, Version 5.3, May

U.S. Department of Defense (DoD), 2018, ***General Data Validation Guidelines***, February.

U.S. Environmental Protection Agency (EPA), 2010, ***Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review***, EPA/540/R-94/013, January.

U.S. Environmental Protection Agency (EPA), 2008, ***Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review***, EPA/540/R-08/01, June.

U.S. Environmental Protection Agency (EPA), 1994, ***Region 3 Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses***, September.

U.S. Environmental Protection Agency (EPA), 1993, ***Region 3 Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses***, April.

Worksheet No. 35: Data Verification Procedures

Step IIa/IIb	Validation Input	Description	Responsible for Validation (Name, Organization)
IIa	Compliance Review	Review all laboratory information against Request for Analysis and determine if all samples were preserved, received, and analyzed within project specifications. Determine if sample delivery group (SDG) is complete.	Level 1 Data Validation – APTIM
IIa, IIb	Organics Level 2 DOD QSM 5.3 or latest version Data Validation	Level 2 (QC review only): Perform first-level data validation review. Complete automated data review report and verify exception list or complete data validation checklist based on EPA National Functional Guidelines (NFG) prior to 2015, DOD QSM V5.3 or latest approved after 2015, and project requirements.	APTIM
IIa, IIb	Inorganics Level 2 DOD QSM 5.3 or latest version Data Validation	Level 2 (QC review only): Perform first-level data validation review. Complete automated data review report and verify exception list or complete data validation checklist based on NFG prior to 2015, DOD QSM V5.3 or latest approved after 2015, and project requirements.	APTIM
IIa, IIb	Organics Level 3 DOD QSM 5.3 or latest version Data Validation (or equivalent)	Level 3 (QC validation or equivalent): Perform first-level data validation review. Complete automated data review report and verify exception list or complete data validation checklist based on NFG prior to 2015, DOD QSM V5.3 or latest approved after 2015, and project requirements.	APTIM
IIa, IIb	Inorganics Level 3 DOD QSM 5.3 or latest version Data Validation (or equivalent)	Level 3 (QC validation or equivalent): Perform first-level data validation review. Complete automated data review report and verify exception list or complete data validation checklist based on NFG prior to 2015, DOD QSM V5.3 or latest approved after 2015, and project requirements.	APTIM
IIb	QC Summary Report	Review data validation results and provide concurrence, determine data usability, and summarize data quality issues.	APTIM Project Chemist Vicki Graves

Note(s):

The APTIM Data Validation Group acts independently from field operations. The validators are not responsible for field work or associated with the technical team working on the RSA Project.

Sample data are validated by the APTIM validation team using the U.S. Department of Defense (DoD) General Validation Guidelines (DoD, 2018) and the DoD QSM, Version 5.3 (DoD, 2019) or latest version for analytical specific criteria. EPA Region 3 *Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses* (EPA, 1994) and *Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (EPA, 1993) are applied during the blank evaluation portion of the validation activities. Specific QC criteria identified in the IW QAPP (the most current version), analytical methods, and laboratory standard operating procedures were applied to all sample results. For those analytical methods not addressed by the validation guidelines, the evaluation is based on the published method requirements, laboratory-specific standard operating procedures, and technical judgment following the logic of the Contract Laboratory Program validation guidelines for data qualification.

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Data validation is based on the DoD General Validation Guidelines and the analytical specifics in the DoD QSM 5.3 or latest version and applies the validation criteria provided in the QAPP (e.g., WS Nos. 12, 28, etc.).

LCS, MS/MSD, and Surrogate Recoveries control limits are presented in Worksheets Nos.12 and 28.

The attached tables list general qualifier guidelines used for the data validation process

Worksheet No. 35: Data Verification Procedures

Table 35-1 – Validator General Flagging Guidelines

QC Requirement	Criteria	Flag	Flag Applied To
Holding Time	Time exceeded for completion of extraction or analysis	UR for nondetects > 2X hold time, or J for all positive results	All analytes in the sample. In the event that holding time is only marginally exceeded, qualify positive results as J.
LCS	Percent recovery (%R) > upper control limit (UCL) %R < lower control limit (LCL) %R < 10%	J for all positive results J for all positive results UJ for nondetects J for all positive results UR for nondetects	The specific analyte(s) in all samples in the associated analytical batch
LCSD	RPD > CL	J/UJ for all results	The specific analyte(s) in all samples in the associated analytical batch No qualifiers for non-detect if percent recoveries >100%; positive bias
Method Blank	Analyte(s) detected	UB for the results within 5X the blank concentration UB for the results within the 10X for common laboratory contaminants	The specific analyte(s) in all samples in the associated analytical batch Common laboratory contaminants: VOA; methylene chloride, acetone, 2-butanone; and semivolatile organic compounds; phthalates
Equipment Blank	Analyte(s) detected	UB for the results within 5X the blank concentration UB for the results within the 10X for common laboratory contaminants	The specific analyte(s) in all samples with the same sampling date and sampling equipment as the equipment blank
Field Duplicates	Field duplicates > RLs and RPD outside control limits 20 Water; 50soil	J for all positive results or UJ for nondetects	The specific analyte(s) in all samples collected on the same sampling date by the same sampling crew at the same site
MS/MSD	MS or MSD % R > UCL or MS or MSD % R < LCL or MS or MSD %R < 10% MS/MSD RPD > CL	J for all positive results J/UJ for all result J/UJ(*UR) for all results	Where the concentration in the parent sample is <4 times the spike concentration. Qualify MS/MSD sample only. Use professional judgment to qualify other samples in batch. (*UR non-detects if extremely low (example: <50% of QAPP control limits)

Worksheet No. 35: Data Verification Procedures

QC Requirement	Criteria	Flag	Flag Applied To
Sample Preservation / Collection	Preservation / collection requirements not met	Professional judgment will be used for validation of samples when standard temperature guidelines are marginally exceeded.	All analytes in the sample
Laboratory Sample Storage	0± 6ºC	J for all positive results UJ/R for nondetects	All analytes in the sample

Notes:

CL – Control Limit.
J – Results estimated during data validation.
LCS – Laboratory Control Sample.
LCSD – Laboratory Control Sample Duplicate.
LCL – Lower Control Limit.
MS – Matrix Spike.
MSD – Matrix Spike Duplicate.
%R – Percent Recovery.
R – Rejected (during data validation).
RPD – Relative Percent Difference.
UCL – Upper Control Limit.
UJ – Nondetected results estimated during data validation.
UB – Result determined to be nondetect at reported concentrations during validation due to contamination in an associated blank.

Control limits for criteria listed in this table are found on Worksheet Nos.12 and 28.

Worksheet No. 35: Data Verification Procedures

Table 35-2
Guidelines for Reporting Results

Result	Flag *
LOQ	U
> DL < LOQ	J
≥ LOQ	As needed

* Example 1: If the DL is 0.04, the LOQ is 0.9, and the result is 0.03, the concentration reported on the tabulated data form would be ND (0.9) (the sample specific LOQ) and the qualifier would be U.

Example 2: If the DL is 0.04, the LOQ is 0.9, and the result is 0.07, the concentration reported on the result form would be 0.07 and the qualifier flag would be J.

Example 3: If the DL is 0.04, the LOQ is 0.9, and the result is 1.2, the concentration reported on the result form would be 1.2 and the qualifier would be any flag needed because of a data quality problem (e.g., R, J, B, etc.).

Notes:
DL- Decision Limit.
J – Estimated results, detected above the detection limit but below the LOQ.
LOQ – Limits of Quantitation.
U – Results not detected.

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Table 35-3 – Validator Flagging Guidelines Specific to Organic Methods

QC Requirement	Criteria	Flag	Flag Applied To
Temperature Blank (as applicable)	Temperature on sample receipt at laboratory	J/UJ for results outside the range of 0-6C	All compound(s) in the affected sample shipment
Trip Blank (VOC samples only)	Compound(s) detected	UB for the results within 5X the blank concentration UB for the results within the 10X for common laboratory contaminants	The specific analyte(s) in all samples shipped in the same cooler as the blank
Initial Five-Point Calibration (GC and HPLC Methods)	Linearity criterion not met	J/UJ	The specific analyte(s) in all samples associated with the initial calibration
Initial Five-Point Calibration (GC/Mass Spectroscopy Methods)	RSD criteria not met	J/UJ	All analytes in all samples associated with the initial calibration
	Linearity criterion not met	J/UJ	The specific analyte(s) in all samples associated with the initial calibration
Initial Daily Calibration Verification (GC and HPLC Methods)	%D >UCL %D <LCL	J J/UJ	The specific analyte(s) in all samples associated with the initial calibration verification
Calibration Verification (GC/MS Methods)	%D >UCL %D <LCL	J J/UJ	All analytes in all samples associated with the calibration verification
	CL exceeded	J/UJ	The specific analyte(s) in all samples associated with the calibration verification
Calibration Verification (GC and HPLC Methods)	CL exceeded	J/UJ	The specific analyte(s) in the sample associated with the continuing calibration verification
Retention time	Retention time of analyte outside of established retention time window	J/UR	The specific analyte(s) in the sample
Surrogates	Surrogate % R > UCL or Surrogate % R < LCL Surrogate % R < LCL and % R < 10%	J for all positive results J for all positive results UJ for the non-detects J for all positive results UR for the non-detects	All analytes in the sample associated with the surrogate(s)
Mass Spectrometer Tune	Ion abundance criteria not met	J/UR for all results	All analytes in all samples Associated with the tune

Worksheet No. 35: Data Verification Procedures

QC Requirement	Criteria	Flag	Flag Applied To
Second Column/ Second Detector Confirmation (GC and HPLC Methods)	Not performed	J	All analytes ≥RL
	Agreement between results not within ±40%	J	All affected analytes
Internal Standard	Retention time not within ±30 seconds: Area counts not within –50% to +100% of last calibration verification	J	> 100% J positive/nondetects no qualifiers
		J/UR(*UJ)	< 50% J positive / UR nondetects (*if >20%<50% UJ upon further evaluation)
Lowest Calibration Standard	At or below RL in initial calibration	J	All results below the lowest calibration standard used
MS/MSD	%R>UCL %R<LCL	J J/UJ(*UR)	Where the concentration in the parent sample is <4 times the spike concentration. Qualify MS/MSD sample only. Use professional judgment to qualify other samples in batch. (*UR non-detects if extremely low (example: <50% of QAPP control limits)

Notes:
GC – Gas Chromatography.
GC/MS - Gas Chromatography/Mass Spectroscopy.
HPLC – High Performance Liquid Chromatography.
J/UJ - Results estimated during data validation/nondetect results estimated during data validation.
J/UR - Results estimated during data validation/rejected nondetect.
%R - Percent Recovery.
RL - Reporting Limit.
RSD - Relative Standard Deviation.
UB - Result determined to be nondetect at reported concentrations during validation due to contamination in an associated blank
VOC – Volatile Organic Compound.

Worksheet No. 35: Data Verification Procedures

Table 35-4 – Validator Flagging Guidelines Specific to Inorganic Methods

QC Requirement	Criteria	Flag	Flag Applied To
Initial calibration (minimum one standard and a blank for metals or as required by other inorganic methods)	Linearity criterion not met	J/UR	The specific analyte(s) in all samples associated with the initial calibration UR calibration not performed
Initial Calibration Verification	%R>110% %R <90% %R<30%	J J/UJ R (unusable)	The specific analyte(s) in all samples associated with the initial calibration
Low-Level Calibration Check Standard (at or below RL)	CL exceeded	J Positives UJ Nondetects < LCL	The specific analyte(s) in all samples associated with the low-level check standard
Second Source Calibration Verification	CL exceeded	J/UJ	The specific analyte(s) in all samples associated with the second source calibration verification
Interference Check Solution (ICS)	%R >120% %R 50-79% %R<50%	J J/UJ J/UR	The specific analyte(s) in all samples associated with the ICS (Professional Judgment: Qualify data if samples with concentrations of interferents that are comparable to, or greater than, their respective levels in the ICS)
Serial Dilution Test	CL exceeded	J for all positive results	The specific analyte(s) in the sample associated with the serial dilution
MS/MSD	CL exceeded	J Positives if > UCL J/UJ all results if <LCL. However if < 30% see post-digestion spike.	The specific analyte(s) in the sample associated with the spike sample (results <4X spike)
Post-Digestion Spike Addition	If MS/MSD CL exceeded and if post-digestion spike lower CL exceeded (i.e., PDS<80%)	UR for nondetects if <LCL otherwise flag as per MS/MSD	The specific analyte(s) in the sample associated with the spike sample UR if not tuned prior to calibration
Mass Spectrometer Tune	Ion abundance criteria not met	J/UR for all results	All analytes in all samples associated with the tune
Internal Standard (ICP-MS)	%RI <30% or >120%	J/UJ(UR*)	Apply J/UJ to all results for specific analytes associated with the internal standard (UR - if extremely low; example:<50% of LCL (30%) to nondetects)

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NOTES:
CL – Control Limit.
J – Results estimated during data validation.
J/UJ – Results estimated during data validation/nondetect results estimated during data validation.
J/UR – Results estimated during data validation/rejected nondetect.
J/UJ (UR) – Results estimated during data validation/nondetect results estimated during data validation/ Rejected nondetect.
LCL – Lower Control Limit.
MS/MSD – Matrix Spike/Matrix Spike Duplicate.
UCL – Upper Control Limit.
UR – Rejected nondetect.

Worksheet No. 36: Data Validation Procedures

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator (title and organizational affiliation)
IIb	Soil	VOC	Low	SW8260C; DoD_QSM_5.3 or latest version	APTIM Data validation group or approved subcontractor

Note(s):
The APTIM Data Validator Group acts independently from field operations. The validators are not responsible for field work or are associated with the technical team working on RSA.

DOD QSM V 5.3 denotes *U.S. Department of Defense Quality Systems Manual, Version 5.3 (U.S. Department of Defense, 2019)*

EPA - U.S. Environmental Protection Agency.

VOC - Volatile organic compound.

Worksheet No. 37: Data Usability Assessment

Identify the personnel responsible for performing the usability assessment:

Field data generated by the field personnel will be initially reviewed, processed, and evaluated on site by the technical lead, task manager, and/or designee. Copies of the original forms will be maintained on site for reference and the originals will then be forwarded to the data coordinator for further review, inclusion into the project database, and final storage in the project Central Files.

The Project Chemist and/or the task lead will perform the usability assessment on analytical data as defined by definition of precision, accuracy, representativeness, completeness, and comparability (PARCC).

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

A combination of checklists and/or data validation summaries will be used to document data validation activities. A quality control summary report (QCSR) or similar documentation will be used to assess the performance of the measurement quality objectives (MQO), (which are the PARCC parameters). These indicators of performance are compared against data quality objectives (DQO) to determine the usability of the data. Guidance from QA-G4/QA-G9 is used as a basis for this assessment.

Hard copy and electronic analytical data will be delivered to the data coordinator for initial review, copying, and distribution, with the original hard copy going to project Central Files. If required, data validators will receive a working hard copy to review. Electronic files will be forwarded to the database manager for checking and uploading into the database. APTIM will then issue summary reports and updates, as required, as final data reviews are completed. The final project deliverables may include electronic file copies for stakeholder use. The data usability assessment will be performed by APTIM for data associated with delineation, risk assessment, or confirmatory sampling.

The APTIM Project Chemist will (1) determine if the MQOs have been met and (2) calculate the data completeness for the project. These results will be included in the data package deliverables for each task.

For a given investigative task, a specific list of target constituents will be formulated; and if they cannot be quantified by the methods summarized in the Installation-Wide (IW) Quality Assurance Program Plan (QAPP), they will be addressed in a task-specific plan. All applicable analyses will meet the recommended method guidance found in *Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods, SW-846,* (U.S. Environmental Protection Agency [EPA], 1997) and its subsequent updates. All other requested analyses must conform to their specified method. These may include the *Annual Book of ASTM Standards* (American Society for Testing and Materials, 2002), *Methods for Chemical Analysis of Water and Waste* (EPA, 1993), and similar sources.

Worksheet No. 37: Data Usability Assessment

Part of the review to determine whether DQOs were met is evaluation of a series of data quality indicators that include measurements of the PARCC and sensitivity parameters. How each of these measurements is to be performed and assessed is discussed in the worksheet. The target acceptance criteria for the results have been developed for a wide variety of anticipated analyses on soil/sediment, surface water, and groundwater matrix samples and are presented in the internal laboratory quality control (QC) validation criteria found in Table 35-1 in Worksheet No. 35. Other data quality indicators may be developed as needed for other sampling media and other analysis programs and presented in their task-specific plans.

Precision

Precision refers to the reproducibility of measurements and is defined as the measurement of mutual agreement among individual measurements of the same property, usually under “prescribed similar conditions.” Precision is expressed in terms of the relative percent difference (RPD) between duplicate determinations or in terms of the relative standard deviation (RSD) when three or more determinations are made. Various measures of precision exist, depending on the prescribed similar conditions.

Overall sampling and analysis precision will be assessed using RPD for duplicate environmental samples. The RPD for matrix spike (MS)/matrix spike duplicate (MSD) sample results will be used to assess laboratory spike recovery precision. RPD is defined as the difference between two measurements divided by their mean and expressed as a percent as shown in Equation (1):

$$\text{RPD} = \left[\frac{|D_1 - D_2|}{\left(\frac{D_1 + D_2}{2} \right)} \right] \times 100 \qquad (1)$$

where:

1. D_1 = The result from the original determination
2. D_2 = The result from a duplicate measurement.

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RSD is the standard deviation of a set of values divided by the average value expressed as a percent as shown in Equation (2):

$$\mathrm{RSD} = \left(\frac{\sigma_{n-1}}{\overline{X}(x_1 \ldots x_n)} \right) \times 100 \qquad (2)$$

where:

3. σ_{n-1} = The sample standard deviation of the sample data
4. n = The number of determinations
5. $\overline{X}(x_1 \ldots x_n)$ = The arithmetic mean of the sample data.

Accuracy

Accuracy is a measure of the bias in a system or the degree of agreement of a measurement, X (or an average of measurements of the same parameter), against an accepted reference or true value, T. Accuracy is typically expressed as a percent recovery calculated by the ratio of the measurement and accepted true value as shown in Equation (3):

$$\text{Percent Recovery} = \left(\frac{(X - S)}{T} \right) \times 100 \qquad (3)$$

where:

6. X = The experimentally determined concentration
7. S = The sample concentration before spiking
8. T = The “true” concentration.

Analytical accuracy is assessed through the analysis of spikes, such as surrogates, MS/MSDs, and laboratory control samples (LCS); audit samples and/or standard reference materials; and calibration check samples. With the surrogates and MS/MSDs that are spiked onto the actual sample matrix and analyzed, these accuracy indicators must take into account the nature of the matrix in question and the native concentration of the analyte spiked. Matrix variability or interferences from high concentrations of native compounds may adversely affect spike recovery and yield less than conclusive data. Accuracy checks which focus on analytical method and consist of compounds spiked in a “blank” or noninterfering matrix (e.g., LCSs, standard reference

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materials, or calibration check samples) address the accuracy of the method and/or instrumentation at detecting the target analyte(s) at a certain quantification level and are not considered to be subject to matrix effects.

Measuring the bias of the overall sampling program is also difficult, especially with respect to collection of samples for analysis for volatile organic compounds. These organic compounds can be volatilized and lost from collected samples, resulting in a negative bias, or the sample can become contaminated with foreign compounds during sample collection, handling, and preparation, resulting in a positive bias. Using proven sample collection methods that incorporate steps to minimize sample disturbance during collection, providing for the isolation of samples from known sources of contamination, and incorporating the immediate preservation of samples on ice should reduce the potential for bias. Accuracy of the sampling system, emphasizing cross-contamination with volatile compounds, will be assessed by evaluating analytical results for field quality assurance (QA) samples, including field-prepared field blanks, laboratory-prepared trip blanks, equipment rinsate blanks, laboratory storage blanks, and analytical method blanks.

Representativeness

Representativeness is a qualitative parameter that expresses the degree to which sample data actually represent the matrix conditions. For example, in conducting groundwater monitoring, representativeness requires proper location of wells and the collection of samples under consistent, documented procedures. Wells are located based upon the results of the hydrogeologic study in progress and are designed to provide maximum coverage of the flow conditions. Requirements and procedures for sample collection and handling are designed to maximize sample representativeness. Representativeness can also be monitored by reviewing field documentation and performing field QA audits.

Other sampling approaches in which representativeness is a concern are building composite samples and using an unbiased grid sampling system. In compositing, individual subsamples are collected and combined to represent a greater physical area or cover a particular time period. Often, to characterize a large unknown surface area, a grid sampling pattern is established and then samples are collected at randomized node locations where horizontal and vertical traverse lines intersect. Considerations such as number of samples required and their spatial relationship will affect the degree to which the unbiased grid sample results are representative. In such cases, the sampling objective must be well defined and the intended purpose for the sample data generated must be reviewed to establish through statistical analysis the representativeness of the DQOs. Parameters, such as the number of subsamples composited, the number of samples submitted for analysis, and the sampling interval, can then be specified to increase the confidence interval and improve representativeness when warranted by the performance objective.

Completeness

Data completeness represents the percentage of valid or usable data collected from a sampling/analytical program or measurement system compared to the amount expected to be obtained under optimal or normal conditions. Completeness is calculated for the aggregation of data for each analyte measured for any particular sampling event or other defined set of samples. Completeness is calculated and reported for each method, matrix, and analyte

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combination. The number of valid results divided by the number of possible individual analyte results and expressed as a percentage determines the completeness of the data set. For completeness requirements, valid results are all results not qualified as rejected in the data review and validation process. The requirement for completeness is 90 percent of all critical field samples requiring chemical or geotechnical analyses. For any instances of samples that could not be analyzed for any reason (holding time violations in which resampling and analysis were not possible, samples spilled or broken, etc.), the numerator of this calculation becomes the number of valid results minus the number of possible results not reported.

The formula for calculating completeness is shown in Equation (4):

$$Completeness = \left(\frac{number\ of\ \ valid\ (i.e., non - R - flagged\ )\ results}{number\ of\ \ possible\ results} \right) \qquad (4)$$

Site-specific completeness goals may also be defined in the site-specific sampling and analysis plan.

For statistically based sampling designs, completeness will be dependent upon the number of usable samples that are needed to meet the tolerances for decision errors. The mechanism for determining completeness for statistically based sampling designs will be provided in the site-specific field sampling plans.

Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. Comparability for sampling and analysis tasks is achieved by:

- Specifying well-recognized techniques and accepted standard methods for sampling and analysis using well-trained sampling and analysis technicians to execute the prescribed methods consistently
- Requiring that all involved sampling and analysis personnel produce adequate documentation to record how the prescribed methods were actually executed, noting nonconformances and corrective measures taken.

The specification of standardized laboratory methods helps to ensure that the data generated for an event are comparable to past and future activities. Periodic field and laboratory audits to assess consistency of method implementation for these prescribed procedures are also critical in determining comparability.

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Sensitivity

Sensitivity is a qualitative parameter that addresses the ability of the analytical method or instrumentation to differentiate between responses that represent concentrations of analytes. Sensitivity is important, as it is the ability to detect the target analytes at the levels of interest so that project-specific goals are met. The requirements of sensitivity include the establishment of various limits such as those for calibration, which include instrument detection limits (DL), and those that are project specific, such as limits of quantitation. The DLs are based on interference-free matrices which do not take into account the matrix effects of environmental samples. Therefore, project-specific LOQ are established to meet project objectives for analytes of interest (these values are provided in Worksheet 15 tables).

The Project Chemist or designee will review all preliminary data for obvious data quality issues, such as sensitivity and QC errors, and will 1) perform a final review of the raw data to ensure that data have been transcribed correctly, 2) review chromatograms and mass spectra to ensure that compounds have been identified correctly, and 3) review QC data to ensure that all data have been qualified correctly. The Project Chemist will not recalculate data from raw data. When required, any recalculations will be performed by the Data Validator. The Data Validator will review a minimum of 10 percent of the raw data against the QC requirements presented in the IW QAPP.

The following guidelines will be considered during evaluation for usability:

- Review the case narratives pertaining to the data packages and establish that corrective actions (CA) were performed.
- Review all qualifier flags based on acceptance criteria.
- Ascertain if the representativeness objective for the project was achieved.
- Be aware of previous investigations for the specific projects and pre-existing data gaps.
- Calculate completeness of sample and analytical data collection to check against the objectives of the project.
- Identify data gaps based on completeness and nonconformance events.
- Identify data that do not meet project-specific sensitivity requirements.
- Determine if the data gaps prevent RSA from making decisions intended in DQOs.
- Document instances where professional judgment should be used; and discuss them with the CEHNC Chemist and, if necessary, the Alabama Department of Environmental Management chemist and/or the EPA Region 4 chemist.

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- Document all evaluations, calculation, rejections, and recommendations and provide rationale for all specific validation actions.
- Submit a QCSR.

The following items should be considered when evaluating data usability when acceptance criteria have been exceeded:

- **Holding Times** – Consider the stability of the different analytes when holding times have not been met. Volatile organics are more susceptible to loss over time than semivolatile organic compounds, such as pesticides and dioxins or metals. Samples that are reanalyzed a few days past holding time because the QC results are outside acceptance criteria but also have both passing criteria in the reanalysis and comparable results to the original analyses, should not be rejected with the exception of volatile organics. If the holding time for volatile organics is exceeded, the data will be rejected and there will be no further use of the data.
- **Blanks** – If the concentration of the analyte in the sample is greater than five times the concentration in the blank, do not qualify the sample concentration as “B.” Pay special attention when the result is near the governing criterion.
- **Sample Preservation** – For preservation of all analytes in the sample, if a sample is received at no greater than 10 degrees Celsius, is within 48 hours of collection, there is documentation that the sample was properly preserved with ice at the time of shipment, then qualify the samples as UJ for nondetects for positive results. Adhere to sample preservation criteria whenever possible and reject volatiles samples that are improperly preserved.
- **Surrogates** – Matrix effects may impact surrogate recovery. If surrogates are within acceptance criteria in the LCS and the method blank and the internal standard area counts are acceptable in the sample, evaluate the raw data to see if the results in the sample are acceptable. In multiple surrogate methods, one surrogate may be slightly outside acceptance criteria and the data for that sample may still be usable. The Data Validator should investigate whether the root cause of the poor recoveries was examined by the laboratory and, when necessary, whether the CA was performed before accepting the data. Evaluate the raw data for usability based on DQOs.
- **Surrogates and Matrix Spikes** – Surrogates and MSs with concentrations diluted out cannot be evaluated.
- **Sensitivity** – Where generic action limits are used as action levels, use the lowest achievable laboratory DL to evaluate sensitivity. Where project- or task-specific action levels have been developed, identify sample results that do not meet the expected sensitivity requirements during a preliminary review of the data and determine why the exceedance occurred. If the exceedance is determined to be minor, (i.e., less than 20 percent) evaluate the sample result against the laboratory’s detection limits and review similar data collected to determine the extent of the condition. If a systematic error has occurred, determine the overall impact to the data and report the condition to the project/task manager and regulators as needed to determine if additional sampling should be performed. If the results are clearly unusable (i.e., exceedance greater than 20 percent), determine the cause for the exceedance, initiate CA if required, and request reanalysis and/or resampling, as appropriate.

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In the event that the Data Validator needs to modify the data qualifiers due to a scenario that is not presented in the IW QAPP, the APTIM Project Chemist will contact the CEHNC chemist for discussion on effects on the data and CA.

Describe the evaluative procedures used to assess overall measurement error associated with the project:
Data verification is defined as "confirmation by examination and provision of objective evidence that specified requirements have been fulfilled." Data validation is defined as "confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use have been fulfilled" (EPA QA/G-5).

The APTIM Project Chemist or designee will review the entire definitive data report package with the field records and apply the final data qualifiers for the definitive data. APTIM will evaluate laboratory data, QC results, and laboratory data qualifiers and apply data validation qualifiers. These qualifiers may be different from those applied by the laboratory. APTIM will use various checklists during the verification process to document all the verification activities. Completed checklists will be available for review upon request; however, these checklists should not be included as part of the data packages. All qualifications must be explained in the Data Validation Report. All qualified data near the governing criteria will be evaluated against project DQOs for fitness for use.

Note that all criteria that are included in the IW QAPP are to be considered target goals. Generally, the data are flagged by the laboratory and a more detailed evaluation of the data is performed. Evaluation of the exceedances by the analytical Data Coordinator, the Laboratory Project Manager, and the Laboratory QA officer will be completed, and a recommendation will be made concerning the usefulness of the data. CA procedures may then be formulated and implemented in the field or laboratory to avoid reoccurrence of the condition. In all cases, the results of the usefulness of the evaluation will be documented and discussed in the project reports.

To determine the precision of an analytical method and/or laboratory analyst, a routine program of duplicate analyses is performed. The results of the duplicate analyses are used to calculate the RPD, which is the governing QC parameter for precision. APTIM will determine the precision of the analyses conducted during this investigation by reviewing the results of field replicate samples and laboratory duplicate samples (where applicable), then, if sufficient data are obtained, the arithmetic mean and standard deviation of a group of results may be calculated.

The accuracy of a method is an estimate of the difference between the true value and the determined mean value. Certain QA parameters, such as LCSs, reagent water spike samples, QC check samples, MS samples, and surrogate spike samples, have known concentrations prior to analysis. By comparing the percent recovery of the analysis of these samples to the true value, it is possible to measure the accuracy of the analysis.

Worksheet No. 37: Data Usability Assessment

Percent recovery values and control limits or DQOs are reported by the laboratory as a measure of method accuracy and will be compared with the established laboratory limits or the published U.S. Department of Defense (DoD) Quality Systems Manual (QSM) Version 5.3 criteria or latest approved for the accuracy of an individual method. QC data not meeting the established laboratory criteria or DoD QSM Version 5.3 or latest approved target criteria for accuracy may be flagged and their usability assessed. Associated field sample data should be considered estimated.

Data completeness will be expressed both as the percentage of total tests conducted that are deemed valid and as the percentage of the total tests required in the scope of work that are deemed valid. Percent completeness is calculated with respect to the purpose of analysis (i.e., chemical, geotechnical, soil classification), as well as type of sample (i.e., field sample or QA/QC sample). The purpose and total number of each type of sample planned in the scope of work will be calculated and tabularized in the task work plan for each specific task. As part of the evaluation of the task completeness performed in the task final report, the actual number of samples collected will be compared to the planned number, and completeness will be discussed in the task-specific report. The completeness goal for all the different types of samples on this project is 90 percent, except for QA/QC samples. Completeness of QA/QC samples will have to be judged on a case-by-case basis in the report documents. Enough QA/QC data must be available to allow a thorough assessment of data quality to be performed.

APTIM will review the QC (laboratory and field) samples and field logs and appropriately flag any of the associated samples identified with the QC samples, as explained in Tables 35-1, 35-2, 35-3, and 35-4. At minimum, case narratives, calibrations, blanks, spikes, and duplicates will be reviewed. Additionally, raw data, such as chromatograms, mass spectra, and instrument output, will be reviewed for transcription errors. Each MS sample will only be qualified by the laboratory, while APTIM will apply the final qualifying flag for a matrix effect to all samples collected from the same site as the parent sample or all samples showing the same lithologic characteristics as the MS/MSD.

Definitions for Data Qualifiers:

Validation	Definition
“null”	Detected and no qualifications during data validation
U	Not detected
J	Estimated due to data value between RL/LOQ and DL/MDL or due to validation anomaly
UJ	Not detected, estimated due to data validation anomaly
UB	Potential blank contamination
R	Rejected due to data validation anomaly
UR	Not detected; Rejected due to data validation anomaly

Worksheet No. 37: Data Usability Assessment

X1, X2, X3	Historical data that have been collected in a manner that is now considered to be inconsistent with good scientific practice; these data are considered unusable
X	Sample has been excavated.

Preliminary Data Use

To meet the goals of the RSA Program Management Contract, it may be necessary to make use of preliminary data, but not for site closure or action level compliance. The data must be released by the APTIM Project Chemist or APTIM Corporate Quality Management Director to the project staff for use. Ideally, the data will have been reviewed against the RSA QC criteria before the data are released to the project team. The team will be made aware that the data has not been completely validated and that they are using the data at risk. Acceptable uses for preliminary data include step-out discussions, additional sampling requirements, etc. Unacceptable uses of preliminary data include public meetings, risk assessment decisions, no further action decisions, and final decision-making purposes.

References:

American Society for Testing and Materials, 2002, ***Annual Book of ASTM Standards***.

U.S. Department of Defense, (DoD) 2019, ***Quality Systems Manual for Environmental Laboratories,*** Version 5.3, May.

U.S. Environmental Protection Agency (EPA), 1993, ***Methods for Chemical Analysis of Water and Waste***, EPA 600/4-79-020, Revision 2.0.

U.S. Environmental Protection Agency (EPA), 1997, ***Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods***, SW-846, Third Edition, Office of Solid Waste, June.

ATTACHMENT D-1

ARMY SCOPING SESSION MEMORANDUM

FINAL
SYSTEMATIC PROJECT PLANNING
CMIP SCOPING MEETING MEMORANDUM

Corrective Measures Implementation Work Plan
RSA-014, Unlined Inactive Burn Trenches, Unit #2
Redstone Arsenal, Madison County, Alabama

1.0 Introduction

This document provides a record of the Scoping Meeting for the Corrective Measures Implementation Work Plan (CMIP) for RSA-014 at the Redstone Arsenal (RSA) in Huntsville, Alabama. This virtual meeting commenced at 9:00 a.m. CDT on June 11, 2020 using the Microsoft Teams application. The meeting was attended by the Project Team members listed in Table 1.1. Decisions and action items covered during the meeting are summarized in Section 1.2. Meeting materials are listed in Section 2.0 and provided as Attachment A, *Slide Presentation*, and Attachment B, *Data Quality Objectives*.

Table 1.1: Kickoff Meeting Participants

Participant Information	Participant Information
CEHNC COR Ashley Roeske	AEC Jennifer Graham
ADEM Kel Morrissette	RSA PM Bob Gorman
ADEM Jason Wilson	APTIM PM Don Burton
ADEM Daniel Arthur	APTIM SME Gail Cooley
CEHNC Technical Manager Dr. Heather McDonald, PE	APTIM Technical Lead/SME Emily Davis
CEHNC Mike D'Auben	APTIM SME Ray Clark
CEHNC Kenny Jones	APTIM SME Dennis Seymore

ADEM – Alabama Department of Environmental Management.
AEC – Army Environmental Center.
CEHNC – U.S. Army Engineering and Support Center, Huntsville.
COR – Contracting Officer Representative.
PM – Project Manager.
RSA – Redstone Arsenal.
SME - Subject Matter Expert.

1.1 Objectives

The purpose of the meeting was to present the CMIP execution strategy and proposed CMIP activities for RSA-014 to the Project Team and stakeholders. To support this presentation, a site description/history, document status, and Resource Conservation and Recovery Act facility investigation and Corrective Measures Study (CMS) summaries were presented.

APTIM is performing this project for the CEHNC under Contract No. W912DY-17-D-0003, Delivery Order (DO) No. W912DY19F1116 for the corrective measures at RSA-013, RSA-014,

RSA-109, RSA-122, RSA-141-R-01, RSA-183, RSA-221-R-01, RSA-312-R-01, and RSA-313-R-01 at RSA in Huntsville, Alabama.

The objectives for RSA-014 under this DO are:

1) Achieve Department of the Army (DA) approval of the CMS report (complete).

2) Achieve DA approval and regulatory concurrence of the CMIP.

3) Achieve DA approval of the Statement of Basis/Decision Document.

4) Achieve DA approval of the Safety Submission.

5) Conduct of the Corrective Measures Implementation-Construction activities and the Corrective Measures Report for RSA-014 are optional tasks that can be exercised by the Army.

1.2 Meeting Discussion Topics

Don Burton began the discussion by leading the Project Team members through Slide 15 of the CMIP Scoping Meeting presentation for RSA-014 (Attachment A). Mr. Burton then turned the presentation over to Gail Cooley. Ms. Cooley summarized Slides 16 through 28 and then opened the call for any discussion/questions. The following comments and discussions occurred during the meeting with the decisions and details summarized below.

- Kel Morrissette asked whether a Notice of Environmental Use Restriction (NEUR) would be needed to protect residential receptors. Emily Davis explained that because the identified unacceptable risk is driven by the high-intensity soil exposure to volatilization of trichloroethene (TCE) for the construction worker, there are no unacceptable risks to the residential receptor. Once the identified risk to the construction worker is addressed, soils will not pose unacceptable risk to any receptor. Ms. Davis further explained that the inhalation risk is driven primarily by the noncancer evaluation. Mr. Morrissette noted that this risk situation is unusual and Ms. Davis acknowledged this and stated that it can occur with more volatile compounds in the shallow subsurface that would be disturbed in a more intense manner during construction work than by typical actions of a residential receptor.

  Mr. Morrissette further noted his concerns with the unexploded ordnance (UXO) probability and the trenches at the site since the only planned corrective measures are soil excavation and disposal. Mr. Burton addressed Mr. Morrissette's concern regarding an NEUR for this site by stating that the Army was still discussing how to best incorporate controls for the UXO probability. Mr. Morrissette understands that the NEUR, if applicable, would be included in the corrective measures report rather than in the CMIP.

  Daniel Arthur spoke to the NEUR, stating that if the limits (cleanup goals) for the construction worker were not met (during corrective measures), then a "notice" would be necessary to capture this. Mr. Arthur then followed up by stating that because of the moderate/high UXO risk, ADEM would like to see some long-term controls put in place for this site in addition to the action for the TCE in soil. Ms. Davis stated that the Army team had gone back and forth on this issue and that ADEM would be kept in the loop with a proposed resolution.

Mr. Burton asked parties in attendance if there were further questions. There were no additional comments or questions.

- **Do outs to ensure that the CMIP review can go smoothly:**
    - Ensure that ADEM is on board early in the CMIP development with how the Army plans to implement long-term controls for this site given the "Moderate/High" UXO probability.

The meeting was adjourned at approximately 9:30 a.m. CDT.

2.0 Meeting Materials

The following meeting materials are provided as an attachment to this memorandum:

- Attachment A: Slide Presentation
- Attachment B: Data Quality Objectives.

ATTACHMENT A

Slide Presentation

SCOPING SESSION CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN FOR RSA-014

Redstone Arsenal, Madison County, Alabama

11 June 2020

US Army Corps of Engineers

SCOPE OF SERVICES

- Base Delivery Order Objectives for RSA-014:
  - Achieve Department of Army (DA) approval of Corrective Measures Study (CMS) report.
  - Achieve DA and Regulatory approvals of Corrective Measures Implementation Plan (CMIP).
  - Achieve DA approval of Statement of Basis/Decision Document (SB/DD).
  - Achieve DA approval of the Safety Submission (SS).
- Optional Delivery Order Objective for RSA-014:
  - Achieve DA and Regulatory approval of the CMI-C activities and the CMR (complete remediation services and achieve response complete).

REGULATORY BASIS

- Resource Conservation and Recovery Act (RCRA) Corrective Action Program
- Alabama Hazardous Wastes Management and Minimization Act (AHWMMA) Hazardous Storage Facility/Thermal Treatment/Solid Waste Management Unit (SWMU) Corrective Action Permit (ID # AL7210020742)
- RSA is a federal facility on the National Priorities List and actions are required to meet the substantive requirements of the National Oil and Hazardous Substances Pollution Contingency Plan under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

COMPLIANCE REQUIREMENTS

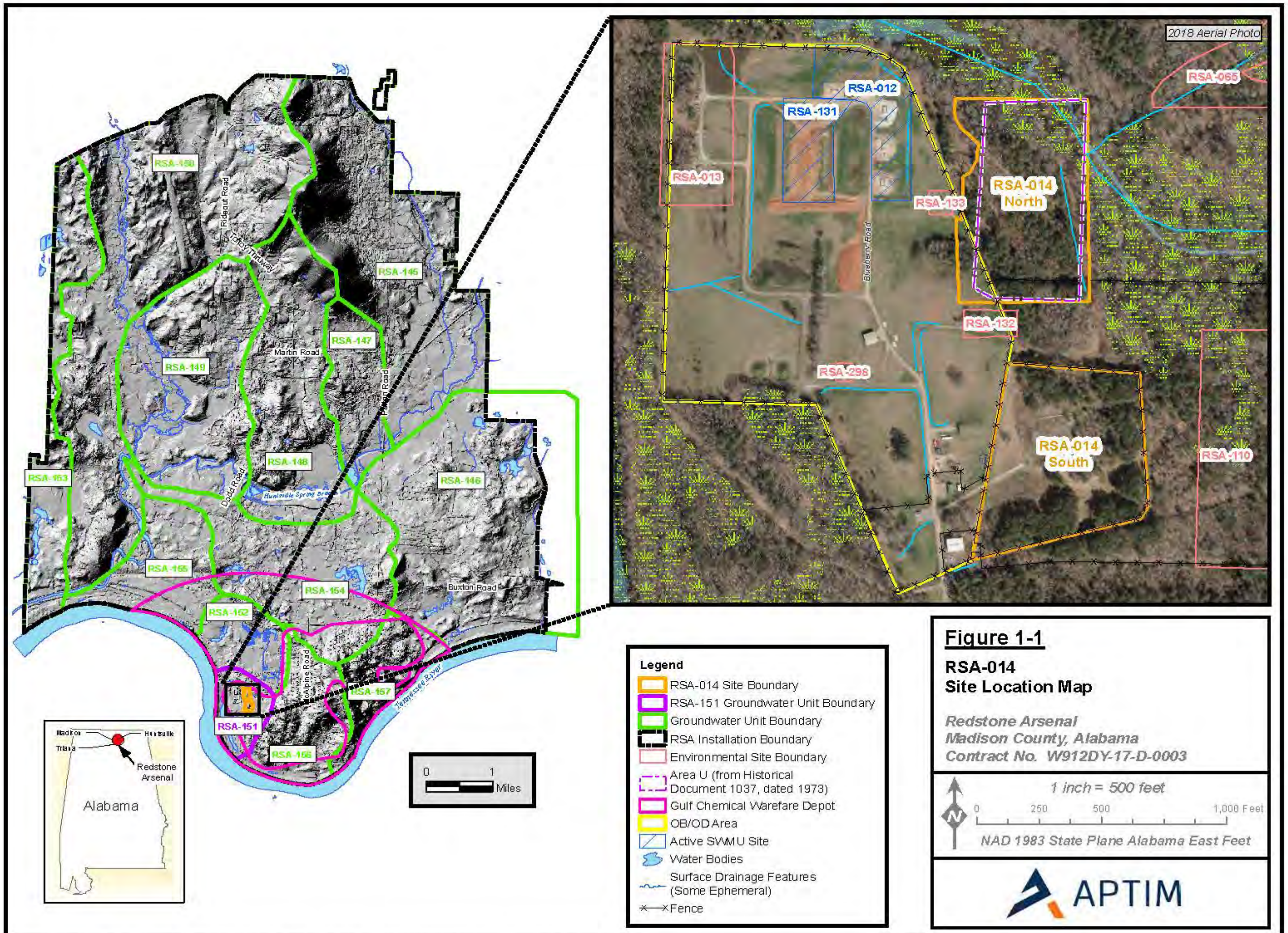
- RCRA
- Department of Defense
- Department of Army
- US Army Corps of Engineers - Data Item Descriptions (DID)
- US Army Garrison - Redstone Arsenal (RSA)
- Federal and State Regulations and Guidance to include Interim Guidance (IG)

AGENDA

- Topics for Scoping Session:
- Site Description/History
- Document Status
- Resource Conservation and Recovery Act Facility Investigation (RFI) Summary
- Corrective Measures Study (CMS) Summary
- SB/DD Summary
- CMIP Execution Strategy
- Proposed CMIP Activities
- Schedule
- Path Forward

RSA-014 UNLINED INACTIVE BURN TRENCHES, UNIT #2

SITE LOCATION MAP



H:\Redstone_MEGA\GIS_Documents\Project_Maps\RSA_014\RSA_014_Rev1_CMS_Jan2020\RSA_014_Site_Location_Map.mxd

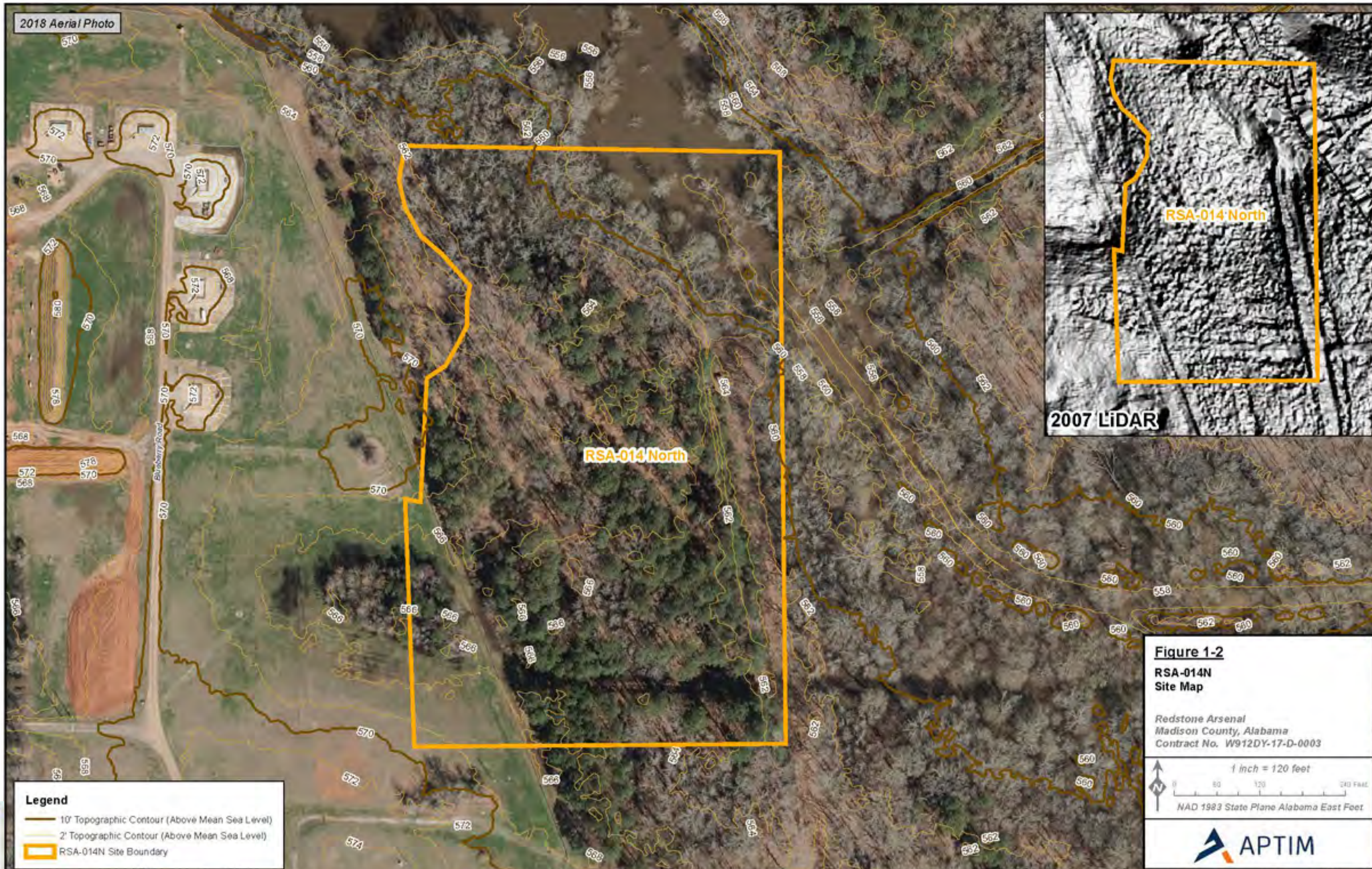
SITE DESCRIPTION/HISTORY RSA-014

- RSA-014 is located in the southern portion of RSA, above the RSA-151 groundwater unit.
- Original RSA-014 site encompassed 9.8 acres which included two former unlined burn trenches.
- Potential source area investigation in 2004 identified a 9.7 acre parcel to the north of this area which may have been used as a disposal area.
- In 2009, this northern area was added to the footprint for RSA-014 and the site moved forward into investigation as RSA-014 North (RSA-014N) and RSA-014 South (RSA-014S).
- No buildings are present within either parcel.
- Both parcels lie just outside the fenced OB/OD area except for the southwest corner of RSA-014N.
- Current and future land use: Industrial zone and primary missions include range operations, explosive operations, storage, open space, and buffer zone.

SITE DESCRIPTION/HISTORY RSA-014N

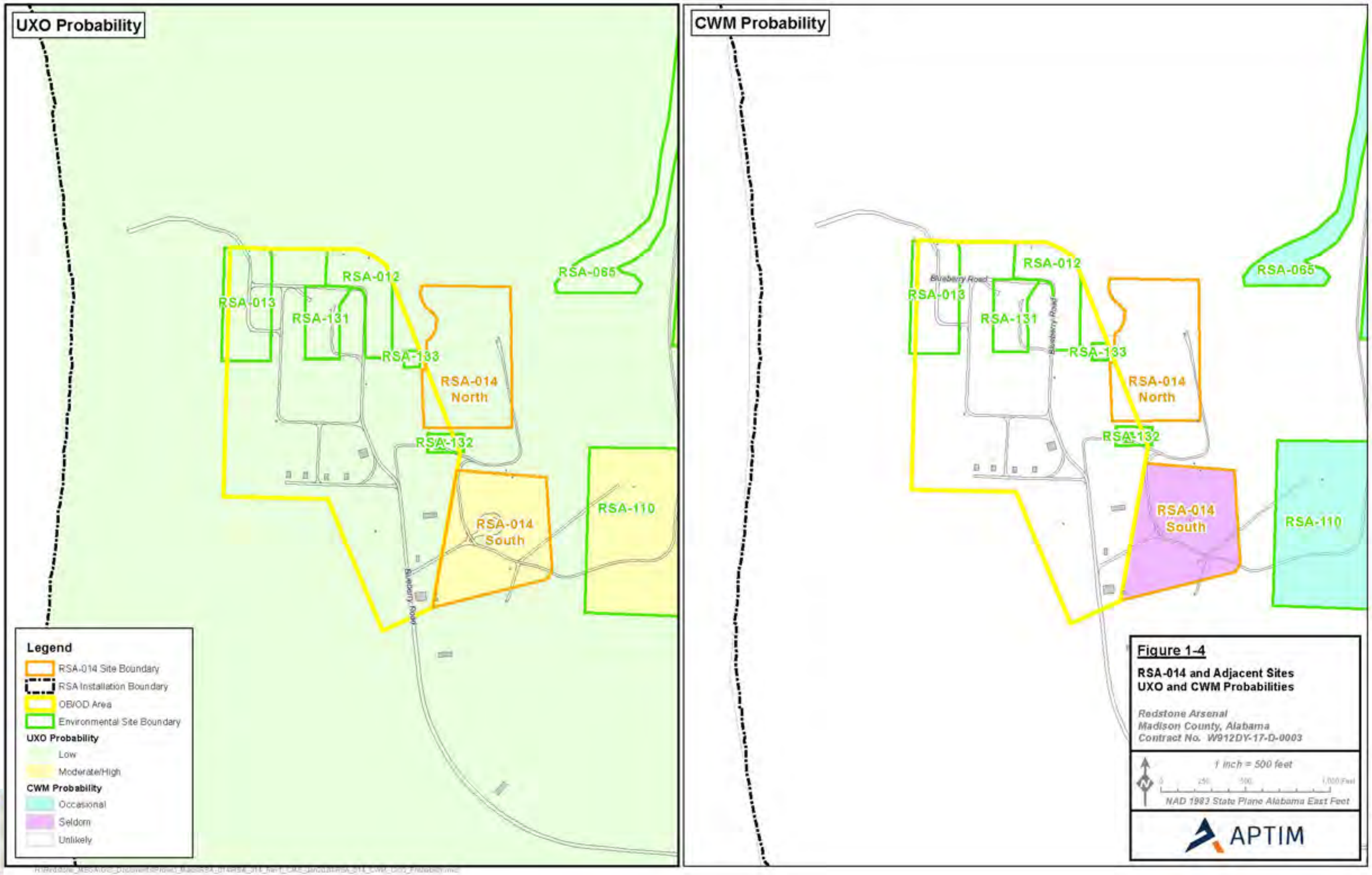
- Area may have been used as disposal area primarily for beryllium, small quantities of miscellaneous laboratory samples, and production chemicals (e.g., energetic oxidizers) per a 1973 Army map.
- Site reconnaissance in 2013 and review of LiDAR imaging did not reveal signs of trenching, mounding, or any other evidence of surface or subsurface disposal.
- The northeast corner of RSA-014N encompasses wetlands and a stream feeds an embankment of the Tennessee River.
- RSA-014N is largely forested except for grass within the southwest corner that lies within the fenced OB/OD area.
- UXO Probability is “Low.” CWM probability is “Unlikely.”

RSA-014N SITE MAP



U.S.ARMY

RSA-014N UXO AND CWM PROBABILITIES

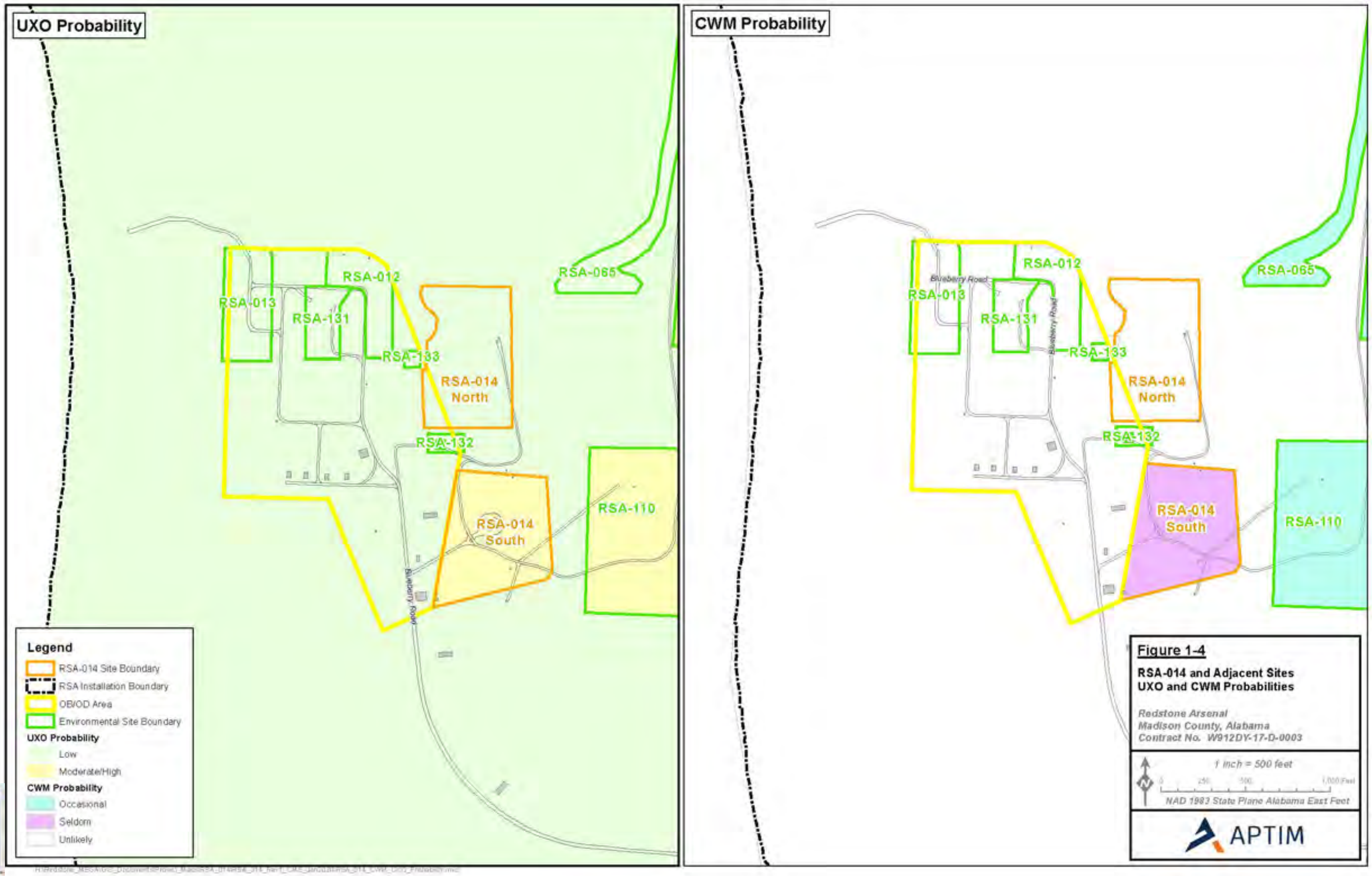


SITE DESCRIPTION/HISTORY RSA-014S

- Consists of two former unlined burn trenches approximately 150-200 feet long, 35 feet wide, and 6-12 feet deep.
- Trenches operated from mid-1950s to 1991 for disposal and burning of packaging and pallets used to ship munitions and contaminated metals (metals later recovered for recycling).
- Some of ash, residue, and metal debris from the RSA-013 burn pads were also disposed in the trenches.
- In 1984, Army was made aware that the trenches were receiving propellant-contaminated solvents and explosives from Thiokol's operations; disposal of these wastes were discontinued. Nonhazardous propellant-contaminated materials with less than 4% propellant were allowed to be disposed in the trenches.
- All burning/disposal ceased by 1991 and trenches were filled and covered with clean fill.
- RSA-014S is fenced with 6-foot-chain-link fencing and three-strand barbed wire along top.
- UXO Probability is "Moderate/High." CWM probability is "Seldom."

RSA-014S SITE MAP

RSA-014S UXO AND CWM PROBABILITIES



RCRA DOCUMENT STATUS: RSA-014

- Restoration Document Status:
  - **RFI report**: The Rev. 1 RFI report was submitted to ADEM on August 2, 2017 and received concurrence on September 21, 2017.
  - **Final focused CMS report:** The final focused CMS report was submitted to Army on November 3, 2107 following RSA review and approval.
  - **Revised final focused CMS report**:
    - Advance Review: To Army on February 7, 2020. Received official CEHNC and CX comments on March 17, 2020.
    - Backcheck: To Army on March 31, 2020. CEHNC and CX reviewers had no further comments. AEC Legal comments received on April 2, 2020.
    - Backcheck: To Army on April 23, 2020. AEC concurred with the report on May 5, 2020.
    - Final version: To Army May 12, 2020 for COR concurrence.

RCRA DOCUMENT STATUS (CONTINUED): RSA-014

– **SB/DD**:

- Draft SB/DD submitted to Army on September 27, 2017.
- Comments received from RSA on November 2, 2017.
- Public comment period held December 3, 2017 to January 2, 2018; no comments received.
- Backcheck to RSA on January 25, 2018. RSA concurrence on January 26, 2018.
- Final SB/DD submitted January 26, 2018.
- RSA Legal comments received March 9, 2018.
- Backcheck to RSA on April 4, 2018. Concurrence from RSA on April 5, 2018.
- Revised Final SB/DD submitted April 6, 2018.
- Unknown if SB/DD received final signatures.

RCRA DOCUMENT STATUS (CONTINUED): RSA-014

- Contracted Work
  - CMS: Revised Final Focused CMS (April 2020) complete.
  - SB/DD: April 2018 SB/DD to be revised based on DA approved Final CMS.
  - SS: Prepare SS and obtain DA approval.
  - CMIP: Prepare CMIP and obtain DA approval and Regulatory concurrence.
- Optional Work
  - CMIC: Conduct corrective measures in accordance with approved CMIP.
  - CMR: Prepare CMR and obtain DA approval and Regulatory concurrence.

RFI SUMMARY: RSA-014N

- Conceptual site model (CSM) for Army historical operations included:
  - Release of volatile organic compounds (VOC), semivolatile organic compounds (SVOC) including polynuclear aromatic hydrocarbons (PAH), metals, explosives, and perchlorate from potential disposal of beryllium, laboratory samples, and energetic oxidizers.
  - Potential release of chemical agent/agent breakdown products due to the site's proximity to chemical agent storage within the former Gulf Chemical Warfare Depot.
- No constituents detected in surface media (soil, sediment, or surface water) at concentrations above preliminary screening values (PSV) and background screening values (BSV) (metals).
- Exposure to surface media poses no unacceptable risks to human health, ecological receptors, or the environment.
- Numerous COCs (metals, VOCs, SVOCs, perchlorate, and explosives) in groundwater pose unacceptable risk to human health if it is developed as a potable source.

RFI SUMMARY: RSA-014S

- Conceptual site model (CSM) for Army historical operations includes:
  - Release of volatile organic compounds (VOC), semivolatile organic compounds (SVOC) including polynuclear aromatic hydrocarbons (PAH), metals, explosives, and perchlorate from burning operations.
  - Potential release of chemical agent/agent breakdown products due to its proximity to chemical agent storage within the former Gulf Chemical Warfare Depot and the disposal of munitions pallets and packaging.
- Constituents detected in soil at concentrations above preliminary screening values (PSV) and background screening values (BSV) (metals) were delineated to concentrations below applicable screening criteria:
  - Surface soil: arsenic, tetrachloroethene, and TCE
  - Subsurface soil: TCE and perchlorate
- Only TCE in surface soil at RSA-014S poses unacceptable risk to human health (construction worker from inhalation). No constituents in soil pose unacceptable risk to the environment, or a leaching threat to groundwater.
- Numerous COCs (metals, VOCs, SVOCs, perchlorate, and explosives) in groundwater pose unacceptable risk to human health if it is developed as a potable source.

RFI SUMMARY (CONTINUED): RSA-014N AND RSA-014S

- The RFI recommended no further action for surface media at RSA-014N.
- The RFI recommended corrective measures to manage the unacceptable risk of TCE in soil to the construction worker at RSA-014S.
- The RFI recommended corrective measures to manage the COCs requiring action in groundwater under both RSA-014N and RSA-014S to be conducted with the RSA-151 groundwater unit; the COCs are present as commingled plumes that are best addressed on a broader scale than the surface media site level.
- ADEM concurred with the RFI recommendations on September 21, 2017.

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FOCUSED CMS REPORT: RSA-014

- Based on information and recommendations in the RFI report, a focused CMS report was prepared for RSA-014S to address TCE in surface soil posing unacceptable risk to a construction worker via the inhalation in ambient air.
- The CMO is to prevent or reduce current and future construction worker exposure to TCE in surface soil at RSA-014S such that no unacceptable hazard or risk is present.
- The CMS presented a focused set of presumptive remedies (technologies) for addressing TCE in surface soil at RSA-014S posing unacceptable risk to the construction worker receptor.
- Selected alternatives evaluated in the CMS:
  - Alternative 1: No Action
  - Alternative 2: Excavation with Off-Site Disposal

FOCUSED CMS REPORT (CONTINUED): RSA-014

- Following a detailed analysis of alternatives, Alternative 2 (Excavation with Off-Site Disposal) was recommended for RSA-014S.
- DA has concurred with the recommendation of Alternative 2.

SB/DD SUMMARY: RSA-014

- SB/DD presents Army's preferred corrective measure alternative in accordance with public participation requirements under RCRA and CERCLA and the Army's Defense Environmental Restoration Program (DERP) guidance.
- SB/DD presents a declaration, decision summary, and responsiveness summary as outlined in EPA protocol for proposed plans, RODs, and other decision documents and in format agreed upon by the Army.
- SB/DD contains:
  - Summary of site description/history, investigation history and results, and human health and ecological risks
  - Problems warranting action from the RFI report, CMOs, CGs, feasible technologies evaluated, corrective measure alternatives, and evaluation of the alternatives to the criteria in the EPA RCRA corrective action plan guidance along with consideration of public and regulatory acceptance
  - Army's preferred alternative from the CMS report
  - Responsiveness summary detailing public involvement in the corrective measures including a public comment period, a public meeting (if requested), and responses to comments received
  - Supporting tables and figures

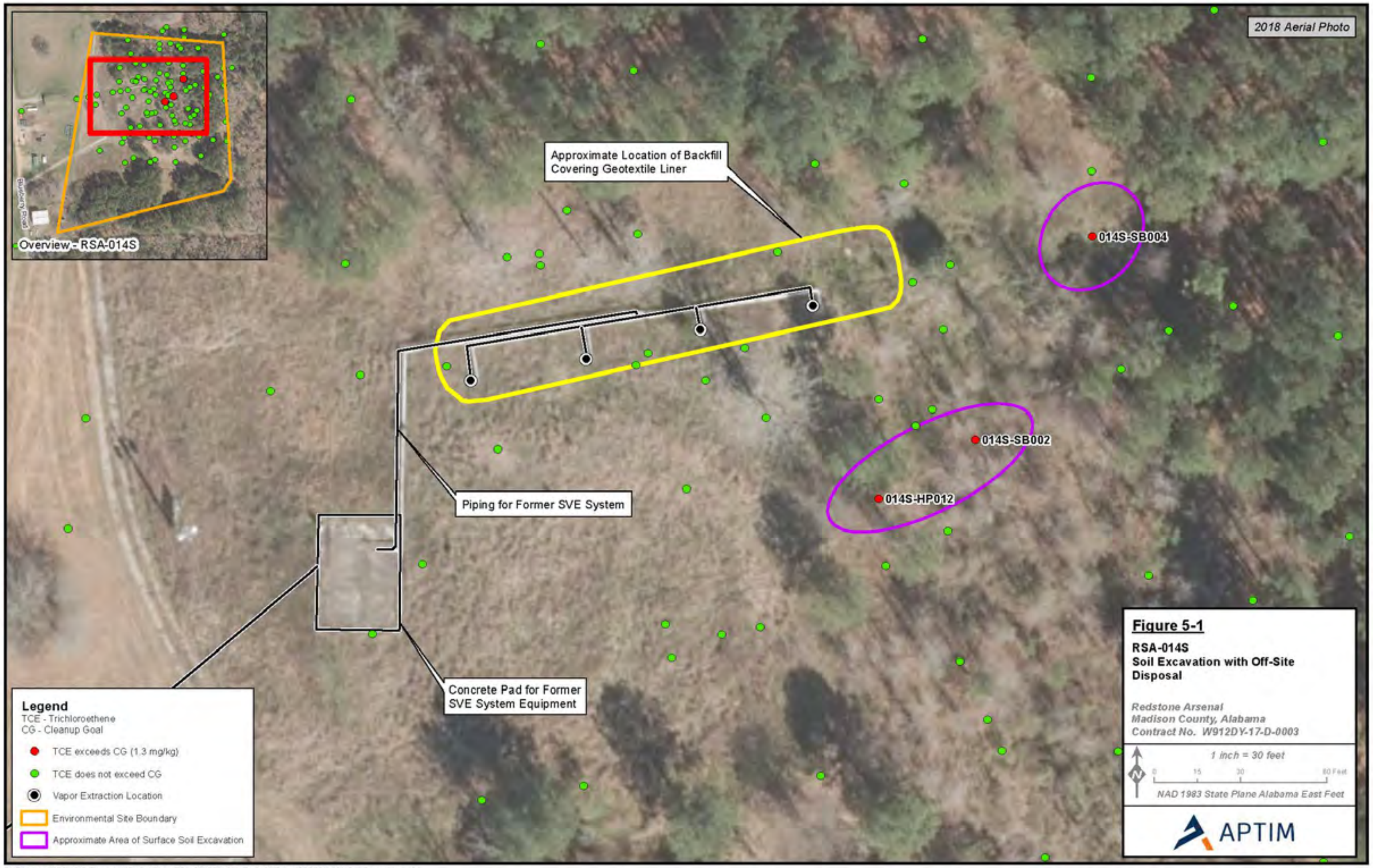
SB/DD SUMMARY (CONTINUED): RSA-014

- April 2018 SB/DD requires revision to be consistent with the April 2020 Final CMS report. Advance review SB/DD to be submitted to Army for review during preparation of the CMIP.
- Following receipt of RSA, CEHNC, and EMCX comments, the SB/DD and responses to comments to be submitted for backcheck review.
- If no further comments from RSA, CEHNC, and EMCX, the SB/DD is submitted to AEC for review concurrently with submittal of CMIP to ADEM. Respond to AEC comments and receive backcheck approval.
- Prepare and submit a final SB/DD for DA approval to meet delivery order objective.
- AEC will staff the SB/DD through G9 (formerly ACSIM) signature delegation.

CMIP EXECUTION STRATEGY: RSA-014

- Prepare CMIP to implement the CMS recommended Alternative 2 (Excavation with Off-Site Disposal) and obtain DA and Regulatory approvals.
- The CMIP will present the following in accordance with Attachment G of the PWS:
  - Summaries of site history/description, environmental setting, investigation history, nature and extent of contamination, fate and transport, site risks, and final CSM
  - Basis for action, including the CMOs, CGs, and selected corrective measures
  - Planned CMI activities
  - Contingencies will be discussed for unforeseen but possible events at the site (e.g., MEC is unexpectedly encountered during excavation)

CORRECTIVE MEASURE FIGURE



PROPOSED CMIP ACTIVITIES

- Proposed DQOs for RSA-014 (refer to separate DQO file)
- The proposed corrective measures include the following:
  - On-site UXO construction support; manage UXO and CWM probabilities under the Army's Site Access Control Program and approved Installation-Wide Low Probability Contingency Plan for CWM (CEHNC, 2019)
  - Excavate approximately 280 loose cubic yards of TCE-contaminated soils (2-foot depth planned) exceeding the CG of 1.3 mg/kg
  - Collect soil confirmation samples from excavations to confirm that TCE concentrations remaining in soil are equal to or below the CG
  - Collect samples from excavated soil for waste characterization
  - Transport contaminated soil off-site for disposal at an ADEM-approved Subtitle D landfill for nonhazardous waste
  - Backfill and grading of the excavated area
  - Site restoration to pre-existing conditions.

SCHEDULE IMPACTS TO BE CONSIDERED IN THE CMIP

- The CMIP will address the following potential schedule impacts to implement the corrective measures:
  - Schedule constraints with corrective measures during ongoing OB/OD operations and gray bat active season from April 1 to November 30
    - Night and weekend work to be conducted, if needed.
    - Tree clearing, if needed, to be conducted outside of the gray bat active season.
  - Coordinating corrective measures outside of seasonal flooding of this area preventing access to site
  - Need for on-site UXO construction support and practicing anomaly avoidance due to the Moderate/High UXO probability

PATH FORWARD

- CMIP Scoping Meeting RSA-014: 11 June 2020
- Minutes and revised scoping slides to Army within 14 days of meeting
- RSA-014 Advance Review Rev. 0 CMIP to Army: 2 July 2020 or 30 days following Army and Regulatory approval of corrective measures as presented during the CMIP Scoping Meeting in accordance with Table 4-1 List of Submittals of the 25 July 2019 PWS

ADDITIONAL QUESTIONS/COMMENTS

Don Burton
don.burton@aptim.com
865 207 1394

ATTACHMENT B

Data Quality Objectives

Proposed DQOs for RSA-014:

Task Related DQO Planning	
Step 1. State the Problem	• The Resource Conservation and Recovery Act facility investigation (RFI) concluded that TCE in surface soil at RSA-014S poses unacceptable risks to the construction worker. Elevated concentrations of numerous chemicals of concern (COC) present in groundwater as commingled plumes will be addressed on a regional basis with the RSA-151 groundwater unit. These problems are a result of former Department of Defense (DoD) activities. • Based on the current CWM (Seldom) and UXO (Moderate/High) probability ratings, restrictions to the site (access) and intrusive restrictions will remain. • Removal of TCE in surface soil above the CG at RSA-014S is required to reduce the potential unacceptable exposure for the construction worker. • COCs in groundwater under RSA-014 require corrective measures; groundwater cleanup will be the responsibility of the RSA-151 groundwater unit.
Step 2. Identify the Goal of the Study	• Elevated concentrations of TCE present in soil above the CG have been identified as requiring corrective measures to address unacceptable risks to human health for a construction worker during inhalation of ambient air.
Step 3. Identify Informational Inputs	• Table VI.6 of Redstone Arsenal's Alabama Hazardous Wastes Management and Minimization Act (AHWMMA) Permit indicates that a CMI work plan is required for RSA-014 soil (RSA-014S only) and groundwater (groundwater is the responsibility of RSA-151). • Review of historical documents indicating that site was used to burn and dispose propellant-contaminated solvents, packaging and pallets used to ship munitions, and contaminated metals in two disposal trenches, each approximately 150 to 200 feet long, 35 feet wide, and 6 to 12 feet deep. • Results of the existing investigations. • The conceptual site model (CSM) for RSA-014. • Existing quality control (QC) and quality assurance (QA) records of data quality checks.
Step 4. Define the Boundaries of the Study	• Study boundaries for the COC in soil (TCE) were defined in the RFI, which was conducted in accordance with the Department's Alabama Environmental Investigation and Remediation Guidance (AEIRG). • Based on site history and existing data collected, the current site boundary includes historical site features and structures. • These historical site features and structures have been identified as release points for potential contaminants. • Potential locations where releases of TCE may be present have been defined.

Task Related DQO Planning	
	• Corrective measures will be conducted for elevated TCE concentrations in soil until the confirmatory sample results are less than or equal to the CG. The CG has been established in the corrective measures study and will be summarized in the CMI work plan.
Step 5. Develop the Analytic Decision Approach	• The corrective measures will include confirmatory soil sampling in accordance with the Department's AEIRG for analysis of TCE to determine the effectiveness of the selected alternative. • If review of the confirmatory soil sampling data indicates the CG has not been achieved, additional soil removal will be implemented to meet the CG. • If review of the confirmatory soil sampling data indicates the CG has been achieved, no further soil removal will be conducted, as the stated objectives will be met.
Step 6. Specify Performance or Acceptance Criteria	• Selected definable features of work and tasks will achieve the performance criteria specified in the CMI work plan and supporting documents. • Soil samples collected will be analyzed by an Environmental Laboratory Accreditation Program (ELAP) certified subcontracted laboratory for the COC (TCE). • Analytical results generated by off-site laboratories will be evaluated using procedures outlined in the QAPP portion of the CMI work plan to ensure they are suitable for final decision making. • Soil sample results will be reviewed by the APTIM Project Chemist or as delegated and the U.S. Army Engineering and Support Center, Huntsville (CEHNC) Chemist. • Analytical results from waste characterization samples will be submitted to the off-site disposal facility to adequately classify waste materials and meet the applicable waste profile package requirements for disposal.
Step 7. Develop/Optimize the Plan for Obtaining Data	• Only qualified personnel will perform corrective measures activities. • Requirements of the CMI work plan will be subject to QC and QA reviews.

APPENDIX E

SITE-SPECIFIC HEALTH AND SAFETY PLAN

Appendix E

Site-Specific Safety and Health Plan

Corrective Measures Implementation
RSA-014S, Unlined Inactive Burn Trenches, Unit #2
Operable Unit 14
U.S. Army Garrison-Redstone
Madison County, Alabama
EPA ID No. AL7 210 020 742

Prepared for:

U.S. Army Engineering & Support Center, Huntsville
5021 Bradford Drive East
Huntsville, Alabama 35805

Prepared by:

Aptim Federal Services, LLC
11400 Parkside Drive, Suite 400
Knoxville, TN 37934

Contract No. W912DY-17-D-0003
Delivery Order No. W912DY19F1116
APTIM Project No. 501388

August 2021

Site Safety and Health Plan
Corrective Measures Implementation, RSA-014S
Redstone Arsenal, Madison County, Alabama

Contract No. W912DY-17-D-0003

Plan Preparer:

______________________________ 8/1/2021
Doug Russell, Program HSE Manager Date
Aptim Federal Services, LLC

Plan Approval:

______________________________ 8/1/2021
Don Burton, Project Manager Date
Aptim Federal Services, LLC

______________________________ 8/1/2021
Larry Verdier, CIH, CSP, CPEA Date
Aptim Federal Services, LLC

ACKNOWLEDGEMENTS

The approved version of this site-specific safety and health plan (SSHP) for corrective measures implementation of soil and groundwater at RSA-014S has been provided to the Quality Control Site Manager (QCSM). I acknowledge my responsibility to provide the QCSM with the equipment, materials, and qualified personnel to implement fully all safety requirements in this SSHP. I will formally review this plan with the health and safety staff at least annually until project completion.

Don C. Burton ____________________ ____________8/1/2021
Don Burton, APTIM Project Manager Date

I acknowledge receipt of this SSHP from the Project Manager and that it is my responsibility to explain its contents to all site personnel and cause these requirements to be fully implemented. Any change in conditions, scope of work, or other change that might affect worker safety requires me to notify the Project Manager and the Health and Safety Field Manager.

____________________ ____________8/1/2021
Brian Rhodes, APTIM QCSM Date

SAFETY AND HEALTH PLAN
ACKNOWLEDGEMENT FORM

I have been informed of and will abide by the procedures set forth in this site-specific safety and health plan for the RSA-014S corrective measures implementation at Redstone Arsenal. By signing this acknowledgement form, I certify receipt of hazard communication training required for safe performance of my job at Redstone Arsenal, Madison County, Alabama.

Printed Name	***Signature***	***Representing***	***Date***

EMERGENCY CONTACT INFORMATION

In case of emergency or unplanned situation, contact the appropriate responder from the list below.

- In emergency situations, contact the site Point of Contact (POC) who will then contact the appropriate response teams.
- If a serious, life threatening emergency arises, contact emergency personnel before contacting the site POC.

EMERGENCY TELEPHONE NUMBERS AND PROJECT CONTACTS

Emergency Medical Care		
Hospital: Huntsville Hospital (Emergency/Trauma Center)	911 (256) 265-1000	
Core Health Networks	(877) 347-7429	
Occupational Health Center, Crestwood Family Practice	(256) 721-9916	
Crestwood Workers Care Madison	(256) 830-8930	
Chemical Agent Emergencies (state that you are at Redstone)	911	
National Poison Control Center	(800) 222-1222	
National Response Center Environmental Emergencies	(800) 424-8802	
Federal Occupational Safety and Health Administration (OSHA) Emergency Hotline	(800) 321-6742	
Local Emergency Numbers		
Fire Department Emergency ask for Redstone Arsenal Fire Department	Emergency Nonemergency	911 (256) 876-2117
Law Enforcement Military Police	Emergency Nonemergency	911 (256) 876-2222
Installation Emergency Operations Center	Nonemergency	(256) 313-1043
Installation Operations Center	Nonemergency	(256) 313-1043
Garrison Safety Office Safety Manager Safety & Occupational Health Specialist Munitions and Explosives of Concern (MEC) support	Nonemergency Michael Moore Keith Coates Rusty Brands	(256) 876-2944 (256) 313-3297 (256) 876-3383 (256) 876-3855
USACE and Army		
U.S. Army Engineering and Support Center, Huntsville (CEHNC) Contracting Officer's Representative and Project Manager	Ashley Roeske	(256) 895-1933
CEHNC-OEC, Safety Chief	John Lewis	(256) 895-1589 (office) (251) 721-5276 (mobile)
CEHNC-OEC Operations Manager	Wilson Walters	(256) 895-1290 (office) (256) 990-1512

		(mobile)
US Army Garrison-Redstone	Clint Howard	(256) 758-7084 (office) (256) 842-3702 (mobile)
Chemical, Biological, Radiological, Nuclear, and High-Yield Explosives Analytical and Remediation Activity	Charles Hendricks	(870) 540-6711
APTIM Contact Information		
Health and Safety Emergency Number		(800) 537-9540 opt. 2
Project Manager	Don Burton	(865) 207-1394
Program HSE Manager	Doug Russell	(865) 414-9545 (cell) (865) 560-7918 (office)
Corporate Quality Management Representative	Tricia Felt	(303) 741-7426
Senior Unexploded Ordnance (UXO) Supervisor	To be determined	
Site Safety & Health Officer	Brian Rhodes	(256) 714-4200
Senior Vice President Health, Safety, Environmental	Jeff Thompson, CSP	(303) 741-7163
Project Certified Industrial Hygienist	Larry Verdier	(513) 378-8021
Occupational Physician	Dr. William Nassetta	(225) 756-2673

DIRECTIONS TO THE EMERGENCY MEDICAL CENTER

The Huntsville Hospital is located at 101 Sivley Road SW, Huntsville, Alabama, 35801 as shown following on Figure E-1.

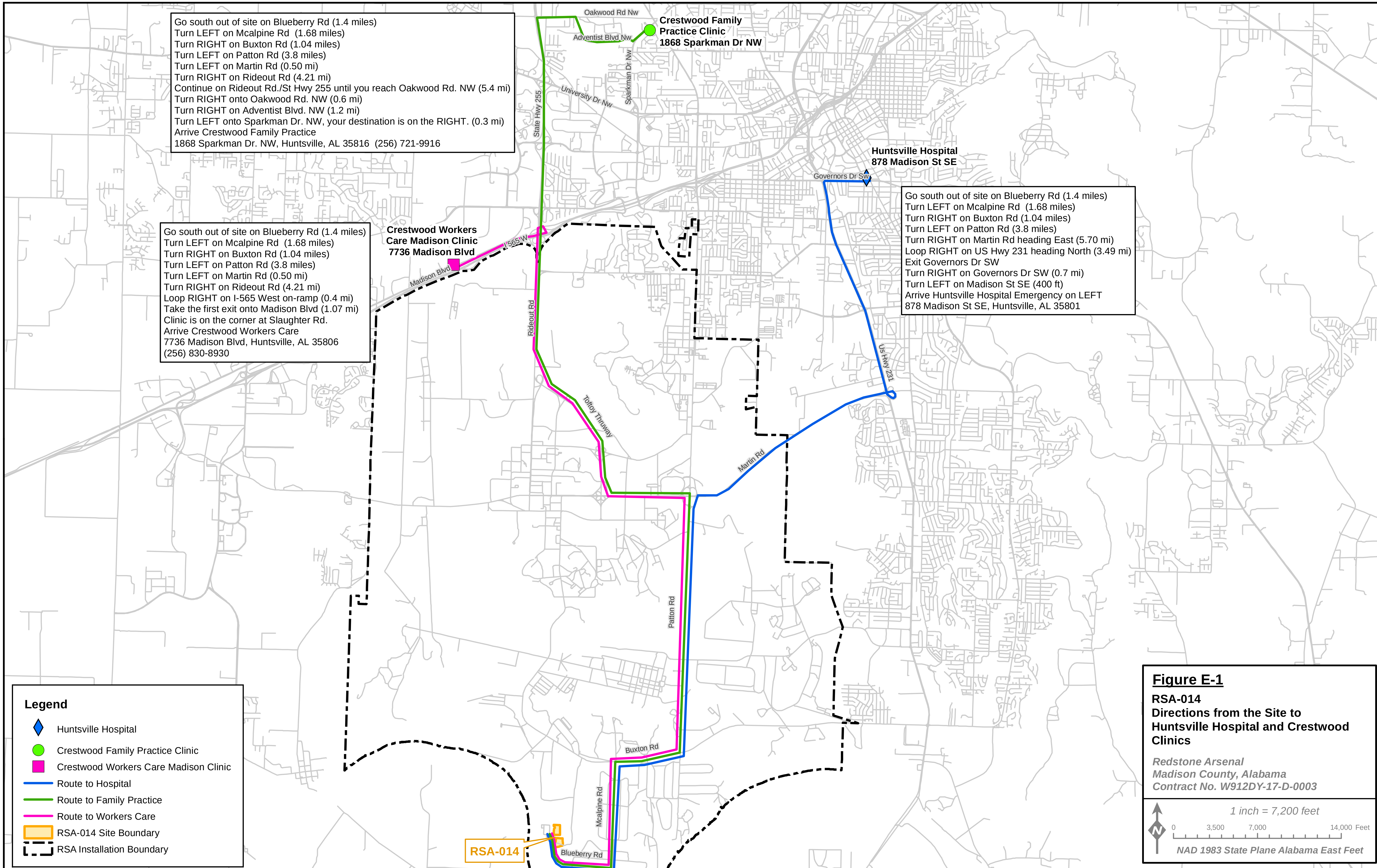


Figure E-1

RSA-014
Directions from the Site to Huntsville Hospital and Crestwood Clinics

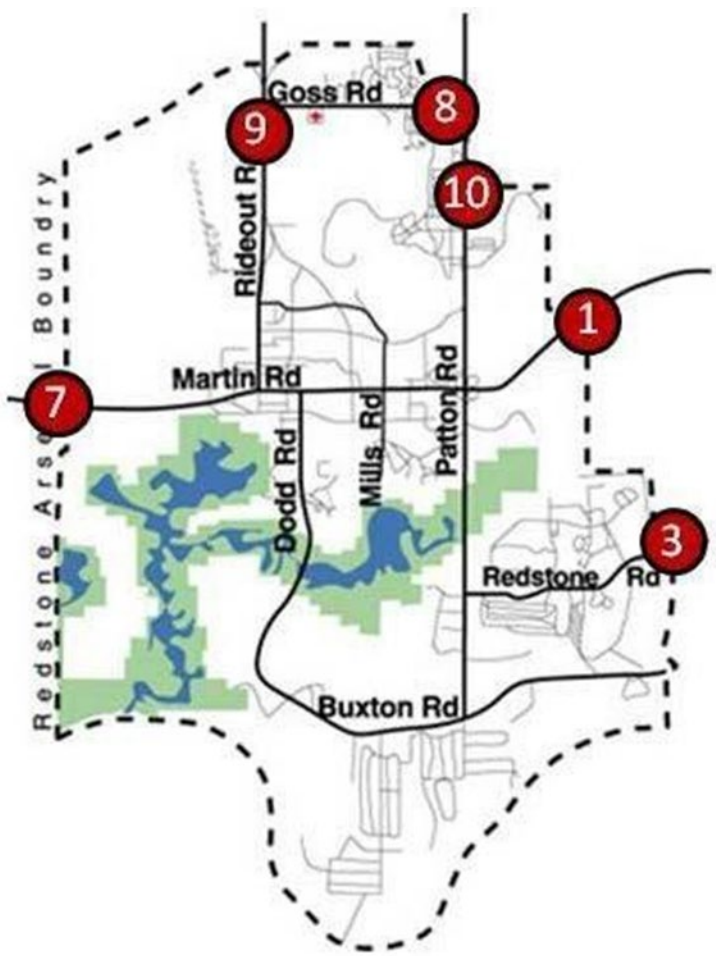
Redstone Arsenal
Madison County, Alabama
Contract No. W912DY-17-D-0003

Redstone Arsenal Gate Hours

Location	Weekdays	Weekends
Gate1	0530 - 2100	Closed
Gate 3	0530 – 1300*	Closed
Gate 7	0530 – 1300*	Closed
Gate 8	0530 – 2100	0530 - 2100
Gate 9	24/7	24/7
Gate 10	0530 – 2100	Closed
Visitor Center 1	0600 - 1430	Closed
Visitor Center 9	0600 - 1700	Closed

*Gate 3 outbound lanes will remain open until 1800
*Gate 7 outbound lanes will remain open until 1800

Gate hours and conditions are subject to change because of homeland defense initiatives; therefore, the point of contact for the current gate operational hours is the Provost Marshall Office at (256) 876-4195.



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List of Acronyms and Abbreviations

°F	degrees Fahrenheit
ACGIH	American Conference of Governmental Industrial Hygienists
ADEM	Alabama Department of Environmental Management
AHA	Activity Hazard Analysis
APP	Accident Prevention Plan
APTIM	Aptim Federal Services, LLC
bgs	below ground surface
CA	chemical agent
CCP	COVID-19 Control Plan
CDHS	Corporate Director of Health and Safety
CEHNC	U.S. Army Engineering Support Center, Huntsville
CFR	Code of Federal Regulations
CMI	corrective measures implementation
COVID-19	Coronavirus Disease 2019
CPR	cardiopulmonary resuscitation
CRZ	contamination reduction zone
CWM	chemical warfare materiel
dBA	A-weighted decibel
DDESB	Department of Defense Explosives Safety Board
DEET	N,N-Diethyl-m-toluamide
DoD	U.S. Department of Defense
ECT	equivalent chill temperature
EM	engineer manual
EP	engineer pamphlet
EZ	exclusion zone
F-B	flash to bang
GWTS	groundwater treatment system
HAZWOPER	Hazardous Waste Operations and Emergency Response
HSM	Health and Safety Manager
IAW	in accordance with
IEOC	Garrison Installation Emergency Operations Center
MEC	munitions and explosives of concern
MPPEH	material potentially presenting an explosive hazard

List of Acronyms and Abbreviations *(Continued)*

OB/OD	open burn/open detonation
OESS	Ordnance and Explosives Safety Specialist
OSHA	Occupational Safety and Health Administration
PM	Project Manager
PPE	personal protective equipment
PWP	plasticized white phosphorus
RFI	Resource Conservation and Recovery Act facility investigation
RSA	Redstone Arsenal
SDS	safety data sheet
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
SUXOS	Senior Unexploded Ordnance Supervisor
SVE	soil vapor extraction
SZ	support zone
TCE	trichloroethene
TLV®	threshold limit value
TSM	tailgate safety meeting
USACE	U.S. Army Corps of Engineers
UXO	unexploded ordnance
UXOSO	Unexploded Ordnance Safety Officer
VOC	volatile organic compound
WBGT	wet bulb globe temperature
WP	white phosphorus

E1.0 Site Description and Contamination Characterization

E1.1 RSA-014 Site Description

RSA-014 is located in the southern portion of Redstone Arsenal (RSA), within the RSA-151 groundwater unit. No buildings are located within the RSA-014 site boundaries. RSA-014 is located east of the Tennessee River and south of an embayment to the river (corrective measures implementation [CMI] work plan Figure 1-1). The RSA-151 groundwater unit underlying RSA-014 covers approximately 572 acres in the southern portion of RSA.

The original footprint for RSA-014 encompassed 9.8 acres that included and surrounded two former unlined burn trenches. These trenches were used from the mid-1950s to 1991 for the disposal and burning of contaminated metals (later recovered for scrap) and pallets and packaging used to ship munitions. The trenches also received ash and residue from adjacent burn pads at RSA-013 and propellant-contaminated solvents and explosives from rocket motor research and development operations. Review of historical documents for the RSA-151 potential source area investigation in 2004 identified an area north of the RSA-014 burn trenches, identified as 151-PS-04C, as possibly having been used as a disposal area for beryllium and small quantities of miscellaneous laboratory samples and production chemicals (Shaw Environmental, Inc., 2006). In 2009, based on agreement and recommendation from the Redstone Tier 1 Team, the 9.7-acre parcel north of RSA-014 was included as RSA-014N as part of the RSA-014 site. The Alabama Department of Environmental Management (ADEM) formally accepted the Army's recommendation to add this north parcel (RSA-014N) to the RSA-014 site on October 8, 2010.

Site maps for RSA-014N and RSA-014S are presented on Figures 1-2 and 1-3 of the CMI work plan. Topography in the vicinity of the two parcels is relatively flat, with ground elevations that range from approximately 556 to 566 feet above mean sea level within RSA-014N and from approximately 565 to 580 feet above mean sea level within RSA-014S. Much of the site lies within the 100-year floodplain, generally defined as the 565-foot elevation contour. Based on direct-push technology and auger refusal depths observed during intrusive fieldwork, overburden thickness ranges from approximately 43 to 86.8 feet in the vicinity of RSA-014N and from 23.5 to 63 feet at RSA-014S. The average depth to groundwater is 9.1 feet below ground surface (bgs) at RSA-014N and 13.6 feet bgs at RSA-014S (CB&I Federal Services LLC, 2017).

A soil vapor extraction (SVE) system was constructed within the northern burn trench during the summer 1998 through winter 1999 time frame and brought on line in January 1999. The SVE system was designed to recover residual volatile organic compounds (VOC) adsorbed in the soil within the trenches. To prevent the system from pulling in air from the surface, an impermeable geosynthetic liner was installed across the northern trench and expected SVE treatment area. Also, to enhance the ability of the system to remove VOCs from the soil, a horizontal dewatering well was installed beneath the northern trench and operated as part of the RSA-013 Groundwater Treatment System (GWTS). The horizontal well/SVE system functioned to dewater the area under the trench and strip the VOCs adsorbed to the soils. When operational, the well with a 160-foot-long screen was capable of producing approximately 25 gallons of groundwater per minute from the overburden. Use of the SVE system was discontinued in October 2000 when the RSA-013 GWTS was shut down due to the discovery of perchlorate in the effluent. The horizontal well is currently being evaluated for use in a pilot study for collecting necessary chemical and hydrogeological data to support the design and construction of an in situ enhanced bioremediation recirculation system. This recirculation system is a significant component of the overburden groundwater remedy for the trichloroethene (TCE) plume under RSA-014 as part of the RSA-151 groundwater unit corrective measures. Section 1.4 of the CMI work plan provides a detailed summary of the RSA-014 description and operational history and Chapter 2.0 provides a detailed summary of the site investigation results.

The current chemical warfare materiel (CWM) and unexploded ordnance (UXO) probability designations for RSA-014N are “Unlikely” and “Low,” respectively, and are “Seldom” and “Moderate/High” for RSA-014S. According to the RSA Master Plan, this site is located in an area designated as Industrial Zone, representing Range Operations, Explosive Operations, Storage, Test Areas, Open Space, and Buffer Zone in the RSA Master Plan. Both parcels lie adjacent to the Open Burn/Open Detonation (OB/OD) area, with the southwest corner of RSA-014N falling within the OB/OD area. Due to the Moderate/High UXO probability at RSA-014S, the project team will be required to have on-site UXO support for site access, surface clearance, vegetation removal, surface and shallow surface soil excavation, anomaly identification and removal if necessary, soil confirmation sampling, MEC/MPPEH handling and disposal if necessary, and off-site disposal of TCE-contaminated soil.

E1.2 Project Objective

The U.S. Army is conducting investigation and remediation of known or suspected waste sites at RSA in Madison County, Alabama, under the Resource Conservation and Recovery Act. The Army has contracted Aptim Federal Services, LLC (APTIM) to perform remediation services under the management of the U.S. Army Environmental Command. APTIM, on behalf of the Army, prepared this CMI work plan site-specific safety and health plan (SSHP) for RSA-014S, Unlined Inactive Burn Trenches, Unit #2, located within Operable Unit 14 (Figure 1-1 of the

CMI work plan). This plan incorporates applicable elements of ADEM Hazardous Waste Facility Permit No. AL7 210 020 742 and the most recent edition of the Alabama Environmental Investigation and Remediation Guidance. This plan protects employee's human health from hazardous constituents at concentrations exceeding applicable limits.

The CMI work plan describes the corrective measures necessary to support completion of corrective measures and achievement of response complete at RSA-014S. The Resource Conservation and Recovery Act facility investigation (RFI) report for RSA-014 concluded that the Army's historical operations have resulted in a release of TCE to surface soil within RSA-014S that poses an unacceptable risk to human health during high-intensity, short-term exposures such as construction work due to inhalation of TCE in ambient air. No surface media within RSA-014N require an action. Chemicals of concern in groundwater under both site parcels will be conducted with the RSA-151 groundwater unit corrective measures under a separate contract.

E1.3 Project Tasks

The following project activities to meet the CMI objectives in support of a soil removal action are detailed in the RSA-014S CMI work plan:

- Mobilization/demobilization
- Instrument-aided surface clearance of the proposed areas associated with corrective measures (e.g., contaminated soil excavation areas and soil stockpile areas)
- Utility clearance and marking
- Installation of surface water and erosion controls
- Vegetation clearance
- Surveying and marking of proposed excavation areas
- Protection and/or closure of existing monitoring wells
- Subsurface removal at planned excavation areas
- Excavation of contaminated soil and confirmation sampling and analysis
- Waste characterization sampling
- Transport and disposal of excavated soils contaminated with TCE as nonhazardous waste (Subtitle D landfill)
- Munitions and explosives of concern (MEC)/material potentially presenting an explosive hazard (MPPEH) handling and disposal, if necessary

- Site restoration, including application of backfill and topsoil and revegetation with approved grass mixtures
- On-site UXO Support
- Establishment of LUC boundary
- Outlining of land use restrictions for this site in the RSA Property Master Plan
- Compliance with requirements in Alabama Administrative Code r. 335-5-1-.02(3)(a)
- Annual routine LUC inspections, sign/fence repairs, and reporting.

This SSHP is intended to be used in conjunction with the approved Final Installation-Wide Accident Prevention Plan (APP) for RSA (U.S. Army Engineering and Support Center, Huntsville [CEHNC], 2019), as applicable. Activities will be conducted in compliance with federal, state, and Army regulation, technical, and/or administrative procedures. All personnel on this site shall have received training, informational programs, and medical surveillance as outlined in the Final Installation-Wide APP (CEHNC, 2019) and be familiar with the requirements of this SSHP.

E1.4 Contamination Characterization

Based on review of available data for RSA-014S, TCE presents a potential safety hazard to potential current and future construction workers breathing ambient air within a future construction area. Otherwise, TCE poses no unacceptable risks to residential receptors or to the environment. The principal source of TCE is primarily associated for former site activities. A detailed discussion of TCE is provided in the CMI work plan. It is extremely unlikely, based on the concentration of site contaminants, that personnel performing soil disturbance activity will be exposed to industrial chemicals at or above their respective 8-hour or short- term occupational exposure limit.

Corrective measures are needed to address TCE-contaminated surface soil at three areas of RSA-014S (014S-HP012, 014S-SB002, and 014S-SB004). The selected corrective measures to be supported by on-site UXO support include but are not limited to surface clearance, vegetation removal, surface and shallow surface soil excavation, anomaly identification and removal if necessary, soil confirmation sampling, MEC/MPPEH handling and disposal if necessary, and off-site disposal of TCE-contaminated soil. Section 4.0 of the CMI work plan details the planned corrective measures.

E2.0 Activity Hazard Analysis

E2.1 Anticipated Hazards

The nature and extent of contamination at RSA-014 has been characterized. The only site-related chemical exceeding residential screening values and determined to be a chemical of concern requiring action to protect human health is TCE.

The results of the RSA-014 RFI indicated that TCE in surface soil at RSA-014S poses an unacceptable risk to human health during high-intensity, short-term exposures such as construction work due to the inhalation of TCE in ambient air. Exposure of construction workers to soil would pose an unacceptable health risk due to the presence of TCE in soil at RSA-014S. This exposure scenario does not apply to trained remediation workers associated with the recommended corrective measures in terms of Occupational Safety and Health Administration (OSHA) occupational exposure.

The RSA-014N surface media (surface soil, subsurface soil, sediment, and surface water) do not pose unacceptable risks to potential human or ecological receptors and do not pose a leaching threat to groundwater. Thus, no further action is needed for surface media at RSA-014N, and ADEM was in agreement with the Army's no-further-action recommendation in the RFI report.

Thus, based on the results from the RFI for RSA-014, a corrective measure is required for TCE in soil from past Army activities. Chemicals of concern in groundwater pose unacceptable risks to receptors who may consume the groundwater; however, installation-wide restrictions are in place to prohibit consumption of groundwater for potable purposes and manage non-potable uses.

Table E2-1 lists contaminants of interest and potential acute health effects.

Munitions and Explosives of Concern/Chemical Warfare Materiel/Chemical Agent. The current UXO and CWM probability designations for RSA-014S are "Moderate/High" and "Seldom," respectively.

MEC items are military munitions that may pose unique explosives safety risks, such as UXO, discarded military munitions, or munitions constituents present in high enough concentrations to pose an explosive hazard. Munitions constituents are any materials originating from UXO, discarded military munitions, or other military munitions, including explosive and nonexplosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions (10 U.S. Code 2710[e][3]) and 10 U.S. Code 2710[e][2]).

Should any suspicious item be encountered during site activities, protocol as documented in Chapter 5.7 of the RSA-014S CMI work plan will be followed, which includes but is not limited to stopping all work and notifying appropriate project personnel.

E2.2 COVID-19 Virus Hazards

Coronavirus Disease 2019 (COVID-19) is a respiratory disease caused by the SARS-CoV-2 virus. COVID-19 spread from China to many other countries around the world, including the United States. The COVID-19 pandemic is impacting all aspects of daily life, including travel, trade, tourism, food supplies, and financial markets. Procedures and information for awareness and education, screening methods, contamination prevention and sanitation, and reporting and illness/exposure management are presented in AMS-710-01-FM-04201, *COVID-19 Control Plan* (CCP).

- A continual assessment of hazards is required to maintain a current awareness of exposures and the effectiveness of current controls. These methods will ensure employees have access to current information on how the pandemic is progressing, known site-specific exposures, site-specific controls and how to effectively implement them, and reporting requirements.

- Employees can be exposed both at the job site and away from the job site. Fever/chills, coughing, shortness of breath/difficulty breathing, fatigue, muscle/body aches, headache, new loss of taste or smell, sore throat, congestion/runny nose, nausea/vomiting, and diarrhea are currently the primary symptoms that may occur between 2 and 14 days from contraction of the virus. It is critical to remind employees to identify any of these symptoms and to quickly isolate employees who are symptomatic from other employees.

- Current medical understanding is that the virus is primarily transmitted via respiratory droplets. The virus can potentially survive on varying surfaces from hours to multiple days. Primary routes of entry include the mouth, eyes and nose. Practices such as "sick employees stay at home," social distancing, and the use of face masks will be used as prevention measures against the virus spread. Sanitation of work areas, office trailers, and restroom facilities will be performed regularly, including additional attention to personal hygiene and hand washing.

- APTIM has suspended all non-essential business travel. Essential business travel must be approved by APTIM leadership. Anyone approved to travel will be screened prior to reporting back to the jobsite.

- Additional reporting and illness management procedures will also be implemented as a management tool to help understand the virus and prevent it's spread. This includes a listing of roles and responsibilities for APTIM's management team, employees, and medical providers. APTIM expects subcontractors to protect their employees through compliance with APTIM's CCP or through the development and implementation of a CCP specific to their risks. APTIM and CEHNC leadership must approve subcontractor plans before implementation at the jobsite.

These requirements are in effect at least for the duration of the pandemic. The APTIM COVID-19 Task Force will amend these requirements or suspend their operation when no longer necessary.

E2.3 Activity Hazard Analyses

Detailed project-specific hazards and controls for each major definable feature of work/activity will be addressed in task-specific activity hazard analyses (AHA) (Attachment 1).

AHAs have been prepared for the following corrective measures activities at RSA-014S:

- Mobilization and demobilization
- Visual site inspections and civil surveys
- Site surveys (utility)
- Surface clearance
- Vegetation clearance or removal
- Subsurface removal in excavation areas, excavation, and backfilling
- Soil sampling
- Waste management and disposal of investigation-derived waste
- MEC/MPPEH handling and disposal, if necessary
- Equipment decontamination
- Pressure washing
- Site restoration
- COVID-19 job site work practices
- Vehicle and fueling operations.

If new operations or tasks are introduced, the Site Safety and Health Officer (SSHO)/Unexploded Ordnance Safety Officer (UXOSO) will perform a hazard analysis. If operations change significantly during the course of this project, the related AHA will be updated to accommodate these changes. The SSHO will approve any changes in personal protective equipment (PPE) or operating procedures before they are implemented. Changes will be communicated to the field team(s) during daily tailgate safety meeting (TSM). The SSHO/UXOSO will be responsible for ensuring that the required controls are being properly implemented for each operation or task.

E2.4 Classic Safety Hazards

E2.4.1 Slip, Trip, and Fall Hazards

Hazard Identification

Work areas may contain slip, trip, and fall hazards for site workers, such as:

- Holes, pits, or ditches
- Slippery surfaces
- Uneven and rough terrain
- Vegetation and debris such as fallen branches, vines, and roots
- Weather conditions that make surfaces slippery and obscure visibility, and thunderstorms and tornados.

Hazard Mitigation/Prevention

Site personnel will be instructed to look for these potential safety hazards and immediately inform the SSHO/UXOSO about any encountered or new slip, trip, or fall hazards. If the hazard cannot be immediately removed or mitigated, action will be taken to notify site personnel about the hazard. Slips, trips, and fall hazards will be a daily tailgate safety briefing item. Operations will cease if weather conditions will cause activities to become hazardous.

E2.4.2 Motor Vehicles and Heavy Equipment

Hazard Identification

Site tasks such as site preparation, brush clearing, excavation, and vehicle and/or heavy equipment operation may present a hazard. Injuries can result from being hit or run over by a moving vehicle; from vehicles overturning; or from being struck, burned, or otherwise injured by moving parts. Vehicles and heavy equipment design and operation will be according to 29 Code of Federal Regulations (CFR) Subpart O, 1926.600 through 1926.602. The types of heavy equipment anticipated to be used on site include earth-moving machinery, pickup trucks, track hoes, utility trailers, flatbed trucks, and dump trucks.

Hazard Mitigation/Prevention

Before any machinery or mechanized equipment is placed into use, it will be inspected and tested to verify that it is in safe operating condition. Records of tests and inspections will be maintained at the site.

Procedures for mitigation and prevention of hazards associated with motor vehicles are contained in AMS-710-02-PR-02700, *Non-Commercial Motor Vehicle Safety;* AMS-710-02-PR-05700, *Mechanized and Marine Equipment*; and AMS-710-02-PR-03900, *Commercial Motor Vehicle Safety* (Attachment 2). APTIM has also implemented additional protocols for motor vehicle use on RSA. A 360-degree walk-around is required before placing vehicles and equipment in motion that have been parked or temporarily staged. Traffic cones are required at the rear of all parked site trucks to facilitate the 360-degree walk-around. Personnel working at remote areas on site with limited roadway space shall position vehicles in the direction of egress to facilitate quick exit in event of emergency. Additionally, use of cellular phones while driving on RSA is strictly prohibited. Violators are subject to fines and loss of driving privileges on base when cited by Military Police in violation of this regulation.

The following safety procedures will be adhered to on sites using heavy machinery and equipment:

- APTIM will designate a competent person to be responsible for the daily inspection of all machinery and equipment and during use to ensure that it is in safe operating condition. Tests will 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.

- Preventive maintenance procedures recommended by the manufacturer will be followed. Any machinery or equipment found to be unsafe will immediately be removed from service and its use prohibited until unsafe conditions have been corrected. A tag indicating that the equipment may not be operated will be placed in a conspicuous location on the equipment. The tag will remain until it is demonstrated to the individual tagging the equipment that it is safe to operate. Where possible, lockout procedures are the preferred method of control to use.

- Only designated personnel will operate machinery and mechanized equipment. Equipment deficiencies observed at any time that affect safe operation will be corrected before continuing operation. Seats and seat belts will be installed and used by operators and passengers of heavy equipment. The only exception to this requirement will be for heavy equipment designed for stand-up operation. Entering or exiting any equipment while it is in motion is prohibited. Machinery or equipment requiring an operator will not be permitted to run unattended. Machinery or equipment will not be operated in a manner that will endanger individuals or property, and safe operating speeds or loads will not be exceeded.

- Equipment operated on the public roads will be equipped with turn signals visible from the front and rear. Mechanized equipment will be shut down prior to and during fueling operations. Closed systems with automatic shut-off that prevent spillage if connections are broken, may be used to fuel diesel-powered equipment left running.

- All towing devices used on any combination of equipment will be structurally adequate for the weight drawn and securely mounted. Persons will not be permitted to go between a towed and towing piece of equipment except to connect the equipment. All equipment with windshields will be equipped with powered wipers. Vehicles that operate under conditions that cause fogging or frosting of windshields will be equipped with operable defogging or defrosting devices.

- Whenever the equipment is parked, the parking brake will be set. Equipment parked on inclines will have the wheels chocked or track mechanism blocked and the parking brake set.

- Personnel will not work or pass underneath the loads handled by lifting or digging equipment.

- Each piece of heavy equipment on site will be equipped with at least one dry chemical or carbon dioxide fire extinguisher.

- A warning device or signal person will be provided where there is danger to nearby workers from moving equipment such as swinging loads, buckets, or booms. Where manual (hand) signals are used, only one person will be designated to give signals to the operator. The signal person will be located to see the load and be clearly visible to the operator. Employees will be required to stay clear of any vehicle being loaded or unloaded to avoid being struck by any spilling or falling materials.

- Loose, ill-fitting clothing and jewelry can become caught in heavy equipment; therefore, jewelry will be removed, and proper fitting clothing will be worn during field activities that involve heavy equipment. Long hair that extends below the hard hat will be tied in a manner to prevent contact with moving equipment parts. PPE will be required of all persons working with or near heavy equipment operations, in accordance with (IAW) this SSHP. Employees exposed to public vehicular traffic will be provided with, and will wear, warning vests or other suitable garments marked with or made of reflective or highly-visible material.

E2.4.3 Underground Utilities

Hazard Identification

The specific hazards include, but are not limited to, utilities such as sewers, telephone, cable, fiber optic, water, fuel, gas, and electrical lines.

Hazard Mitigation/Prevention

Before excavating, the existence and location of underground pipe, electrical equipment, and gas lines will be determined. This will be done IAW AMS-710-02-PR-01610, *Utility Contact Prevention* (Attachment 2), by contacting the appropriate RSA representative to mark the location of the lines. Before beginning any intrusive activities, the SSHO/UXOSO will obtain a digging clearance if appropriate, and will document phone calls, correspondence, and confirmation numbers. Site personnel will not enter underground utilities. If the local utility service cannot access all areas of the site where utilities may be located, geophysical instruments or utility locators will be used to scan for buried utilities.

E2.4.4 Trenching and Excavation

During excavation and trenching, AMS-710-02-PR-01600, *Excavation and Trenching*; AMS-710-02-PR-01610, *Utility Contact Prevention;* and AMS-710-02-PR-05700, *Mechanized and Marine Equipment* (Attachment 2), must be followed. This procedure complies with OSHA Regulations 29 CFR 1926.650 through 29 CFR 1926.652 and Engineer Manual (EM) 385 1-1. No one is permitted to enter any excavation more than 4 feet deep. The planned depth of excavation will extend to a depth of 2 feet below ground surface. If during excavation conditions occur placing personnel or equipment at potential risk of falling into the excavation, sloping shall occur and take into account at a minimum the angle of incline required to prevent a cave-in with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

All excavation shall be performed from a stable ground position. Daily inspections of the excavation shall be made as needed throughout work shifts and after every rainstorm or other hazard-increasing occurrence by a competent person who has received training and is competent in excavation safety. The competent person shall determine the likelihood of a cave-in, and reasonable actions such as sloping or shoring shall be taken if the walls appear to be unstable. When it is necessary for personnel to be near the excavation for photodocumentation, an excavation-competent person must deem it safe to do so. Otherwise, all photographs of the excavation shall be performed by the excavator operator from within the cab when it is safe to do so.

All spoil shall be located at least 3 feet from the edge of the excavation to prevent loading on the excavation platform. The excavation shall be guarded on all sides by barricades or caution tape at least 10 feet from the edge. Class II protection around excavations within the delineated exclusion zone (EZ) shall be utilized.

E2.4.5 Hazardous Energy Control

It is crucial to be aware of hazardous energy to prevent accidents. At the sites included in this contract, overhead and underground utilities are a hazardous energy of concern. Additionally, stored energy associated with heavy equipment hydraulics can be released during servicing or maintenance. Accidents can occur when hazardous energy sources are not evaluated. Accidents also occur when equipment is not properly isolated, shut down, and/or de-energized.

Lock-out/tag-out activities shall follow AMS-710-02-PR-01500, *Control of Hazardous Energy* (Attachment 2). APTIM will coordinate lock-out/tag-out with the Department of Public Works in cases where they are required to assist in hazardous energy control and an APTIM employee or subcontractor is not the authorized user.

E2.4.6 Cumulative Trauma Disorder

Hazard Identification

Injuries may occur from hand digging with shovels, clearing and grubbing tools, and hand augers. Workers will be instructed to avoid over-reaching, lifting, and twisting while moving equipment and to verify that footing is solid before lifting commences.

Hazard Mitigation/Prevention

The following actions will be taken to minimize ergonomic risks:

- Use a hand truck or other mechanical aids to move heavy objects.
- Push rather than pull whenever possible.
- Readjust the load before moving it or change position to avoid twisting or stretching the body to lift the load.
- Consider the size, shape, and weight of the object to be lifted. No individual employee is permitted to lift any object that weighs over 50 pounds. Multiple employees or the use of mechanical lifting devices is required for objects over the 50-pound limit.
- Consider that the safe lifting zone is between the knees and shoulders. If the object is below knee level, bend the knees and lift with the legs. If the load is above the shoulders, use a sturdy step ladder.
- Inspect the anticipated path to the destination for the presence of slip, trip, and fall hazards, and clear obstacles before commencing to move the load/object. Place feet far enough apart for good balance and stability (typically shoulder width).
- Get as close to the load as possible. Bend legs at the knees.
- Keep the back as straight as possible and abdominal muscles tightened.
- Avoid twisting motions when performing manual lifts.

- Straighten legs from their bent position to lift the object.
- Take small turning steps without twisting the knees or the back if it is necessary to turn with the load.
- Never carry a load that cannot be seen over or around.

E2.4.7 Vibration

Hazard Identification

Both hand-held and stationary tools that transmit vibration through a work piece can cause vibration "white fingers" or hand-arm vibration syndrome. The use of these types of tools is not anticipated on this project; however, if they should be required, proper control measures will be used to minimize hand-arm vibration.

Hazard Mitigation/Prevention

The control measures may include the following:

- Using anti-vibration tools and/or gloves
- Keeping hands and body warm
- Minimizing the vibration coupling between the hand and the tool
- Participating in the medical surveillance program
- Adhering to the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV®) for hand-arm vibration.

E2.4.8 Material Handling and Lifting

Hazard Identification

Improper handling and lifting of materials and equipment on site can result in specific injuries to the body, most notably the back.

Hazard Mitigation/Prevention

Site personnel will exercise care in lifting and handling heavy or bulky items. No site worker will attempt to lift any item in excess of 50 pounds without assistance or use of a mechanical device. Materials being lifted either mechanically or manually will not be moved or suspended over personnel unless precautions have been made to protect the personnel from falling objects. Whenever heavy or bulky material is to be moved manually, the size, shape, and weight of the object and the distance and path of movement must be considered to prevent joint and back injuries. Adhere to the following hierarchy in selecting a means for material handling:

1. Movement of the material by mechanical device (lift truck, crane, and similar)
2. Movement by manual means using mechanical aid (dolly or cart)
3. Movement manually in a planned manner with an adequate number of personnel.

The SSHO will train employees in proper lifting techniques and require that they lift objects properly. The following procedures will be followed:

1. Ensure the hands and object are free of oil, grease, or water that might prevent a firm grip. A firm grip on the object is essential.

2. Keep hands, and especially the fingers, away from any points where pinching or crushing could occur, particularly when setting the object down.

3. Inspect the item for metal slivers, jagged edges, burrs, rough or slippery surfaces and pinch points, and, if necessary, use gloves to protect the hands.

4. Place the feet far enough apart for good balance and stability.

5. Ensure that solid footing is available before lifting the object. When lifting, remain as close to the load as possible, bending legs at the knees, keeping the back as straight as possible, and lifting the object with the legs while straightening from a bended position.

6. Never carry a load that cannot be seen over or around while carrying it.

7. When setting an object down, keep the stance and position identical to that for lifting, with the back straight and the legs bent at the knees while the object is lowered.

8. When two or more people are required to carry an object, distribute the load uniformly. Each person should face the direction in which the object is being carried as much as possible.

E2.4.9 Explosive Ordnance Hazards

This SSHP covers the site preparation activities, MEC surface and subsurface removal, inspection and handling, and MEC disposal which will be conducted in accordance with the CMI work plan and related appendices. Only Department of Defense Explosives Safety Board (DDESB) TP-18 qualified UXO personnel will execute munitions related activities.

E2.4.9.1 Surface Clearance

Surface clearance procedures are discussed in the CMI work plan.

E2.4.9.2 Material Potentially Presenting an Explosive Hazard

Based on the "Moderate/High" UXO probability rating at RSA-014S, it is possible that the field teams may encounter MEC items that have been fired, buried, or abandoned and that still represent a hazard. If MEC or MPPEH is encountered or suspected to have been encountered, DON'T TOUCH IT. Personnel will follow the 3R's: **Recognize**, **Retreat**, and **Report**. The location(s) will be marked, personnel will be kept out of the area, and appropriate personnel will be notified. MEC safety precautions will be provided during daily safety meetings and are addressed in Engineer Pamphlet (EP) 75-1-2, *Munitions and Explosives of Concern (MEC) Support During Hazardous, Toxic, and Radioactive Waste (HTRW) and Construction Activities* (U.S. Army Corps of Engineers [USACE], 2004 or most current); RSA *Explosive Safety Management Program (ESMP)* (U.S. Army Aviation and Missile Command Safety Office, 2018); and EP 385-1-97 Change 1, *Explosives Safety and Health Requirements Manual* (U.S. Department of the Army, 2013, or most current).

E2.4.9.3 MEC Hazard Safety

All site personnel will be given ordnance recognition training prior to working on the site and qualified UXO personnel will be on site during all site activities. The training will be verified by signature on the site training form. Personnel should be alert for UXO and munitions debris.

If MEC is encountered or suspected to have been encountered during any phase of work, the SSHO/UXOSO will be immediately notified. In general, the following MEC safety precautions and protocols will be followed:

- Personnel will follow the 3R's: **Recognize**, **Retreat**, and **Report**. The location(s) will be marked, personnel will be kept out of the area, and appropriate personnel will be notified.
- Always remain alert at all times for MEC, UXO, and related scrap or MPPEH.
- Observe the cardinal principle involving ordnance, explosives, ammunition, severe fire hazards, or toxic materials i.e., to limit the exposure to a minimum number of personnel, for the minimum amount of time, to a minimum amount of hazardous material consistent with a safe and efficient operation.
- Always assume MEC hazards contain a live charge until determined otherwise.
- DO NOT forget that death or injury can occur from MEC/UXO and explosive-related accidents.
- DO NOT forget that the age or condition of a MEC hazard does not decrease the effectiveness. MEC that has been exposed to the elements for an extended period of

time can become more sensitive to shock, movement, and friction because the stabilizing agent in the explosives may be degraded.

- Consider MEC that has been exposed to fire as extremely hazardous. Chemical and physical changes to the contents may have occurred that render it more sensitive than it was in its original state.

- DO NOT approach leaking plasticized white phosphorus (PWP) or white phosphorus (WP) munitions. Burning PWP/WP may detonate the explosive burster charge.

- DO NOT touch crusted-over PWP/WP. Handling of crusted-over PWP/WP munitions will be done only at the discretion of the UXOSO.

- DO NOT touch, move, or jar any ordnance items regardless of the markings or apparent condition. Under no circumstances will any MEC be handled during avoidance activities or moved in an attempt to make a positive identification.

- DO NOT touch, pick up, kick, or move anything that is unfamiliar or unknown.

- DO NOT roll the item over or scrape the item to identify markings.

- MEC suspected of containing CWM shall not be handled by APTIM personnel. All suspect CWM material shall be handled and managed by chemical, biological, radiological, and nuclear analytical and remediation activity.

- DO NOT approach or enter a munitions site if an electrical storm is occurring or approaching. If a storm approaches during site operations, leave the site immediately and seek shelter.

- DO NOT transmit radios or cellular phones in the vicinity of suspect MEC hazards.

- DO NOT walk across an area where the ground surface cannot be seen and that has not been cleared of MEC hazards by the UXO technician.

- DO NOT rely on color codes for positive identification of ordnance items or their contents.

- DO NOT drive vehicles into a suspected MEC area. Use clearly marked lanes.

- DO NOT carry matches, cigarettes, lighters, or other flame-producing devices into a MEC site.

- DO NOT be misled by markings on the MEC item stating, “practice bomb,” “dummy,” or “inert.” Practice ordnance can have explosive charges that are used to mark and/or spot the point of impact, or the item could be marked incorrectly.

- Post the following warning on site:

— WARNING —

Removing or taking any munitions, explosive, UXO, or munitions-related debris from the site by any employee is strictly prohibited.

Additional MEC safety precautions will be provided during daily safety meetings and are addressed in the CMI work plan and Engineer Pamphlet 385-1-97, *Explosives Safety and Health Requirements Manual*.

E2.5 Chemical Hazards

Table E2-1 lists potential contaminants that may have been used at RSA-014S and the potential routes of exposure and symptoms for each contaminant that may be encountered. Other information such as TLVs®, Permissible Exposure Limits, Immediately Dangerous to Life or Health values, Worker Protection Limits, and physical properties are also included.

Chemical hazards associated with site activities also includes fuels and oils brought on site for equipment use and maintenance. All site personnel will follow the procedures and precautions outlined in the appropriate Safety Data Sheet (SDS) for the appropriate use and storage of these materials. The SDS binder will be kept in the SSHO/UXOSO site vehicle or office and available to all employees on request.

E2.6 Night Operations

Night operations are not planned for RSA-014S. If night operations should become necessary because of the site's location adjacent to the OB/OD Area, the lighting requirements are presented in Table E2-2. The SSHO/UXOSO will conduct prescribed light surveys to verify employees working on specific site work areas have adequate lighting IAW EM 385-1-1. During night work, portable light plants or fixtures will be positioned to provide adequate lighting in select site work areas such as:

- Excavation areas
- Loading areas
- Support area.

The lighting will be directed towards the work area and positioned to provide optimum work area illumination. Personnel may also use hand-held portable or body-attached lighting as necessary to provide focused beam lighting. If, at any time, the lighting conditions do not provide a safe work environment, activities will be halted and necessary adjustment to portable lighting made or additional light plants procured.

A Testo 545 Light Meter or equivalent with National Institute of Standards and Technology calibration certificate will be used to measure lighting at the site. Before the light meter is used, it will be calibrated according to the manufacturer recommendations. The light meter units will be set to measure in foot-candles/Lumens/square foot. A light monitoring log will be maintained. All light measurement logs will be turned over to site quality control for the site report. The SSHO/UXOSO or designee will be trained in the use of the light meter.

E2.7 Physical Hazards

E2.7.1 Severe Weather

Hazard Identification

During the course of field operations, severe weather may be encountered, including thunderstorms, rainstorms, tornados, and other unsafe weather conditions (i.e., high winds). Criteria indicating that severe weather conditions may exist include:

- High winds (greater than 40 miles per hour – depending on the tree cover and other site- specific conditions)
- Tornado watch or warning in place for the area
- Visible lightning
- Extreme temperatures (e.g., greater than 100 degrees Fahrenheit [°F] or less than 32°F)
- Heavy rainfall or fog that makes footing treacherous and visibility difficult.

Hazard Mitigation/Prevention

The SSHO/UXOSO will be responsible for checking the weather conditions at least twice a day through the use of local radio and television broadcasts, internet weather sites, or a weather radio. When severe weather threatens, the SSHO/UXOSO will be responsible for deciding if site operations should cease.

If work is suspended, the SSHO/UXOSO will notify the teams and individuals via radio or cellular telephone. These individuals will be responsible for relaying the work suspension to other personnel in their areas. All personnel will cease operations, secure equipment if time permits, and expeditiously move to designated assembly areas for further instruction. Once the severe weather hazard has passed, the SSHO will notify the Site Manager that work may resume.

If a tornado is projected to impact the location of the job site, several measures will be taken. If the tornado's projected path is forecast to move through the area, the site and all equipment will be secured, and personnel will evacuate to a designated safe location, if time allows. If there is not enough time, personnel will immediately evacuate to a designated storm shelter without securing the site or equipment. The specific directions from the Munitions Response Site to the closest shelter will be detailed during the site-specific briefing or TSM.

If there is not enough time to get to a shelter, possible actions include:

- Immediately get into a vehicle, buckle the seat belt, and try to drive to the closest sturdy shelter. If hit by flying debris while driving, pull over and park.
- Take cover in a stationary vehicle. Put the seat belt on and cover head with arms and a blanket, coat or other cushion if possible.
- Lie in an area noticeably lower than the level of the roadway and cover head with arms and a blanket, coat, or other cushion if possible.

In all situations:

- Do not get under an overpass or bridge. Low, flat locations are safer.
- Never try to outrun a tornado in urban or congested areas in a car or truck. Instead, leave the vehicle immediately for safe shelter.
- Watch out for flying debris. Flying debris from tornadoes causes most fatalities and injuries.

E2.7.2 Lightning

Hazard Identification

Noting the time from lightning flash to the bang of the associated thunder offers a way to estimate the distance of the lightning to a given person's position. For each 5-second count from flash to bang (F-B), lightning is 1 mile away. Thus, an F-B of 10 means that lightning is 2 miles away and an F-B of 15 means that lightning is 3 miles away, and so on. The lightning safety evacuation plan will be implemented at a count of 50 (10 miles) or as soon as lightning is observed or thunder is heard. This plan will be enacted for a minimum of 30 minutes after the last audible thunder or visible flash of lightning.

Hazard Mitigation/Prevention

If a lightning storm is observed, all outdoor site activities will cease, and personnel will seek safe shelter. A safe shelter may consist of:

- Fully enclosed metal vehicles with windows up and vehicle radio off
- Enclosed buildings
- Low ground.

Unsafe shelter areas include all nearby outdoor metallic objects such as flagpoles, fences, high mast lightpoles, gates, etc. Trees, water, and open fields will be avoided, and personnel will avoid using the telephone.

E2.7.3 Hazardous Noise

Hazard Identification

Planned activities may involve the use of noise-producing equipment such as weed trimmers, bobcats, backhoes, and other noise-producing equipment. The unprotected exposure of site workers to this noise during activities can result in noise-induced hearing loss.

A hazardous noise condition exists when communication between individuals separated by 3 feet requires shouting.

Hazard Mitigation/Prevention

Hearing protection is required any time the noise level reaches 85 a-weighted decibel (dbA) or greater or when communication between individuals separated by 3 feet requires shouting. Double protection is required anytime noise levels exceed 115 dbA. The SSHO/UXOSO will ensure that either earmuffs or disposable foam earplugs are available to, and used by, all personnel near sources of hazardous noise.

Where equipment generates high levels of continuous or impact noise, the SSHO will conduct a noise survey to verify that appropriate PPE is being used.

E2.7.4 Heat and Cold Stress

A detailed discussion of heat and cold stress symptoms, mitigation, and prevention is provided in Chapter 8.0.

E2.8 Biological Hazards

Personnel will be made aware of the various biological hazards that may be encountered while working at the sites, including ticks, poisonous insects (for example, fire ants, chiggers, and disease-bearing mosquitoes), poison ivy, and snakes, during the initial site safety orientation. Appropriate preventative measures will be employed to minimize potential exposure to biological hazards, including designating a field member to watch for biological hazards. Table E2-3 shows the biological hazards for the site. Additionally, hazards associated with COVID-19 are discussed in Section E2.2 and associated AHAs (Attachment 1).

The SSHO/UXOSO will be responsible for instructing personnel in avoiding or minimizing exposure to biological hazards. The keys to avoiding biological hazards are awareness of one's surroundings and general knowledge of the habits of various species that may present a threat. In general, the vertebrates will escape to avoid human contact when encountered. Reptiles will often seek out warm sunny locations in morning hours and during cold weather. A reconnaissance of the site work area should be conducted every morning to identify the presence of potential threat species of plants, insects, and animals. Clearings of vegetation and soil excavation near burrows are activities that potentially disturb reptiles or hornet nests in proximity to personnel. Extra care and caution should be exercised in any work area that disturbs vegetation or soil or when entering any vegetated area where one cannot directly see the ground surface at all times.

The work sites may contain ticks, venomous spiders, and venomous insects. Venomous insects and spiders are generally reclusive, and the greatest potential for exposure arises when personnel are opening containers, structures, buildings, and well casings; handling idle equipment; or moving construction material stockpiles. For example, caution should be taken when opening the casing around monitoring wells.

E2.8.1 Mosquitoes

Mosquitoes are bothersome and may carry diseases, such as the West Nile and Zika viruses. They are attracted by heat, sweat, body odor, and carbon dioxide. Site personnel should wear protective clothing and insect repellent containing N,N-Diethyl-m-toluamide (DEET). Insect repellent should be reapplied at least every four hours. The following suggestions should provide some protection from mosquitoes (OSHA, 2016):

- Review the hazards associated with the West Nile virus and Zika virus through exposure to mosquito bites periodically during the TSMs. Zika virus prevention is an important issue because contracting this virus during pregnancy appears to pose a significant risk of neurological birth defects including microcephaly. Infection appears to be much less dangerous for healthy adults. Get regular updates on transmission and controls from Centers for Disease Control - nwww.cdc.gov/zika/.

- Document the briefing and the topics covered. Standard tailgate forms can be used as long as the form documents the topics covered. Have all sign attendees sign to verify training on Zika virus has been conducted.

- Apply sunscreen first and then insect repellent.

- Take extra precautions like Thermocell units and head nets (as long as they do not interfere with visual acuity).

- Increase protective measures when working at dawn, dusk, and in the early evening.

- Reduce the area of exposed skin when working outdoors. Long-sleeved shirts with sleeves rolled down are recommended; however, it should be understood that mosquitoes may bite through thin clothing. To avoid mosquitoes, personnel should evaluate the actual Level D clothing worn. For example, heavy long-sleeved work shirts and heavy dungarees/jeans may mitigate mosquito bites. The use of a disposable coverall, such as Tyvek®, may further reduce the risk of mosquito bites.

- Use an insect repellent containing approximately 30 percent DEET. Use the repellent according to the manufacturer's directions provided on the container. Frequent reapplication or saturation is not necessary for repellent containing DEET to be effective. Avoid prolonged and excessive use of DEET. (Caution: some individuals may be sensitive to DEET–always read and follow label directions.) After returning from outdoor field activities, wash treated skin with soap and water.

- Use commercially prepared clothing and gear with insect repellants containing 0.5 percent permethrin when additional protection against mosquitoes is necessary. These repellants, such as Repel Permanone™, are available in the sporting goods departments at major retailers. Clothing and gear insect repellants are not for use on skin. Use the repellent according to the manufacturer's recommendations provided on the container.

- Avoid using fragrances.

- Prevent accumulation of water, which can provide breeding grounds for mosquitoes.

The Zika virus is primarily transmitted through mosquitoes but may also be spread via bloodborne (contact) transmissions and sexual transmission (partner to partner). Only one in five infected individuals develops signs and symptoms, which include fever, rash, joint and muscle pain, headaches and red or pink eyes. Symptoms begin to occur between 2 and 7 days after exposure, are usually mild, and can last up to a week.

E2.8.2 Fire Ants

Nests should not be allowed to form near structures and areas where personnel will continue to have a need for access. If bitten, personnel should wash the bite area with soap and water; apply cool compress to the area; elevate the area on a pillow, and apply a paste of baking soda and water for itching.

E2.8.3 Stinging Insects

Workers should keep alert for bee and wasp activity and avoid wearing bright-clothing and scented toiletries when working outside. Be wary of areas around structures where bees and wasps may live. If bee or wasp activity is noted, the area should be avoided if possible. The use of insect repellants containing DEET is not effective in preventing stings. Anyone can have an allergic reaction to a bee sting, even people who were stung before with no reaction. Allergic reactions to bee stings may include swelling around the lips and eyes, rapid development of a rash, difficulty breathing, or signs of shock (pale skin, rapid pulse, and fainting). If any of these symptoms occur, call 911 immediately. Individuals who have had a previous reaction should notify the SSHO before fieldwork begins and carry a “bee-sting kit,” EpiPen®, or Ana-Kit. All personnel will immediately report stings to the SSHO/UXOSO.

Nests should not be allowed to form near structures and areas where personnel will continue to have a need for access. If stung, personnel should wash the bite area with soap and water, apply a cool compress to the area, elevate the area on a pillow, and make a paste of baking soda and water for itching.

Africanized Honey Bees (“killer bees”) are more aggressive and dangerous than other types of bees. If attacked by bees, workers should cover their faces, run away from the hive, and seek shelter in an enclosed area. If stung, the stinger should be removed and first aid sought if necessary.

E2.8.4 Centipedes

Centipedes are commonly found throughout Alabama and grow up to 3 inches in length. Centipedes are venomous though rarely fatal; however, if bitten, observe the individual for signs of allergic reaction for a minimum of 30 minutes. If a team member is bitten by a centipede, immediately report the incident to the SSHO/UXOSO to provide first aid treatment.

E2.8.5 Black, Brown, and Red Widow Spiders

The widow family of spiders are not usually aggressive unless agitated when the female is guarding her egg sac. They live in a variety of natural and domestic habitats such as under rocks and wooden boards and in dense plant growth. The female widows typically have bulbous, glossy abdomens approximately 1 inch long and marked with a characteristic marking on the underside of the abdomen (red hourglass on black for black widows and yellow hourglass on brown for brown widows, and the red widow is typically red-legged, black abdomen with yellow/red patches). The male is rarely seen and is smaller.

Widow spider venom affects the nervous system. The venom causes pain in the lymph nodes. Other symptoms of a severe bite include nausea, elevated blood pressure, sweating, tremors, and increased white blood cell counts. The wound may appear as a bluish red spot surrounded by a whitish area. Victims of a 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. The pain quickly spreads and is followed by profuse sweating, rigid abdominal muscles, muscle spasms, breathing difficulty, slurred speech, and poor coordination, dilated pupils, and generalized swelling of the face and extremities.

E2.8.6 Brown Recluse Spiders

Adult brown recluse spiders are soft bodied, yellowish tan to dark brown, about ¼ to ½ inch long, and have long, delicate grayish to dark brown legs covered with short, dark hairs. The leg span is about the size of a half-dollar.

The spider’s most distinguishing characteristic is the existence of three pairs of eyes arranged in a semicircle on the forepart of the head and a dark, violin-shaped marking immediately behind the semicircle of eyes. Normally, all spiders have 4 pairs of eyes; 8 altogether. The neck of the violin points toward the abdomen.

The spider may be found in sheltered corners among debris, in woodpiles, and under loose bark and stones. Hands, underarms, lower abdomen, and the ankles are the areas of the body most likely to be bitten. A bite may go unnoticed for six to eight hours before a reddening, swelling, and blistering area around the wound starts to appear. A severe bite can produce an area of dead skin tissue that may require surgery. 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, pustule lesion with a bulls-eye appearance.

- Systemic affects may include a generalized rash, joint pain, chills, fever, nausea, and vomiting.
- Pain may become severe after eight hours, with the onset of tissue necrosis.

There is no effective first aid treatment for black widow or brown recluse bites. Except for very young, very old, or weak victims, spider bites are not considered to be life threatening. Medical treatment must be sought, however, to reduce the extent of damage caused by the injected toxins. If the spider can be retrieved, it should be taken with the patient to medical treatment. If venomous spiders are suspected or known to be on site, the SSHO/UXOSO will brief the site personnel as to their identification and avoidance. As with stinging insects, site personnel should report to the SSHO if they locate these spiders on site or notice any type of bite while involved in site activities.

E2.8.7 Ticks

Nearly all work sites on this project may contain ticks. Working in tall grass, especially in or at the edge of wooded areas, increases the potential for ticks to bite workers. Ticks can be particularly numerous in the spring and fall. Ticks are vectors of many different diseases, including Lyme disease. Ticks attach to the skin and feed on blood, creating an opportunity for disease transmission.

The primary symptoms of tick-borne diseases are high fever, head and joint aches, nausea, and vomiting. Additionally, persons develop rashes or experience occasional coughs, chest pain, and severe pneumonia. Lyme disease usually presents a distinctive bull's eye rash at the site of the bite in addition to flu-like symptoms and swollen lymph nodes.

If ticks are prevalent, treat clothing with a permethrin-based product like Permanone™ as directed by the manufacturer. Use an insect repellent containing approximately 30 percent DEET on any bare skin. Insect repellant will be available to personnel. (Caution: some individuals may be sensitive to DEET – always read and follow label directions.) Close pant legs with tape or elastic bands or tuck them into socks. Tuck shirts into pants.

Periodically during the workday, employees should inspect themselves for the presence of ticks. If a tick is discovered, use the following procedure to remove it:

- Use fine-tipped tweezers to detach a tick. Do not try to detach the tick with bare fingers because bacteria from a crushed tick may penetrate even unbroken skin.
- Grip the tick as close to the skin as possible and gently pull it straight away from the skin until it releases its hold.

- Do not twist the tick as it is pulled and do not squeeze its body; this may inject bacteria into the skin.

- Wash hands and the bite area thoroughly with soap and water, and then apply an antiseptic to the bite area.

E2.8.8 Venomous Snakes

Alabama has a variety of snakes; however, the Coral Snake, Eastern Diamondback Rattlesnake, Pygmy Rattlesnake, Timber Rattlesnake, Copperhead, and Cottonmouth (or Water Moccasin) are the venomous varieties native to the state. All except the Coral Snake are within the venomous pit viper family. The Coral Snake belongs to elapid family.

Coral Snake

The Coral Snake is typically seldom seen and tends to be nocturnal. They are small snakes, averaging approximately 20 inches in length. Coral Snakes have rings of red, yellow, and black along the length of their bodies. Their noses are always black, with a yellow ring. They do not have long fangs and would need to "chew" on a person in order to inject their venom. Many snakes mimic the Coral Snake; however, the Coral Snake is the only snake that has red and yellow stripes touching.

Eastern Diamondback Rattlesnake

The Eastern Diamondback Rattlesnake is the largest rattlesnake native to North America, with average lengths reaching 6 feet. They are characterized by their large brown, black, and beige diamond marks on their back. The snake lives in forests near palmetto bushes and makes its home typically in old animal burrows. As a precaution, it is important to note that an Eastern Diamondback Rattlesnake does not always rattle before it strikes.

Pygmy Rattlesnake

The Pygmy Rattlesnake is a relatively small snake, with a length of 18 to 30 inches. They are gray with brownish round markings along the spine (top). They are typically very aggressive.

Timber Rattlesnakes

Timber Rattlesnakes are not aggressive and are sometimes reluctant to bite. If this snake is encountered, leave it alone. Its venom is highly toxic and can be fatal. Timber Rattlesnakes range in size between 3 and 5 feet. The coloration of this species is blackish, yellowish, pinkish, or grayish with dark, bent, cross bands aligned along the dorsal length of its body. A reddish dorsal stripe runs between the cross bands, and it has a black tail. Timber Rattlesnakes typically inhabit forest, nearby fields, and swampy areas and may be found throughout Alabama.

Copperhead

Copperheads are usually not aggressive, and theirbite is very rarely lethal. Like most members of the pit viper family, the Copperhead is a heavy-bodied snake.These snakes range between 24 and 36 inches in length and are covered in hourglass-shaped crossbands which vary in coloration among different populations. The crossbands may be copper, pinkish, reddish brown, or orange. Copperheads are found state-wide in forests and sometimes in fields. The tips of the tails of young Copperheads are yellow, and they flick them back and forth in a manner that attracts prey.

Cottonmouth

Cottonmouths are typically found near a water source, mostly in dormant water. Coloration varies according to age and habitat, but typically are black to greenish-brown. Their lengths can span up to 5 feet.

E2.8.9 Snake Bite First-Aid Treatment

If bitten, a person's physical reaction to the venom is aggravated by fear, anxiety, the amount of venom injected, and the speed of absorption of venom into the victim's circulation;the size of the victim; protection provided by clothing (including shoes and gloves); how quickly the victim receives antivenom therapy; and the location of the bite.

It should be noted that the American Red Cross does not advocate the use of snakebite kits for snakebite injuries. Experience has shown that the victim has a better chance of recovery without permanent damage when the site of the wound is immobilized, and the victim rushed to the closest emergency medical facility (preferably within 30 minutes).

What to Do if Bitten by a Venomous Snake

1. According to the American Red Cross, take the following steps:
   a) Wash the bite with soap and water.
   b) Immobilize the bitten area and keep it lower than the heart.
   c) Get medical help.

2. If a victim is unable to reach medical care within 30 minutes, take the following steps:
   a) Allow bite to bleed freely for 15 to 30 seconds.
   b) Cleanse and rapidly disinfect area.
   c) Wrap leg/arm rapidly with 3- to 6-inch Ace bandage past the knee or elbow joint. Leave fang marks open. Apply suction cup extractor (if available) immediately. Wrap bandage no tighter than one would for a sprain.
   d) Apply extractor until there is no more drainage from fang marks. The extractor can be left in place 30 minutes or more if necessary. It also aids in keeping the

venom from spreading by applying a negative pressure against the tissue where the venom was initially deposited.

e) If an extractor is not available: Apply direct pressure over the bite using a 4H4-gauze pad folded in half twice. Tape in place with adhesive tape.

f) Soak gauze pad in Betadine™ solution if available.

g) Strap gauze pad tightly in place with adhesive tape.

h) Overwrap dressing above and below bite area with ACE or crepe bandage.

i) Wrap ACE bandage as tight as one would for a sprain; not too tight.

j) Check for pulse above and below elastic wrap; if too tight, unpin and loosen

k) Immobilize bitten extremity, use splinting if available.

l) Transport victim to nearest hospital or medical facility as soon as possible.

m) Try and identify, kill, and bring (ONLY if safe to do so) the offending snake.

3. Do NOT take the following actions if bitten by a venomous snake:

a) DO NOT permit removal of pressure dressings or ACE bandage until at a facility that is ready and able to administer antivenin. As soon as the dressings are released the venom will spread. The hospital at this time must be prepared to administer the antidote (antivenin).

b) Do not eat or drink anything unless approved by medical sources.

c) Do not engage in strenuous physical activity.

d) Do not apply oral (mouth) suction to bite.

e) Do not cut into or incise bite marks with a blade.

f) Do not drink any alcohol or use any medication.

g) Do not apply either hot or cold packs.

h) Do not apply a narrow, constrictive tourniquet such as a belt, necktie or cord.

E2.8.10 Protective Measures for Snakes

1. Learn to identify poisonous snakes. The site-specific safety training will review this information.
2. Observe areas before being seated, placing hands and feet. Observe where to place feet when exiting a vehicle.
3. Avoid rock piles, crevices, and brushy areas. If movement of materials (such as rocks or brush) is necessary, use a remote means to initially relocate the material. Prior to entering an area, look and listen carefully.
4. Do not place hands into holes, crevices, debris, or anyplace that may hide a snake.
5. Never handle snakes that appear to be dead.
6. Do not attempt to capture or kill ANY snakes.

E2.8.11 Allergenic Plants

A variety of hazardous plants may be encountered on site. The ailments associated with these plants range from mild hay fever to contact dermatitis to carcinogenic effects. The plants that present the greatest degree of risk to site personnel (i.e., potential for contact versus effect produced) are those that produce skin reactions and skin and tissue injury.

Some of the most common and severe allergic reactions resulting from contact with hazardous plants are caused by poison ivy, poison oak, and poison sumac. The most distinctive features of poison ivy and poison oak are their leaves, which are composed of three leaflets. In certain seasons, both plants also have greenish-white flowers and berries that grow in clusters.

Poison sumac is a tall shrub or small tree with 6 to 12 leaflets arranged in pairs with a single leaflet at the end. Pictures of poison ivy, poison oak, and poison sumac are shown in Table E2-3.

Contact with the poisonous sap (urushiol) of these plants produces a severe rash characterized by redness, blisters, swelling, and intense burning and itching. Although most cases occur in the spring and summer months, it is important to note that contact dermatitis from poison ivy, poison oak, and poison sumac is prevalent in the winter since the vines and stems of the plants also contain urushiol. In some cases, the victim may develop a high fever and may become very ill. Ordinarily, the rash begins within a few hours after exposure, but it may take as long as 24 to 48 hours to appear. The following preventive measures can prove effective for most site personnel:

- Avoid contact with any hazardous plants on site.
- Remove gloves prior to touching face, neck, or other exposed areas of the body.
- Wash hands, face, or other exposed areas at the beginning of each break period and at the end of each workday.
- Keep the skin covered as much as possible (i.e., long pants and long-sleeved shirts) in areas where these plants are known to exist.
- Wash any clothing suspected of being exposed separately in hot water with detergent.
- Be vigilant not to handle tools or equipment suspected of contacting these plants. Clean tools with rubbing alcohol or soap and water. Urushiol can remain active on the surface of objects for several years.

Workers who have come into contact with these plants should do the following:

- Rinse skin immediately with rubbing alcohol, specialized poison plant washes, degreasing soap (such as dishwashing soap) or detergent and lots of water. Do not use soaps with lotions, they will spread the plant oils. Rinse frequently so that wash solutions do not dry on the skin and further spread the urushiol. Scrub under the fingernails with a brush.

- Apply wet compresses, calamine lotion, or hydrocortisone cream to the skin to reduce itching and blistering.
- Take an antihistamine such as diphenhydramine (Benadryl) to help relieve itching (follow directions).

E2.8.12 Bloodborne Pathogens

Bloodborne pathogens enter the human body and blood circulation system through punctures, cuts, or abrasions of the skin or mucous membranes. They are not usually transmitted through ingestion (swallowing), through the lungs (breathing), or by contact with whole, healthy skin. However, under the principle of universal precautions, all blood will be considered infectious, and all skin and mucous membranes will be considered to have possible points of entry for pathogens.

Potential bloodborne pathogen exposures include:

- Contact with contaminated medical equipment or medical waste or sharps
- Medical emergency response operations such as administering first aid or cardiopulmonary resuscitation (CPR)
- Contact with human wastes such as domestic sewage
- Accidental contact with someone’s blood from cuts and scratches incurred during field operations such as brush clearing, excavation, or clearance of munitions debris.

Whenever there is a potential for exposure, personnel will wear the proper PPE (including gloves and masks, when appropriate) to prevent exposure to bloodborne pathogens. If exposure to bloodborne pathogens is suspected, the SSHO/UXOSO will be informed and immediate medical attention will be sought. First aid responders shall follow the guidelines contained in AMS-710-01-PR-00300, *Bloodborne Pathogens* (Attachment 2).

All occupational injuries or illness shall be immediately reported and investigated IAW APTIM Management System procedures. Attachment 3 contains the Incident Reporting Management Procedure.

E2.9 Mishap Reporting and Investigation

E2.9.1 Exposure Data (Man-Hours Worked)

The Project Manager (PM) is responsible for reporting and maintaining records of all exposure and accident experiences incidental to the work, including those of subcontractors. The PM is responsible for ensuring the information is reported to USACE. At a minimum, these records will include exposure work hours and equivalents as prescribed by 29 CFR 1904. This exposure data will be provided to USACE using the USACE Prime Contractor Monthly Record of Work-Related Injuries/Illnesses and Exposure Form or equivalent format accepted by the Contracting Officer's Representative.

E2.9.2 Accident Investigations, Reports, and Logs

The Site Manager, SSHO, and PM shall conduct accident/incident investigations in consultation with the Health and Safety Manager (HSM). A report is completed by the Site Manager or Senior Unexploded Ordnance Supervisor (SUXOS) and must be submitted to the HSM and APTIM Corporate Safety Department in Baton Rouge, Louisiana. The incident reporting forms are provided in AMS-710-05-FM-02401, *Incident Report* (Attachment 3). The PM shall report all accidents to the U.S. Army Garrison, Chief Installation Restoration Branch, and Contracting Officer's Representative as soon as possible but no more than 24 hours after the incident/accident.

Engineer Form 3394 is required to be prepared and submitted in reporting Lost Work Day cases, accidents where three or more persons are admitted to a hospital, a fatality, permanent totally disabling injury, permanent partial disabling injury, or property damage greater than $500,000. ENG Form 3394 must be submitted to the Contracting Officer or authorized representative following the accident in accordance with EM 385-1-1 as soon as possible but no more than 5 days following the accident. The CEHNC Preliminary Accident Notification form is also to be utilized for collection of information relating to accidents. These forms are included in Attachment 3.

Minor incidents such as near-misses or on-site first-aid injuries shall be included in the daily field quality control reports. These incidents shall also be reported immediately to the HSM and be documented in accordance with AMS-710-05-PR-02200, *Incident Reporting.*

E2.9.3 Immediate Notification Requirements

Immediate notification and investigation of accidents is an important component of APTIM's accident prevention program. A full report will be provided to the HSM within 24 hours.

Accidents involving the following categories shall immediately be reported to the Government Designated Authority or authorized representative, HSM, and APTIM Environmental, Health and Safety Hotline:

a. A fatal injury or illness

b. A permanent total disability injury/illness

c. A permanent partial disabling injury/illness

d. Hospitalization of three or more people as inpatients resulting from a single occurrence

e. Property damage of $500,000 or more or damage in an amount specified by USACE in current accident reporting regulations

f. Arc flash incident/accident

g. Army aircraft destroyed or missing

h. Three or more individuals ill or with medical condition suspected to be related to a site condition, or a hazardous or toxic agent on the site.

The SSHO will investigate the accident after all emergency actions have been taken. ENG Form 3394 and/or the Preliminary Accident Notification form will be filled out by the SSHO and submitted to the HSM. A verbal notification should be given to the HSM that the forms are being filled out.

IAW 29 CFR 1904.39, the contractor will notify OSHA within eight hours when there is a fatality or the hospitalization (in-patient) of one or more persons as a result of a single occurrence. IAW DID HNC-001.02, HNC-002, the contractor will immediately report to the Contracting Officer or government designated authority any accident that could bring adverse attention or publicity to the USACE. Other lost-time or OSHA-recordable accidents/incidents will be formally reported (i.e., using a written report) to CEHNC within five working days. The Ordnance and Explosives Safety representative will be notified within one day of any accident or injury that may require reporting. An OSHA 300 log of work-related injuries and illnesses will be maintained at the site.

E2.9.4 Accident Response

The nearest workers will immediately assist a person who shows signs of medical distress or who is involved in an accident as long as the accident scene is safe. The SSHO will be immediately summoned if not already aware of the situation to begin immediate first aid. The

SSHO will immediately make contact with other field personnel to alert them of a medical emergency situation and recommended action if required. The SSHO will advise the following information:

a. Location of the victim at the work site
b. Nature of the emergency
c. Whether the victim is conscious
d. Specific conditions contributing to the injury, if known.

For additional information pertaining to Mishap Reporting, please refer to Section 8.0 of the Installation-Wide APP (CEHNC, 2019). Attachment 3 contains the APTIM Incident Notification, Reporting, and Management Procedures and applicable forms in accordance with EM 385-1-1, Section 01, Paragraph 01.D, sub-paragraph 01.D.05 as provided in Section 8.0 of the Installation-Wide APP (CEHNC, 2019). Engineer Form 3394 and the CEHNC Preliminary Accident Notification form are included in Attachment 3.

E3.0 Staff Organization, Qualifications, and Responsibilities

The staffing organization has been based on the proposed corrective measures to be conducted on site and IAW Chapter 6 of EP 75-1-2 (USACE, 2004) based on the current UXO probability rating of "Moderate/High."

E3.1 Health and Safety Manager

The HSM, Doug Russell, in coordination with the SSHO or UXOSO, is responsible for the development, implementation, and oversight of the SSHP. The HSM shall be available for emergencies and on-site consultation.

E3.2 Project Manager

The PM, Don Burton, is ultimately responsible for ensuring that all project activities are completed IAW requirements set forth in this plan. The PM is responsible for conducting at least one on-site safety inspection each month during the project and ensuring all accidents, incidents, and near misses on the project are reported and thoroughly investigated. The PM must approve in writing any addenda or modifications of the APP with the concurrence of the HSM for the project. Other responsibilities include:

- Enforcing the requirements of the SSHP. This includes performing safety inspections of the work site and, at a minimum, one formal site safety inspection each month.
- Stopping work, as required, to ensure personal safety and protection of property, or where life or property-threatening noncompliance with safety requirements is found.
- Working with the SSHO or UXOSO to ensure that all site personnel have received the proper medical clearance, ensuring that all site personnel have met appropriate training requirements and have the appropriate training documentation on site, and monitoring all team members to ensure compliance with the SSHP

E3.3 Unexploded Ordnance Safety Officer

The UXOSO will be the competent person identified to perform SSHO duties and will be responsible for implementation of this SSHP during all site activities, as well as making recommendations and revisions for the HSM, PM, and SUXOS approval. The UXOSO will conduct daily inspections to determine if operations are being conducted IAW the Installation-Wide APP, USACE requirements, and OSHA regulations. The UXOSO reports directly to the HSM for matters pertaining to worker safety and health. An open dialogue is kept between the UXOSO, SUXOS, HSM, and PM to ensure that safety issues are quickly addressed and corrective actions taken. The UXOSO has the authority to take immediate steps to correct unsafe or unhealthful conditions, including the stoppage of fieldwork when deemed necessary.

The UXOSO will implement the requirements of all APTIM, U.S. Department of Defense (DoD), federal, state, and local statutes and codes; analyze chemical or explosives operational risks, hazards, and safety requirements; establish and ensure compliance with all site-specific safety requirements, chemical, and (if encountered) explosives operations; enforce personnel limits and safety EZs for operations; conduct safety inspections to ensure compliance with chemical or munitions safety codes; and operate and maintain conventional air monitoring equipment in the event material is encountered that requires further exposure evaluation.

E3.4 Senior Unexploded Ordnance Supervisor

The SUXOS will be the senior UXO technician and is a competent person to supervise MEC or CWM operations. The SUXOS directly controls the operations of all field personnel performing MEC activities and will monitor performance of UXO project personnel to help achieve maximum operational safety and efficiency. The SUXOS reports directly to the PM and will implement the approved plans in the field and must review and approve any changes to the approved UXO plans. The SUXOS will supervise all UXO teams on the project. Additionally, the SUXOS has the authority to stop work to correct an unsafe condition or procedure.

The SUXOS meets all requirements specified in DDESB TP-18, *Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel* (DDESB, 2004). In addition to the required DDESB training, the SUXOS will be up to date on applicable OSHA training, IAW 29 CFR 1926.65.

E3.5 UXO Technician Qualifications

The UXO Technician takes daily direction from and reports directly to the SUXOS. The UXO Technician directs the action of a MEC team IAW the approved site-specific CMI work plan and daily verbal direction of the SUXOS. The UXO Technician maintains continuous communication with the SUXOS during the performance of MEC operations and has the authority to temporarily stop the performance of work to resolve and correct any unsafe condition. The UXO Technician meets all requirements as specified in DDESB TP 18 (DoD, 2004). In addition to the required DDESB training, the UXO Technician will be up to date on applicable OSHA training IAW 29 CFR 1926.65.

E3.6 UXO Team Composition

For all activities in areas with the probability of encountering MEC, a UXO team consisting of at least two UXO-qualified personnel (one UXO Technician III and one UXO Technician II) will be required to provide safety support. If MEC is encountered during any phase of work, the SSHO/UXOSO will be immediately notified. The UXO team will provide the MEC recognition, location, and safety functions and will conduct MEC safety briefings for all site personnel and visitors.

E3.7 Site Safety and Health Officer

The SSHO, Brian Rhodes, has the ultimate responsibility to stop any operation that threatens the health and safety of the team or surrounding populace or that causes significant adverse impact to the environment. Mr. Rhodes is the designated competent person for planned activities at RSA-014. Attachment 4 contains proof of qualifications and experience. Other responsibilities include but are not limited to:

- Implementing all safety procedures and operations on site
- Observing work crew members for symptoms of on-site exposure or stress
- Upgrading or downgrading, in coordination with the HSM and the PM, the levels of personal protection based upon site observations and monitoring results
- Informing the project HSM of significant changes in the site environment that require equipment or procedure changes
- Arranging for the availability of first aid and on-site emergency medical care, as necessary
- Determining evacuation routes, establishing and posting local emergency telephone numbers, and arranging emergency transportation
- Ensuring that all site personnel and visitors have received the proper training and medical clearance prior to entering the site
- Establishing EZs, contamination reduction zones (CRZ), and support zones (SZ)
- Presenting TSMs and maintaining attendance logs and records
- Ensuring that the respiratory protection program is implemented
- Ensuring that decontamination procedures meet established criteria
- Ensuring that there are qualified first-aid persons on site who are trained in universal precautions and the use of PPE
- Coordinating safety activities such as training, identifying site hazards, and establishing controls for all site workers as necessary.

E3.8 Subcontractors and Suppliers

The subcontractors for the provided definable features of work/activities (Section E2.3) have not been identified at this time. Subcontractor personnel proof of training and competency and certificates of employee medical surveillance program participation will be provided for review and approval prior to the start of any activities listed. Each subcontractor working on the project site will be required to adhere to the Installation-Wide APP/SSHP and the requirements presented below.

- All subcontractors performing work on site will be prequalified and screened for safety performance and compliance with federal alcohol and substance abuse requirements prior to being issued any contract. APTIM will utilize AMS-710-02-PR-04400, *Subcontractor Evaluation, Selection, and Monitoring*, to provide a consistent approach to subcontractor procurement, including review of their internal safety programs, plans, and procedures. Subcontractors will comply with the requirements for site safety as outlined in this SSHP. The SSHO will be responsible for oversight of the conduct and control of APTIM subcontractors.

- All subcontractor employees are subject to the same training and medical surveillance requirements as APTIM personnel, which are dependent upon their specific job activity. All activities involving the potential for worker exposure to site-related hazardous materials will require medical and training certification as mandated by 29 CFR 1910.120, *General Industry Regulations HAZWOPER*; 29 CFR 1910.1200, *Hazard Communication*; and EM 385-1-1, *USACE Safety and Health Requirements Manual*.

- All subcontractor personnel will be required to sign in daily and to attend a daily meeting discussing operations and safety issues. All incidents involving subcontractor employees shall be reported immediately to the PM and HSM, and a copy of the subcontractor's and APTIM incident report shall be submitted to the SSHO within 24 hours. Subcontractors are required to read and sign the SSHP and comply with all requirements of this SSHP. Contractors not in compliance will be immediately dismissed from the site.

- Suppliers delivering various materials to the project site or providing equipment and/or equipment maintenance will comply with all APTIM rules and regulations. Supplier personnel will not be permitted into restricted areas unless training and medical surveillance are in accordance with 29 CFR 1910.120.

- The management organization of each subcontractor is responsible for the compliance of their personnel with the Installation-Wide APP/SSHP as well as their own health and safety program. The SSHO will ensure subcontractor compliance with this SSHP. Since subcontractors are hired for their specific expertise, they must assume primary responsibility for the safety and health of their personnel. However, APTIM is still responsible for the actions of the subcontractors, which is why subcontractors must abide by the Installation-Wide APP/SSHP. APTIM may elect to allow subcontractors to follow their own health and safety plan procedures as long as they are more protective of APTIM's or EM 385-1-1 requirements following review and approval by the HSM and client as applicable.

E3.9 Stop Work Authority

All personnel have the right and duty to stop work when conditions are unsafe and to assist in correcting these conditions IAW AMS-710-05-PR-00400, *Stop Work Authority* (Attachment 2). If the SSHO determines that workplace conditions present an immediate uncontrolled risk of injury or illness, immediate resolution with the PM shall be sought. If the PM is unable to correct the unsafe conditions, the PM will consult with the HSM and will be authorized and required to issue a Stop Work Order, which shall be immediately binding on all affected APTIM employees, subcontractors, and operations.

E4.0 Training

E4.1 Initial and Supervisory Training

All APTIM or subcontractor employees performing work at RSA shall receive initial safety indoctrination training before beginning actual fieldwork. This training will be performed by the competent/qualified Site Manager, SSHO, SUXOS, or UXOSO. At a minimum, this initial training shall include but not be limited to the following:

a. RSA facility-specific health and safety training
b. Site location and description, including emergency routes, first-aid kit locations, occupational medical clinics, and hospital locations
c. Statement of the APTIM health and safety policy
d. Project organization, key personnel, and responsibilities
e. Chemical, physical, and biological hazards including RSA Explosives Safety Management Program
f. AHA
g. Hazard communication program
h. Heat/cold stress
i. Hearing conservation
j. Control of hazardous energy
k. Covid-19 Control Plan
l. Sanitation
m. Buddy system requirements
n. Fire prevention and protection/hot work
o. Excavation safety
p. PPE
q. Site control measures
r. Exposure monitoring air sampling
s. Medical surveillance
t. Emergency Response and Contingency Plan
u. Record keeping and data management
v. Incident and near miss reporting and investigation
w. Site-specific hazard communication.

E4.2 Mandatory Training and Certifications

IAW 29 CFR 1926.65(e), *Hazardous Waste Operations and Emergency Response* (HAZWOPER); EM 385 1-1, *Safety and Health Requirements Manual*, Section 28; HAZWOPER, EM 385-1-97; and AMS-710-04-PR-00300, *Hazardous Waste Operations* (Attachment 2), mandatory training and certifications applicable to the field personnel at the start of the project and any additional personnel assigned during project execution, and some subcontractors include the following at a minimum:

a. Installation-Wide APP (CEHNC, 2019)/SSHP training
b. HAZWOPER 40-hour training
c. Twenty-four-hour supervised training
d. Hazardous Waste Site Supervisor training (for HAZWOPER supervisors)
e. Thirty-hour OSHA Construction Safety Training (for UXOSO/SSHO)
f. Eight-hour HAZWOPER refresher training
g. APTIM defensive driver training
h. Hazard communication training
i. CPR and first-aid training for a minimum of two people.

Depending on the nature of work and risk assessment, the above requirements may be altered for certain activities.

UXO personnel shall meet the training requirements of TP-18, *Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities*. Recertification or refresher training for the cited Technical Paper shall be maintained and documentation available for review.

Personnel who are designated first-aid and CPR responders shall follow the guidelines contained in AMS-710-01-PR-00300, *Bloodborne Pathogens* (Attachment 2).

E4.3 Emergency Response Training

There are no tasks in the scope of work that require specific emergency response training beyond what is required in Sections E4.1 and E4.2. All APTIM personnel who have completed the APTIM 40-hour HAZWOPER training are qualified as emergency first responder operations level per 29 CFR 1926.65(q)(6)(ii). Site-specific emergency response procedures will be reviewed with all site personnel as applicable to the scope of work as a part of site indoctrination. If unanticipated hazardous material is identified during site work, APTIM will stop work; leave the location; and notify the PM, SSHO, HSM, and SUXOS as applicable.

E4.4 Supervisory and Employee Safety Meetings

E4.4.1 Daily Safety and Tailgate Meetings

The SSHO will conduct daily TSMs at the start of each work shift for all on-site personnel and require any subcontractors to follow equivalent meeting procedures and participate in the APTIM daily safety meetings. The tailgate meeting is a short training or informative session that provides safety guidelines for the planned work activities for the day. The daily tailgate form includes project name and number, date and time, client, work activities, hospital name, address and phone number, ambulance, chemical hazards, physical hazards, PPE, new equipment introduced on site, and other safety topics. All attendees shall sign off on the tailgate safety form as well as the competent person conducting the meeting. The SSHO will also provide assistance with delivery of safety topics relevant to the day's activity. Additionally, SSHO shall employ the use of a daily job safety analysis IAW AMS-710-05-PR-01700, *Work Area Hazard Assessment* (Attachment 2).

Supervisors, safety personnel, and PMs shall participate in regional leadership safety councils chaired by senior management. Safety council participation is mandatory and tracked by the HSM, secretary for the safety council.

E4.5 Visitor Training

All visitors are required to comply with the provisions of this APP and all applicable federal, state, local, and RSA regulations. Visitors to the site shall abide by the following ("visitor" means persons not involved in routine site work activities):

- All visitors must stay outside the EZ and CRZ and remain within the SZ during the extent of their stay. Visitors shall be escorted at all times when observing site operations

- Visitors who observe work within the EZ must wear all appropriate PPE before entry into that zone. If respiratory protective devices are necessary, visitors who wish to enter the EZ must produce evidence that within the past 12 months they have had a complete physical examination and respiratory protection training, and have been fit tested for the respirator to be used.

- Visitors must check in at the office where the purpose of their visit will be evaluated. At a minimum, any visitor planning to access a work area will be briefed on the daily TSM information and will sign off attending the safety briefing.

E4.6 UXO Training

Non-UXO Personnel. All non-UXO trained site personnel will be trained in MEC/chemical agent (CA) recognition, hazards, and actions to take in the event that they are encountered.

UXO Personnel. All UXO-trained personnel, regardless of position, will receive site-specific MEC and CA training.

E4.7 Training Documentation

Documentation of training requirements is the responsibility of APTIM and the subcontractors. Written documentation verifying compliance with 29 CFR 1926.65 (e)(3), (e)(4) (as applicable), and (e)(8) will be submitted to the SSHO before beginning work at the site. Personnel proof of training and competency will be provided for Army review and approval prior to commencement of field operations. Types of training documentation include 40-hour HAZWOPER, 8-hour HAZWOPER refresher, 8-hour supervisor training, 30-hour OSHA construction safety, UXO, bloodborne pathogens, hazard communication, first aid, CPR, current physician's certificate, and hearing conservation training. Documentation of all workers' current training credentials will be kept on site.

E5.0 Personal Protective Equipment

The SSHO will perform daily hazard assessments of work areas and immediately correct any situation where PPE is not being used IAW EM 385-1-1 or this SSHP. The daily assessments will entail compliance with the AHA provided in the SSHP and the job safety analysis, which are the primary forms of hazard evaluation to determine PPE.

APTIM personnel on site will have completed 40-hour HAZWOPER training and annual refresher courses. This training includes when and what type PPE is most protective; how to don, doff, inspect, and wear appropriate PPE; and limitations, care, testing, maintenance, useful life, storage, and proper disposal of PPE.

If APTIM or supervision suspects or is made aware that an employee may not have the proper understanding and skill required of the training, that employee shall be retrained by internal training programs or on site as a daily safety topic associated with pre-shift TSMs and documented as to who received the training and the subjects taught. When new PPE is procured, if previous training was not encompassing specific to the equipment, on-site training will be implemented by competent persons.

AMS-710-02-PR-03000, *Personal Protective Equipment* (Attachment 2), outlines minimum PPE requirements as well as PPE that is provided by APTIM. This procedure, coupled with health and safety management experience, training in proper selection use and maintenance of PPE, site-specific conditions, potential environmental contaminants, physical hazards, and Department of Army guidance documents, will dictate site-specific requirements. Initial protection levels provided in the SSHP have been established for the site work activities based on the anticipated levels of site contaminants, physical hazards, and the scope of work. The SSHP and AHAs, in conjunction with AMS-710-02-PR-03000, shall serve as the written certification for use of PPE. All selected PPE shall be used IAW manufacturer's recommendations and best management practices. Once on site, visual inspection of the work activities by the SSHO or PM may indicate the need for changes in PPE level(s). Any significant change in the PPE level will be approved by the program HSM and/or Certified Industrial Hygienist. PPE requirements and procedures for COVID-19 are presented in Section E5.2.

E5.1 PPE Summary

Hazard and risk assessment is a continuing process to be conducted through the duration of the project. Changes in specific PPE may be made IAW information obtained from actual implementation of site activities. As a rule, levels of PPE or the incorporation of respiratory protection will need to be reassessed if any of the following occur:

- Appearance of previously unidentified or anticipated chemicals, conditions, or task hazards
- Change in ambient weather conditions that impact the use of assigned PPE
- Introduction of a new task or expansion in scope of a previously assigned and evaluated task.

The SSHO/UXOSO will ensure PPE complies with all applicable OSHA, USACE, and Army regulations. It is the responsibility of each employee to report to work wearing proper attire and to inspect the necessary PPE.

Personnel will use the appropriate type of PPE specified in this plan for each individual task. The work activities will begin in the following levels of protection.

Task	Initial Level of PPE
Mobilization and equipment staging	Level D
Utilities identification and locating	Level D
Construction of erosion controls	Level D
Vegetation clearing and grubbing	Level D
Protection and/or closure of existing wells	Level D
Surveying and marking the proposed excavation areas	Level D
MEC Surface and Subsurface Clearance/Soil excavation	Level D
Potential MPPEH Inspection and Handling	Level D
Potential MEC/MPPEH Disposal	Level D
Post-excavation confirmation soil sampling and analysis	Level D
Waste characterization sampling	Level D
Transport and disposal of excavated soils contaminated with TCE as nonhazardous waste (Subtitle D landfill)	Level D
Backfilling	Level D
Heavy equipment decontamination	Modified Level D
Site restoration	Level D

Complete descriptions of Level D and Modified Level D protection follow.

Level D. The following equipment will be used for Level D protection:

- Long-sleeved shirt and long pants
- Leather gloves (when handling sharp objects)
- Nitrile gloves (when handling potentially contaminated materials)
- Steel/composite-toed safety boots

- Safety glasses
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment).

Modified Level D. The following equipment will be used for Modified Level D protection:

- Permeable Tyvek®, Kleenguard, or its equivalent
- Latex boot covers
- Nitrile gloves (outer)
- Lightweight nitrile gloves (inner)
- Steel/composite-toed safety boots
- Safety glasses
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment).

Operators of pressure washing equipment shall wear a face shield, metatarsal guards for the protection of the feet, and leg guards. This will be required in addition to Modified Level D PPE.

Level C. Level C protection is not anticipated unless an upgrade in respiratory protection is required based on air monitoring action levels. The equipment to be used for Level C protection will be provided by SSHO as applicable.

Table E5-1 provides PPE action levels.

E5.2 Special PPE Considerations

The following considerations will be observed in the selection of PPE:

- During COVID-19 working conditions and when not overruled by EZ respiratory PPE requirements, each employee shall wear a face mask or other facial covering (as practical) when around other people, especially when social distancing measures (distance of 6 feet in separation) are not practical to maintain. It is also recommended that employees, as practical, wear nitrile gloves at a minimum when working outside the EZ.

- For dermal protection from poisonous plant species, if necessary; Permeable Tyvek® or its equivalent with elastic wrist and ankle cuff; Latex boot covers (as desired by worker or directed by the UXOSO); and nitrile inner gloves (as desired by worker or directed by the UXOSO).

- Hard hats will be required when working around heavy equipment or an overhead hazard exists.

- Where steel-toe boots are not required for an activity, it will be noted in that activity's AHA.

- Safety glasses will be selected that provide site personnel with the best protection from physical hazards, such as flying objects, and adequate splash protection.
- Site tasks should continually be evaluated to identify hazards, and PPE will be provided to ensure the safety and health of site personnel, based on activity they perform.

E5.3 PPE Inspection, Cleaning, Maintenance, And Storage

All PPE will be inspected before being used to ensure that it is in functional order and that its structural integrity has not been compromised. Reusable PPE (such as safety glasses and hard hats) also will be inspected before being used if it has been in storage for any length of time and following any maintenance. Hard hats will be inspected for expiration dates. Site personnel finding a piece of PPE that is defective will report it to the SSHO, and the defective article will be repaired or replaced.

PPE will be maintained IAW the manufacturer's instructions, and only by personnel who have received proper instruction in the maintenance of the PPE. PPE will be stored in a way that does not compromise the natural shape of the equipment.

E5.4 Respiratory Protection

The level of respiratory protection selected will be based on real-time air monitoring of the work environment IAW AMS-710-02-PR-03500, *Respiratory Protection Program* (Attachment 2). Based on the highest concentrations of TCE, identified in soil from previous investigations, respiratory protection will not be required.

E5.5 Personal Protective Equipment for Visitors

An adequate supply of hard hats, safety glasses, and other basic PPE will be maintained on site for use by government personnel and other visitors. This does not apply to other government contractors, who must supply all of their own PPE.

E6.0 Medical Surveillance

APTIM will utilize the services of a Board-Certified Occupational Medicine physician for the medical surveillance requirements of this project IAW AMS-710-01-PR-05000, *Medical Surveillance Program* (Attachment 2). Dr. William Nassetta (contact information below) will review all APTIM employee medical examinations and will be available for medical consultation on an as-needed basis.

Dr. William Nassetta, MD, MPH
CORE Health Services
12091 Bricksome Avenue, Suite B
Baton Rouge, Louisiana 70816
(225) 756-2673 (office)
(225) 295-4846 (fax)

Subcontractors are responsible to provide APTIM medical surveillance documentation reviewed and approved by their licensed occupational physician. The medical clearance shall reference an applicable exam that has been performed in accordance with 29 CFR 1910.120 and 29 CFR 1926.65.

A copy of applicable medical clearance for APTIM and subcontractor personnel shall be maintained on site and furnished to the Contracting Officer's Representative prior to commencement of work

E6.1 COVID-19 Virus Control Plan

AMS-710-01-FM-04201, *COVID-19 Control Plan*, presents the following medical procedures and guidelines that will be followed during the COVID-19 pandemic:

- Medical screening methods and reporting and illness management
- Return to work protocol
- Guidance for potential or known exposures to COVID-19 and employees with COVID-19 symptoms
- Roles and responsibilities for APTIM's preferred Occupational Medical Provider
- Additional resources from the Centers for Disease Control and Prevention.

E6.2 Medical Examination

As required by APTIM, all personnel working hazardous, toxic, and radioactive waste or HAZWOPER projects shall have successfully completed a pre-placement or periodic/updated physical examination. The contents of this examination were determined by the Occupational Medical Physician. The HSM may consult with the physician and recommend additional testing of employees or subcontractors.

Workers exposed to site hazards, including all employees of APTIM, will participate in a program of medical surveillance of the type specified in 29 CFR 1926.65, the OSHA standard on "Workplace Health and Safety in Hazardous Waste Operations and Emergency Response." Such workers must present a physician's statement that they are medically qualified for (1) work in hazardous waste operations, and (2) the use of respirators. The SSHO will evaluate all physicians' letters and refer any questions to the Corporate Director of Health and Safety (CDHS). Annual or biennial medical certification is required; a physician's statement must be no older than two years.

E6.3 Pre-Placement Examination

This examination was designed to meet the requirements of 29 CFR 1926.65 and 29 CFR 1910.120. The APTIM medical surveillance program examination, at a minimum, consists of:

a. Medical and occupational history questionnaire that includes information on past gastrointestinal, hematologic, renal, cardiovascular, reproductive, immunological, and neurologic problems

b. Physical examination

c. Blood pressure measurements

d. Complete blood count and differential to include hemoglobin and hematocrit determinations, red cell indices, and smear of peripheral morphology

e. Blood urea nitrogen and serum creatinine

f. Pulmonary function test (spirometry)

g. Respiratory protection clearance

h. Electrocardiogram

i. Audiogram

j. Drug screening

k. Visual acuity.

The employee and his immediate supervisor will be informed of any medical conditions that would result in work restriction or prevent the employee from working at hazardous waste sites.

E6.4 Annual Examination

APTIM field employees performing conventional HAZWOPER receive an annual update examination meeting the requirements of 29 CFR 1926.65 and 29 CFR 1910.120. The results of these exams are compared to previous results and the baseline physical to determine if any effects due to exposure have occurred. Appropriate actions are taken as recommended by the physician should the results indicate an exposure; otherwise, employees are cleared for continued work.

The SSHO/UXOSO will note any restrictions stated on a physician's statement and make arrangements to avoid any prohibited activity or condition. In addition, the SSHO will monitor all employees to detect early signs of exhaustion, heat stress, or other conditions that might suggest a lack of fitness for a particular task.

Medical treatment received related to a workplace injury or illness will be managed IAW the OSHA standard referenced in Section E6.2. The SSHO/UXOSO will notify the CDHS immediately if such an event occurs.

E7.0 Exposure Air Monitoring and Air Sampling Program

The primary contaminants of concern based on review of historical information and analytical data from previous soil sampling activities is TCE. Chemical exposure through skin contact and inhalation during corrective measures is unlikely based on low concentrations of TCE previously identified. The SSHO or qualified field leader will perform air monitoring for total dust during the following activities:

- Site setup and installation of best management practices
- Excavation of contaminated soil.

A calibrated combustible gas/oxygen analyzer with a photoionization detector (i.e., MSA Sirius or equivalent) will be utilized to monitor the work area for potential flammable and/or oxygen-deficient atmospheres and volatile organic compounds. A DataRam 1000 aerosol monitor or equivalent will be used to determine if airborne material may be present that would necessitate engineering controls such as wetting soils or upgrading of protection level. Action levels for air monitoring are provided in Table E7-1. A conservative action limit for surface soil is based on maximum concentrations detected. The subsurface soil action limit is based on the highest level detected which will be further investigated under this CMI. Table E7-2 provides the minimum air monitoring frequency and locations.

E8.0 Heat Stress and Cold Stress

The potential for heat stress is high due to the physical nature of the work that will be performed during the summer months. Care must be taken to control work schedules and hydration and to observe and respond to symptoms.

E8.1 Heat Stress Monitoring Plan

Heat Stress. There is a potential for heat stress for this project because fieldwork may be conducted during the summer months. Team members must realize that extra care must be taken to observe and respond to symptoms as the weather gets warmer and humidity increases. Sweating does not cool the body unless the sweat is evaporated from the body. The use of some PPE (e.g., semipermeable or nonpermeable clothing) can reduce the body's ability to eliminate heat because the evaporation of sweat is hampered. When this occurs, heat stress is a potential for concern. Increased body temperature and physical discomfort also promote irritability and a decreased attention to the performance of potentially hazardous tasks.

Types of Heat Stress

- **Heat Rash** is a red or pink rash usually found on body areas covered by clothing. It can develop when the sweat ducts become blocked and swell and often leads to discomfort and itching. It is common in hot, humid climates. To help relieve symptoms start by removing or loosening clothing and moving to a cool, shady spot. Let the skin air-dry instead of using towels. Avoid ointments or other lotions because they can irritate the skin.

- **Heat Cramps** are painful, brief muscle cramps that occur during or after exercise or work in a hot environment. Muscles may spasm or jerk involuntarily. Cramping may also be delayed and occur a few hours later. Heat cramps are thought to be caused by a deficiency in electrolytes. Heat cramps signs and symptoms are painful muscle spasms usually involving the legs, chest, or abdomen. Rest briefly and cool down. Drink clear juice or an electrolyte-containing sports drink. Practice gentle, range-of-motion stretching and gentle massage of the affected muscle group. Don't resume strenuous activity for several hours or longer after heat cramps go away. Call a doctor if cramps persist after one hour.

- **Heat Exhaustion** occurs when the body gets too hot. Heat exhaustion requires immediate attention because it can progress to heat stroke, a life-threatening illness. The primary treatment for heat exhaustion is to rest in a shady spot or, better, an air-conditioned room, and to drink cool (not icy) fluids. Core body temperature can be lowered by immersion in cold water or spraying with cold water and fanning.

Drinking water is usually enough to reverse dehydration, but drinking a sports drink that contains electrolytes is also helpful.

- **Heat Stroke** occurs when the body's temperature regulatory system has failed. Skin is hot, dry, red, and spotted. These skin color changes may not be readily evident in darker skinned individuals and other signs must be relied upon. The affected person may be mentally confused, delirious, and convulsions may occur. A person exhibiting signs of heat stroke should be removed from the work area to a shaded area immediately. The person should be soaked with water and fanned to promote evaporation. Medical attention must be obtained immediately.

Early Symptoms of Heat Stress. Personnel should recognize these early symptoms of heat stress:

- Reduced performance
- Lack of coordination
- Lack of alertness
- Unsteady walk
- Excessive fatigue
- Muscle cramps
- Dizziness.

Treatment of Heat Stress. Workers who exhibit heat stress shall seek medical attention. Those employees with more than one heat-related episode in a month will have a doctor's written release prior to returning to exposures in a potential heat stress environment. Table E8-1 provides first-aid steps suggested for victims of heat stress.

Heat Stress Prevention. In hot environments, the following guidelines will be followed to prevent heat-related injury.

a. Drinking water will be made available to employees, and employees will be encouraged to frequently drink small amounts (for example, 1 cup every 15 to 20 minutes). The water will be kept reasonably cool.

b. Initial project safety training will include training on the symptoms of heat-related problems, contributing factors to heat-related injuries, and prevention measures. These topics will be repeated during the daily tailgate safety briefing, as needed.

c. When practical, work will be scheduled for cooler periods during the day.

d. A buddy system will be established to encourage fluid intake and watch for symptoms of heat-related injury

e. The SSHO will monitor those individuals who may be more susceptible to heat-related illness. This includes those individuals who have had a previous heat-related illness, are known to be on certain medications which increase the chance for susceptibility to heat injury, or exhibit signs of possibly having consumed large amounts of alcohol in the previous 24 hours.

f. Breaks will be taken in shaded or air-conditioned areas at intervals to prevent harmful heat stress.

g. Individuals who are not acclimated will be allowed additional breaks. The period and number should be determined by the SSHO and provided to the supervisor and employee for implementation.

h. Additional measures will be taken, as needed, to minimize heat stress. These measures may include measures such as pop-up tents over the work area and personal cooling products such as water-retentive bandanas and neck wraps.

i. Sunscreen should be applied to prevent sunburn. Sunscreen with a sun protection factor of at least 30 will be encouraged, in addition to the use of hats, long-sleeved shirts, sunglasses, or other protective attire.

Heat Stress Monitoring. The SSHO will monitor heat stress and adjust heat stress controls to control the hazard to personnel. This monitoring will include visual monitoring of work and work site conditions as well as feedback from work crews.

When conditions at the site exceed 75°F, the SSHO/UXOSO will conduct heat stress monitoring. The preferred method of monitoring is through use of a wet bulb globe temperature (WBGT) heat stress monitor (such as the 3M Questemp QT32 or similar) and the heat stress TLV®. The SSHO may also use local reports of heat index or applications such as OSHA's Heat Safety Tool.

The risk of heat-related illness among healthy workers who are acclimated to hot work is low if the WBGT value does not exceed the ACGIH "screening criteria" shown in Table E8-2 (ACGIH, 2019). To use Table E8-2, the SSHO/UXOSO must determine the worker's metabolic heat load (light, moderate, heavy, or very heavy) and determine if a heat stress situation may exist.

It is important to note that Table E8-2 is intended for permeable clothing ensembles only. Nonpermeable ensembles are not anticipated for work at this site; if it is determined that nonpermeable clothing is required, the UXOSO/SSHO will post and implement a similar table for nonpermeable clothing ensembles. Table E8-3 defines the different workloads.

Note: These values are intended as an initial screening tool to evaluate whether a heat stress situation may exist and thus, the values are more protective that the TLV®. Because the values are more protective, they are not intended to prescribe work and recovery periods (ACGIH, 2019).

If impermeable clothing is worn in hot environments, additional controls such as cooling vests will be implemented. Physiological monitoring will also be conducted if impermeable clothing is being worn. The following heart rate guidance should be used:

- Count the radial (wrist) pulse during a 30-second period as early as possible in the rest period.
- If the heart rate exceeds 180 beats per minute minus the person's age in years (i.e., 180-age) at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same.
- If the heart rate still exceeds the calculated heart rate at the next rest period, shorten the following work cycle by an additional one-third and keep the rest period the same.

Additional physiological monitoring, such as continual pulse or core temperature, may be implemented, as needed.

E8.2 Cold Stress Monitoring Plan

Cold Stress. In addition to the exposure to high temperatures presented in the previous section, exposure to low temperatures presents a risk to employee safety and health through the direct effect of low temperature on the body and collateral effects such as slipping on ice, decreased dexterity, and reduced dependability of equipment. The average low temperature in the winter months at the site can approach 18°F, with January being the coolest month on average. The effects of cold exposure include frostbite and hypothermia, with wind increasing the chances of these effects taking place.

Types and Symptoms of Cold Stress. Hypothermia is a life-threatening condition in which the core body temperature falls below 95°F. Hypothermia can occur at temperatures above freezing particularly when the skin or clothing becomes wet. During exposure to cold, maximum shivering occurs when the core temperature falls to 95°F. As hypothermia progresses, depression of the central nervous system becomes increasingly more severe (Table E8-4). This accounts for the progressive signs and symptoms ranging from sluggishness and slurred speech to disorientation and eventually unconsciousness.

Frostbite is a term which denotes areas of cold injury on a body. Frostbite rarely occurs unless environmental temperatures are below freezing, usually below 20°F. Injuries from frostbite normally occur on the distal parts of the body (nose, earlobes, hands, and feet) that are subject to intense vasoconstriction when they get cold. The three general categories of frostbite are presented in Table E8-5.

Cold Stress Prevention*.* The potential for cold stress is determined primarily by two variables: the temperature of the air and the speed of the wind. The cooling effects of moving air on exposed flesh can be expressed as an equivalent chill temperature (ECT), which combines temperature and air speed. At a given temperature, calm air is less dangerous.

Table E8-6 shows values of ECT for various temperature and speed combinations. The conditions represented by Zones B and C are extremely dangerous to exposed skin. Continuous exposure of exposed skin should not be permitted if the ECT is 25°F or less. Work under conditions represented by Zone A is much less dangerous to exposed skin. However, workers can suffer frostbite injury in the less severe environment if they develop a false sense of security and fail to take precautions.

At low ECT values, precautions against hypothermia are necessary, even if workers are dressed in well-insulated clothing. The danger of hypothermia is especially severe if immersion in water is possible during the work.

The SSHO/UXOSO will make an assessment of the potential for cold stress before fieldwork begins, primarily through local weather reports but also by using thermometers orwind speed measuring equipment on site as needed. When the wind chill falls below 0°F (-17 degrees Celsius), the air temperature and wind speed will be monitored every 2 hours or more frequently.

Work rules related to the prevention of cold-related injury will be required if conditions of the types represented in Zones A, B, or C in the ECT table are anticipated. Under such conditions, the SSHO/UXOSO will measure temperature and wind speed when work commences each day and at routine intervals (at least every 4 hours) thereafter, unless he/she believes that some other means of hazard assessment is adequate. The CDHS must approve any alternative means of hazard assessment. When work is conducted under conditions represented in Zones A, B, or C, the SSHO/UXOSO will implement the work rules described below to manage the potential hazard.

- Employees will receive training on the dangers and symptoms of cold-related injury and the work rules adopted to prevent it.
- Site workers will be warned that older individuals and people with circulatory problems might be at increased risk for cold-related injury and that added precautions might be necessary to protect them.
- Each employee will be under protective observation by someone else during work (use of the “buddy system” will be required).

- Employees who experience pain in the extremities or are shivering will be removed from exposure to the cold work environment.

- Work must be halted if frostbite cannot be prevented. Continuous skin exposure will not be permitted when the ECT is -25°F or less (Zones B and C on the ECT table).

- Tasks should be scheduled to avoid long periods during which workers must sit or stand still.

- Work expectations for new employees should be adjusted downward for the first few days, to permit acclimatization to the cold conditions.

- Dehydration, which decreases blood flow to the extremities, should be avoided. Employees will be encouraged to replenish water lost to perspiration and respiration. The SSHO will provide soups and warm sweet drinks as appropriate.

- The SSHO will develop procedures that reduce the likelihood of immersion in water or soaking of the clothing by other means during project work. Such precautions should apply to any work with liquids like gasoline, alcohols, solvents, or cleaning fluids.

- The SSHO will plan for any likely scenarios that would lead to wet clothing (through immersion in water, soaking by mist, etc.), and provide for quick changing into dry clothing and treatment for hypothermia.

- Emergency plans will give special attention to the prevention of cold-related injury (hypothermia and freezing of damaged tissues).

If continuous work must be performed at an ECT below 19.4°F, then the SSHO or PM will provide a heated shelter (truck, car, tent, cabin, or similar space) for warming after exposure to the cold environment. Employees should be encouraged to use the shelter at frequent intervals and upon (1) onset of pain or heavy shivering; (2) occurrence of minor frostbite; or (3) onset of feelings of excessive fatigue, drowsiness, irritability, or euphoria. For these conditions, the SSHO will monitor weather and environmental conditions and implement a mandatory work/warming regimen according to Table E8-7.

The rules implemented by the SSHO/UXOSO will require that employees wear adequately insulating dry clothing if conditions of the type represented in Zones A, B, or C in the ECT table are anticipated. Workers should wear cold-protective clothing appropriate for the environmental conditions and the level of physical activity. The following considerations should guide the selection and use of protective clothing:

- Layered clothing will be used to preserve body heat. An easily removable outer windbreak garment should be worn in windy conditions.

- Inner garments and underwear will be made of fabrics that dry quickly and wick moisture away from the body.
- Outer garments will be made with provisions for easy ventilation to prevent inner layers to be wetted by sweat.
- An employee will not enter or remain in a cold work environment if his or her clothing is wet as a consequence of sweating. If clothing is wet, then the employee must change into dry clothing before returning to the cold environment.
- Gloves and/or mittens will be used as necessary to protect the hands, and employees will be warned not to touch very cold objects and surfaces with bare skin.
- Workers will routinely change socks and removable felt insoles to reduce moisture around the feet.
- Eye protection suitable to the type of hazard will be used. Special precautions against ultraviolet light and glare might be necessary in snow-covered terrain.
- Hard hat liners will be used. If work must be done on slippery surfaces, then shoe attachments that enhance traction shall be used.

E9.0 Standard Operating Safety Procedures, Engineering Controls, and Work Practices

This chapter outlines the general hazards and safe work practices that all site personnel will follow to eliminate or reduce the risk of exposure to anticipated site hazards. These controls are presented as a guide for site personnel and do not cover all compliance issues. The Site Manager and SSHO will ensure full compliance with applicable regulatory requirements.

E9.1 Site Rules/Prohibitions

General safe work practices for every job site include the following:

- ***Using the Buddy System.*** Employees will not work alone. Every employee is required to work near someone else who could offer assistance or summon help in the event of an accident or illness. At all times, an employee on a field site must be observable by at least one other person or sufficiently close to at least one other person to communicate by voice.

- ***Reporting Unsafe Conditions.*** Site personnel will immediately stop unsafe work and report to the SSHO any unsafe acts or conditions, including violations of this document or the Installation-Wide APP (CEHNC, 2019).

- ***Reporting Injuries and Illnesses.*** All injuries or illnesses, including the potential harmful effects of the COVID-19 virus and apparently minor ones such as insect bites, will be reported to the SSHO/UXOSO promptly.

- ***Reporting Pre-Existing Medical Conditions.*** Site personnel will inform the SSHO/UXOSO of any known medical conditions that may cause illness in the workplace, aggravate a possible work-related illness, or increase the likelihood of accidents. This includes hypersensitive allergic reactions to stinging and biting insects or to contact with poisonous plants; diabetes; high blood pressure; skin or eye sensitivity to sunlight and ultraviolet radiation; chronic illness; and acute illnesses such as a cold, the flu, or stomach/intestinal disorders. Persons with known hypersensitive allergic reactions to stinging/biting insects or to toxic plants will carry appropriate emergency medical antidotes on their person at all times when on site.

- ***Prohibiting Horseplay.*** Site personnel will not engage in horseplay, running, or other irresponsible behavior or harm people, property, or the environment.

- ***Avoiding Skin Contact with Poisonous Plants.*** Personnel in vegetated or wooded areas will wear long-sleeve shirts with the sleeves rolled down to reduce contact with poisonous plants.

- ***Eating, Drinking, and Smoking Restrictions.*** Eating, drinking, and smoking will be permitted only in areas designated by the SSHO/UXOSO and at designated break times after employees have washed their hands. Eating, drinking, and smoking will be forbidden in any EZ or nearby decontamination area.

- ***Prohibiting Ignition Sources.*** Ignition of flammable materials in any work area is prohibited, unless approved in writing by the SSHO/UXOSO. Matches, lighters, or other sources of sparks will not be allowed in any EZ or nearby decontamination area.

- ***Limiting Personnel Exposed to Potential Risks.*** The number of personnel in any work area will be the minimum number necessary to perform work tasks in a safe and efficient manner.

- ***Reporting the Location of Site Personnel.*** Site personnel will check in with the SSHO/UXOSO before leaving the site and upon returning to the site.

- ***Escorting Site Visitors***. Site visitors are to be escorted by the SSHO/UXOSO, or an appropriate designee, at all times.

- ***Qualifying Personnel for Specific Tasks.*** Site personnel will perform only those tasks for which they are qualified by training and, when applicable, appropriate certifications. Such certifications will include those required by this document.

- ***Limiting Admission to Work Areas.*** No one may enter a site work area without the approval of the SSHO/UXOSO. The SSHO/UXOSO will consider the qualifications of each entrant and the risks present in the areas into which entry is desired.

- ***Housekeeping.*** All work areas will be maintained in a clean, neat, and orderly fashion, free of loose debris and scrap. Any materials and equipment not being used will be stored or discarded properly. All work areas will be supplied with a trash receptacle that includes a lid. The contents of all trash receptacles either will be removed from the site daily or emptied daily into a larger trash storage container that will be tightly closed each night prior to departure of personnel from the sites.

E9.2 Work Permit Requirements

The scope of work for this project does not anticipate work requiring work permits, such as radioactive work, hot work, confined space, etc. Should a work permit be required, AMS-710-02-PR-06400, *Permit to Work* (Attachment 2), will be followed.

E9.3 Material Handling Procedures

Execution of on-site activities will require handling of numerous items. Precautions shall be taken when lifting or handling heavy or bulky items. Back strain or injury may be prevented by using proper lifting techniques. The fundamentals of proper lifting include:

a. Consider the size, shape, and weight of the object to be lifted. Two persons must lift an object if it cannot be lifted safely alone (e.g., greater than 60 pounds).

b. The hands and the object should be free of dirt or grease that could prevent a firm grip.

c. Gloves must be used, and the object inspected for metal slivers, jagged edges, and burrs, rough or slippery surfaces.

E9.4 Drum/Container/Tank Handling

Improper handling of drums and containers can result in severe injuries. These include painful back sprains, smashed toes and fingers, or exposure to potentially hazardous chemicals, if the contents are leaking. Proper work practices can minimize risk of injury, so personnel should use the following recommendations:

a. Prior to handling the drum, read the label on the drum and look for symbols, words, or other marks that indicate if its contents are hazardous, corrosive, toxic, or flammable. If the drum is not labeled, consider the contents hazardous until they are positively identified.

b. Look around the drum to see if it is leaking. Before cleaning up any spill, make sure the substance has been identified. Make sure that you have been trained in the hazards of the chemical and have the correct materials for cleaning it up. Find and review the appropriate Safety Data Sheet.

c. Before moving the drum or barrel, replace missing bungs and/or lids and secure as necessary.

d. Depending upon the contents of the drum, estimate its weight. Determine whether you can move it yourself or if you need assistance. A 55-gallon drum can weigh 400 to 800 pounds, depending on content.

e. Use a forklift or heavy equipment, such as a hand truck or a drum cart that is designed specifically for drum handling.

f. If the drum can be rolled, stand in front of it and place both hands on the far side of the chime. Pull the drum forward until it balances on the bottom chime. You can now roll the drum on its chime, being careful to keep your hands from crossing over one another. You can also lower the drum to the ground for rolling by shifting your hands to the bottom side of the chime (not where they will be crushed). Then slowly lower the drum to the floor. Keep your back straight and bend at your knees. Then roll the drum with both hands. Do not use your feet or grasp the ends.

E9.5 Fatigue Management Plan

The following workday duration limitations shall be in effect for work at the site:

- Personnel working on site, including those who are operating hoisting equipment or mobile construction equipment, may work up to 12 hours at the site, not including travel time to/from their home/motel or uncompensated lunch breaks. This workday duration is subject to reduction by the other requirements and factors described in the bullets below. The 12-hour limit is primarily because of motor vehicle driving restrictions.

- While on duty, personnel will not operate motor vehicles after being in a duty status (regardless of their role or function) for more than 12 hours during any 24-hour period without at least 8 consecutive hours of rest. Personnel may work an additional 2 hours at the motel or their home (for a total 14-hour day), though they are still subject to reduction by the other requirements and factors described below. A minimum of 8 consecutive hours will be provided for rest in each 24-hour period.

- Personnel shall not operate motor vehicles after being in a duty status (regardless of their role or function) for more than 12 hours during any 24-hour period without at least 8 consecutive hours of rest. A minimum of 8 consecutive hours shall be provided for rest in each 24-hour period.

- No employee may drive continuously for more than 10 hours in any single, on-duty period (or 24-hour period without at least eight consecutive hours of rest).

Training provided to personnel in the Safety and Occupational Health Orientation will include symptoms of fatigue, habits and actions the worker may take to avoid fatigue, actions workers should take if they observe fatigue in a co-worker, a discussion of fatigue impacting driving to and from work, and controls in place to prevent fatigue.

The SSHO is responsible for adjusting the workday duration within the limits set above. The following factors will be considered for adjusting the workday duration:

- Time of year (e.g., reduce the workday duration because there is less daylight in winter).
- Temperature/weather (e.g., reduce workday duration when the temperature is very hot or very windy).
- Type of work (e.g., reduce workday duration for personnel involved in physically demanding phases of work).

E9.6 Hearing Conservation

Equipment and tools generate noise. Hearing loss resulting from occupational exposure to noise can be prevented through the use of hearing protection. Personnel will wear hearing protection when working with or around operating equipment or power tools that generate noise at 85 dBA or above—levels that require a person to raise his/her voice to carry on a conversation at a distance of 3 feet. Warning signs will be posted in areas where noise greater than 85 dBA necessitates the use of hearing protection. The use of headphones for entertainment purposes is prohibited.

E9.7 Fire Prevention Plan

Any APTIM activities that could cause a spark will be carefully monitored. At least one 10BC rated fire extinguisher will be kept in each site vehicle and maintained on site during operations. The SSHO will ensure that the extinguishers are inspected monthly. The following standard safety measures will also be implemented during site field activities to minimize the risk of fire and/or explosion:

a. Smoking is permitted on site only in the designated smoke area at least 50 feet from operations with a potential fire hazard.

b. Good housekeeping procedures will be required on site to keep work areas clear of accumulating combustible scrap and debris.

c. Material storage methods will be in accordance with manufacturers' recommendations.

d. Flammable liquids will be stored in approved portable containers.

e. All handling or use of flammable and combustible liquids shall be conducted by trained personnel.

f. Entry and exit pathways and fire lanes shall be kept clear of debris or obstacles.

g. An APTIM hot work permit is required for all spark- and flame-producing operations, and the RSA Fire Inspector shall be notified in advance of planned hot work.

h. Work areas will be cleared of excess vegetation and obstructions.

If a fire or explosion occurs, the SSHO will notify the nearest fire department and Emergency Medical Services, contact the PM, and escort the response personnel to the location of the fire or explosion. The SSHO will determine the extent of the fire, use available on-site fire extinguishers (Type 2A:10BC) on incipient stage fires only, and provide emergency first aid as needed. Site personnel will not fight fires containing explosives. The responding fire department personnel will be informed of the nature of the fire and if explosives are present.

E9.8 Hazard Communication

SDSs for hazardous chemicals that may be required during site operations will be provided on site to all affected employees. The SSHO will manage the SDS file and chemical inventory. AMS-710-01-PR-00400, *Hazard Communication*, will be implemented on site (Attachment 2).

Employee hazard communication training occurs on an annual basis as a component of the APTIM 8-hour HAZWOPER refresher course and site-specific training is a component of initial safety orientation training. Hazard communication training provided in the APTIM 8-hour refresher includes the latest requirements under the Globally Harmonized System.

E10.0 Site Control Measures

Work zones will be established so that on-site activities do not spread contamination. The site will be set up so that there is a clearly defined EZ and a clearly defined SZ with a CRZ as a transition between the EZ and SZ.

E10.1 Work Zone Access Control and Security

The SSHO and Site Manager will control access to the site during operations and enforce the restrictions found elsewhere in this document upon site visitors. If difficulties related to access control and site security arise, the SSHO/UXOSO will confer with the USACE Ordnance and Explosives Safety Specialist (OESS) to identify corrective action. As applicable, workers and site visitors will be screened for COVID-19 IAW AMS-710-01-FM-04201, *COVID-19 Control Plan*.

E10.2 Work Zones

Site Work Zones. The purpose of establishing work zones and maintaining site control is to minimize potential contamination of workers, protect the public, and prevent unauthorized entry to work areas. Site control involves the physical arrangement of, and controlling access into, established work zones. The Layout Plan will help ensure protection against the hazards presented by confining activities to the appropriate areas.

To reduce the spread of hazardous materials by workers from the contaminated areas to the clean areas, zones will be delineated to aid in controlling the flow of personnel and equipment between the zones. The establishment of the 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 work zones allow the use of multiple teams or portions of teams conducting excavations simultaneously. The two work zones, designated the EZ and the SZ, are described in greater detail below.

Exclusion Zone. The EZ is the area in which contamination does or could occur. An EZ will be established during site operations to prevent personnel from entering the active work areas without proper PPE. The EZ around a potentially hazardous operation will be determined in each case by the SSHO/UXOSO. The size of the EZ will depend on the activity being performed and the hazards present at the site.

APTIM personnel and subcontractors will be properly trained in controlling and minimizing access to the EZ. If an unauthorized person enters the EZ, work will stop and said person will be stopped and escorted out of the EZ and met by the SSHO/UXOSO, OESS, or Site Superintendent to determine if there is a need for decontamination or medical assistance. Work will not commence again until the unauthorized person has left the EZ. In addition, site control measures will be reevaluated. The unauthorized entry will be recorded in the field notebook.

Contamination Reduction Zone. The CRZ is the transition area between the contaminated area and the clean area. If required, the personnel decontamination station will be located within the CRZ, preferably upwind in the prevailing wind direction. This zone provides an area to prevent or reduce the transfer of hazardous materials that may have been picked up by personnel or equipment leaving the EZ.

Support Zone. The SZ is considered a clean area and will be located at a sufficient distance from the intrusive activity to ensure the safety of the SZ personnel. The SZ is separated from the CRZ by the contamination control line. Public access beyond the contamination control line will be prevented during intrusive operations. The SZ contains the command post and other support supplies. Level D PPE is appropriate apparel within this zone. Contaminated clothing and equipment are not permitted in the SZ.

E10.3 Site Communications

Effective on-site and off-site communication will be established prior to initiation of site activities. On-site communication will be used to coordinate site operations, to maintain site control, to convey safety information, and to alert site personnel to emergency situations. Off-site communication will be available to ensure effective coordination with off-site management personnel, the USACE, and emergency response services.

All site personnel will be familiar with the different methods of both on-site and off-site communication. The methods that will be used for on-site and off-site communication will include the following:

- Handheld radios issued to the field team leader, supervisors, and managers
- Cellular telephones
- Air horns, bullhorns, sirens, or hand signals, as needed.

Site personnel will use cellular telephones or other supplied communication systems for off-site communication. The SSHO/UXOSO will verify that the 911 service is available and will make appropriate alternative arrangements if it is not available.

E11.0 Personnel Hygiene and Decontamination

Sanitary and washing facilities, personnel and Level D decontamination, and waste control plans are discussed below. Additional minimum sanitation requirements presented in AMS-710-01-FM-04201, *COVID-19 Control Plan*, will be implemented due to the COVID-19 pandemic.

E11.1 Sanitary Facilities

APTIM will ensure toilet facilities are available, with at least one unit for each 15 workers, IAW AMS-710-01-PR-01000, *Sanitation and Potable Water* (Attachment 2), and EM 385-1-1, Section 2 (USACE, 2014).

E11.2 Washing Facilities

APTIM will provide hand-washing supplies convenient to the work area, including potable washing water and soap IAW AMS-710-01-PR-01000, *Sanitation and Potable Water* (Attachment 2). All hand-washing facilities will be supplied with soap, paper towels, and trash receptacles. All washing facilities or areas will be kept clean and free of trash. For remote locations, hand washing may be accomplished using hand sanitizer or disposal sanitary wipes that meet the requirements of AMS-710-01-FM-04201, *COVID-19 Control Plan*.

All field personnel will wash their hands and faces before eating and drinking and before leaving the site for the day.

E11.3 Personnel Decontamination

Effective decontamination is not simply removing contaminants; it begins with preventing contamination. Work practice controls limiting direct contact with soil will occur. Employees are always reminded to operate upwind of remedial action operations. For limited soil contact, i.e., sampling, personnel will utilize disposable sampling equipment, minimize direct hand contact with media, and wear nitrile gloves during sample collection activities..

E11.4 Waste Control and Disposal

Solid trash, paper towels, and other items used in the work areas will be classified as solid waste, containerized, and disposed of appropriately.

E12.0 Equipment Decontamination

An equipment decontamination station will be set up in the CRZ for equipment to be decontaminated when exiting the EZ. Due to the COVID-19 pandemic, hand tools and work surfaces will be decontaminated at the equipment decontamination station and not shared with co-workers unless decontamination is completed. Hand tools will be decontaminated at the equipment decontamination station and common work surfaces using soap and water followed by a bleach solution.

For heavy equipment, the operator cab area, including but not limited to equipment controls, will be decontaminated with a bleach solution or with a solution that contains at least 60 percent denatured alcohol.

E13.0 Emergency Equipment and First Aid

The equipment and personnel required for first aid and CPR will be maintained on site by the SSHO/UXOSO. Emergency equipment required to be on site will have the capacity to respond to project-specific emergencies. Site emergencies may require (but should not be limited to) PPE and equipment to control fires, leaks and spills, or chemical (contaminant or treatment process) exposure.

The emergency equipment listed in Table E13-1 will be on site, stored in the location indicated, and available for use during the operation specified. Emergency equipment assigned to an area or team will be maintained in proper working order by the team, as directed by the team leader. The SSHO/UXOSO will conduct an inspection of all emergency equipment at least weekly to ensure completeness and proper working order.

The size and number of first-aid kits will be sufficient to accommodate the maximum number of people (including government personnel and visitors) on site at any given time.

When required, portable eyewash bottles will be available for immediate use while the injured person is transported to the area where the 15-minute eye flushing station will be available. After flushing, the eyes will be bandaged lightly, and the person will be transported to the appropriate medical facility for further evaluation and treatment, if needed.

Personnel administering first aid and/or CPR will comply with the following:

- Personnel will wear disposable latex gloves if there is any visible body fluid.
- The CPR Pocket Mask will be used when performing CPR and disposed of after use.
- Personnel will immediately change clothing that becomes contaminated with body fluids as a result of performing first aid, or as soon as feasible.
- Personnel will wash their hands immediately after performing first-aid procedures.

E14.0 Emergency Response and Contingency Procedures

The frequency and severity of emergency situations can be dramatically reduced through proper implementation of the Installation-Wide APP (CEHNC, 2019). However, if an emergency does occur, quick, decisive action is required. Delays of only 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. 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 must be implemented before and during any site activities involving exposure to safety and health hazards.

E14.1 Pre-Emergency Planning with Local Emergency Responders

Identification of Local Emergency Services. APTIM has obtained emergency and non-emergency telephone numbers for emergency services (Emergency Management, Police, or Fire). In the event that evacuation of the general public is required, because of either normal site operations or an emergency event, the safety point of contact, USACE OESS, and SSHO/UXOSO are responsible for contacting the appropriate local officials who execute and coordinate an evacuation.

Anyone calling for emergency medical services on RSA by dialing 911 with a cellular phone must state that he/she is located on RSA in order for the call to be directed to the proper emergency management office. Any suspect CA exposure requires notification IAW the Explosive Safety Management Program. In the event a medical or MEC emergency occurs, notify the Garrison Installation Emergency Operations Center (IEOC) at (256) 313-1043 after initial emergency contacts have been completed in order to update IEOC on the situation.

E14.2 Personnel and Lines of Authority for Emergency Situations

Key personnel roles, lines of authority, and communications plan are detailed in Section 4 of the APP. Emergency response roles are discussed below.

Personnel On-Scene Incident Commander. If an emergency arises, the SSHO/UXOSO assumes the responsibility of the site, with the Site Manager as alternate if the SSHO/UXOSO is unavailable or incapacitated. The SSHO/UXOSO has responsibility for directing all on-site and off-site response personnel and, as soon as possible, advises the USACE OESS of the emergency situation. The SSHO/UXOSO has full responsibility and commensurate authority for responding to any emergency that may occur at the MEC work site until APTIM is relieved by the proper authorities.

On-Site Emergency Response Services. APTIM personnel are trained to provide first-aid treatment for minor injuries. At least two people on site will be trained in first aid and CPR. The SSHO/UXOSO will determine whether any injury requires treatment in addition to first aid. Medical support personnel will be on site during intrusive investigation. Personnel on site will include at minimum one Emergency Medical Technician – Basic and one Emergency Medical Technician – Paramedic (certified in Advanced Life Support) who have been trained in CWM casualty care.

Off-Site Emergency Response Services. Off-site emergency response services that may be needed in the event of a site emergency include medical and law enforcement personnel. All requests for emergency services are accessible via the 911 telephone system. For emergencies, state the location as RSA when contacting 911.

E14.3 Emergency Recognition and Prevention

During the development of this SSHP, great attention has been given to identifying potential safety and health hazards associated with conducting site activities. Once identified, these hazards were assessed to determine if they could result in an emergency situation. During an emergency, all active areas will be secured and all work will stop. Field crews will return to predesignated rally points for further direction or the best place of refuge or for evacuation instructions. Emergency alerts will be broadcast on mobile and/or hand-portable field radios. The SSHO/UXOSO will inform the PM of emergencies, security issues, and response actions by telephone as soon as practicable, followed by a written report providing full details. The following potential emergencies may result during site activities:

- Injury or illness
- Fire/explosion
- Inclement weather.

If additional site or task hazard information becomes available during the project, the CDHS will assess this information to determine whether the contingency plans in this section need to be updated.

E14.4 Evacuation Routes and Procedures

Evacuation routes and procedures are discussed below.

Evacuation Route. The established evacuation route will be checked by the SSHO/UXOSO and then reviewed by all site personnel before the start of site activities to become familiar with the route. Emergency meeting points will vary from day to day depending on work location. The planned evacuation route will be discussed with the field crew at the daily tailgate safety briefing.

Emergency evacuation routes will be posted in the field office. All exit routes will be unobstructed and kept free of debris.

Medical Facilities. Huntsville Hospital is the designated Emergency/Trauma Center for the project. Contact information for the hospital and other emergency services has been placed at the front of this SSHP.

Directions to Hospital. To facilitate the quick retrieval of information in the event of an emergency, a summary that includes emergency contact information has been placed at the front of this SSHP. Figure E-1 is a map showing the route from the project site to the hospital.

Medical Evacuation. Medical evacuation requirements will be determined by the emergency first responder. Personnel requiring additional treatment will be evacuated to the hospital. Any further treatment or evacuation will be arranged by the hospital site personnel who will receive specialized training that will be given by the SSHO/UXOSO and conducted prior to initiating site activities involving safety and health hazards. Training will be documented using the site training log and will include the subjects listed below:

- Emergency chain-of-command communication methods and signals
- Emergency equipment and PPE
- Removal of injured personnel from the site
- Emergency contacts, telephone numbers, and hospital route.

E14.5 Emergency Alerting and Response 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, implement the procedural steps outlined in this paragraph for each emergency, regardless of its nature.

Notification. Once the SSHO/UXOSO has been informed of the emergency, the SSHO/UXOSO will use radio communication to:

- Notify personnel and get their attention
- Stop work activity as required
- Lower noise levels to speed and simplify communication
- Begin emergency or evacuation procedures.

If on-site APTIM personnel or off-site emergency personnel are to enter the site in response to the emergency, the SSHO/UXOSO, to the extent possible, will notify response personnel about:

- What happened and when it happened
- Where on the 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 response actions are required.

E15.0 References

American Conference of Governmental Industrial Hygienists (ACGIH), 2019, ***Threshold Limit Values® for Chemical Substances and Physical Agents and Biological Exposure Indices***.

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TABLES

Table E2-1

Toxicological and Physical Properties of Chemicals
RSA-014, Unlined Inactive Burn Trenches Unit #2
Redstone Arsenal, Madison County, Alabama

Substance [CAS]	IP[a] (eV)	Odor Threshold (ppm)	Route[b]	Symptoms of Exposure	Treatment	TWA[c]	STEL[d]	Source[e]	IDLH (NIOSH)[f]
Fuel oil (diesel oil, medium)	None	None	Ing Inh Con	Ingestion causes nausea, vomiting, and cramps; depressed central nervous system, headache, coma, death; pulmonary irritation; kidney and liver damage; aspiration causes severe lung irritation, coughing, gagging, dyspnea, sub-sternal stress, pulmonary edema; broncho-pneumonia; excited, then depressed, central nervous system.	Eye: Irrigate promptly Skin: Soap wash Breath: Respiratory support Swallow: Immediate medical attention Aspiration: Immediate medical attention	n/a n/a TWA 100 mg/m3 (as kerosene)		PEL TLV REL	
Gasoline [8006-61-9]	None	0.3	Inh Ing Con	Intoxication, headaches, blurred vision, dizziness, nausea; eye, nose throat irritation; potential kidney and other cancers. Car-cinogenic.	Eye: Irrigate immediately (15 min) Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	300 ppm Ca, lowest feasible conc. (LOQ 15 ppm)	500 ppm	PEL TLV REL	1400 ppm 10% LEL
Hydrogen chloride (hydrochloric acid) [74-90-8]	12.74	0.255–10.6	Inh Ing Con	Inflamed nose, throat, larynx; cough, burns throat, choking; burns eyes, skin; dermatitis; in animals; laryngeal spasm; pulmonary edema.	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention	NIOSH REL C 5 ppm (7 mg/m3) OSHA PEL C 5 ppm (7 mg/m3)	C5 ppm C5 ppm C5 ppm	PEL TLV REL	100 ppm
Isopropyl alcohol (isopropanol) [67-63-0]	10.16	43–200	Inh Ing Con	Mild irritation of the eyes, nose, and throat; drowsi-ness, dizziness, headache; dry, cracked skin.	Eye: Irrigate immediately Skin: Water flush Breath: Respiratory support Swallow: Immediate medical attention	400 ppm 400 ppm 400 ppm	500 ppm 500 ppm 500 ppm	PEL TLV REL	2,000 ppm

Table E2-1

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RSA-014, Unlined Inactive Burn Trenches Unit #2
Redstone Arsenal, Madison County, Alabama

Substance [CAS]	IP[a] (eV)	Odor Threshold (ppm)	Route[b]	Symptoms of Exposure	Treatment	TWA[c]	STEL[d]	Source[e]	IDLH (NIOSH)[f]
Methanol	10.85	4.2-5960	Inh Abs Ing Con	Irritated eyes, headache, drowsiness, lightheadedness, nausea, vomiting, disturbance in vision, blindness.	Eye: Irrigate immediately Skin: Water flush promptly Breath: Fresh air Swallow: Immediate medical attention	NIOSH/OSHA= 200 ppm	260 ppm	PEL TLV REL	6000 ppm
Nitric acid [7697-37-2]	11.95	0.3–1	Inh Ing Con	Irritated eyes, mucous membranes, and skin; delayed pulmonary edema, pneumonitis, bronchitis; dental erosion.	Eye: Irrigate immediately Skin: Water flush promptly Breath: Respiratory support Swallow: Immediate medical attention	2 ppm 2 ppm 2 ppm	4 ppm 4 ppm 4 ppm	PEL TLV REL	100 ppm
Petroleum hydrocarbons (Examples: oils, grease, diesel) *[See specific compound and/or product-specific MSDS*	Varies	Varies by compound	Inh Ing Con Abs	Irritated skin, eyes, nose, and throat; headache, dizziness; dermatitis; some components of gasoline and diesel exhaust are carcinogenic	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	Varies by compound	Varies by compound	NA	Varies by compound
Trichloroethylene (TCE, trichloroethene) [79-01-6]	9.45	1.36	Inh Ing Con	Headache, vertigo; visual disturbance, tremors, somnolence, nausea, vomiting; irritated eyes; dermatitis; cardiac arrhythmia paresthesia. Carcinogenic.	Eye: Irrigate Immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 10 ppm 25 ppm* *(10 hr TWA)	C200 ppm;300ppm* 100 ppm Ca *5 Min peak in any 2 hrs	PEL TLV REL	Ca [1,000 ppm]

Table E2-1

Toxicological and Physical Properties of Chemicals
RSA-014, Unlined Inactive Burn Trenches Unit #2
Redstone Arsenal, Madison County, Alabama

Substance [CAS]	IP[a] (eV)	Odor Threshold (ppm)	Route[b]	Symptoms of Exposure	Treatment	TWA[c]	STEL[d]	Source[e]	IDLH (NIOSH)[f]
Portland cement			Inh	Fine gray powder that can be irritating if inhaled or in eyes.	Eye: Irrigate immediately Skin: Soap wash flush Breath: Respiratory support Swallow: Immediate medical attention	10 mg/m^3 15 mg/m^3 total dust 5 mg/m^3 respirable fraction 10 mg/m^3/total dust 5 mg/m^3 respirable fraction		TLV PEL REL	

Chemical substances italicized represent material that will be used onsite and is not representative of site contaminants.

[a]IP - Ionization potential (electron volts).
[b]Route - Inh, Inhalation; Abs, Skin absorption; Ing, Ingestion; Con, Skin and/or eye contact.
[c]TWA - Time-weighted average. The TWA concentration for a normal work day (usually 8 or 10 hours) and a 40-hour work week, to which nearly all workers may be repeatedly exposed, day after day without adverse effect.
[d]STEL - Short-term exposure limit. A 15-minute TWA exposure that should not be exceeded at any time during a workday, even if the TWA is not exceeded.
[e]PEL - Occupational Safety and Health Administration (OSHA) permissible exposure limit (29 CFR 1910.1000, Table Z).
AEL - Airborne Exposure Limit.
TLV - American Conference of Governmental Industrial Hygiene (ACGIH) threshold limit value—TWA.
REL - National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit.
[f]IDLH (NIOSH)—Immediately dangerous to life or health (NIOSH). Represents the maximum concentration from which, in the event of respirator failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing or irreversible health effects.
NE - No evidence could be found for the existence of an IDLH (NIOSH Pocket Guide to Chemical Hazards, Pub. No. 90-117, 2012).
C - Ceiling limit value which should not be exceeded at any time.
Ca - Carcinogen.
NA - Not applicable.
? - Unknown.
LEL - Lower explosive limits.
LC_{50} - Lethal concentration for 50 percent of population tested.
LD_{50} - Lethal dose for 50 percent of population tested.
NIC - Notice of intended change (ACGIH).

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Table E2-1

Toxicological and Physical Properties of Chemicals
RSA-014, Unlined Inactive Burn Trenches Unit #2
Redstone Arsenal, Madison County, Alabama

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Workplace Environmental Exposure Levels, American Industrial Hygiene Association, 1992.

Table E2-2

Lighting Requirements for Night Operations
RSA-014, Unlined Inactive Burn Trenches Unit #2
Redstone Arsenal, Madison County, Alabama

Location	Illuminance – lx (lumens per square foot)	Monitoring Frequency
Construction areas-general outdoor	33 (3)	Initial shift start/mid-shift
Work areas-general	325 (30)	
Administrative areas (offices, drafting and meeting rooms, etc.)	540 (50)	
Outdoor parking areas	33 (3)	
Visitor areas	215 (20)	
Outdoor storage	33 (3)	

Table E2-3

Biological Hazards
RSA-014, Unlined Inactive Burn Trenches Unit #2
Redstone Arsenal, Madison County, Alabama

(Page 1 of 2)

Ticks

Snakes

Coral Snake

Copperhead

Timber Rattlesnake

Eastern Diamondback Rattlesnake

Pygmy Rattlesnake

Cottonmouth (water moccasin)

Spiders

Black Widow

Brown Widow

Red Widow

Brown Recluse

Table E2-3

Biological Hazards
RSA-014, Unlined Inactive Burn Trenches Unit #2
Redstone Arsenal, Madison County, Alabama

Stinging and Biting Insects	
 **Various Bees and Wasps**  **Ants (including Fire Ants)**	 **Mosquitoes**  **Centipedes**

Poisonous Plants
 **Poison Ivy** **Poison Oak** **Poison Sumac**

Table E5-1

PPE Action Levels
Corrective Measures Implementation
RSA-014, Unlined Inactive Burn Trenches Unit #2
Redstone Arsenal, Madison County, Alabama

Level of Protection	Activity Example	Criteria for Use	Action Taken for Upgrade Criteria
Level D	Site setup, nonintrusive anomaly surface sweep, vegetation clearing, surveying; subsurface anomaly acquisition/removal;waste characterization sampling, confirmation sampling, excavation backfilling, site restoration.	Required for all work outside of EZs or during nonintrusive activities	If unanticipated chemical hazards are encountered
Modified Level D	Soil excavation, post-excavation confirmation soil sampling, decontamination.	Initial level of protection for all work in EZ	Upgrade to Level C if: • Air monitoring detects industrial chemicals at or above action levels. • Presence of strange odor. • Discovery of discolored soils.
Level C	Soil excavation, post-excavation confirmation soil sampling.	Initial level of protection when: • Air monitoring detects possible industrial chemicals at or above Action Levels and below 1 x STEL. • No chemical splash hazards.	• NA

EZ – Exclusion zone.
PPE – Personal protective equipment.
STEL – Short-Term Exposure Limit.

Table E7-1

VOC Concentrations and PPE Action Levels
Corrective Measures Implementation
RSA-014, Unlined Inactive Burn Trenches, Unit #2
Redstone Arsenal, Madison County, Alabama

When in Level C PPE

Analyte	Action Level	Required Action
VOCs	≥ 200 ppm above background in Breathing Zone	Stop work, evacuate work area; contact HSM.
Oxygen	≥ 20%, <23%	Normal operations
	< 20%, > 23%	Stop work, evacuate work area; contact HSM.
Flammable vapors	≥ 10% LEL	Stop work, evacuate work area; contact HSM.
	< 10% LEL	Continue operations, monitor for VOCs.
Respirable dust	≥ 5 mg/m^3	Water suppression dust control.

When in Level D Modified/D PPE

Analyte	Action Level	Required Action
VOCs	≥ 10 ppm above background in Breathing Zone (TLV® for TCE is 10 ppm)	Stop activities, suspend work activities for 15 to 30 minutes; if readings are sustained, contact HSM.
Oxygen	≥ 20%, <23%	Normal operations
	< 20%, > 23%	Stop work, evacuate work area; contact HSM.
Flammable vapors	≥ 10% LEL	Stop work, evacuate work area; contact HSM.
	< 10% LEL	Continue operations, monitor for VOCs.
Respirable dust	≥ 0.5 mg/m^3	Water suppression dust control.

When in Support Zone

Analyte	Action Level	Required Action
VOCs	≥ 1 ppm above background in Breathing Zone	Evacuate support zone and re-establish perimeter of exclusion zone.

No one is permitted to downgrade levels of PPE without authorization from the HSM.

HSM – Health and Safety Manager.
LEL – Lower explosive limit.
PPE – Personal protective equipment.
ppm – Parts per million.
TBD – To be determined by Contractor.
TCE – Trichloroethene.
TLV – Threshold limit value.
VOC – Volatile organic compound.

Table E7-2

Air Monitoring Frequency and Location
Corrective Measures Implementation
RSA-014, Unlined Inactive Burn Trenches Unit #2
Redstone Arsenal, Madison County, Alabama

Work Activity	Instrument	Frequency	Location
Excavation	OV Monitor CGI/O_2/H_2S Data Ram	Periodically	BZ of employees in excavation area
Confirmation soil sampling	CGI/O_2/H_2S OV Monitor	Periodically	BZ of employees

BZ - Breathing zone.
CGI - Combustible gas indicator.
H_2S - Hydrogen sulfide.
ISEB – In situ enhanced bioremediation.
OV - Organic vapor (photoionization detector 10.6-electron volt lamp).
O_2 - Oxygen.

Table E8-1

Suggested Treatment Actions for Heat Stress
RSA-014, Unlined Inactive Burn Trenches Unit #2
Redstone Arsenal, Madison County, Alabama

Heat Rash	• Keep the affected area dry. • Use dusting powder to increase comfort.
Heat Cramps	• Stop all activity. • Sit in a cool place. • Do not return to work for a few hours after the cramps subside – further exertion may lead to heat exhaustion or stroke. • Seek medical attention if the worker has heart problems, worker is on a low-sodium diet, or the cramps do not go away in an hour
Heat Exhaustion	• Move to a cool, shaded (or air-conditioned) area. • Loosen any restrictive clothing. • Drink plenty of water. • Pat skin with a damp rag or sponge.
Heat Stroke	• **CALL 911** (or designated emergency number). • Move to a cool, shaded location. • Cool by soaking clothes with water, spraying or showering them with water, or fanning body.

Adapted from Centers of Disease Control and Prevention Workplace Safety and Health Topics, www.cdc.gov/niosh/topics/heatstress

Table E8-2

ACGIH Screening Criteria and Action Limit for Heat Stress Exposure
(WBGT Values in Degrees Celsius/°F)
RSA-014, Unlined Inactive Burn Trenches Unit #2
Redstone Arsenal, Madison County, Alabama

Work/Recovery Cycle (each hour)	TLV®				Action Limit			
	Light	Moderate	Heavy	Very Heavy	Light	Moderate	Heavy	Very Heavy
75 - 100% work	31/87.8	28/82.4	-	-	28/82.4	25/77	-	-
50 - 75% work	31/87.8	29/82.2	27.5/81.5	-	28.5/83.3	26/78.8	24/75.2	-
25 - 50% work	32/89.6	30/86	29/84.2	28/82.4	29.5/85.1	27/80.6	25.5/77.9	24.5/76.1
0 - 25% work	32.5/90.5	31.5/88.7	30.5/86.9	30/86	30/86	29/79	28/82.4	27/80.6

Values from the current edition of the ACGIH publication Threshold Limit Values (TLV®) and Biological Exposure Indices.

Proposed Heat Stress Index for working conditions

	WHITE TYVEK		NORMAL CLOTHING	
Flag color	Heat Index	Work/rest cycle	Heat Index	Work/rest cycle
Green	80F-92F	45/15	80F-92F	None
Yellow	93F-99F	30/30	93F-105F	30/30
Orange	100F-105F	20/20	106F-110F	20/20
Stop work	106F		111F	

***This table applies to light or moderate work type.**

ACGIH – American Conference of Governmental Industrial Hygienists.

WBGT – Wet Bulb Globe Temperature.

Table E8-3

Work Load Definitions, Modified ACGIH Table 3, Metabolic Rate Changes
RSA-014, Unlined Inactive Burn Trenches Unit #2
Redstone Arsenal, Madison County, Alabama

Work Load	Examples
Rest	Sitting.
Light	Sitting with light manual work with hands or hands and arms and driving. Standing with some light arm work and occasional walking.
Moderate	Sustained moderate hand and arm work, moderate arm and leg work, moderate arm and trunk work, or light pushing and pulling. Normal walking. Examples: Scrubbing in a standing position. Walking about with moderate lifting or pushing. Walking on level ground at 3.75 miles/hour while carrying a 6-pound load.
Heavy	Intense arm and trunk work, carrying, shoveling, manual sawing, pushing and pulling heavy loads and walking at a fast pace. Examples: Intermittent heavy lifting with pushing or pulling (e.g. pick and shovel work).
Very Heavy	Very intense activity at a fast to maximum pace. Shoveling wet sand.

ACGIH – American Conference of Governmental Industrial Hygienists.

Table E8-4

Symptoms of Hypothermia
RSA-014, Unlined Inactive Burn Trenches Unit #2
Redstone Arsenal, Madison County, Alabama

Core Temperature (°F)	Symptoms
98.6	Normal body temperature
96.8	Person feels cold
95	Shivering
93.2	Clumsy, irrational, confused; may appear drunk
91.4	Muscle stiffness
89.6	Shivering stops, collapse
87.8	Semiconscious
86	Semiconscious; no response to painful stimulus
84.2	Slow pulse and breathing
82.4	Cardiac arrest; no obvious pulse or breathing; pupils dilated

Table E8-5

Types and Symptoms of Frostbite
RSA-014, Unlined Inactive Burn Trenches Unit #2
Redstone Arsenal, Madison County, Alabama

Condition	Symptoms
Frostnip	Area of skin whitened; slightly burning or painful.
Superficial Frostbite	Waxy, white skin with a firm sensation but with some resiliency. Feels “warm” to the victim with a notable cessation of pain.
Deep Frostbite	Tissue damage deeper than the skin, sometimes down to the bone. Skin is cold, numb, and hard.

Table E8-6

Equivalent Chill Temperature (°F) at Various Air Temperatures and Wind Speeds
RSA-014, Unlined Inactive Burn Trenches Unit #2
Redstone Arsenal, Madison County, Alabama

Estimated Wind Speed (mph)	Actual Temperature Reading (^{0}F)											
	50	**40**	**30**	**20**	**10**	**0**	**-10**	**-20**	**-30**	**-40**	**-50**	**-60**
	Equivalent Chill Temperature (^{0}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
>40 has little additional effect	***LITTLE DANGER*** *In less than 1 hour with dry skin. Maximum danger is false sense of security.*				***INCREASING DANGER*** *From freezing of exposed flesh within 1 minute.*			***GREAT DANGER*** *Flesh may freeze within 30 seconds.*				
	Zone A				***Zone B***			***Zone C***				
	Trench foot and immersion foot may occur at any point on this chart.											

Notes:
- * Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.
- * Equivalent chill temperature requiring dry clothing to maintain core body temperature above 96.80F per ACGIH cold stress TLV.

°F – Degrees Fahrenheit.

Table E8-7

Work/Warming Schedule for a 4-Hour Shift
RSA-014, Unlined Inactive Burn Trenches Unit #2
Redstone Arsenal, Madison County, Alabama

Air Temp. (°F)	Air Speed (mph)				
	Calm	**5**	**10**	**15**	**20**
-15 to -19	Normal Breaks (1)	Normal Breaks (1)	75 min. max. work period with 2 breaks	55 min. max. work period with 3 breaks	40 min. max. work period with 4 breaks
-20 to -24	Normal Breaks (1)	75 min. max. work period with 2 breaks	55 min. max. work period with 3 breaks	40 min. max. work period with 4 breaks	30 min. max. work period with 5 breaks
-25 to -29	75 min. max. work period with 2 breaks	55 min. max. work period with 3 breaks	40 min. max. work period with 4 breaks	30 min. max. work period with 5 breaks	
-30 to -34	55 min. max. work period with 3 breaks	40 min. max. work period with 4 breaks	30 min. max. work period with 5 breaks		
-35 to -39	40 min. max. work period with 4 breaks	30 min. max. work period with 5 breaks	**Nonemergency work should cease.** NOTE: The above work/warming regimens are applicable to workers in dry **not** wet clothing.		
-40 to -44	30 min. max. work period with 5 breaks				
-45 and below					

Break period is a 10-minute warmup time in a warm location. Source: ACGIH TLVs and BEIs, Cincinnati, OH, 2015

Adapted from the Occupational Health and Safety Division, Saskatchewan Department of Labor

°F – Degrees Fahrenheit.

mph – Miles per hour.

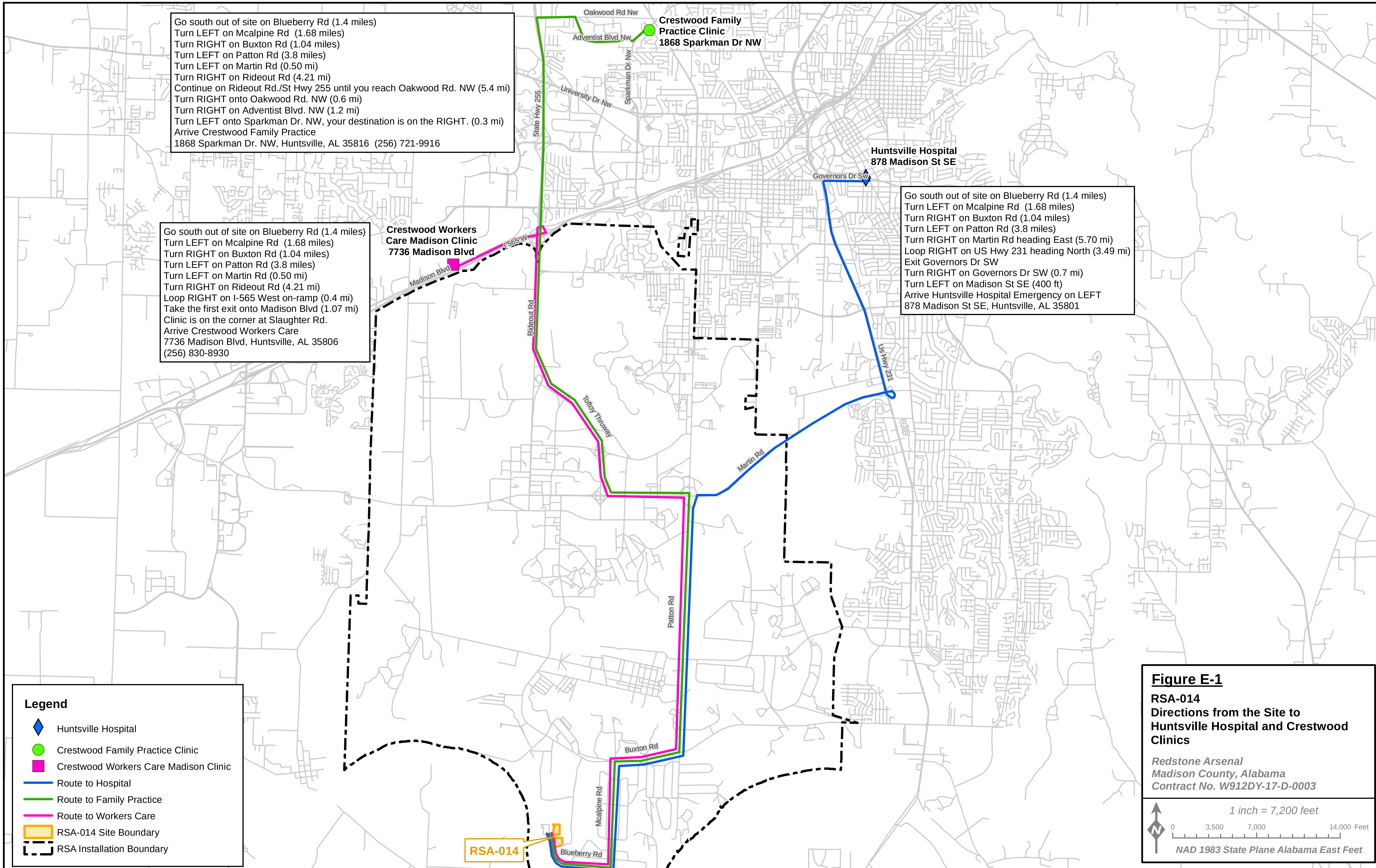
Table E13-1

Emergency Equipment Requirements
RSA-014, Unlined Inactive Burn Trenches Unit #2
Redstone Arsenal, Madison County, Alabama

Emergency Equipment	No. Per Location	Area Where Item(s) Will Be Stored	Operation Requiring Specified Equipment
Portable Eye Wash Kit*	2 each	Each vehicle	All operations
First Aid Kit	1 each	On site	All operations
Fire Extinguisher	1 each	Support vehicles, and SZ	All operations
Cellular Telephone/ Site Communication	1 each	[SUXOS/Site Manager]/[SSHO/UXOSO] and SZ	All operations

*For use if employees are exposed to corrosives, strong irritants, or toxic chemicals.
SSHO – Site Safety and Health Officer.
SUXOS – Senior Unexploded Ordnance Supervisor.
SZ – Support Zone.
UXOSO – Unexploded Ordnance Safety Officer.

FIGURES



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ATTACHMENT 1

ACTIVITY HAZARD ANALYSES

List of AHAs RSA-014S

01 – Mobilization and Demobilization

02 – Visual Site Inspections and Civil Surveys

03 – Site Survey, Utility Clearance and Marking

04 – Surface Clearance

05 – Vegetation Clearance

06 – Intrusive Investigation

07 – Excavation & Backfilling

08 – Soil Sampling

09 – Equipment Decontamination

10 – Pressure Washing

11 – Waste Management

12 – Fueling Operations

13 – Disposal of RDW

14 – MEC and MPPEH Handling and Disposal

15 – Vehicle Operations

16 – Site Restoration

17 – COVID-19 Job Site Practices

Activity Hazard Analysis (AHA)

Activity/Work Task: Mobilization (and Demobilization)	Overall Risk Assessment Code (RAC) (Use highest code)					M
Project Location: RSA-014 Redstone Arsenal Huntsville AL	**Risk Assessment Code (RAC) Matrix**					
Contract Number: W912DY-17-D-0003	**Severity**	**Probability**				
Date Prepared: 06/25/20		Frequent	Likely	Occasional	Seldom	Unlikely
Prepared by (Name/Title): Dennis Seymore, Scientist	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
Reviewed by: Larry Verdier, CIH, CSP, HSE Manager	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L

Notes: (Field Notes, Review Comments, etc.)
This AHA serves as the hazard assessment

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom, or Unlikely.	**RAC Chart**
"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible	**E = Extremely High Risk** **H = High Risk**
Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.	**M = Moderate Risk** **L = Low Risk**

Job Steps	Hazards	Controls	EM 385-1-1	RAC
Travel at project site.	Vehicle Operation.	See AHA 2.0.	18.A	M
Arrival of new personnel at site.	Untrained personnel.	All personnel working on hazardous, toxic, and radioactive waste (HTRW) shall submit HAZWOPER training certificates (40-hour, 8-hour (if applicable), and supervisor (if applicable) to a Site Safety and Health Officer (SSHO). All personnel shall attend a site safety orientation. Other training certifications shall also be made available on site.	18.A	M
	Medical qualifications.	All personnel working on HTRW shall submit current physician's certificate stating that employee is participating in an appropriate medical surveillance program meeting 29 Code of Federal Regulation (CFR) 1910.120	01.B.03 01.E.01 28	L
	Allergies.	All personnel should complete the Known Allergies Questionnaire (voluntary only).	01.C.01	L

Job Steps	Hazards	Controls	EM 385-1-1	RAC
Arrival of new personnel at site (continued).	Unfamiliarity with: site, general (chemical, physical, environmental) site hazards, project safety rules and hazard control procedures, chain of command, and emergency procedures.	All personnel shall attend the site orientation training. The site orientation shall include a review of the phone locations, evacuation routes, and any special requests from the manager of the facility. After personnel are trained in the contents of the Accident Prevention Plan (APP), APP Addenda, and they shall sign the APP Acknowledgment Form. Personnel who may participate in intrusive activities shall attend Munitions and Explosives of Concern Awareness Training. All pertinent AHAs shall be reviewed with personnel (as applicable). Post all hazard warning signs, emergency maps, and emergency phone numbers.	01.B.03 01.E.01 28 03.A.01.b	**M**
Unload equipment/prepare site.	Failure to properly plan daily activities.	A Job Safety Analysis (JSA), as required by Aptim shall be prepared by the crew prior to commencing daily activities. The JSA may be used as a component of the morning Tailgate Safety Meeting. The JSA shall be revised at any time throughout the workday when new tasks are initiated, unforeseen circumstances arise, or if working conditions change. Personnel shall implement Hazard Assessment Resolution Program.		**M**
	Heavy lifting, strains, and sprains.	No individual employee is permitted to lift any object that weighs over 50 pounds. Proper lifting techniques shall be used. Multiple employees or the use of mechanical lifting devices are required for lifting objects over the 50-pound limit.	14.A.01	**M**
	Use of mechanical equipment.	Only qualified personnel shall be permitted to operate equipment. Mechanical equipment shall be inspected daily. Deficiencies in equipment shall be noted on the inspection form. Equipment found to be unsafe shall not be used. All equipment shall be operated at safe speeds and in a safe manner. Equipment operators shall wear safety belts and hearing protection. Ground personnel shall not position themselves between equipment and stationary objects. Personnel are only permitted to approach equipment after a signal from the operator	18.G	**M**
Prepare site.	Hand injuries.	Items to be handled shall be inspected for sharp edges prior to being handled. Personnel shall wear leather gloves when handling sharp materials. Personnel shall be aware of and avoid pinch point hazards.	05.A.08	**L**
	Electrical.	Ground-fault circuit interrupters shall be used on all power tools and extension cords. Extension cords, power tools, and lighting equipment shall be inspected before each use, protected from damage, and kept out of wet areas. Keep extension cords off of roads. Only qualified and authorized electricians will perform electrical installations or maintenance.	11.A	**M**