Area of Concern – S

Final RFI Work Plan Addendum

Addendum to RCRA Facility Investigation Work Plan

Area of Concern (AOC) - S
Fort Rucker, Alabama

FINAL

Contract No. W91ZLK-05-D-0014
Contract Task Order No. 0001

Prepared for:

U.S. Army Environmental Command

Prepared by:

CH2MHILL

Northpark 400
1000 Abernathy Road
Suite 1600
Atlanta, GA 30328

April 2010

ES110509181349ATL

Groundwater Scientist Certification

"I certify that I am a qualified groundwater scientist who has received a baccalaureate or post-graduate degree in the natural sciences or engineering and has sufficient training and experience in groundwater hydrology and related fields as demonstrated by State registration, professional Certifications, or completion of accredited university programs that enable me to make sound professional judgments regarding groundwater monitoring, contaminant fate and transport, and corrective action. I further certify that this Work Plan was prepared and/or reviewed by myself or by a subordinate working under my direction."

MARK A. SHERRILL
LIC. 0885
ALABAMA LICENSED PROFESSIONAL GEOLOGIST

Mark A. Sherrill

PG No. 885
Expires February 28, 2011

DATE 05 April 2010

Contents

Tables

Figures

Appendix

Acronyms and Abbreviations

ADEM	Alabama Department of Environmental Management
AOC	Area of Concern
CH2M HILL	CH2M HILL Constructors, Inc.
EPA	U.S. Environmental Protection Agency
MS/MSD	matrix spike/matrix spike duplicate
PCE	tetrachloroethene
PPE	personal protective equipment
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SSHP	Site Safety and Health Plan
USACE	U.S. Army Corps of Engineers
USAEC	U.S. Army Environmental Command
VOC	volatile organic compound
WMP	Waste Management Plan

1. Introduction

1.1 Project Overview

This addendum to the *Final Work Plan for RCRA Facility Investigation at Area of Concern (AOC)–S, Fort Rucker, Alabama* (CH2M HILL, 2007) has been prepared for the U.S. Army Environmental Command (USAEC), by CH2M HILL Constructors, Inc. (CH2M HILL), under Contract No. W91ZLK-05-D-0014, Task Order 0001. It describes additional field activities and laboratory analyses to be completed at AOC-S in order to address Alabama Department of Environmental Management (ADEM) comments on the *Draft Final RCRA Facility Investigation Report for Area of Concern (AOC)–S, Fort Rucker, Alabama* (CH2M HILL, 2009). The ADEM comments, along with CH2M HILL's responses, are presented in the **Appendix**. The results of the additional field activities and laboratory analyses will be incorporated into a final Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) report for AOC-S.

The field activities will include advancement of soil borings, installation of groundwater monitoring wells, collection of groundwater samples, sample handling and shipping, and waste handling and disposal. Drilling and well installation, surveying, analytical services, and waste handling and disposal will be performed by subcontractors under CH2M HILL's supervision.

1.2 Organization of the Addendum to the Work Plan

This addendum is organized as follows.

- **Section 1**: Introduces the purpose for the additional investigation and organization of the addendum.
- **Section 2**: Describes the project management structure and a schedule for completion of the additional RFI activities.
- **Section 3**: Introduces the field activities.
- **Section 4**: Lists the references used in preparing this addendum.

2. Project Organization and Schedule

2.1 Organization

The organizational structure for this project includes personnel from the USAEC, U.S. Army Corps of Engineers (USACE), Fort Rucker, CH2M HILL, and a number of subcontractors. The project organizational structure for completion of the RFI at AOC-S is presented as **Figure 2-1**.

2.2 Project Schedule

The project schedule for the AOC–S RFI is presented as **Figure 2-2**. The schedule depicts the anticipated duration (in days) for each task, anticipated start and end dates for each task, a graphical representation of the timeframes for the performance of each task, and the interrelationship between various tasks.

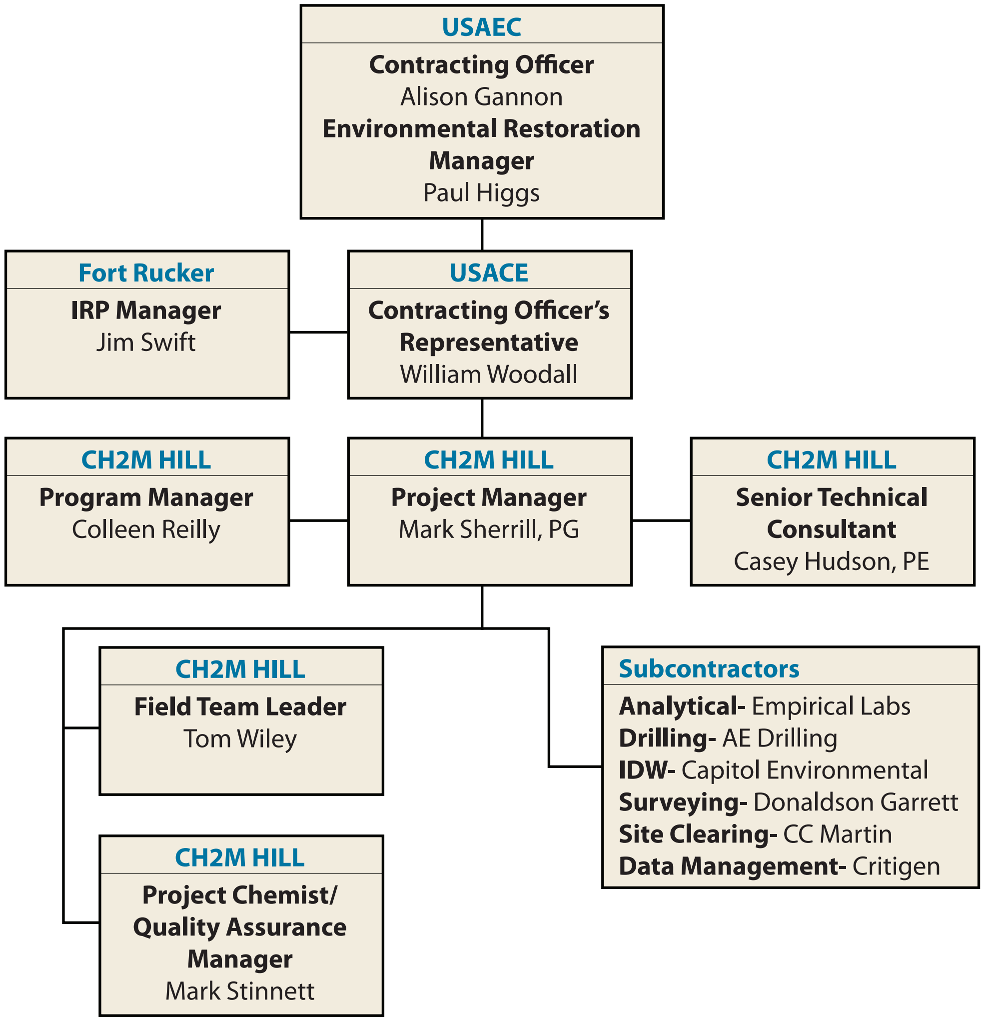
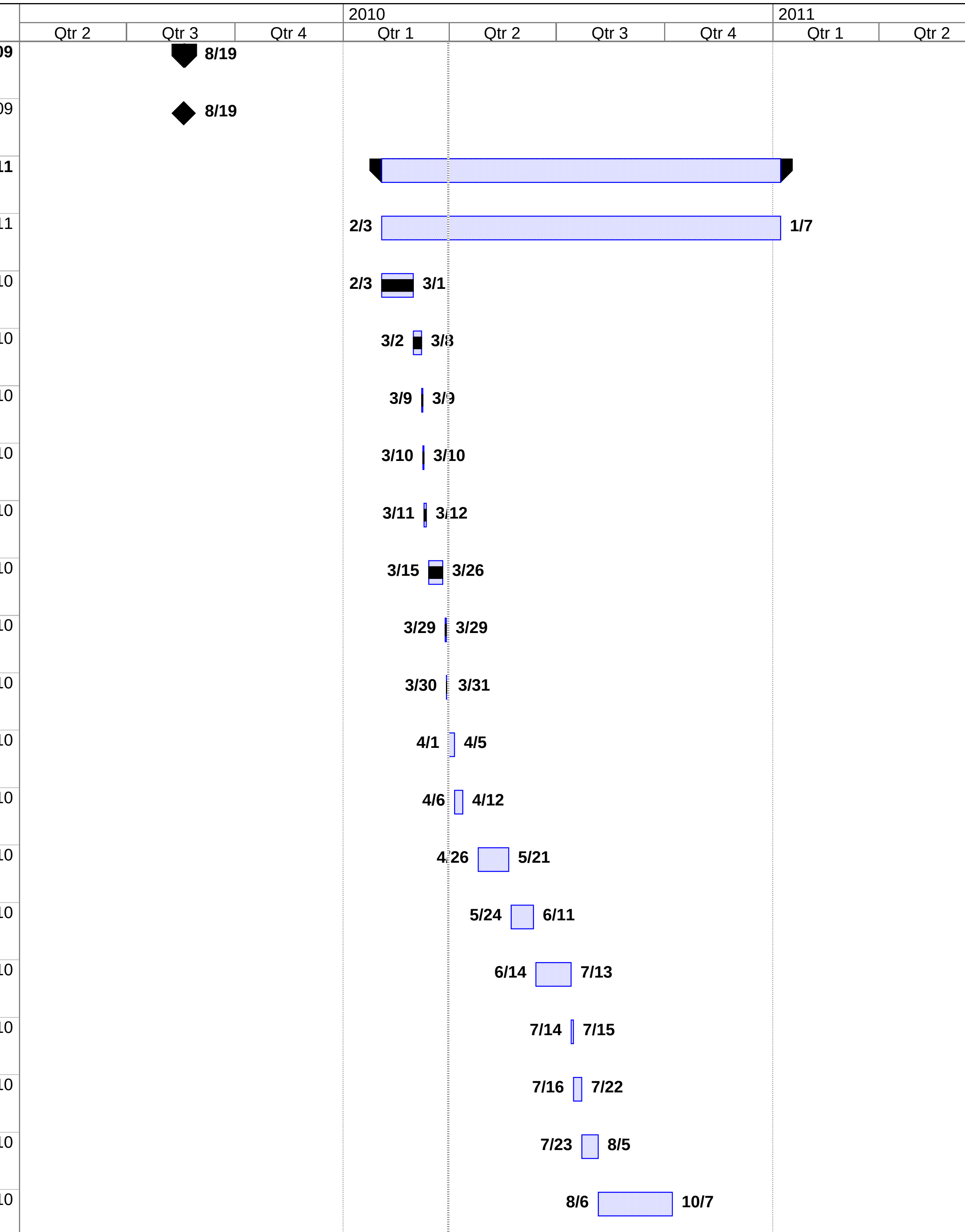


FIGURE 2-1
Organizational Chart
Addendum to RCRA Facility Investigation
AOC-S
Fort Rucker, Alabama

FIGURE 2-2
AOC-s
Addendum to RFI
Project Schedule
Fort Rucker, AL

ID		WBS	Task Name	Duration	Start	Finish
1		**2004**	**ENVIRONMENTAL REMEDIATION SERVICES AT FT. RUCKER**	**1 day**	**Wed 8/19/09**	**Wed 8/19/09**
2		2004A	Award Date	1 day	Wed 8/19/09	Wed 8/19/09
3		**2004DA**	**IRP SITE AOC-S**	**243 days**	**Wed 2/3/10**	**Fri 1/7/11**
4		**2004DA1**	**FINAL RFI**	243 days	Wed 2/3/10	Fri 1/7/11
5	✓	2004DA2	Draft RFI Technical Memorandum Work Plan Preparation and Submittal	19 days	Wed 2/3/10	Mon 3/1/10
6	✓	2004DA3	Army Review/Comment	5 days	Tue 3/2/10	Mon 3/8/10
7	✓	2004DA4	Prepare Response to Army Comments and Submittal	1 day	Tue 3/9/10	Tue 3/9/10
8	✓	2004DA5	Army Review/Acceptance of Response to Comments	1 day	Wed 3/10/10	Wed 3/10/10
9	✓	2004DA6	Draft Final RFI Technical Memorandum Work Plan Preparation and Submittal	2 days	Thu 3/11/10	Fri 3/12/10
10	✓	2004DA7	ADEM/Army Review/Comment	10 days	Mon 3/15/10	Fri 3/26/10
11	✓	2004DA8	Prepare Response to ADEM/Army Comments and Response Submittal	1 day	Mon 3/29/10	Mon 3/29/10
12	✓	2004DA9	ADEM/Army Review/Acceptance of Response to Comments	2 days	Tue 3/30/10	Wed 3/31/10
13		2004DA10	Final RFI Technical Memorandum Work Plan Preparation and Submittal	3 days	Thu 4/1/10	Mon 4/5/10
14		2004DA11	Army/ADEM Approval of Final RFI Technical Memorandum Work Plan	5 days	Tue 4/6/10	Mon 4/12/10
15		2004DA12	RFI Field Work-Well Installation/Sampling	20 days	Mon 4/26/10	Fri 5/21/10
16		2004DA13	Final (Draft) RFI Report Preparation and Submittal	15 days	Mon 5/24/10	Fri 6/11/10
17		2004DA14	Army Review/Comment	22 days	Mon 6/14/10	Tue 7/13/10
18		2004DA15	Prepare Response to Army Comments and Submittal	2 days	Wed 7/14/10	Thu 7/15/10
19		2004DA16	Army Review/Acceptance of Response to Comments	5 days	Fri 7/16/10	Thu 7/22/10
20		2004DA17	Final (Draft Final) RFI Report Preparation and Submittal	10 days	Fri 7/23/10	Thu 8/5/10
21		2004DA18	Army/ADEM Review/Comment	45 days	Fri 8/6/10	Thu 10/7/10

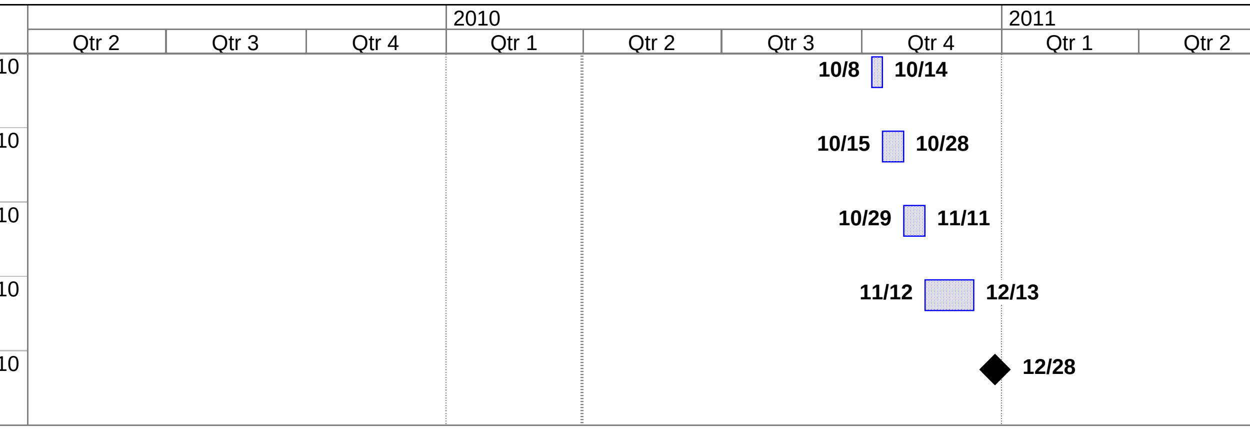


Project: FORT RUCKER PROJECT S
Date: 03/31/2010

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

FIGURE 2-2
AOC-s
Addendum to RFI
Project Schedule
Fort Rucker, AL

ID		WBS	Task Name	Duration	Start	Finish
22		2004DA19	Prepare Response to ADEM/Army Comments and Response Submittal	5 days	Fri 10/8/10	Thu 10/14/10
23		2004DA20	ADEM/Army Review/Acceptance of Response to Comments	10 days	Fri 10/15/10	Thu 10/28/10
24		2004DA21	Final RFI Report Preparation and Submittal	10 days	Fri 10/29/10	Thu 11/11/10
25		2004DA22	ADEM/Army Review of Final RFI Report	22 days	Fri 11/12/10	Mon 12/13/10
26		**2004DA23**	***Army/ADEM Approval of Final RFI Report***	1 day	Tue 12/28/10	Tue 12/28/10



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3. Investigation Activities

The goal of the RFI addendum field investigation is to further delineate the horizontal extent of tetrachloroethene (PCE) in groundwater at AOC-S. This section discusses the investigation tasks to be performed at AOC-S, located in the southern portion of the Fort Rucker cantonment area, and on private property located south of AOC-S, as well as the rationale for performing those investigation tasks.

All field activities will follow the Field Sampling Plan, Quality Assurance Project Plan, Waste Management Plan (WMP), and Site Safety and Health Plan (SSHP), which were presented as appendices in the *Final Work Plan for RCRA Facility Investigation at Area of Concern (AOC) – S, Fort Rucker, Alabama* (CH2M HILL, 2007).

3.1 Utility Clearance and Permits

Prior to mobilization to the field, CH2M HILL will contact the Alabama One-Call Number to obtain available information regarding subsurface utilities at the investigation area and the necessary utility clearances and dig permits to perform the planned investigation. The USACE will secure the Right of Entry area to further define the horizontal extent of PCE on the private property located south of AOC-S and the Fort Rucker boundary. USACE Real Estate is currently staffed to gain Right of Entry to the private property. Final access to the private property will depend upon talks with the landowner.

3.2 Monitoring Well Installation and Groundwater Sampling

During the addendum field investigation, four hollow-stem auger borings, totaling an estimated maximum footage of 155 linear feet, will be drilled and completed as monitoring wells within AOC-S. The locations of the proposed additional monitoring wells are based on data collected from 23 existing monitoring wells installed and sampled during previous RFI investigation activities and are presented on **Figure 3-1**. The results of previous RFI activities are documented in the *Draft Final RCRA Facility Investigation Report for Area of Concern (AOC) – S, Fort Rucker, Alabama* (CH2M HILL, 2009). The monitoring wells will be constructed of 2-inch-diameter, threaded, schedule 40 polyvinyl chloride (PVC) riser and 10 feet of 0.010-inch slot PVC screen.

The proposed monitoring well construction details are summarized in **Table 3-1**.

After completion of the four additional monitoring wells, a groundwater sample will be collected from the newly installed wells using a micro-flow purge and sampling technique. Each groundwater sample will be analyzed for ADEM Chapter 13, Appendix I volatile organic compounds (VOCs), including PCE, using U.S. Environmental Protection Agency (EPA) Method SW846 8260B, and metals, using EPA Method SW 846 6010B/7400. One field duplicate, one equipment blank, and one matrix spike/matrix spike duplicate (MS/MSD) will also be collected and analyzed.

Existing Monitoring Well

Proposed Monitoring Well

Surface Water Sample Location (Off-Post)

Extent of Closed Incinerator Ash Landfill (SWMU 8)

Trail

Potentiometric Surface Contour (5 foot interval)

Approximate Tetrachloroethene Plume <1ugL (dashed where inferred)

Off-Post Investigation Area

Well ID's In Blue Boxes Signifies
Fix-Base Lab Detection of Tetrachloroethene

* All concentrations in ug/L
(ND) = Non-Detect
(J) = Estimated Value

Note: Black square box is part of the aerial photograph and does not pertain to this project.

Figure 3-1
Proposed Monitoring Well Locations
Addendum to RFI Work Plan
Fort Rucker, Alabama

CH2MHILL

\\GALILEO\PROJ\USACE\FT_RUCKER\MAPFILES\PCE_GW-20100328.MXD SSMITH21 3/29/2010 07:55:56

TABLE 3-1
Proposed Monitoring Well Depths and Screened Intervals
Addendum to RFI at AOC-S, Fort Rucker, Alabama

Well	Proposed Well Depth (ft-bgs)	Proposed Screened Interval	Estimated Depth to Water (ft-bgs)	Location	Surface Completion	Latitude	Longitude
S-MW19	50	40-50	40	On-Post	Manhole	31.322674	-85.696367
S-MW20	35	25-35	26	On-Post	Stand Up*	31.316776	-85.694504
S-MW21	15	5-15	5	Off-Post	Manhole	31.315287	-85.691279
S-MW22	55	45-55	48	On-Post	Manhole	31.320036	-85.695123

Notes:
ft-bgs = feet below ground surface

*Stand Up Cover includes Bollards

Table 3-2 shows the estimated number of groundwater samples to be collected.

TABLE 3-2
Groundwater Samples
Addendum to RFI at AOC-S, Fort Rucker, Alabama

Parameter	Analytical Method	Field Samples	Field Duplicates	MS/MSD[1] Samples	Field Blank	Trip Blank	Equipment Blank	Total Samples
ADEM Appendix I VOCs	SW 846 8260B	4	1	1/1	0	1	1	9
ADEM Appendix I Metals	SW 846 6010B/7470 (mercury)	4	1	1/1	0	0	1	8

[1]MS/MSD - individual sample numbers listed, not MS/MSD set.

3.3 Surveying and Mapping

The monitoring wells will be surveyed for horizontal and vertical control (ground surface elevation and top of casing elevation) by an Alabama-licensed surveyor. The survey will be tied to the Local State Plane coordinate system, North American Datum 1983 and elevations will be National Geodetic Vertical Datum.

3.4 Final RFI Report

The addendum field investigation, sample analysis, and laboratory data validation will be incorporated into the *Draft Final RCRA Facility Investigation Report for Area of Concern (AOC) – S, Fort Rucker, Alabama* (CH2M HILL, 2009) and a final RFI report will be prepared and submitted.

3.5 Management of Investigation-Derived Waste

Materials likely to be generated during the investigation include soil cuttings; drilling wastes; used personal protective equipment (PPE) such as gloves and Tyvek coveralls; used disposable sampling equipment; decontamination fluids; and general trash, such as paper, wrappers, and similar wastes. All material, except for general trash and PPE, will be placed into drums and retained onsite pending disposal. The materials will be managed and disposed of by a subcontractor that is supervised by CH2M HILL. Details regarding waste storage and handling procedures are presented in the WMP, included as Appendix C in the *Final Work Plan for RCRA Facility Investigation at Area of Concern (AOC) – S, Fort Rucker, Alabama* (CH2M HILL, 2007).

3.6 Site Safety and Health

The addendum field investigation will follow the SSHP included as Appendix D in the *Final Work Plan for RCRA Facility Investigation at Area of Concern (AOC) – S, Fort Rucker, Alabama* (CH2M HILL, 2007).

4. References

CH2M HILL. 2007. *Final Work Plan for RCRA Facility Investigation at Area of Concern (AOC)-S, Fort Rucker, Alabama*. May.

CH2M HILL. 2009. Draft *Final RCRA Facility Investigation for Area of Concern (AOC)-S, Fort Rucker, Alabama*. March.

APPENDIX

CH2M HILL Response to ADEM Comments on Draft Final RCRA Facility Investigation Report for Area of Concern (AOC)–S, Fort Rucker, Alabama

CH2M HILL
Northpark 400
1000 Abernathy Road
Suite 1600
Atlanta, GA 30328
Tel 770-604-9095 x54320
Fax 770-604-9183

December 2, 2009

Mr. Mark Harrison
Alabama Department of Environmental Management
1400 Coliseum Blvd. 36110-2059
Montgomery, Alabama 36130-1463

RE: ADEM Review and Comment: *Draft Final RFI Report for Area of Concern-S, Dated March 13, 2009*
U.S. Army Aviation Center-Fort Rucker
Fort Rucker, Alabama
EPA I.D. No. AL6210 020 776

Dear Mr. Harrison:

CH2M HILL and the Army Team appreciates meeting with you on November 20, 2009 to discuss and resolve the Alabama Department of Environmental Management (ADEM) review comments on the referenced document. Presented below are the specific ADEM comments and our response to each comment. Our responses are intended to facilitate ADEM's re-evaluation of the Draft Final RFI Report so that consensus can be reached on the path forward to finalize the RFI Report for Area of Concern-S.

ADEM Comment 1:

It appears that field screening methods for total chlorinated hydrocarbons and the installation of temporary wells were utilized to delineate the extent of tetrachloroethene (PCE) in groundwater during this investigation. Although field screening methods and temporary wells may be appropriate to determine the approximate boundary of the contaminant plume, data collected from permanent monitoring wells should be used when making decisions regarding groundwater quality and contaminant delineation. Therefore, additional groundwater samples from permanent monitoring wells should be collected and analyzed for PCE and submitted to the Department for review. This information should be collected as part of a Phase II RFI.

CH2M HILL Response to ADEM Comment 1:

Permanent groundwater monitoring wells were installed as part of the RFI at Area of Concern-S and used to make decisions regarding groundwater quality and contaminant delineation, specifically PCE. The number and location of these wells were discussed with ADEM during a meeting held at ADEM's office on May 23, 2008. At that time, the Army proposed the installation of 14 permanent groundwater monitoring wells to be installed, with 11 wells on-post and three wells off-post. ADEM submitted a letter to the Army on June 26, *2008 requesting an additional four monitoring wells be installed, along with revised locations. The Army submitted a follow-up letter on July 29, 2008 agreeing to install 18 permanent groundwater monitoring wells to address both lateral and vertical delineation of PCE.*

Eighteen new permanent groundwater monitoring wells were installed as part of the RFI at Area of Concern-S. The wells were numbered S-MW1 through S-MW18. The eighteen new wells, along with five existing wells (8-G1 through 8-G5) were analyzed for ADEM Chapter 13, Appendix I volatile organic compounds (VOCs) and metals. The well construction details are summarized in Table 3-2, page 3-7 in the Draft Final RFI Report. The analyses performed on each permanent well are summarized in Table 3-3, page 3-8 of the Draft Final RFI Report. The constituents, including PCE detected from each permanent monitoring well are summarized in Table 5-6, pages 5-14 and 5-15.

ADEM Comment 2:

To more effectively characterize the nature and extent of the PCE plume, the Army should set the boundary such that permanent monitoring wells where PCE has been detected at levels above MCLs are within the boundary of AOC-S and extend the plume boundary to wells where PCE is consistently detected at concentrations below MCLs. In addition, to better define the plume boundary, installation of additional permanent groundwater monitoring wells is warranted. Therefore, additional permanent monitoring wells should be installed along the boundary of the plume at a frequency appropriate to monitor the potential migration of the contaminant plume.

CH2M HILL Response ADEM Comment 2:

CH2M HILL will revise Figure 5-2 Distribution of PCE in Groundwater/Surface Water, page 5-16 in the Draft Final RFI Report, to show the PCE plume boundary in wells with consistent concentration of less than 1 micrograms per liter. PCE was the only constituent detected above MCLs. In addition, to facilitate interpretation of the results, CH2M HILL will remove the screening results from the temporary wells and direct push points and only show the PCE results from the permanent groundwater monitoring wells.

Based on the stability of groundwater flow direction at Area of Concern-S, as demonstrated in Figure 4-3 Potentiometric Surface Map (December 2008), page 4-9 and Figure 4-4 Potentiometric Surface Map (August 2007), page 4-10, and the field screening data, CH2M HILL proposes to install three additional permanent groundwater monitoring wells to further define the low level dissolved plume and further monitor the potential migration of PCE. The wells will be located and installed within the shallow water-table aquifer as follows:

1. *One shallow water-table well located up-gradient of the source area.*
2. *One shallow water-table well located west of well 8-G4.*
3. *One shallow water-table well located at the down-gradient edge of the < 1 micrograms per liter contour.*

The revised Figure 5-2, along with the locations of the additional proposed permanent groundwater monitoring wells is included as an Attachment to this correspondence.

ADEM Comment 3:

Fourteen soils samples were collected in suspected source areas and at areas exhibiting the highest total chlorinated hydrocarbon concentrations during field screening. However, it appears that the horizontal and vertical extent of contaminated soil was not determined. Therefore, additional soil samples are warranted as part of the Phase II RFI to delineate the extent of impacted soil.

CH2M HILL Response to ADEM Comment 3:

As described in the comment, the soil samples were collected in suspected source areas and at areas which exhibited the highest total chlorinated hydrocarbon concentrations during field screening. Specifically, soil samples were collected using a DPT within and adjacent to the source area (former wash rack) and at DPT-19, which exhibited the highest total chlorinated hydrocarbon concentration of 120 micrograms per liter during field screening. Each soil sample was collected above the water table. The source area samples were as follows:

S-DPT49SB0135-40 collected at a depth of 35 to 40 feet below ground surface
S-DPT49SB0140-45D collected at a depth of 40 to 45 feet below ground surface
S-DPT50SB0125-30 collected at a depth of 25 to 30 feet below ground surface
S-DPT52SB0130-35 collected at a depth of 30 to 35 feet below ground surface
S-DPT53SB0125-30 collected at a depth of 25-30 feet below ground surface

The DPT-19 soil sample was S-SPT19SB015-10 collected at 5-10 feet below ground surface.

In addition, other soil samples were collected farther down-gradient from the source area. These samples were as follows:

S-DPT01SB0145-50 collected at a depth of 45 to 50 feet below ground surface
S-DPT02SB0145-50 collected at a depth of 45 to 50 feet below ground surface
S-DPT03SB0140-45 collected at a depth of 40 to 45 feet below ground surface
S-DPT04SB0145-50 collected at a depth of 45 to 50 feet below ground surface
S-DPT05SB0140-45 collected at a depth of 40 to 45 feet below ground surface
S-DPT06SB0135-40 collected at a depth of 35 to 40 feet below ground surface
S-DPT07SB0140-45 collected at a depth of 40 to 45 feet below ground surface
S-DPT13SB0145-50 collected at a depth of 45 to 50 feet below ground surface

Each soil sample was submitted for analysis of the ADEM Chapter 13, Appendix I VOCs. The soil sample results are summarized in Table 5-5, page 5-11 and 5-12 in the Draft Final RFI Report. As shown in Table 5-5, acetone, carbon disulfide, and 2-butanone were detected. These constituents were well below their respective Region 9 Preliminary

Remediation Goals. No other VOCs including PCE were detected in the soil samples. The complete analytical data sheets are included on CD in Appendix B of the Draft Final RFI Report.

Given the absence of VOCs, including PCE which was the only VOC detected in groundwater above its MCL, the data indicates soil in the area of the former wash rack is not impacted. No additional soil samples are warranted.

ADEM Comment 4:

Investigation Derived Waste (IDW) produced during the RFI at AOC-S consisted of 80 drums of soil and drilling waste and 36 drums of liquid waste. The Army should provide ADEM with more detailed information regarding the analysis, transport, and fate of the IDW. In addition, it appears that the number of composite samples taken to characterize the IDW was not adequate. Fort Rucker should contact the Department prior to disposal of IDW in the future to ensure that the appropriate number of samples are collected to properly characterize the waste. The RFI report should be revised to include the requested information.

CH2M HILL Response to ADEM Comment 4:

CH2M HILL will include the manifests and certificates of disposal in the Final RFI Report.

ADEM Comment 5:

The RFI Report is not certified in accordance with ADEM Admin. Code 335-14-8-02 (2)(d). The revised RFI report should include the appropriate certification statement and signature.

CH2M HILL Response to ADEM Comment 5:

CH2M HILL agrees to include the appropriate certification statement and signature in accordance with ADEM Admin. Code 335-14-8-02 (2)(d).

For any questions or concerns regarding these responses or the revised figure, contact Mark Sherrill at 678-938-0923.

Sincerely,

CH2M HILL

Mark Sherrill, P.G.
Project Manager

Attachment

Cc: Mr. William Woodall/USACE
Mr. Dennis Mayton/USACE
Mr. Paul Higgs/USAEC
Mr. Jim Swift/Fort Rucker
Ms. Susan Cowart/Fort Rucker
Mr. Jason Wilson/ADEM
Mr. Bob Barnwell/ADEM

ATTACHMENT

Existing Monitoring Well
Proposed Monitoring Well
Surface Water Sample Location (Off-Post)
Extent of Closed Incinerator Ash Landfill (SWMU 8)
Trail

Potentiometric Surface Contour (5 foot interval)
Approximate Tetrachloroethene Plume <1ugL (dashed where inferred)
Off-Post Investigation Area

N

0 125 250 500 750 1,000
Feet

Well ID's In Blue Boxes Signifies
Fix-Base Lab Detection of Tetrachloroethene

* All concentrations in ug/L
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Note: Black square box is part of the aerial photograph and does not pertain to this project.

Figure 5-2
Distribution of PCE in Groundwater/Surface Water
AOC-S
Fort Rucker, Alabama
CH2MHILL

\\GALILEO\PROJ\USACE\FT_RUCKER\MAPFILES\PCE_GW-20091129.MXD SSMITH21 11/30/2009 06:28:18

Revised Final Addendum RFI Work Plan Replacement Pages

CH2M HILL
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Fax 770-604-9183

25 May 2010

Mr. William Woodall
U.S. Army Corps of Engineers, Mobile District
CESAM-EN-GE
109 Saint Joseph Street
Mobile, Alabama 36602-3630

RE: Revised Pages to Final Addendum to AOC-S RFI Work Plan
Fort Rucker, Alabama Environmental Remediation Services
Contract W91ZK-05-D-0014, Task Order 0001

Dear Mr. Woodall:

Enclosed is one hard copy of the revised pages to be inserted into the *Final Addendum to AOC-S RFI Work Plan* submitted April 5, 2010. Revisions to the Final document were necessary to incorporate language regarding Right of Entry issues for placement of one off-post groundwater monitoring well as discussed with ADEM on May 4, 2010. Please remove the corresponding pages from the previous submittal and insert the revised pages. I have forwarded these revised pages to the final document under copy of this correspondence to Mr. Jim Swift (Fort Rucker), Mr. Dennis Mayton (USACE), Mr. Paul Higgs (USAEC), and Mr. Mark Harrison (ADEM).

If you have any questions regarding the contents of these draft documents, please call me at 678-938-0923.

Sincerely,

CH2M HILL

Mark Sherrill, P.G.
Project Manager

cc: Mr. Jim Swift/Fort Rucker (2 copies)
Mr. Dennis Mayton/USACE (1 copy)
Mr. Paul Higgs/USAEC (1 copy)
Mr. Mark Harrison/ADEM (3 copies)

Contents (Revised)

Tables

Figures

Appendix

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The organizational structure for this project includes personnel from the USAEC, U.S. Army Corps of Engineers (USACE), Fort Rucker, CH2M HILL, and a number of subcontractors. The project organizational structure for completion of the RFI at AOC-S is presented as **Figure 2-1**.

2.2 Project Schedule

The project schedule for the AOC–S RFI is presented as **Figure 2-2**. The schedule depicts the anticipated duration (in days) for each task, anticipated start and end dates for each task, a graphical representation of the timeframes for the performance of each task, and the interrelationship between various tasks.

FIGURE 2-1
Organizational Chart

FIGURE 2-2
Project Schedule

7 pages

3. Investigation Activities (Revised)

The goal of the RFI addendum field investigation is to further delineate the horizontal extent of tetrachloroethene (PCE) in groundwater at AOC-S. This section discusses the investigation tasks to be performed at AOC-S, located in the southern portion of the Fort Rucker cantonment area, and on private property located south of AOC-S, as well as the rationale for performing those investigation tasks.

All field activities will follow the Field Sampling Plan, Quality Assurance Project Plan, Waste Management Plan (WMP), and Site Safety and Health Plan (SSHP), which were presented as appendices in the *Final Work Plan for RCRA Facility Investigation at Area of Concern (AOC) – S, Fort Rucker, Alabama* (CH2M HILL, 2007).

3.1 Utility Clearance and Permits

Prior to mobilization to the field, CH2M HILL will contact the Alabama One-Call Number to obtain available information regarding subsurface utilities at the investigation area and the necessary utility clearances and dig permits to perform the planned investigation. The USACE will secure the Right of Entry area to further define the horizontal extent of PCE on the private property located south of AOC-S and the Fort Rucker boundary. USACE Real Estate is currently staffed to gain Right of Entry to the private property. **At this time, the property owner has not signed the Right of Entry allowing the Army to install the additional groundwater monitoring well to be located off-post. The family has requested that the Army wait until the family deals with private matters. They have requested that the Army delay a minimum of 90 days before requesting access to the property. Final access to the private property will depend upon talks with the landowner and his family.**

The Right of Entry issues were discussed with ADEM during a meeting held on May 4, 2010. ADEM understands that it is not in the Army's best interest to push for the Right of Entry at this time. ADEM is in agreement that the delay in installing the off-post well should not delay finalizing the RFI report. The Army and CH2M HILL intend to install the off-post monitoring well discussed in Section 3.2 once the Right of Entry is obtained and the installation can be scheduled with other site tasks.

3.2 Monitoring Well Installation and Groundwater Sampling

During the addendum field investigation, four hollow-stem auger borings, totaling an estimated maximum footage of 155 linear feet, will be drilled and completed as monitoring wells within AOC-S. The locations of the proposed additional monitoring wells are based on data collected from 23 existing monitoring wells installed and sampled during previous RFI investigation activities and are presented on **Figure 3-1**. The results of previous RFI activities are documented in the *Draft Final RCRA Facility Investigation Report for Area of Concern (AOC) – S, Fort Rucker, Alabama* (CH2M HILL, 2009). The monitoring wells will be constructed of 2-inch-diameter, threaded, schedule 40 polyvinyl chloride (PVC) riser and 10 feet of 0.010-inch slot PVC screen.

FIGURE 3-1
Proposed Addendum Monitoring Wells

The proposed monitoring well construction details are summarized in **Table 3-1**.

After completion of the four additional monitoring wells, a groundwater sample will be collected from the newly installed wells using a micro-flow purge and sampling technique. Each groundwater sample will be analyzed for ADEM Chapter 13, Appendix I volatile organic compounds (VOCs), including PCE, using U.S. Environmental Protection Agency (EPA) Method SW846 8260B, and metals, using EPA Method SW 846 6010B/7400. One field duplicate, one equipment blank, and one matrix spike/matrix spike duplicate (MS/MSD) will also be collected and analyzed.

TABLE 3-1
Proposed Monitoring Well Depths and Screened Intervals
Addendum to RFI at AOC-S, Fort Rucker, Alabama

Well	Proposed Well Depth (ft-bgs)	Proposed Screened Interval	Estimated Depth to Water (ft-bgs)	Location	Surface Completion	Latitude	Longitude
S-MW19	50	40-50	40	On-Post	Manhole	31.322674	-85.696367
S-MW20	35	25-35	26	On-Post	Stand Up*	31.316776	-85.694504
S-MW21	**15**	**5-15**	**5**	**Off-Post**	**Manhole**	**31.315287**	**-85.691279**
S-MW22	55	45-55	48	On-Post	Manhole	31.320036	-85.695123

Notes:
ft-bgs = feet below ground surface
*Stand Up Cover includes Bollards
S-MW21 will be installed after Right of Entry is obtained as discussed in Section 3.1

Table 3-2 shows the estimated number of groundwater samples to be collected.

TABLE 3-2
Groundwater Samples
Addendum to RFI at AOC-S, Fort Rucker, Alabama

Parameter	Analytical Method	Field Samples	Field Duplicates	MS/MSD[1] Samples	Field Blank	Trip Blank	Equipment Blank	Total Samples
ADEM Appendix I VOCs	SW 846 8260B	4	1	1/1	0	1	1	9
ADEM Appendix I Metals	SW 846 6010B/7470 (mercury)	4	1	1/1	0	0	1	8

[1]MS/MSD - individual sample numbers listed, not MS/MSD set.

3.3 Surveying and Mapping

The monitoring wells will be surveyed for horizontal and vertical control (ground surface elevation and top of casing elevation) by an Alabama-licensed surveyor. The survey will be tied to the Local State Plane coordinate system, North American Datum 1983 and elevations will be National Geodetic Vertical Datum.

3.4 Final RFI Report

The addendum field investigation, sample analysis, and laboratory data validation will be incorporated into the *Draft Final RCRA Facility Investigation Report for Area of Concern (AOC) – S, Fort Rucker, Alabama* (CH2M HILL, 2009) and a final RFI report will be prepared and submitted.

3.5 Management of Investigation-Derived Waste

Materials likely to be generated during the investigation include soil cuttings; drilling wastes; used personal protective equipment (PPE) such as gloves and Tyvek coveralls; used disposable sampling equipment; decontamination fluids; and general trash, such as paper, wrappers, and similar wastes. All material, except for general trash and PPE, will be placed into drums and retained onsite pending disposal. The materials will be managed and disposed of by a subcontractor that is supervised by CH2M HILL. Details regarding waste storage and handling procedures are presented in the WMP, included as Appendix C in the *Final Work Plan for RCRA Facility Investigation at Area of Concern (AOC) – S, Fort Rucker, Alabama* (CH2M HILL, 2007).

3.6 Site Safety and Health

The addendum field investigation will follow the SSHP included as Appendix D in the *Final Work Plan for RCRA Facility Investigation at Area of Concern (AOC) – S, Fort Rucker, Alabama* (CH2M HILL, 2007).

4. References

CH2M HILL. 2007. *Final Work Plan for RCRA Facility Investigation at Area of Concern (AOC)-S, Fort Rucker, Alabama*. May.

CH2M HILL. 2009. Draft *Final RCRA Facility Investigation for Area of Concern (AOC)-S, Fort Rucker, Alabama*. March.

APPENDIX

CH2M HILL Response to ADEM Comments on Draft Final RCRA Facility Investigation Report for Area of Concern (AOC)–S, Fort Rucker, Alabama

Meetings

Kickoff Meeting-Environmental Remediation Services at Fort Rucker, Alabama – September 22, 2009

From: Mark Sherrill
Date: September 30, 2009
Contract: W91ZLK-05-D-0014
Task Order: 0001

Attendees:

Name	Organization	Email Address	Telephone Number
Mark Sherrill	CH2M HILL	msherril@ch2m.com	678-938-0923
Tom Wiley	CH2M HILL	twiley@ch2m.com	678-530-4388
Jonathan Grimes	CH2M HILL	jgrimes@ch2m.com	678-530-4146
Jim Swift	Fort Rucker	jim.swift@us.army.mil	334-255-1899
Kris Doggett	Silver Wings Golf Club	kristine.doggett@us.army.mil	334-598-2449
Roger Harmon	Silver Wings Golf Club		910-638-3342
Bill Woodall	USACE	william.l.woodall@usace.army.mil	251-694-4364
Dennis Mayton	USACE	dennis.h.mayton.usace.army.mil	251-694-3684
Paul Higgs	USAEC	paul.a.higgs@us.army.mil	731-686-6614
Chris Cochrane	USACE	chris.cochrane@usace.army.mil	256-895-1696
Philip Anderson	Fort Rucker	philip.t.anderson@conus.army.mil	334-255-3308
Susan Cowart	Fort Rucker	susan.cowart@us.army.mil	334-255-1652
Jason Wilson	ADEM	jwilson@adem.state.al.us	334-271-7789
Mark Harrison	ADEM	mdharrison@adem.state.al.us	334-270-5610

The kickoff meeting for environmental remediation services to be performed under contract W91ZK-05-D-0014 was held on September 22, 2009 at the Fort Rucker Evironmental Office. The kickoff meeting started at 11:00 am. The kickoff meeting was lead by Mark Sherrill, the CH2M HILL project manager.

The meeting objectives were as follows:

- Introduce the CH2M HILL, Army, Fort Rucker, and Alabama Department of Environmental Management (ADEM) team members and define their respective roles
- Present project performance objectives
- Present key CH2M HILL personnel and subcontractors

- Present key Army and Fort Rucker personnel
- Present key ADEM personnel
- Summarize Technical Approach
- Summarize Project Deliverables
- Summarize Project Schedule

The kickoff meeting presentation in which the above objectives were presented is attached for reference.

After the kickoff presentation, the following issues/clarifications were discussed:

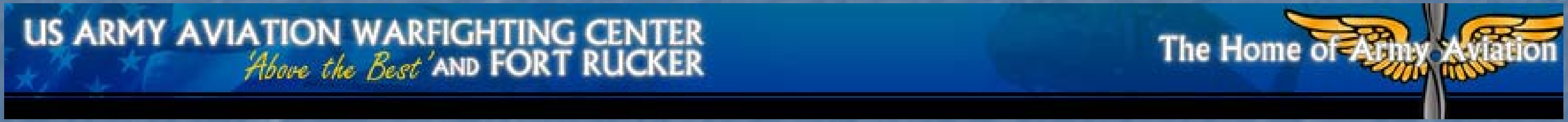
- Karl Blankinship will serve as the USACE Project Manager.
- Dennis Mayton will serve as the USACE Technical Advisor.
- ADEM has issues with the quality of Malcom Pirnie's Site Inspection of the MMRP sites. CH2M HILL will utilize Malcom Pirnie's Site Inspection Report as background for each MMRP site, but understands that ADEM has questions/concerns, which is why the MMRP sites now require the next phase of investigation.
- CH2M HILL will sample soil at the .22-Caliber Target Butt for lead.
- ADEM (Mark Harrison) asked what analytes were sampled for in the temporary wells at Area of Concern (AOC) – S. Mark Sherrill indicated that groundwater from the temporary wells was field screened for total chlorinated hydrocarbons and 10 percent of the samples were submitted to the fixed-base laboratory and analyzed for the ADEM Chapter 13, Appendix I volatile organic compounds.
- ADEM (Mark Harrison) asked if the work at the MMRP sites would be completed before AOC-S. Mark Sherrill and Chris Cochrane indicated there are multiple reviews/approvals by the Army that will have to be done, which can take along time. Mark Sherrill emphasized that the project schedule is a living document.
- CH2M HILL will keep the personnel at the Silver Wings Golf Club (Kris Doggett and Roger Harmon) and the Equestrian Center informed as to the schedule for field work at the MMRP sites in order to minimize impact to their operations.

The kickoff meeting was adjourned at 12:00 pm.

ATTACHMENT

ENVIRONMENTAL REMEDIATION SERVICES
AT
FORT RUCKER, ALABAMA
CONTRACT NO. W91ZK-05-D-0014
Kick-Off Meeting

September 22, 2009



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Agenda

- Introductions & Purpose
- Performance Objectives
- Key Personnel
- Summary of Technical Approach
- Project Deliverables
- Project Schedule

Introductions & Purpose

- Introductions
  - CH2M HILL
  - Army
  - Fort Rucker
  - ADEM
- Purpose
  - Introduce the performance objectives, key personnel, technical approach, project deliverables, and project schedule for Environmental Remediation Services at Fort Rucker

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Performance Objectives

- Approved PMP and QASP
  - Draft PMP and QASP due within 30 days of award
  - Final PMP and QASP due within 30 days of comments on draft

- Achieve ROD/DD at the following sites by September 30, 2011
  - FTRU-001-R-01 – Anti-Tank/Rocket Grenade Range
  - FTRU-003-R-01 – Infiltration/Rocket Grenade Range
  - FTRU-004-R-01 - .22-Caliber Target Butt

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Performance Objectives (Continued)

- Achieve RIP at the following site by February 28, 2011
  - Area of Concern (AOC) - S
    - Upon achievement of RIP, perform RA/O during duration of TO or until achievement of RC
    - Upon achievement of RC, perform LTM for duration of TO

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Key Personnel

- CH2M HILL
  - Program Manager – Colleen Reilly
  - Project Manager – Mark Sherrill
  - QA/QC Manager – Teresa Rojas
  - H&S Manager (AOC-S) – Mike Goldman
  - H&S Manager (MMRP Sites) – Dan Young
  - Senior Technical Advisor (AOC-S) – Dean Williamson
  - Senior Technical Advisor (MMRP Sites) – Ben Redmond
  - Senior Technical Consultant (AOC-S) – Casey Hudson
  - Senior Technical Consultant (MMRP Sites) – Kevin Lombardo

Key Personnel (continued)

- Task Manager (AOC-S) – Tom Wiley
- Senior Remediation Engineer (AOC-S) – Mike Perlmutter
- Construction Manager (AOC-S) – Rob Plsek
- Task Manager (MMRP Sites) – Jonathan Grimes
- Senior Geophysicist (MMRP Sites) – Tamir Klaff
- SUXOS (MMRP Sites) – Chris Rose
- Subcontractors
  - Analytical – Empirical Laboratories
  - Drilling/Well Installation – AE Drilling
  - Surveying – Donaldson, Garrett & Associates
  - Earth Work/Vegetation Clearing – Jacklett Construction
  - Waste Transportation and Disposal – Capital Environmental

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Key Personnel (continued)

  - Remediation Contractor – DeWind One-Pass Trenching, LLC
  - Digital Geophysical Mapping – NAEVA
  - MEC Contractor – UXB
  - Utility Locating Service – OneVision Utility Services

- Army
  - KO – Alison Gannon
  - COR – William Woodall
  - AEC ERM – Paul Higgs
  - USACE PM – Dennis Mayton

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Key Personnel (continued)

- Subject Matter Experts
  - Chris Cochrane (USACE Hunstville) - MMRP
  - Karl Blankinship (USACE Huntsville) - MMRP
  - Richard Kinsella (USACE Mobile) – Chemistry
- Fort Rucker
  - Jim Swift
- ADEM
  - Mark Harrison

Summary of Technical Approach

- FTRU-001-R-01 – Anti-Tank/Rocket Grenade
  - Operated from 1942 – 1951
  - 57acres; 39 acres part of Golf Course and 18 acres wooded
  - SI Results
    - 10% walk with magnetometer
    - Four munitions debris items observed
    - Potential live use ordnance identified
    - Explosives detected below PRGs in 1/10 soil samples

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Summary of Technical Approach (continued)

- Proposed Approach
  - Prepare RFI Work Plan and ESP
  - Perform DGM transect coverage over 3% and intrusive investigation
  - Perform biased MC sampling based on DGM and intrusive results

- FTRU-003-R-01 – Infiltration/Grenade Range
  - Operated from 1942 - 1951
  - 44 acres; includes infiltration range, grenade range, rifle grenade fragmentation range

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Summary of Technical Approach (continued)

- Approximately 34 acres are mowed and maintained grassy areas (used as golf driving range and equestrian center)
- Approximately 10 acres wooded with meandering horse trails
- Adjacent to, but not contiguous with Anti-Tank/Rocket Grenade Range
- SI Results
  - 10% walk with magnetometer
  - Two munitions debris items found in 2003
  - No MEC or debris found during SI
  - Explosives detected below PRGs in 2/10 soil samples

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Summary of Technical Approach (continued)

- Proposed Approach
  - Prepare RFI Work Plan and ESP
  - Perform DGM transect coverage over 3% and intrusive investigation
  - Perform biased MC sampling based on DGM and intrusive results

- FTRU-004-R-01 - .22-Caliber Target Butt
  - Tentatively operated from 1942 – 1951
  - 2.4 acres consisting of running trails and exercise stations
  - Heavily wooded with thick undergrowth
  - SI Results

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Summary of Technical Approach (continued)

- Extensive site walk performed
- Empty trip flare found
- No other indications of target use were found/target butt did not appear to have been constructed
- One soil sample collected; no explosives detected

- Proposed Approach
  - 10% instrument-assisted site walkabout
  - Biased XRF screening and soil sampling for metals based on walkabout results

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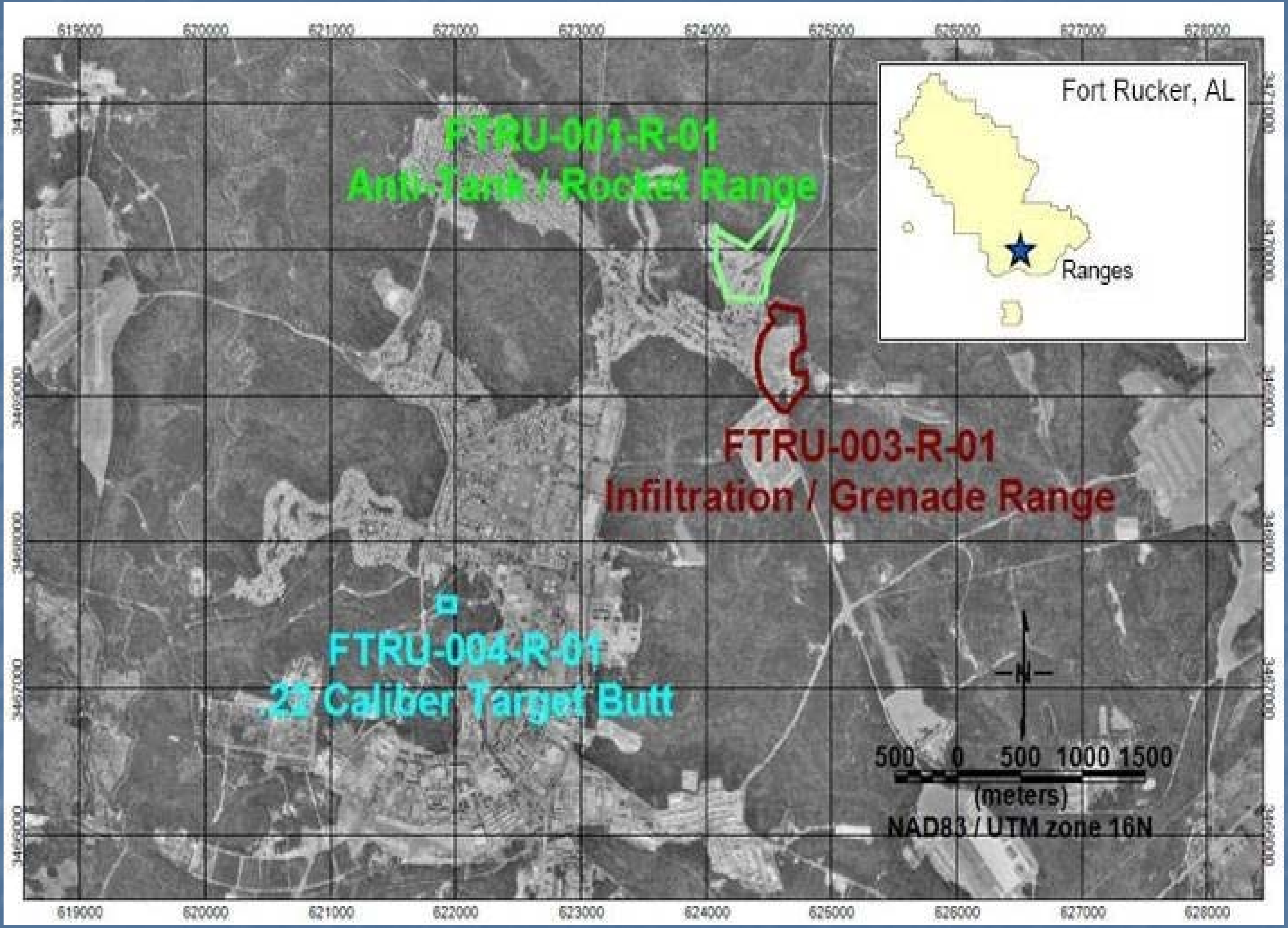
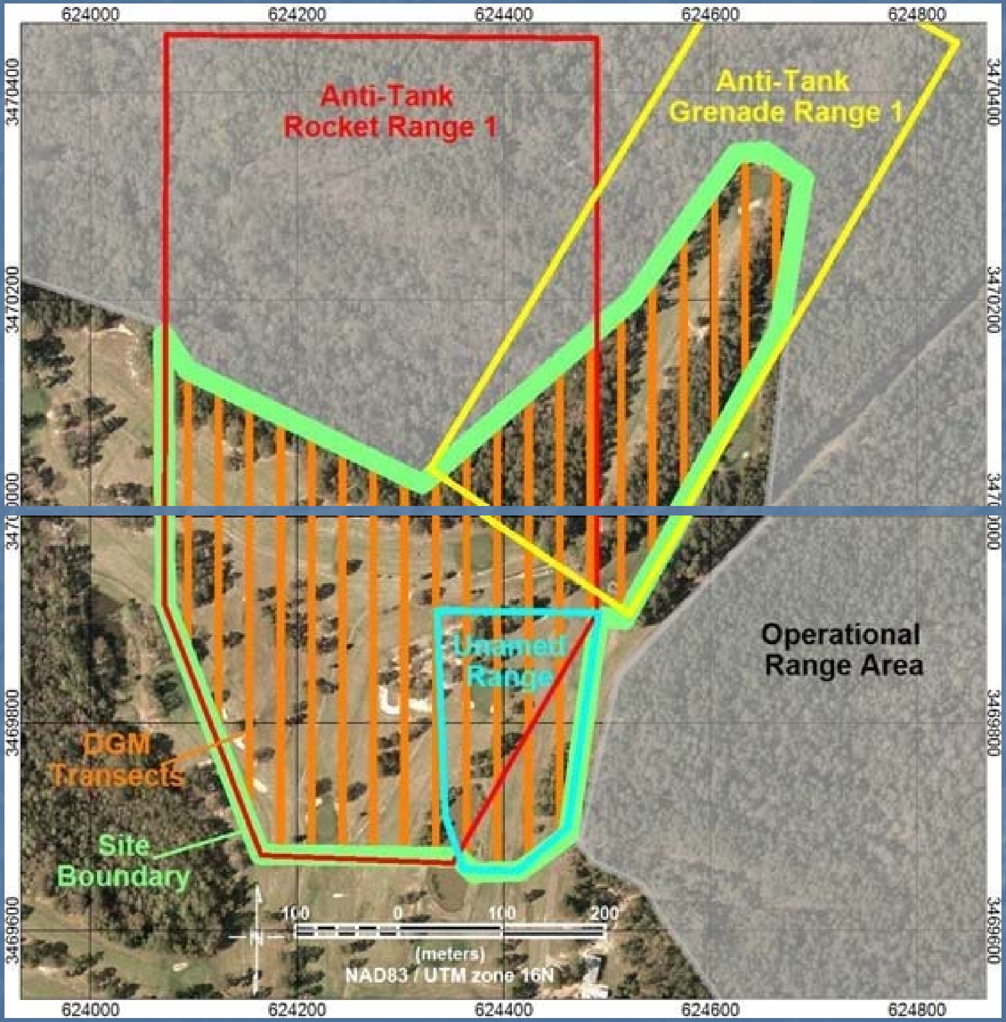
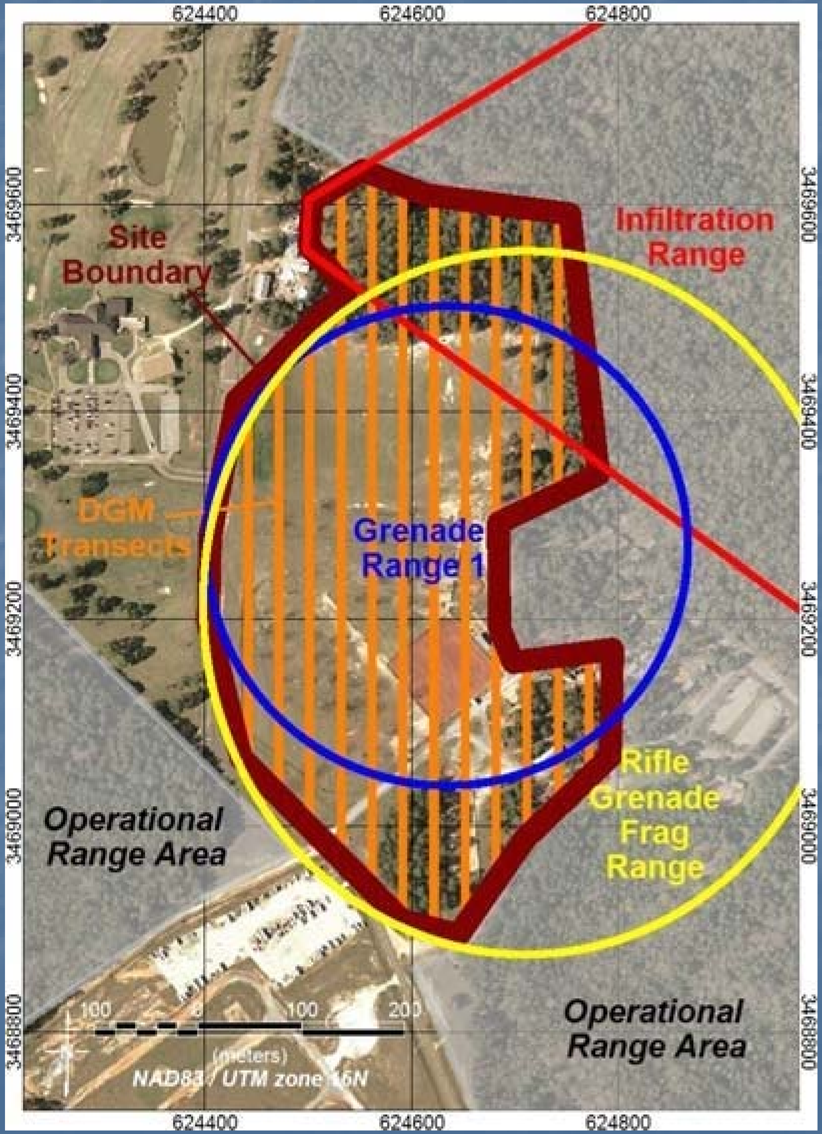
Location of MMRP Sites



Field Sampling Designs for Anti-Tank/Rocket Grenade and Infiltration/Grenade Range





Summary of Technical Approach (continued)

- Area of Concern (AOC) – S
  - Contaminant of Concern is tetrachloroethene (PCE) in groundwater
  - Suspected source is former wash rack operated from 1950s to 1980s
  - Wash rack has been removed but no records exist
  - PCE plume covers approximately 60 acres (2900 ft x 900 ft)
  - PCE plume is well-defined (23 monitoring wells and 60 temp wells)

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Summary of Technical Approach (continued)

- Maximum concentration in source area is 120 µg/L in vicinity of source and 4 µg/L off-post
- Very few degradation products detected
- Proposed Approach
  - Finalize RFI by installing one upgradient monitoring well and collecting soil samples in two "hotspot" areas to confirm source
  - Perform ARBCA evaluation to establish site-specific RBTLs for PCE
  - Prepare CMS/CMIP
  - Implement corrective action by installing ZVI PRB along southern post boundary

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Summary of Technical Approach (continued)

- Perform LTM activities and document effectiveness of ZVI PRB

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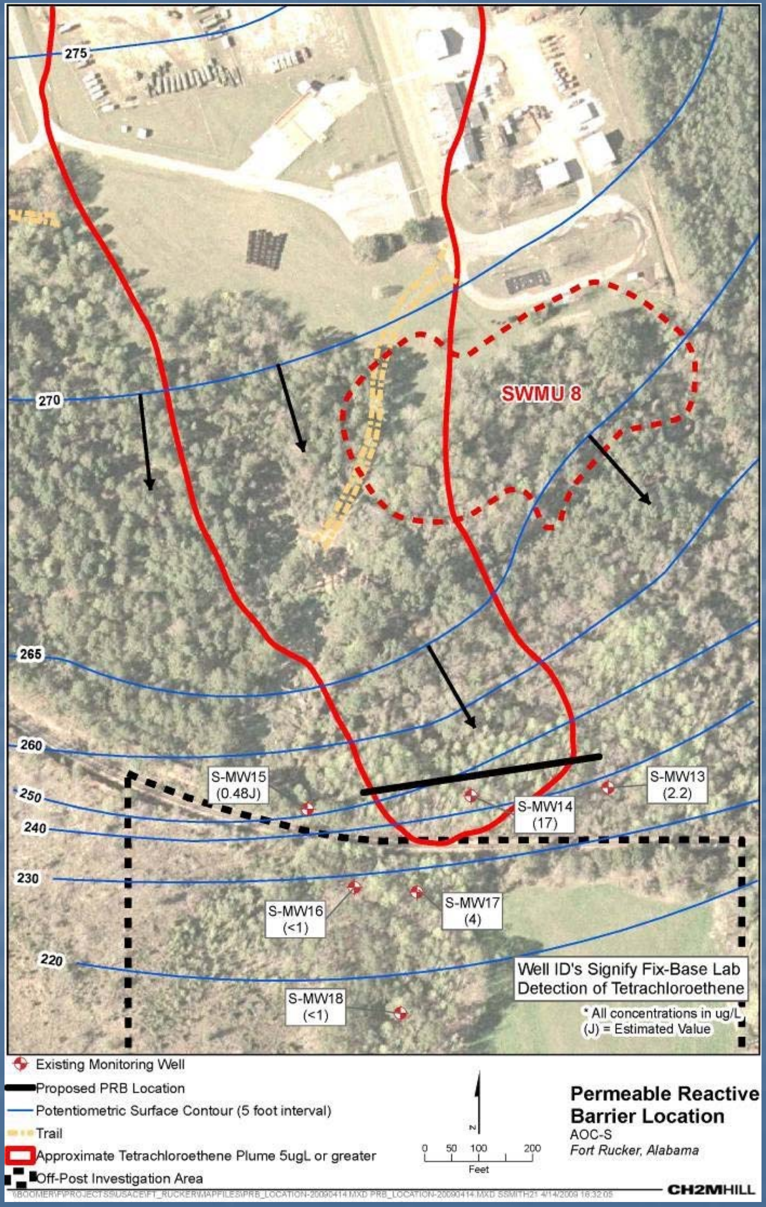
Location of ZVI PRB



Project Deliverables

- PMP and QASP (Draft and Final)
- Site-Wide Plans (FSP, QAPP, WMP, SSHP) (Draft and Final)
- Status Reports
- Stakeholder Presentations
- MMRP Sites
  - ESP (Draft and Final)
  - RFI Work Plan (Draft, Draft Final, and Final)
  - GIS and DGM Data Technical Memorandum (Draft and Final)
  - RFI/CMS Report (Draft, Draft Final, and Final)
  - Statement of Basis for Each Site (Draft, Draft Final, and Final)

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Project Deliverables (continued)

- Area of Concern (AOC) – S
  - RFI Work Plan Technical Memorandum (Draft and Final)
  - Final RFI Report (Draft, Draft Final, and Final)
  - ARBCA Evaluation Technical Memorandum (Draft and Final)
  - CMS/CMIP (Draft, Draft Final, and Final)
  - CMI Report (Draft, Draft Final, and Final)
  - LTM Groundwater Monitoring and CMI Effectiveness Reports (Draft, Draft Final, and Final)
- Remedy Reviews (Draft and Final)

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Project Schedule

- POP ends 12/31/2015
- MMRP Sites
  - DGM/Intrusive Investigations: 2/26/10 – 4/23/10
- AOC-S
  - Final RFI Activities: 11/13/09 – 11/19/09
  - Corrective Measures Implementation
    - Site Preparation: 3/5/10 – 3/26/10
    - ZVI PRB: 4/5/10 – 4/15/10

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Monthly Status Progress Reports

March 2010

CH2M HILL
Northpark 400
1000 Abernathy Road
Suite 1600
Atlanta, GA 30328
Tel 770-604-9095 x54320
Fax 770-604-9183

19 April 2010

Mr. William Woodall
U.S. Army Corps of Engineers, Mobile District
CESAM-EN-GE
109 Saint Joseph Street
Mobile, Alabama 36602-3630

RE: Revised Progress Status Report Numbers 01
Contract W91ZLK-05-D-0014-0001
Fort Rucker, Alabama

Dear Mr. Woodall:

CH2M HILL is pleased to submit this Project Status Report for your review. This status report covers the period from 19 August 2009 to 26 March 2010. The major project activities conducted during this reporting period and projected for the next reporting period (27 March 2010 to 30 April 2010) are summarized below.

PROJECT ACTIVITIES AND MEETINGS FOR REPORTING PERIOD

- Preparation and submittal of Draft Project Management Plan (PMP) and Draft Quality Assurance Surveillance Plan (QASP) on September 14, 2009.
- Project kickoff meeting for stakeholders at Fort Rucker, Alabama was held on September 22, 2009.
- Project kickoff meeting for Fort Rucker Installation Safety, Security, and Range Control personnel for investigation and munitions and explosives of concern (MEC) disposal activities at the Military Munitions Response Program sites at Fort Rucker, Alabama was held on October 21, 2009.
- Preparation and submittal of Draft Site-Wide Health and Safety Plan (HASP), Sampling and Analysis Plan (SAP), Quality Assurance Project Plan (QAPP), and Waste Management Plan (WMP) on October 23, 2009.
- Preparation and submittal of Final PMP on November 4, 2009.
- Preparation and submittal of Draft Explosives Site Plan (ESP) on November 6, 2009.
- Meeting to discuss and resolve Alabama Department of Environmental Management (ADEM) comments on the Area of Concern (AOC)–S Draft Final RCRA Facility Investigation (RFI) was held at ADEM office on November 11, 2009.
- Preparation and submittal of Final HASP, SAP, QAPP, and WMP on January 7, 2010.

- Additional meeting for Fort Rucker Installation Safety, Security, and Range Control personnel, Bill Woodall (COR), and Chris Cochrane of the Huntsville Ordnance and Explosives Design Center to discuss investigation and MEC disposal activities at the MMRP sites at Fort Rucker, Alabama was held on February 24, 2010.
- Preparation and submittal of Draft Technical Memorandum Work Plan to the Final RFI Work Plan for AOC–S on March 1, 2010.
- Preparation and submittal of Draft Final Technical Memorandum Work Plan to the Final RFI Work Plan for AOC-S on March 12, 2010.

PLANNED PROJECT ACTIVITIES AND MEETINGS FOR NEXT REPORTING PERIOD (27 MARCH 2010 – 30 APRIL 2010)

- Preparation and submittal of Final Technical Memorandum Work Plan to the Final RFI Work Plan for AOC-S.
- Prepare and submit Draft Final ESP.
- Obtain dig permit for installation of four additional monitoring wells at AOC-S.

PLANNED PROJECT ACTIVITIES AND MEETINGS FOR MAY 2010

- Preparation and submittal of Draft RFI Work Plan for the MMRP sites.
- Installation of four additional monitoring wells at AOC-S in accordance with the Final Technical Memorandum Work Plan to the Final RFI Work Plan for AOC-S, subject to USACE securing right of entry (ROE) for the McLin property.

TECHNICAL ISSUES ENCOUNTERED FOR REPORTING PERIOD

- CH2M HILL's approach for bringing commercial explosives on to Fort Rucker for the disposal of MEC encountered during the RFI at the MMRP sites is to utilize "just in time" delivery of only the amount of commercial explosives that will be utilized in one day. The explosives will be provided by a Department of Transportation (DOT) and Alabama CDL-licensed Hazardous Material transporter. The truck will follow the safe explosives truck route established at Fort Rucker and will proceed to the MEC disposal location. The truck will unload the commercial explosives and then exit the installation via the safe truck explosives route. This approach will not require temporary storage of explosives at Fort Rucker.

- James Bigam (Fort Rucker Installation Safety Office) disagrees with the above approach and is requiring that for CH2M HILL to bring commercial explosives on to Fort Rucker during the disposal of MEC encountered during the MMRP RFI, CH2M HILL has to do the following:

1. Transport and store commercial explosives at the Fort Rucker Ammunition Storage Point (ASP)
2. Once commercial explosives are stored at the ASP, CH2M HILL is to remove what is needed for one day and then temporarily store those explosives in a Golan unit staged near the MMRP sites.
3. CH2M HILL is to withdraw the needed amount of commercial explosives for the disposal of one MEC location from the temporary storage Golan.
4. In the event that commercial explosives are remaining at the temporary storage Golan, the remaining commercial explosives will need to be transported back to the ASP.
5. In addition to the temporary storage Golan, CH2M HILL is to set up a separate vehicle holding area and a separate holding area for the detonators.

CH2M HILL feels that Mr. Bigam's requirements are overly restrictive and complex and come from an incorrect interpretation of the regulations. It is our understanding that Fort Rucker will not allow storage of commercial explosives at the military ASP. CH2M HILL held a conference call on March 29, 2010 to discuss these issues. Attendees on the call included Chris Cochrane (Huntsville USACE), Walt Zange (Huntsville CX), Dave Becker (Huntsville CX), and Bill Woodall (Mobile USACE/COR). CH2M HILL stated their approach for commercial explosives at Fort Rucker as described above and summarized the Mr. Bigam's requirements. During the call, Mr. Zange and Mr. Becker agreed that the CH2M HILL approach utilizing "just in time" delivery of commercial explosives is a standard and appropriate procedure for bringing commercial explosives on to a military installation.

CH2M HILL intends to submit the Draft Final ESP containing the "just in time" delivery of commercial explosives to the Huntsville CX for review.

SCHEDULE

The revised project schedule is attached. Given that the Task Order for this project was not awarded until August 18, 2009; ADEM did not provide review comments on the Draft Final AOC-S RFI report until October 2009, and several meetings were needed to clarify and resolve their comments; and ADEM review for both AOC-S and MMRP site documents need to be revised to realistic durations, it appears that the achievement of the performance objective dates specified in the Performance Work Statement (PWS) cannot be meet. Based on the revised schedule, achievement of Remedy in Place (RIP) for AOC-S will be achieved on November 23, 2011 (Army/ADEM approval of Final AOC-S Corrective Measures Implementation Report) and not on February 28, 2011 as specified in the PWS and achievement of Record of Decision/Decision Documents (ROD/DD) for the MMRP sites will be achieved on June 19, 2012 (Army/ADEM acceptance of Final Statement of Basis) and not on September 30, 2011 as specified in the PWS.

Variance to Schedule

Performance Objective	Performance Objective Date (PWS)	Proposed Performance Objective Date	Increase in Days
Achieve RIP at AOC-S	February 28, 2011	November 23, 2011	268
Achieve ROD/DD for MMRP Sites	September 30, 2011	June 19, 2012	262

<u>SUMMARY OF PAYMENT MILESTONES COMPLETED TO DATE</u>

The summary of payment milestone completion is attached.

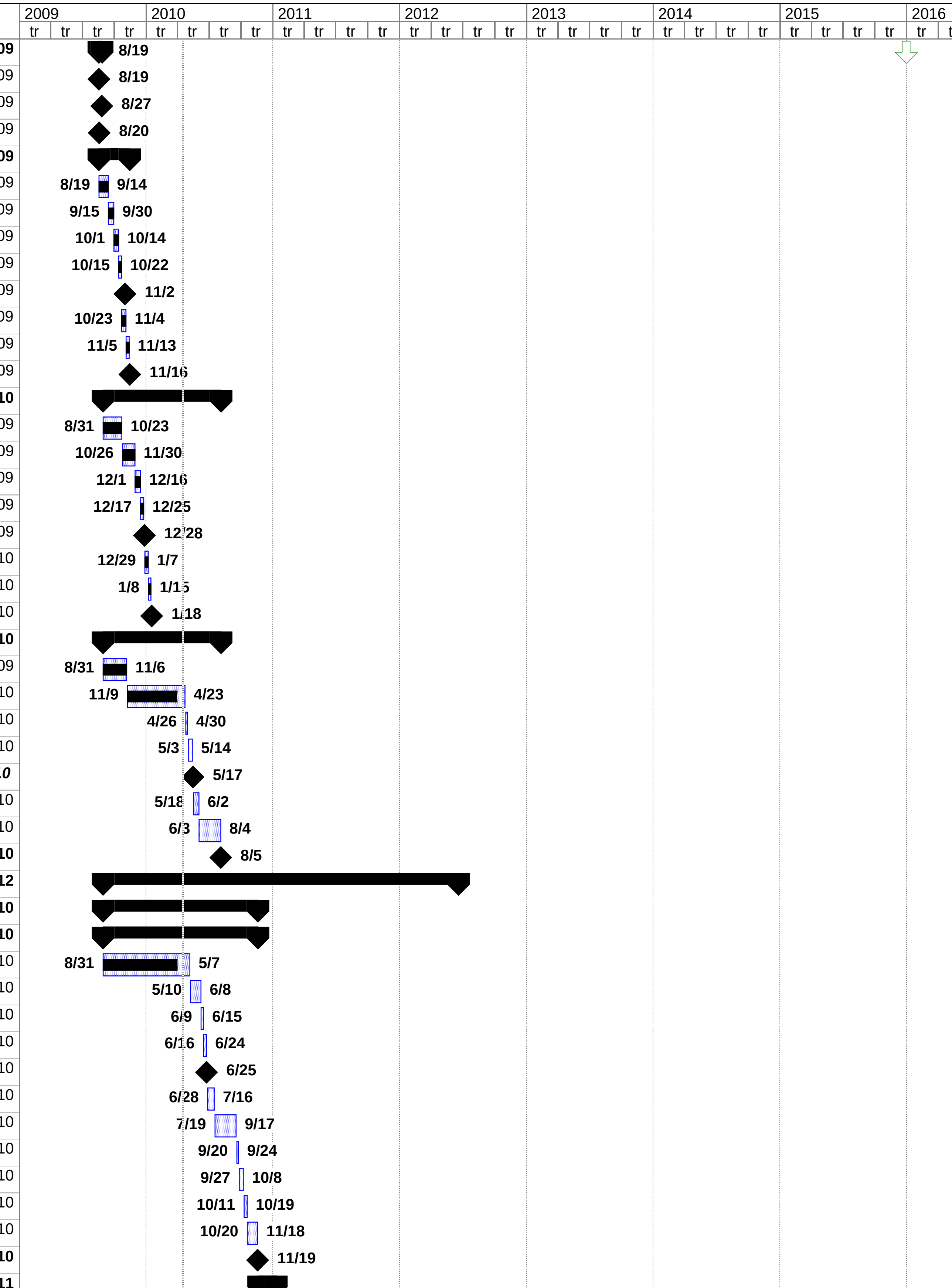
If you have any questions, please do not hesitate to contact me at (678) 938-0923.

Sincerely,

CH2M HILL

Mark Sherrill, P.G.
Project Manager

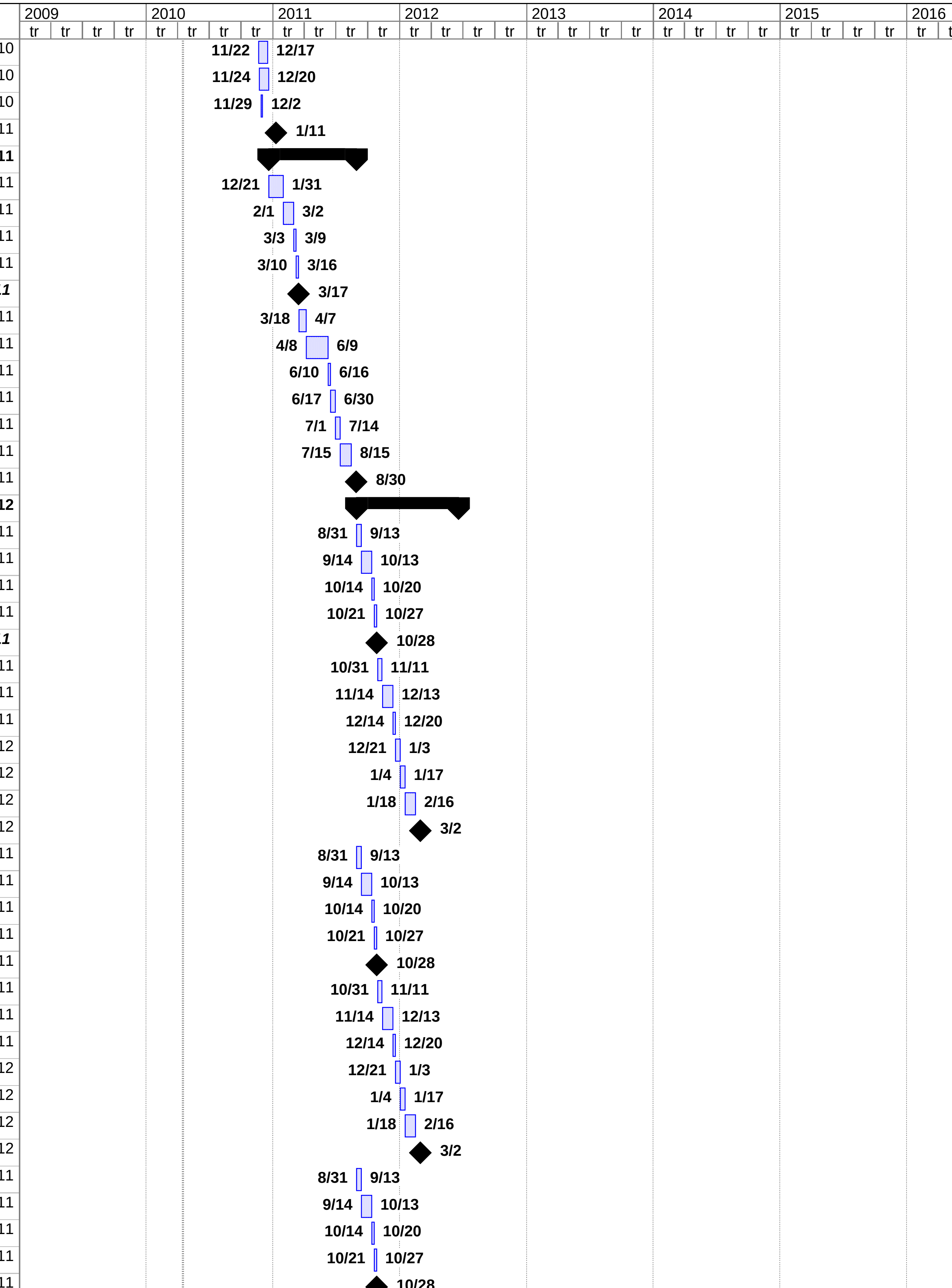
ID	ℹ	WBS	Task Name	Duration	Start	Finish
1	✓	**2004**	**ENVIRONMENTAL REMEDIATION SERVICES AT FT. RUCKER**	**7 days**	**Wed 8/19/09**	**Thu 8/27/09**
2	✓	2004A	Award Date	1 day	Wed 8/19/09	Wed 8/19/09
3	✓	2004B	Site Recon Visit	1 day	Thu 8/27/09	Thu 8/27/09
4	✓	2004C	Project Kick-Off Meeting	1 day	Thu 8/20/09	Thu 8/20/09
5	✓	**2004AA**	**PMP/QASP**	**63 days**	**Wed 8/19/09**	**Mon 11/16/09**
6	✓	2004AA1	Draft PMP/QASP Preparation and Submittal	19 days	Wed 8/19/09	Mon 9/14/09
7	✓	2004AA2	Army Review/Comments	12 days	Tue 9/15/09	Wed 9/30/09
8	✓	2004AA3	Prepare Response to Army Comments and Response Submittal	10 days	Thu 10/1/09	Wed 10/14/09
9	✓	2004AA4	Army Review/Acceptance of Response to Comments	6 days	Thu 10/15/09	Thu 10/22/09
10	✓	2004AA5	***Army Approval of Draft PMP/QASP***	0 days	Mon 11/2/09	Mon 11/2/09
11	✓	2004AA6	Final PMP Preparation and Submittal	9 days	Fri 10/23/09	Wed 11/4/09
12	✓	2004AA7	Army Review of Final PMP	7 days	Thu 11/5/09	Fri 11/13/09
13	✓	2004AA8	***Army Approval of Final PMP/QASP***	0 days	Mon 11/16/09	Mon 11/16/09
14		**2004BA**	**ADDITIONAL SITE-WIDE PLANS**	**244 days**	**Mon 8/31/09**	**Thu 8/5/10**
15	✓	2004BA1	Draft SSHP/SAP/WMP Preparation and Submittal	40 days	Mon 8/31/09	Fri 10/23/09
16	✓	2004BA2	Army Review/Comments	26 days	Mon 10/26/09	Mon 11/30/09
17	✓	2004BA3	Prepare Response to Army Comments and Response Submittal	12 days	Tue 12/1/09	Wed 12/16/09
18	✓	2004BA4	Army Review/Acceptance of Response to Comments	7 days	Thu 12/17/09	Fri 12/25/09
19	✓	2004BA5	***Army Approval of Draft SSHP/SAP//WMP***	1 day	Mon 12/28/09	Mon 12/28/09
20	✓	2004BA6	Final SSHP/SAP/WMP Preparation and Submittal	8 days	Tue 12/29/09	Thu 1/7/10
21	✓	2004BA7	Army Review of Final SSHP/SAP/WMP	6 days	Fri 1/8/10	Fri 1/15/10
22	✓	2004BA8	***Army Approval of Final SSHP/SAP/WMP***	1 day	Mon 1/18/10	Mon 1/18/10
23		**2004BA9**	**Explosives Site Plan (includes all MMRP Sites)**	**244 days**	**Mon 8/31/09**	**Thu 8/5/10**
24	✓	2004BA10	Draft Explosives Siting Plan Preparation and Submittal	50 days	Mon 8/31/09	Fri 11/6/09
25		2004BA11	Army Review/Comments	120 days	Mon 11/9/09	Fri 4/23/10
26		2004BA12	Prepare Response to Army Comments and Response Submittal	5 days	Mon 4/26/10	Fri 4/30/10
27		2004BA13	Army Review/Acceptance of Response to Comments	10 days	Mon 5/3/10	Fri 5/14/10
28		***2004BA14***	***Army Approval of Draft Explosives Siting Plan***	***1 day***	***Mon 5/17/10***	***Mon 5/17/10***
29		2004BA15	Final Explosives Siting Plan Preparation and Submittal	12 days	Tue 5/18/10	Wed 6/2/10
30		2004BA16	Army Review of Final Explosives Siting Plan	45 days	Thu 6/3/10	Wed 8/4/10
31		**2004BA17**	***Army Approval of Final Explosives Siting Plan***	**1 day**	**Thu 8/5/10**	**Thu 8/5/10**
32		**2004CA**	**MMRP SITES**	**732 days**	**Mon 8/31/09**	**Tue 6/19/12**
33		**2004CA1**	**RFI/CMS WORK PLAN**	**320 days**	**Mon 8/31/09**	**Fri 11/19/10**
34		**2004CA2**	**RFI/CMS Work Plan (includes all MMRP Sites)**	**320 days**	**Mon 8/31/09**	**Fri 11/19/10**
35		2004CA3	Draft RFI/CMS Work Plan Preparation and Submittal	180 days	Mon 8/31/09	Fri 5/7/10
36		2004CA4	Army Review/Comments	22 days	Mon 5/10/10	Tue 6/8/10
37		2004CA5	Prepare Response to Army Comments and Response Submittal	5 days	Wed 6/9/10	Tue 6/15/10
38		2004CA6	Army Review/Acceptance of Response to Comments	7 days	Wed 6/16/10	Thu 6/24/10
39		**2004CA7**	***Army Approval of Draft Final RFI/CMS Work Plan***	1 day	Fri 6/25/10	Fri 6/25/10
40		2004CA8	Draft Final RFI/CMS Work Plan Preparation and Submittal	15 days	Mon 6/28/10	Fri 7/16/10
41		2004CA9	ADEM/Army Review/Comments	45 days	Mon 7/19/10	Fri 9/17/10
42		2004CA10	Prepare Response to ADEM/Army Comments and Response Submittal	5 days	Mon 9/20/10	Fri 9/24/10
43		2004CA11	ADEM/Army Review/Acceptance of Response to Comments	10 days	Mon 9/27/10	Fri 10/8/10
44		2004CA12	Final RFI/CMS Work Plan Preparation and Submittal	7 days	Mon 10/11/10	Tue 10/19/10
45		2004CA13	ADEM/Army Review of Final RFI/CMS Work Plan	22 days	Wed 10/20/10	Thu 11/18/10
46		**2004CA14**	***Army/ADEM Approval of Final RFI/CMS Work Plan***	**1 day**	**Fri 11/19/10**	**Fri 11/19/10**
47		**2004CA15**	**RCRA FACILITY INVESTIGATION**	**37 days**	**Mon 11/22/10**	**Tue 1/11/11**



Project: FORT RUCKER PROJECT SC
Date: 04/07/2010

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

ID	WBS	Task Name	Duration	Start	Finish
48	2004CA16	DGM/Instrusive Investigation-Ant-Tank/Rocket Grenade Range	20 days	Mon 11/22/10	Fri 12/17/10
49	2004CA17	DGM/Intrusive Investigation - Infiltration/Grenade Range	19 days	Wed 11/24/10	Mon 12/20/10
50	2004CA18	DGM/Intrusive Investigation - .22-Caliber Target Butt	4 days	Mon 11/29/10	Thu 12/2/10
51	***2004CA19***	***Army Acceptance of Total LF of Geophysical Transects/Instrusive Inv. TM***	1 day	Tue 1/11/11	Tue 1/11/11
52	**2004CA20**	**RCRA FACILITY INVESTIGATION REPORT / CMS**	**181 days**	**Tue 12/21/10**	**Tue 8/30/11**
53	2004CA21	Draft RFI/CMS Report (includes all MMRP Sites) Preparation and Submittal	30 days	Tue 12/21/10	Mon 1/31/11
54	2004CA22	Army Review/Comments	22 days	Tue 2/1/11	Wed 3/2/11
55	2004CA23	Prepare Response to Army Comments and Response Submittal	5 days	Thu 3/3/11	Wed 3/9/11
56	2004CA24	Army Review/Acceptance of Response to Comments	5 days	Thu 3/10/11	Wed 3/16/11
57	***2004CA25***	***Army Approval of Draft Final RFI/CMS Report***	***1 day***	***Thu 3/17/11***	***Thu 3/17/11***
58	2004CA26	Draft Final RFI/CMS Report Preparation and Submittal	15 days	Fri 3/18/11	Thu 4/7/11
59	2004CA27	ADEM/Army Review/Comment	45 days	Fri 4/8/11	Thu 6/9/11
60	2004CA28	Response to ADEM/Army Comments and Response Submittal	5 days	Fri 6/10/11	Thu 6/16/11
61	2004CA29	ADEM/Army Review/Acceptance of Response to Comments	10 days	Fri 6/17/11	Thu 6/30/11
62	2004CA30	Final RFI/CMS Report Preparation and Submittal	10 days	Fri 7/1/11	Thu 7/14/11
63	2004CA31	ADEM/Army Review of Final RFI/CMS Report	22 days	Fri 7/15/11	Mon 8/15/11
64	**2004CA32**	***Army/ADEM Approval of Final RFI/CMS Report***	1 day	Tue 8/30/11	Tue 8/30/11
65	**2004CA33**	**STATEMENT OF BASIS**	**210 days**	**Wed 8/31/11**	**Tue 6/19/12**
66	2004CA34	Draft Statement of Basis - Anti-Tank/Rocket Grenade Range Prep and Submittal	10 days	Wed 8/31/11	Tue 9/13/11
67	2004CA35	Army Review/Comments	22 days	Wed 9/14/11	Thu 10/13/11
68	2004CA36	Prepare Response to Army Comments and Response Submitttal	5 days	Fri 10/14/11	Thu 10/20/11
69	2004CA37	Army Review/Acceptance of Response to Comments	5 days	Fri 10/21/11	Thu 10/27/11
70	*2004CA38*	Army Approval of Draft SB-Anti-Tank/Rocket Grenade Range	***1 day***	***Fri 10/28/11***	***Fri 10/28/11***
71	2004CA39	Draft Final Statement of Basis - Anti-Tank/Rocket Grenade Range Prep and Submittal	10 days	Mon 10/31/11	Fri 11/11/11
72	2004CA40	ADEM/Army Review/Comment	22 days	Mon 11/14/11	Tue 12/13/11
73	2004CA41	Response to ADEM/Army Comments and Response Submittal	5 days	Wed 12/14/11	Tue 12/20/11
74	2004CA42	ADEM/Army Review/Acceptance of Response to Comments	10 days	Wed 12/21/11	Tue 1/3/12
75	2004CA43	Final Statement of Basis - Anti-Tank/Rocket Grenade Range Prep and Submittal	10 days	Wed 1/4/12	Tue 1/17/12
76	2004CA44	ADEM/Army Review of Final Statement of Basis - Anti-Tank/Rocket Grenade Rg	22 days	Wed 1/18/12	Thu 2/16/12
77	**2004CA45**	***Army/ADEM Approval of Final SB-Anti-Tank/Rocket Grenade***	1 day	Fri 3/2/12	Fri 3/2/12
78	2004CA46	Draft Statement of Basis - Infiltration/Grenade Range Preparation and Submittal	10 days	Wed 8/31/11	Tue 9/13/11
79	2004CA47	Army Review/Comments	22 days	Wed 9/14/11	Thu 10/13/11
80	2004CA48	Prepare Response to Army Comments and Response Submittal	5 days	Fri 10/14/11	Thu 10/20/11
81	2004CA49	Army Review/Acceptance of Response to Comments	5 days	Fri 10/21/11	Thu 10/27/11
82	2004CA50	Army Approval of Draft SB-Infiltration/Grenade Range	1 day	Fri 10/28/11	Fri 10/28/11
83	2004CA51	Draft Final Statement of Basis - Infiltration/Grenade Range Prep and Submittal	10 days	Mon 10/31/11	Fri 11/11/11
84	2004CA52	ADEM/Army Review/Comments	22 days	Mon 11/14/11	Tue 12/13/11
85	2004CA53	Prepare Response to ADEM/Army Comments and Response Submittal	5 days	Wed 12/14/11	Tue 12/20/11
86	2004CA54	ADEM/Army Review/Acceptance of Response to Comments	10 days	Wed 12/21/11	Tue 1/3/12
87	2004CA55	Final Statement of Basis - Infiltration/ Grenade Range Prep and Submittal	10 days	Wed 1/4/12	Tue 1/17/12
88	2004CA56	ADEM/Army Review of Final Statement of Basis - Infiltration/Grenade Range	22 days	Wed 1/18/12	Thu 2/16/12
89	**2004CA57**	***Army/ADEM Approval of Final SB-Infiltration/Grenade Range***	1 day	Fri 3/2/12	Fri 3/2/12
90	2004CA658	Draft Statement of Basis - .22-Caliber Target Butt Preparation and Submittal	10 days	Wed 8/31/11	Tue 9/13/11
91	2004CA59	Army Review/Comments	22 days	Wed 9/14/11	Thu 10/13/11
92	2004CA60	Prepare Response to Army Comments and Response Submittal	5 days	Fri 10/14/11	Thu 10/20/11
93	2004CA61	Army Review/Acceptance of Response to Comments	5 days	Fri 10/21/11	Thu 10/27/11
94	2004CA62	Army Approval of Draft SB-.22-Caliber Target Butt	1 day	Fri 10/28/11	Fri 10/28/11



Project: FORT RUCKER PROJECT SC
Date: 04/07/2010

Task | Milestone | Rolled Up Task | Rolled Up Progress | External Tasks | Group By Summary
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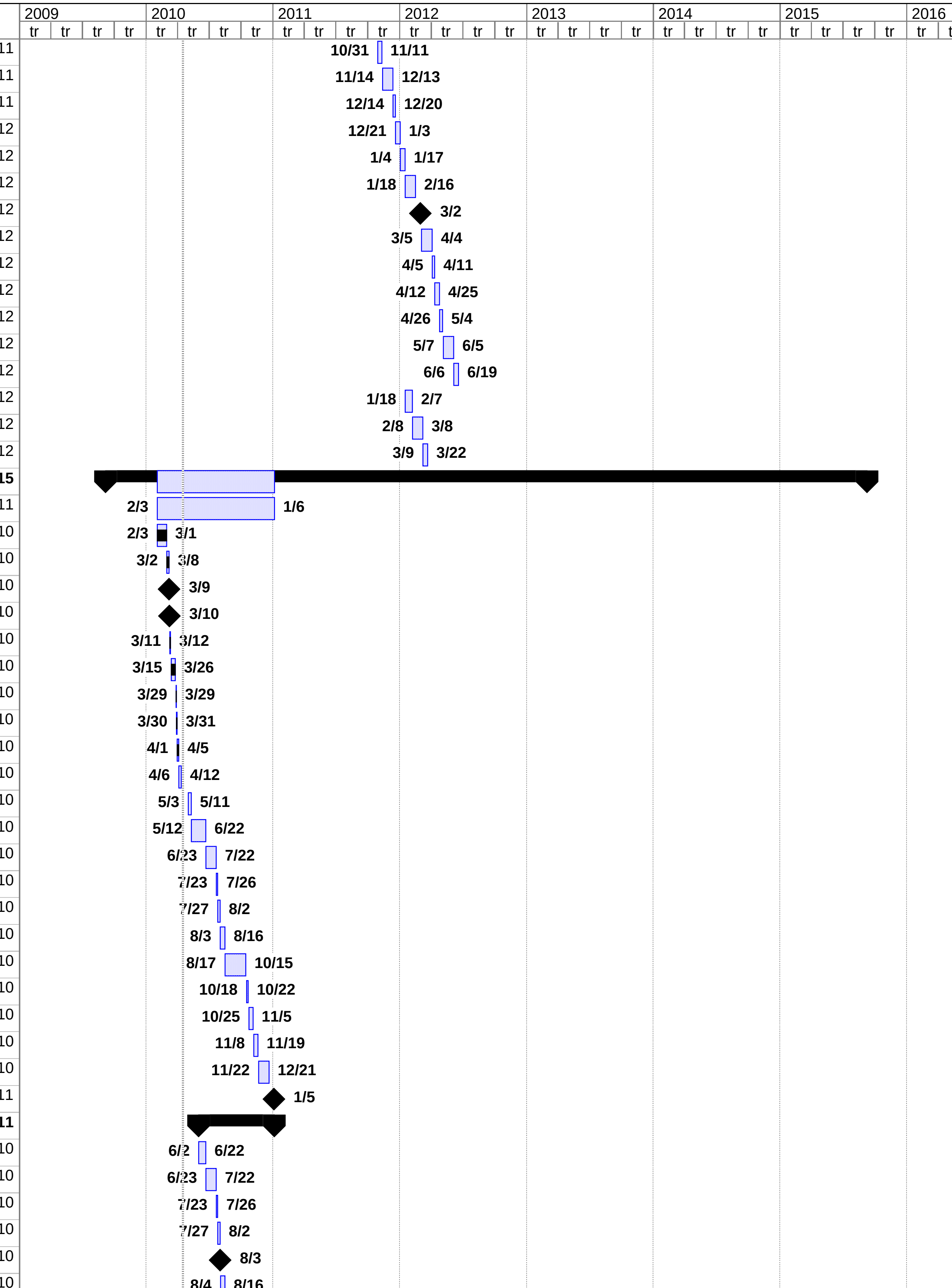
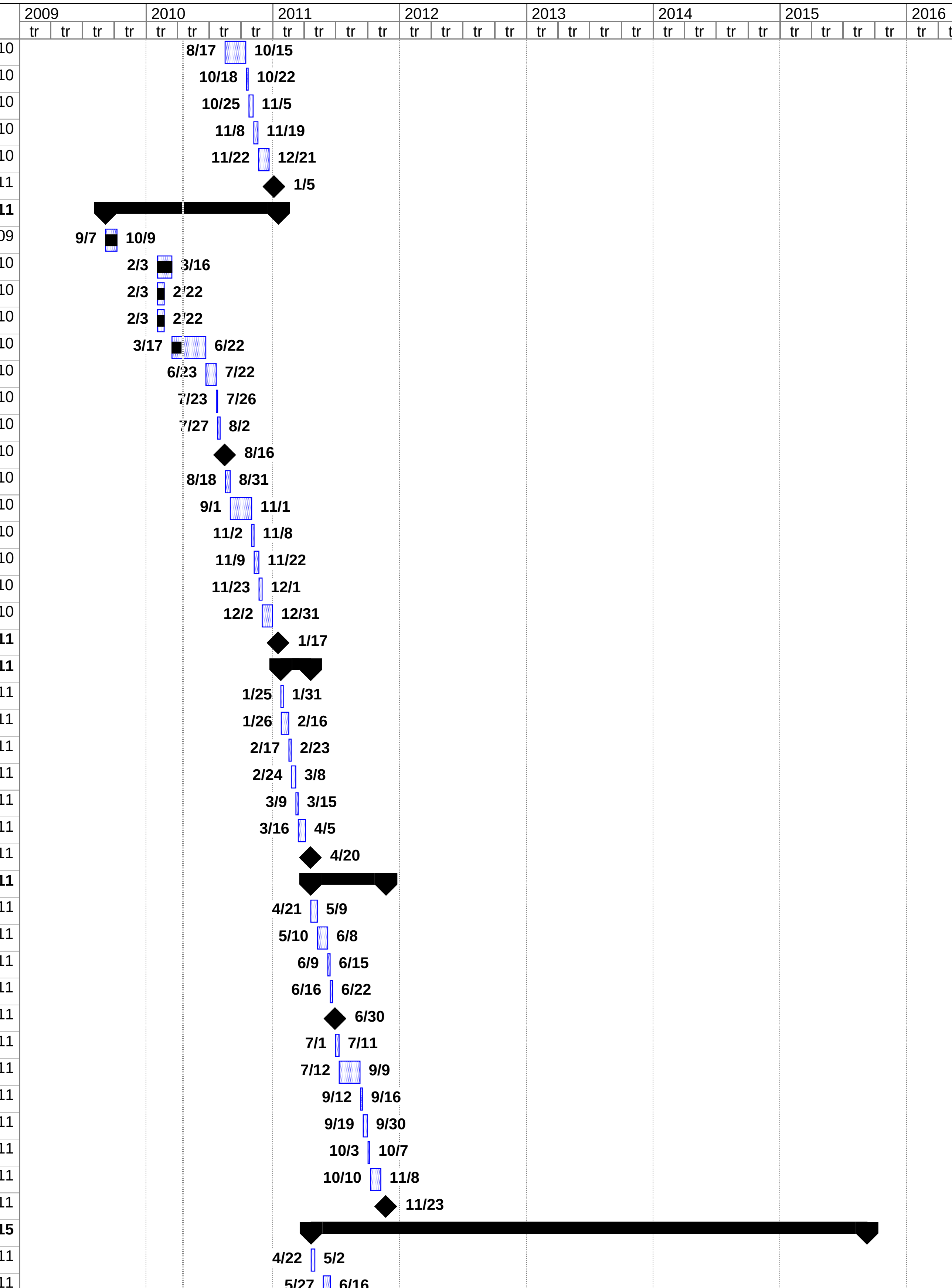
ID		WBS	Task Name	Duration	Start	Finish
95		2004CA63	Draft Final Statement of Basis - .22-Caliber Target Butt Prep and Submittal	10 days	Mon 10/31/11	Fri 11/11/11
96		2004CA64	ADEM/Army Review/Comment	22 days	Mon 11/14/11	Tue 12/13/11
97		2004CA65	Prepare Response to ADEM/Army Comments and Response Submittal	5 days	Wed 12/14/11	Tue 12/20/11
98		2004CA66	ADEM/Army Review/Acceptance of Response to Comments	10 days	Wed 12/21/11	Tue 1/3/12
99		2004CA67	Final Statement of Basis - .22-Caliber Target Butt Prep and Submittal	10 days	Wed 1/4/12	Tue 1/17/12
100		2004CA68	ADEM/Army Review of Final Statement of Basis - .22-Caliber Target Butt	22 days	Wed 1/18/12	Thu 2/16/12
101		**2004CA69**	***Army/ADEM Approval of Final SB-.22-Caliber Target Butt***	1 day	Fri 3/2/12	Fri 3/2/12
102		2004CA70	Public Comment Period (All MMRP Sites)	23 days	Mon 3/5/12	Wed 4/4/12
103		2004CA71	Prepare Response to Public Comments	5 days	Thu 4/5/12	Wed 4/11/12
104		2004CA72	Army/ADEM Review/Acceptance of Response to Public Comments	10 days	Thu 4/12/12	Wed 4/25/12
105		2004CA73	Revise Statement of Basis (If Needed Based on Public Comment)	7 days	Thu 4/26/12	Fri 5/4/12
106		2004CA74	ADEM/Army Review of Final Statement fo Basis	22 days	Mon 5/7/12	Tue 6/5/12
107		2004CA75	Final Statement of Basis - Acceptance of Ranges	10 days	Wed 6/6/12	Tue 6/19/12
108		2004CA76	Draft MMRP Scores Update and Submittal	15 days	Wed 1/18/12	Tue 2/7/12
109		2004CA77	Army Review/Comments	22 days	Wed 2/8/12	Thu 3/8/12
110		2004CA78	Final MMRP Scores Update and Submittal	10 days	Fri 3/9/12	Thu 3/22/12
111		**2004DA**	**IRP SITE AOC-S**	**1568 days?**	**Mon 9/7/09**	**Wed 9/9/15**
112		**2004DA1**	**FINAL RFI**	242 days	Wed 2/3/10	Thu 1/6/11
113	✓	2004DA2	Draft RFI Technical Memorandum Work Plan Preparation and Submittal	19 days	Wed 2/3/10	Mon 3/1/10
114	✓	2004DA3	Army Review/Comment	5 days	Tue 3/2/10	Mon 3/8/10
115	✓	2004DA4	Prepare Response to Army Comments and Submittal	1 day	Tue 3/9/10	Tue 3/9/10
116	✓	2004DA5	Army Review/Acceptance of Response to Comments	1 day	Wed 3/10/10	Wed 3/10/10
117	✓	2004DA6	Draft Final RFI Technical Memorandum Work Plan Preparation and Submittal	2 days	Thu 3/11/10	Fri 3/12/10
118	✓	2004DA7	ADEM/Army Review/Comment	10 days	Mon 3/15/10	Fri 3/26/10
119	✓	2004DA8	Prepare Response to ADEM/Army Comments and Response Submittal	1 day	Mon 3/29/10	Mon 3/29/10
120	✓	2004DA9	ADEM/Army Review/Acceptance of Response to Comments	2 days	Tue 3/30/10	Wed 3/31/10
121	✓	2004DA10	Final RFI Technical Memorandum Work Plan Preparation and Submittal	3 days	Thu 4/1/10	Mon 4/5/10
122		2004DA11	Army/ADEM Approval of Final RFI Technical Memorandum Work Plan	5 days	Tue 4/6/10	Mon 4/12/10
123		2004DA12	RFI Field Work-Well Installation/Sampling	7 days	Mon 5/3/10	Tue 5/11/10
124		2004DA13	Final (Draft) RFI Report Preparation and Submittal	30 days	Wed 5/12/10	Tue 6/22/10
125		2004DA14	Army Review/Comment	22 days	Wed 6/23/10	Thu 7/22/10
126		2004DA15	Prepare Response to Army Comments and Submittal	2 days	Fri 7/23/10	Mon 7/26/10
127		2004DA16	Army Review/Acceptance of Response to Comments	5 days	Tue 7/27/10	Mon 8/2/10
128		2004DA17	Final (Draft Final) RFI Report Preparation and Submittal	10 days	Tue 8/3/10	Mon 8/16/10
129		2004DA18	Army/ADEM Review/Comment	44 days	Tue 8/17/10	Fri 10/15/10
130		2004DA19	Prepare Response to ADEM/Army Comments and Response Submittal	5 days	Mon 10/18/10	Fri 10/22/10
131		2004DA20	ADEM/Army Review/Acceptance of Response to Comments	10 days	Mon 10/25/10	Fri 11/5/10
132		2004DA21	Final RFI Report Preparation and Submittal	10 days	Mon 11/8/10	Fri 11/19/10
133		2004DA22	ADEM/Army Review of Final RFI Report	22 days	Mon 11/22/10	Tue 12/21/10
134		**2004DA23**	***Army/ADEM Approval of Final RFI Report***	1 day	Wed 1/5/11	Wed 1/5/11
135		**2004DA24**	**ARBCA EVALUATION**	**156 days**	**Wed 6/2/10**	**Wed 1/5/11**
136		2004DA25	Draft AOC-S ARBCA Technical Memorandum Preparation and Submittal	15 days	Wed 6/2/10	Tue 6/22/10
137		2004DA26	Army Review/Comment	22 days	Wed 6/23/10	Thu 7/22/10
138		2004DA27	Prepare Response to Army Comments and Submittal	2 days	Fri 7/23/10	Mon 7/26/10
139		2004DA28	Army Review/Acceptance of Response to Comments	5 days	Tue 7/27/10	Mon 8/2/10
140		**2004DA29**	***Army Approval of Draft Final AOC-S ARBCA Technical Memorandum***	1 day	Tue 8/3/10	Tue 8/3/10
141		2004DA30	Draft Final AOC-S ARBCA Technical Memorandum Preparation and Submittal	9 days	Wed 8/4/10	Mon 8/16/10



Project: FORT RUCKER PROJECT SC
Date: 04/07/2010

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

ID		WBS	Task Name	Duration	Start	Finish
142		2004DA31	ADEM/Army Review/Comment	44 days	Tue 8/17/10	Fri 10/15/10
143		2004DA32	Prepare Response to ADEM/Army Comments and Submittal	5 days	Mon 10/18/10	Fri 10/22/10
144		2004DA33	ADEM/Army Review/Acceptance of Response to Comments	10 days	Mon 10/25/10	Fri 11/5/10
145		2004DA34	Final AOC-S ARBCA Technical Memorandum Preparation and Submittal	10 days	Mon 11/8/10	Fri 11/19/10
146		2004DA35	ADEM/Army Review of Final AOC-S ARBCA Technical Memorandum	22 days	Mon 11/22/10	Tue 12/21/10
147		**2004DA36**	***Army/ADEM Approval of Final AOC-S ARBCA Technical Memorandum***	1 day	Wed 1/5/11	Wed 1/5/11
148		**2004DA37**	**CMS/CMIP**	**356 days**	**Mon 9/7/09**	**Mon 1/17/11**
149	✓	2004DA38	Pre-Construction Survey	25 days	Mon 9/7/09	Fri 10/9/09
150	✓	2004DA39	PRB Remedial Design	30 days	Wed 2/3/10	Tue 3/16/10
151	✓	2004DA40	CMS	14 days	Wed 2/3/10	Mon 2/22/10
152	✓	2004DA41	LTM Plan	14 days	Wed 2/3/10	Mon 2/22/10
153		2004DA42	Draft CMS/CMIP Preparation and Submittal	70 days	Wed 3/17/10	Tue 6/22/10
154		2004DA43	Army Review/Comment	22 days	Wed 6/23/10	Thu 7/22/10
155		2004DA44	Prepare Response to Army Comments and Submittal	2 days	Fri 7/23/10	Mon 7/26/10
156		2004DA45	Army Review/Acceptance of Response to Comments	5 days	Tue 7/27/10	Mon 8/2/10
157		**2004DA46**	***Army Approval of Draft Final CMS/CMIP***	1 day	Mon 8/16/10	Mon 8/16/10
158		2004DA47	Draft Final CMS/CMIP Preparation and Submittal	10 days	Wed 8/18/10	Tue 8/31/10
159		2004DA48	ADEM/Army Review/Comment	44 days	Wed 9/1/10	Mon 11/1/10
160		2004DA49	Prepare Response to ADEM/Army Comments and Submittal	5 days	Tue 11/2/10	Mon 11/8/10
161		2004DA50	ADEM/Army Review/Acceptance of Response to Comments	10 days	Tue 11/9/10	Mon 11/22/10
162		2004DA51	Final CMS/CMIP Preparation and Submittal	7 days	Tue 11/23/10	Wed 12/1/10
163		2004DA52	ADEM/Army Review of Final CMS/CMIP	22 days	Thu 12/2/10	Fri 12/31/10
164		**2004DA53**	***Army/ADEM Approval of Final CMS/CMIP***	**1 day**	**Mon 1/17/11**	**Mon 1/17/11**
165		**2004DA54**	**CMI**	**62 days**	**Tue 1/25/11**	**Wed 4/20/11**
166		2004DA55	Site Preparation Mobilization	5 days	Tue 1/25/11	Mon 1/31/11
167		2004DA56	Site Preparation (clearing, work platform)	16 days	Wed 1/26/11	Wed 2/16/11
168		2004DA57	PRB Mobilization	5 days	Thu 2/17/11	Wed 2/23/11
169		2004DA58	PRB Installation	9 days	Thu 2/24/11	Tue 3/8/11
170		2004DA59	PRB Monitoring Well Network Installation	5 days	Wed 3/9/11	Tue 3/15/11
171		2004DA60	Post-Construction Survey	15 days	Wed 3/16/11	Tue 4/5/11
172		***2004DA61***	***Army Acceptance of Installation of ZVI/Sand TM***	1 day	Wed 4/20/11	Wed 4/20/11
173		**2004DA62**	**CMI Report**	**155 days**	**Thu 4/21/11**	**Wed 11/23/11**
174		2004DA63	Draft AOC-S CMI Report Preparation and Submittal	13 days	Thu 4/21/11	Mon 5/9/11
175		2004DA64	Army Review/Comment	22 days	Tue 5/10/11	Wed 6/8/11
176		2004DA65	Prepare Response to Army Comments and Submittal	5 days	Thu 6/9/11	Wed 6/15/11
177		2004DA66	Army Review/Acceptance of Response to Comments	5 days	Thu 6/16/11	Wed 6/22/11
178		**2004DA67**	***Army Approval of Draft Final AOC-S CMI Report***	1 day	Thu 6/30/11	Thu 6/30/11
179		2004DA68	Draft Final AOC-S CMI Report Preparation and Submittal	7 days	Fri 7/1/11	Mon 7/11/11
180		2004DA69	ADEM/Army Review/Comment	44 days	Tue 7/12/11	Fri 9/9/11
181		2004DA70	Prepare Response to ADEM/Army Comments and Submittal	5 days	Mon 9/12/11	Fri 9/16/11
182		2004DA71	ADEM/Army Review/Acceptance of Response to Comments	10 days	Mon 9/19/11	Fri 9/30/11
183		2004DA72	Final AOC-S CMI Report Preparation and Submittal	5 days	Mon 10/3/11	Fri 10/7/11
184		2004DA73	ADEM/Army Review of Final AOC-S CMI Report	22 days	Mon 10/10/11	Tue 11/8/11
185		**2004DA74**	***Army/ADEM Approval of Final AOC-S CMI Report***	1 day	Wed 11/23/11	Wed 11/23/11
186		**2004DB**	**LTM**	**1144 days?**	**Fri 4/22/11**	**Wed 9/9/15**
187		2004DB1	AOC-S LTM Q1 (2011) Monitoring Event	7 days	Fri 4/22/11	Mon 5/2/11
188		2004DB2	AOC-S LTM Q1 (2011) LTM Draft Report Preparation and Submittal	15 days	Fri 5/27/11	Thu 6/16/11



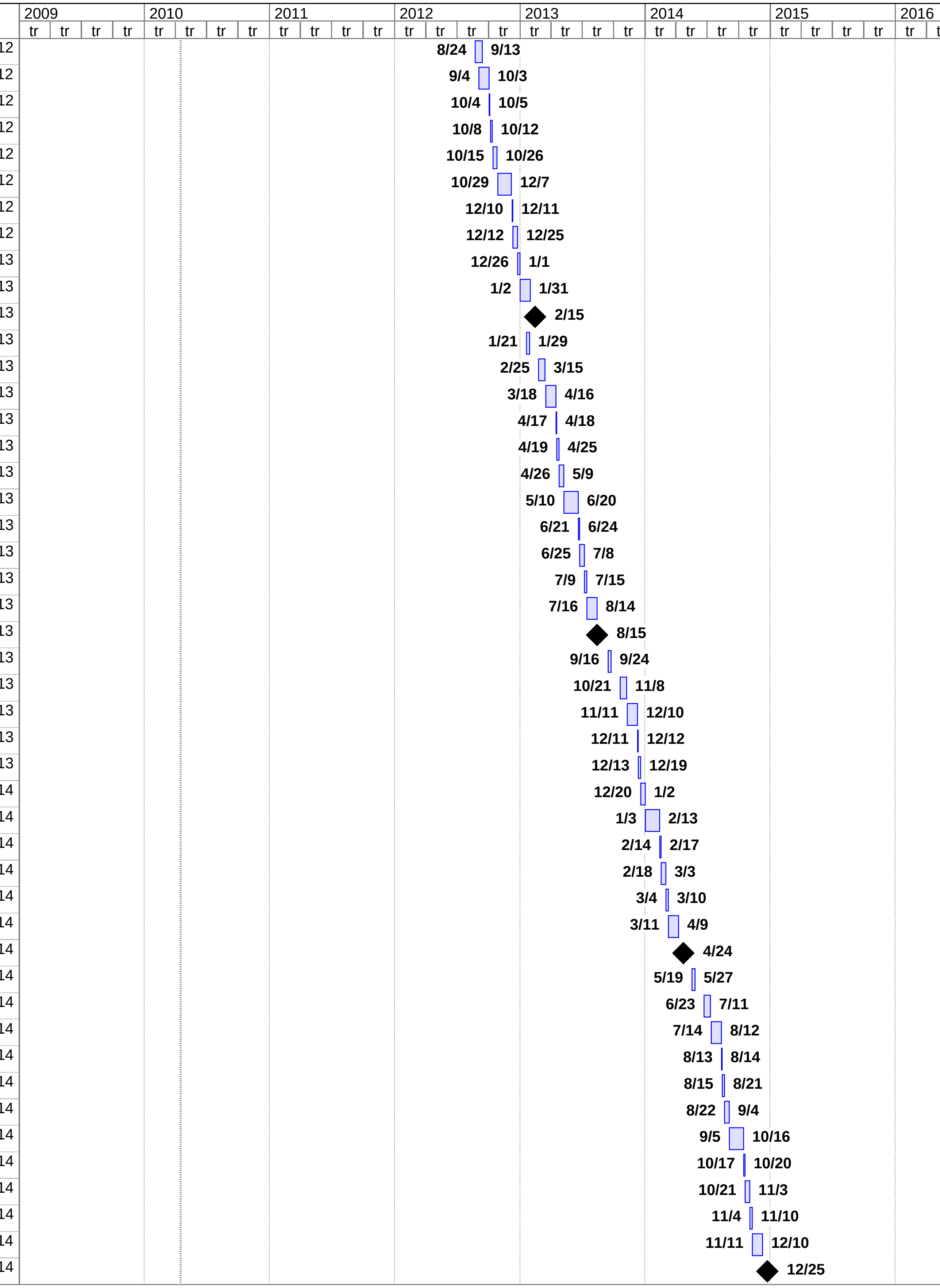
Project: FORT RUCKER PROJECT SC Date: 04/07/2010	Task	Milestone	Rolled Up Task	Rolled Up Progress	External Tasks	Group By Summary
	Progress	Summary	Rolled Up Milestone	Split	Project Summary	Deadline

ID		WBS	Task Name	Duration	Start	Finish
189		2044DB3	Army Review/Comment	22 days	Fri 6/17/11	Mon 7/18/11
190		2044DB4	Prepare Response to Army Comments and Submittal	2 days	Tue 7/19/11	Wed 7/20/11
191		2004DB5	Army Review/Acceptance of Response to Comments	5 days	Thu 7/21/11	Wed 7/27/11
192		2004DB6	AOC-S LTM Q1 (2011) LTM Draft Final Report Preparation and Submittal	10 days	Thu 7/28/11	Wed 8/10/11
193		2004DB7	ADEM/Army Review/Comment	30 days	Thu 8/11/11	Wed 9/21/11
194		2004DB8	Prepare Response to ADEM/Army Comments and Submittal	2 days	Thu 9/22/11	Fri 9/23/11
195		2004DB9	ADEM/Army Review/Acceptance of Response to Comments	10 days	Mon 9/26/11	Fri 10/7/11
196		2004DB10	AOC-S LTM Q1 (2011) LTM Final Report Preparation and Submittal	5 days	Mon 10/10/11	Fri 10/14/11
197		2004DB11	ADEM/Army Review of AOC-S LTM Q1 (2011) Final Report	22 days	Mon 10/17/11	Tue 11/15/11
198		**2004DB12**	***Army/ADEM Approval of AOC-S LTM Q1 (2012) LTM Final Report***	1 day	Wed 11/30/11	Wed 11/30/11
199		2004DB13	AOC-S LTM Q2 (2011) Monitoring Event	7 days	Fri 7/22/11	Mon 8/1/11
200		2004DB14	AOC-S LTM Q2 (2011) LTM Draft Report Preparation and Submittal	15 days	Fri 8/26/11	Thu 9/15/11
201		2004DB15	Army Review/Comment	22 days	Fri 9/16/11	Mon 10/17/11
202		2004DB16	Prepare Response to Army Comments and Submittal	2 days	Tue 10/18/11	Wed 10/19/11
203		2004DB17	Army Review/Acceptance of Response to Comments	5 days	Thu 10/20/11	Wed 10/26/11
204		2004DB18	AOC-S LTM Q2 (2011) LTM Draft Final Report Preparation and Submittal	10 days	Thu 10/27/11	Wed 11/9/11
205		2004DB19	ADEM/Army Review/Comment	30 days	Thu 11/10/11	Wed 12/21/11
206		2004DB20	Prepare Response to ADEM/Army Comments and Submittal	2 days	Thu 12/22/11	Fri 12/23/11
207		2004DB21	ADEM/Army Review/Acceptance of Response to Comments	10 days	Mon 12/26/11	Fri 1/6/12
208		2004DB22	AOC-S LTM Q2 (2011) LTM Final Report Preparation and Submittal	5 days	Mon 1/9/12	Fri 1/13/12
209		2004DB23	ADEM/Army Review of AOC-S LTM Q2 (2011) LTM Final Report	22 days	Mon 1/16/12	Tue 2/14/12
210		**2004DB24**	***Army/ADEM Approval of AOC-S LTM Q2 (2011) LTM Final Report***	1 day	Wed 2/29/12	Wed 2/29/12
211		2004DB25	AOC-S LTM Q3 (2011) Monitoring Event	7 days	Fri 10/21/11	Mon 10/31/11
212		2004DB26	AOC-S LTM Q3 (2011) LTM Draft Report Preparation and Submittal	15 days	Fri 11/25/11	Thu 12/15/11
213		2004DB27	Army Review/Comment	22 days	Fri 12/16/11	Mon 1/16/12
214		2004DB28	Prepare Response to Army Comments and Submittal	2 days	Tue 1/17/12	Wed 1/18/12
215		2004DB29	Army Review/Acceptance of Response to Comments	5 days	Thu 1/19/12	Wed 1/25/12
216		2004DB30	AOC-S LTM Q3 (2011) LTM Draft Final Report Preparation and Submittal	10 days	Thu 1/26/12	Wed 2/8/12
217		2004DB31	ADEM/Army Review/Comment	30 days	Thu 2/9/12	Wed 3/21/12
218		2004DB32	Prepare Response to ADEM/Army Comments and Submittal	2 days	Thu 3/22/12	Fri 3/23/12
219		2004DB33	ADEM/Army Review/Acceptance of Response to Comments	10 days	Mon 3/26/12	Fri 4/6/12
220		2004DB34	AOC-S LTM Q3 (2011) LTM Final Report Preparation and Submittal	5 days	Mon 4/9/12	Fri 4/13/12
221		2004DB35	ADEM/Army Review of AOC-S LTM Q3 (2011) LTM Final Report	22 days	Mon 4/16/12	Tue 5/15/12
222		**2004DB36**	***Army/ADEM Approval of AOC-S LTM Q3 (2011) LTM Final Report***	**1 day**	**Wed 5/30/12**	**Wed 5/30/12**
223		2004DB37	AOC-S LTM Q4 (2012) Monitoring Event	7 days	Fri 1/20/12	Mon 1/30/12
224		2004DB38	AOC-S LTM Q4 (2012) LTM Draft Report Preparation and Submittal	15 days	Fri 2/24/12	Thu 3/15/12
225		2004DB39	Army Review/Comment	22 days	Fri 3/16/12	Mon 4/16/12
226		2004DB40	Prepare Response to Army Comments and Submittal	2 days	Tue 4/17/12	Wed 4/18/12
227		2004DB41	Army Review/Acceptance of Response to Comments	5 days	Thu 4/19/12	Wed 4/25/12
228		2004DB42	AOC-S LTM Q4 (2012) LTM Draft Final Report Preparation and Submittal	10 days	Thu 4/26/12	Wed 5/9/12
229		2004DB43	ADEM/Army Review/Comment	30 days	Thu 5/10/12	Wed 6/20/12
230		2004DB44	Prepare Response to ADEM/Army Comments and Submittal	5 days	Thu 6/21/12	Wed 6/27/12
231		2004DB45	ADEM/Army Review/Acceptance of Response to Comments	10 days	Thu 6/28/12	Wed 7/11/12
232		2004DB446	AOC-S LTM Q4 (2012) LTM Final Report Preparation and Submittal	5 days	Thu 7/12/12	Wed 7/18/12
233		2004DB47	ADEM/Army Review of AOC-S LTM Q4 (2012) LTM Final Report	22 days	Thu 7/19/12	Fri 8/17/12
234		**2004DB48**	***Army/ADEM Approval of AOC-S LTM Q4 (2012) LTM Final Report***	1 day	Mon 9/3/12	Mon 9/3/12
235		2004DC1	AOC-S LTM SA1 (2012) Monitoring Event	7 days	Fri 7/20/12	Mon 7/30/12

Project: FORT RUCKER PROJECT SC
Date: 04/07/2010

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

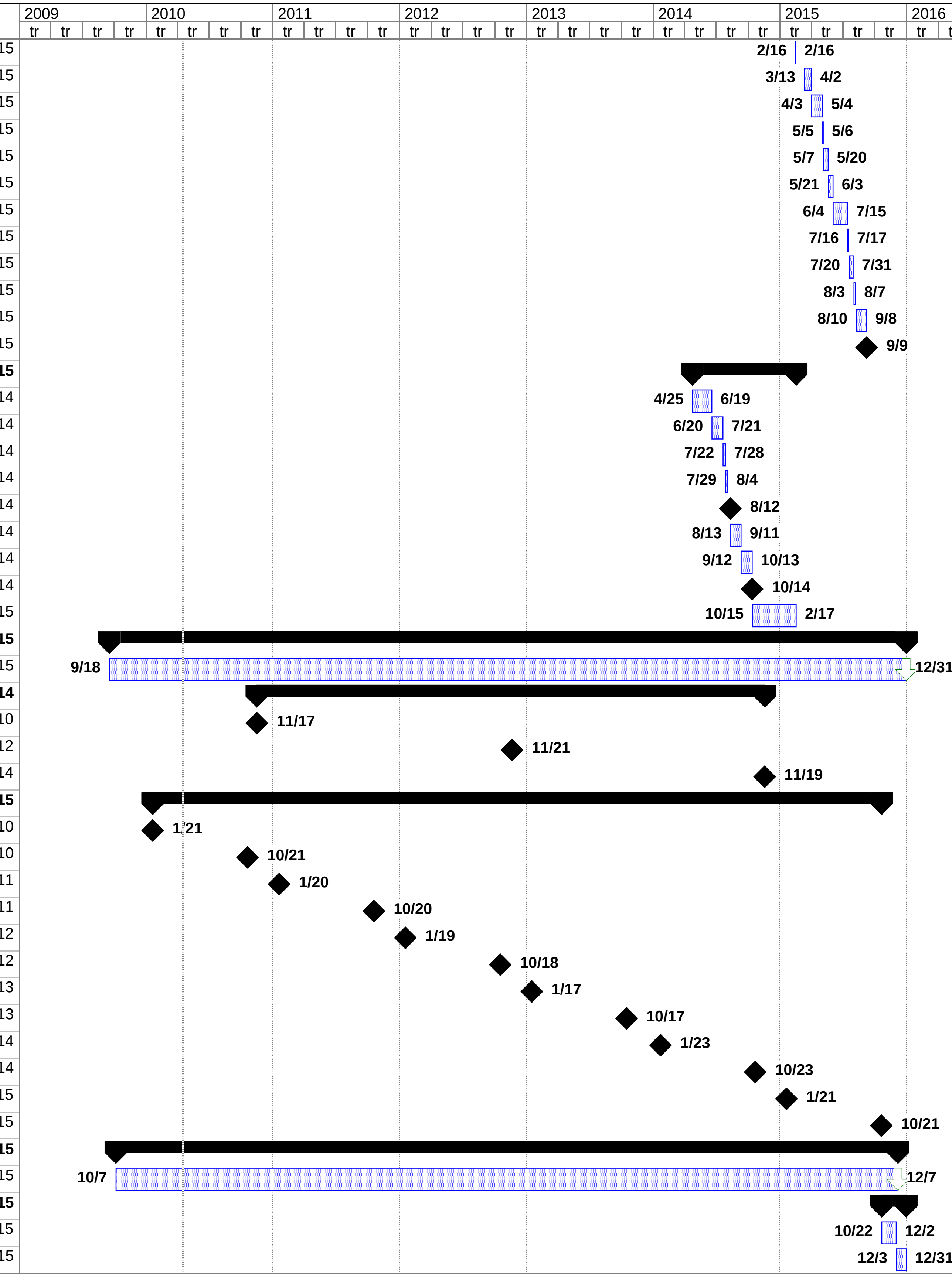
ID		WBS	Task Name	Duration	Start	Finish
236		2004DC2	AOC-S LTM SA1 (2012) LTM Draft Report Preparation and Submittal	15 days	Fri 8/24/12	Thu 9/13/12
237		2004DC3	Army Review/Comment	22 days	Tue 9/4/12	Wed 10/3/12
238		2004DC4	Prepare Response to Army Comments and Submittal	2 days	Thu 10/4/12	Fri 10/5/12
239		2004DC5	Army Review/Acceptance of Response to Comments	5 days	Mon 10/8/12	Fri 10/12/12
240		2004DC6	AOC-S LTM SA1 (2012) LTM Draft Final Report Preparation and Submittal	10 days	Mon 10/15/12	Fri 10/26/12
241		2004DC7	ADEM/Army Review/Comment	30 days	Mon 10/29/12	Fri 12/7/12
242		2004DC8	Prepare Response to ADEM/Army Comments and Submittal	2 days	Mon 12/10/12	Tue 12/11/12
243		2004DC9	ADEM/Army Review/Acceptance of Response to Comments	10 days	Wed 12/12/12	Tue 12/25/12
244		2004DC10	AOC-S LTM SA1 (2012) LTM Final Report Preparation and Submittal	5 days	Wed 12/26/12	Tue 1/1/13
245		2004DC11	ADEM/Army Review of AOC-S LTM SA1 (2012) LTM Final Report	22 days	Wed 1/2/13	Thu 1/31/13
246		**2004DC12**	***Army/ADEM Approval of AOC-S LTM SA1 (2012) LTM Final Report***	1 day	Fri 2/15/13	Fri 2/15/13
247		2004DC13	AOC-S LTM SA2 (2013) Monitoring Event	7 days	Mon 1/21/13	Tue 1/29/13
248		2004DC14	AOC-S LTM SA2 (2013) LTM Draft Report Preparation and Submittal	15 days	Mon 2/25/13	Fri 3/15/13
249		2004DC15	Army Review/Comment	22 days	Mon 3/18/13	Tue 4/16/13
250		2004DC16	Prepare Response to Army Comments and Submittal	2 days	Wed 4/17/13	Thu 4/18/13
251		2004DC17	Army Review/Acceptance of Response to Comments	5 days	Fri 4/19/13	Thu 4/25/13
252		2004DC18	AOC-S LTM SA2 (2013) LTM Draft Final Report Preparation and Submittal	10 days	Fri 4/26/13	Thu 5/9/13
253		2004DC19	ADEM/Army Review/Comment	30 days	Fri 5/10/13	Thu 6/20/13
254		2004DC20	Prepare Response to ADEM/Army Comments and Submittal	2 days	Fri 6/21/13	Mon 6/24/13
255		2004DC21	ADEM/Army Review/Acceptance of Response to Comments	10 days	Tue 6/25/13	Mon 7/8/13
256		2004DC22	AOC-S LTM SA2 (2013) LTM Final Report Preparation and Submittal	5 days	Tue 7/9/13	Mon 7/15/13
257		2004DC23	ADEM/Army Review of AOC-S LTM SA2 (2013) LTM Final Report	22 days	Tue 7/16/13	Wed 8/14/13
258		**2004DC24**	***Army/ADEM Approval of AOC-S LTM SA2 (2013) LTM Final Report***	10 days	Thu 8/15/13	Wed 8/28/13
259		2004DD1	AOC-S LTM A1 (2013) Monitoring Event	7 days	Mon 9/16/13	Tue 9/24/13
260		2004DD2	AOC-S LTM A1 (2013) LTM Draft Report Preparation and Submittal	15 days	Mon 10/21/13	Fri 11/8/13
261		2004DD3	Army Review/Comment	22 days	Mon 11/11/13	Tue 12/10/13
262		2004DD4	Prepare Response to Army Comments and Submittal	2 days	Wed 12/11/13	Thu 12/12/13
263		2004DD5	Army Review/Acceptance of Response to Comments	5 days	Fri 12/13/13	Thu 12/19/13
264		2004DD6	AOC-S LTM A1 (2013) LTM Draft Final Report Preparation and Submittal	10 days	Fri 12/20/13	Thu 1/2/14
265		2004DD7	ADEM/Army Review/Comment	30 days	Fri 1/3/14	Thu 2/13/14
266		2004DD8	Prepare Response to ADEM/Army Comments and Submittal	2 days	Fri 2/14/14	Mon 2/17/14
267		2004DD9	ADEM/Army Review/Acceptance of Response to Comments	10 days	Tue 2/18/14	Mon 3/3/14
268		2004DD10	AOC-S LTM A1 (2013) LTM Final Report Preparation and Submittal	5 days	Tue 3/4/14	Mon 3/10/14
269		2004DD11	ADEM/Army Review of AOC-S LTM A1 (2013) LTM Final Report	22 days	Tue 3/11/14	Wed 4/9/14
270		**2004DD12**	***Army/ADEM Approval of AOC-S LTM A1 (2013) LTM Final Report***	1 day	Thu 4/24/14	Thu 4/24/14
271		2004DE1	AOC-S LTM A2 (2014) Monitoring Event	7 days	Mon 5/19/14	Tue 5/27/14
272		2004DE2	AOC-S LTM A2 (2014) LTM Draft Report Preparation and Submittal	15 days	Mon 6/23/14	Fri 7/11/14
273		2004DE3	Army Review/Comment	22 days	Mon 7/14/14	Tue 8/12/14
274		2004DE4	Prepare Response to Army Comments and Submittal	2 days	Wed 8/13/14	Thu 8/14/14
275		2004DE5	Army Review/Acceptance of Response to Comments	5 days	Fri 8/15/14	Thu 8/21/14
276		2004DE6	AOC-S LTM A2 (2014) LTM Draft Final Report Preparation and Submittal	10 days	Fri 8/22/14	Thu 9/4/14
277		2004DE7	ADEM/Army Review/Comment	30 days	Fri 9/5/14	Thu 10/16/14
278		2004DE8	Prepare Response to ADEM/Army Comments and Submittal	2 days	Fri 10/17/14	Mon 10/20/14
279		2004DE9	ADEM/Army Review/Acceptance of Response to Comments	10 days	Tue 10/21/14	Mon 11/3/14
280		2004DE10	AOC-S LTM A2 (2014) LTM Final Report Preparation and Submittal	5 days	Tue 11/4/14	Mon 11/10/14
281		2004DE11	ADEM/Army Review of AOC-S LTM A2 (2014) LTM Final Report	22 days	Tue 11/11/14	Wed 12/10/14
282		**2004DE12**	***Army/ADEM Approval of AOC-S LTM A2 (2014) LTM Final Report***	1 day	Thu 12/25/14	Thu 12/25/14



Project: FORT RUCKER PROJECT SC
Date: 04/07/2010

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

ID		WBS	Task Name	Duration	Start	Finish
283		2004DF1	AOC-S LTM A3 (2015) Monitoring Event	1 day?	Mon 2/16/15	Mon 2/16/15
284		2004DF2	AOC-S LTM A3 (2015) LTM Draft Report Preparation and Submittal	15 days	Fri 3/13/15	Thu 4/2/15
285		2004DF3	Army Review/Comment	22 days	Fri 4/3/15	Mon 5/4/15
286		2004DF4	Prepare Respnse to Army Comments and Submittal	2 days	Tue 5/5/15	Wed 5/6/15
287		2004DF5	Army Review/Acceptance of Response to Comments	10 days	Thu 5/7/15	Wed 5/20/15
288		2004DF6	AOC-S LTM A3 (2015) LTM Draft Final Report Preparation and Submittal	10 days	Thu 5/21/15	Wed 6/3/15
289		2004DF7	ADEM/Army Review/Comment	30 days	Thu 6/4/15	Wed 7/15/15
290		2004DF8	Prepare Response to ADEM/Army Comments and Submittal	2 days	Thu 7/16/15	Fri 7/17/15
291		2004DF9	ADEM/Army Review/Acceptance of Response to Commetns	10 days	Mon 7/20/15	Fri 7/31/15
292		2004DF10	AOC-S LTM A3 (2015) LTM Final Report Preparation and Submittal	5 days	Mon 8/3/15	Fri 8/7/15
293		2004DF11	ADEM/Army Review of AOC-S LTM A3 (2015) LTM Final Report	22 days	Mon 8/10/15	Tue 9/8/15
294		**2004DF12**	**Army/ADEM Approval of AOC-S LTM A3 (2015) LTM Final Report**	1 day	Wed 9/9/15	Wed 9/9/15
295		**2004DH**	**REMEDY REVIEW**	**213 days**	**Fri 4/25/14**	**Tue 2/17/15**
296		2004DH1	Preparation of Remedy Review Draft Document and Submittal	40 days	Fri 4/25/14	Thu 6/19/14
297		2004DH2	Army Review/Comment	22 days	Fri 6/20/14	Mon 7/21/14
298		2004DH3	Prepare Response to Army Comments and Submittal	5 days	Tue 7/22/14	Mon 7/28/14
299		2004DH4	Army Review/Acceptance of Response to Comments	5 days	Tue 7/29/14	Mon 8/4/14
300		**2004DH5**	***Remedy Review Draft Final Report Acceptance***	1 day	Tue 8/12/14	Tue 8/12/14
301		2004DH6	Remedy Review Final Report Preparation and Submittal	22 days	Wed 8/13/14	Thu 9/11/14
302		2004DH7	Army/ADEM Review of Remedy Review Final Report	22 days	Fri 9/12/14	Mon 10/13/14
303		**2004DH8**	***Remedy Review Final Report Acceptance***	1 day	Tue 10/14/14	Tue 10/14/14
304		2004DH8	Successful Correction of Deficiencies Noted in Remedy Review	90 days	Wed 10/15/14	Tue 2/17/15
305		**2004DI**	**PROJECT REPOSITORY/ADMINISTRATIVE RECORD**	**1640 days**	**Fri 9/18/09**	**Thu 12/31/15**
306		2004DI1	PROJECT REPOSITORY/ADMINISTRATIVE RECORD	1640 days	Fri 9/18/09	Thu 12/31/15
307		**2004DJ**	**BIANNUAL PUBLIC INTEREST ASSESSMENT**	**1046 days**	**Wed 11/17/10**	**Wed 11/19/14**
308		2004DJ1	August 2010	1 day	Wed 11/17/10	Wed 11/17/10
309		2004DJ2	August 2012	1 day	Wed 11/21/12	Wed 11/21/12
310		2004DJ3	August 2014	1 day	Wed 11/19/14	Wed 11/19/14
311		**2004DK**	**STAKEHOLDER PRESENTATIONS**	**1500 days**	**Thu 1/21/10**	**Wed 10/21/15**
312		2004DK1	January 2010	1 day	Thu 1/21/10	Thu 1/21/10
313		2004DK2	October 2010	1 day	Thu 10/21/10	Thu 10/21/10
314		2004DK3	January 2011	1 day	Thu 1/20/11	Thu 1/20/11
315		2004DK4	October 2011	1 day	Thu 10/20/11	Thu 10/20/11
316		2004DK5	January 2012	1 day	Thu 1/19/12	Thu 1/19/12
317		2004DK6	October 2012	1 day	Thu 10/18/12	Thu 10/18/12
318		2004DK7	January 2013	1 day	Thu 1/17/13	Thu 1/17/13
319		2004DK8	October 2013	1 day	Thu 10/17/13	Thu 10/17/13
320		2004DK9	January 2014	1 day	Thu 1/23/14	Thu 1/23/14
321		2004DK10	October 2014	1 day	Thu 10/23/14	Thu 10/23/14
322		2004DK11	January 2015	1 day	Wed 1/21/15	Wed 1/21/15
323		2004DK12	October 2015	1 day	Wed 10/21/15	Wed 10/21/15
324		**2004DL**	**STATUS REPORTS (MONTHLY)**	**1609 days**	**Wed 10/7/09**	**Mon 12/7/15**
325		2004DL1	STATUS REPORTS (MONTHLY)	1609 days	Wed 10/7/09	Mon 12/7/15
326		**2004DM**	**PROJECT CLOSEOUT**	**51 days**	**Thu 10/22/15**	**Thu 12/31/15**
327		2004DM1	Close Out Prep	30 days	Thu 10/22/15	Wed 12/2/15
328		2004DM2	Final Close Out	21 days	Thu 12/3/15	Thu 12/31/15



Project: FORT RUCKER PROJECT SC
Date: 04/07/2010

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

CH2MHILL

CH2M HILL Constructors, Inc.
9191South Jamaica Street
Englewood, CO 80112-5946

INVOICE

Date of Invoice: January 18, 2010
Period Invoiced: Milestone Approval
January 18, 2010

U.S. Army Corps of Engineers, Mobile District
EN-GE (William Woodall)
109 Saint Joseph Street
Mobile, Alabama 36602

Contract W91ZLK-05-D-0014, Task Order 0001
Environmental Remediation Services
Fort Rucker, AL

Payment Milestone 2004BA8, Army Approval of Final HASP/SAP/QAPP/WMP	$15,946
Total This Invoice:	$15,946
Total Invoiced to Date:	$87,011

Invoice Submitted By:

M Sherrill

Mark Sherrill, PG
Project Manager
CH2M HILL

Invoice Approved By:

William Woodall

William Woodall
Contracting Officer's Representative
USACE, Mobile District

Contact for Invoice Questions/Problems: Mark Sherrill, Project Manager, Cell (678) 938-0923, Email msherril@ch2m.com

Fort Rucker, Alabama
Contract W91ZLK-05-D-0014, Task Order 0001
Date: 18 January 2010
Invoice #4

		Contract		Total This Period	Total To Date		
CLIN/SUB-CLIN	**CLIN/SUB-CLIN OR PAYMENT MILESTONE DESCRIPTION**	**CLIN/SUB-CLIN AMOUNT**	**PAYMENT MILESTONE AMOUNT**	**Amount**	**Previous Billed**	**Contract Remaining**	**Percent Complete**
2004	**ENVIRONMENTAL REMEDIATION SERVICES AT FORT RUCKER, ALABAMA in accordance with the attached Performance Work Statement**						
2004AA		**$33,228**		**$0**	**$33,228**	**$0**	**100%**
2004AA5	Army Approval of Draft PMP and Draft QASP		$21,428	$0	$21,428	$0	100%
2004AA8	Army Approval of Final PMP		$11,800	$0	$11,800	$0	100%
2004BA	**Additional Site-Wide Plans prior to Start of Field Work**	**$79,445**		**$15,946**	**$37,837**	**$25,662**	**68%**
2004BA5	Army Approval of Draft HASP/SAP/QAPP/WMP		$37,837	$0	$37,837	$0	100%
2004BA8	Army Approval of Final HASP/SAP/QAPP/WMP		$15,946	$15,946	$0	$0	100%
2004BA14	Army Approval of Draft ESP		$16,501		$0	$16,501	0%
2004BA17	Army Approval of Final ESP		$9,161		$0	$9,161	0%
2004CA	**FTRU-001-R-01 - Anti-Tank/Rocket Grenade Range, FTRU-003-R-01 - Infiltration Course and FTRU-004-R-01 - .22 Caliber Target Butt: Achieve Record of Decision/Decision Document by 30 September 2011**	**$605,246**		**$0**	**$0**	**$605,246**	**0%**
2004CA7	Army Approval of Draft Final RFI/CMS Work Plan/HASP		$36,315		$0	$36,315	0%
2004CA14	Army and Regulator Approval of Final RFI/CMS Work Plan/HASP		$24,210		$0	$24,210	0%
2004CA19	Army Acceptance of Technical Memorandum Summarizing Total Linear Footage of Geophysical Transects/Instrusive Investigations Has Been Completed in Accordance with Army/ADEM approved RFI/CMS Work Plan		$221,563				
2004CA25	Army Approval of Draft Final RFI/CMS Report		$137,478		$0	$137,478	0%
2004CA32	Army and Regulator Approval of Final RFI/CMS Report		$64,631		$0	$64,631	0%
2004CA45	Army and Regulator Approval of Final Statement of Basis for FTRU-001-R-01		$40,350		$0	$40,350	0%
2004CA57	Army and Regulator Approval of Final Statement of Basis for FTRU-003-R-01		$40,350		$0	$40,350	0%
2004CA69	Army and Regulator Approval of Final Statement of Basis for FTRU-004-R-01		$40,349		$0	$40,349	0%
2004DA	**AOC-S: PCE in GW near SWMU 8: Achieve Remedy in Place (RIP) by 28 February 2011**	**$1,225,003**		**$0**	**$0**	**$1,225,003**	**0%**
2004DA29	Army Approval of Draft Final ARBCA Technical Memorandum		$9,740		$0	$9,740	0%
2004DA36	Army and Regulator Approval of Final ARBCA Technical Memorandum		$4,695		$0	$4,695	0%
2004DA23	Army and Regulator Approval of Final RFI		$80,957		$0	$80,957	0%
2004DA46	Army Approval of Draft Final CMS/CMIP		$42,753		$0	$42,753	0%
2004DA53	Army and Regulator Approval of Final CMS/CMIP		$20,420		$0	$20,420	0%
2004DA61	Army Acceptance of Technical Memorandum Summarizing Installation of ZVI/Sand Based on Specifications in Accordance with the Army/ADEM Approved CMIP		$590,760		$0	$590,760	0%
2004DA67	Army Approval of Draft Final CMI Report		$230,677		$0	$230,677	0%
2004DA74	Army and Regulator Approval of Final CMI Report		$245,001		$0	$245,001	0%

Fort Rucker, Alabama
Contract W91ZLK-05-D-0014, Task Order 0001
Date: 18 January 2010
Invoice #4

		Contract		Total This Period	Total To Date		
CLIN/SUB-CLIN	**CLIN/SUB-CLIN OR PAYMENT MILESTONE DESCRIPTION**	**CLIN/SUB-CLIN AMOUNT**	**PAYMENT MILESTONE AMOUNT**	**Amount**	**Previous Billed**	**Contract Remaining**	**Percent Complete**
2004DB	**AOC-S: PCE in GW near SWMU 8: Exit/Ramp Down Strategy, Optimization and RAO/LTM - Year 1**	Option					
2004DB12	Army and Regulator Approval of Final 1st Qtr RAO/LTM Report						
2004DB24	Army and Regulator Approval of Final 2nd Qtr RAO/LTM Report						
2004DB36	Army and Regulator Approval of Final 3rd Qtr RAO/LTM Report						
2004DB48	Army and Regulator Approval of Final 4th Qtr RAO/LTM Report						
2004DC	**AOC-S: PCE in GW near SWMU 8: Exit/Ramp Down Strategy, Optimization and RAO/LTM - Year 2**	Option					
2004DC12	Army and Regulator Approval of Final 1st Semi-Annual RAO/LTM Report						
2004DC24	Army and Regulator Approval of Final 2nd Semi-Annual RAO/LTM Report						
2004DD	**AOC-S: PCE in GW near SWMU 8: Exit/Ramp Down Strategy, Optimization and RAO/LTM - Year 3**	Option					
2004DD12	Army and Regulator Approval of Final Annual RAO/LTM Report						
2004DE	**AOC-S: PCE in GW near SWMU 8: Exit/Ramp Down Strategy, Optimization and RAO/LTM - Year 4**	Option					
2004DE12	Army and Regulator Approval of Final Annual RAO/LTM Report						
2004DF	**AOC-S: PCE in GW near SWMU 8: Exit/Ramp Down Strategy, Optimization and RAO/LTM - Year 5**	Option					
2004DF12	Army and Regulator Approval of Final Annual RAO/LTM Report						
2004DG	**AOC-S: PCE in GW near SWMU 8: Exit/Ramp Down Strategy, Optimization and RAO/LTM - Year 6**	Option					
-	Army and Regulator Approval of Final Annual RAO/LTM Report						
2004DH	**AOC-S: PCE in GW near SWMU 8: Remedy Review**	Option					
2004DH5	Army Approval of Draft Final Remedy Review						
2004DH8	Army and Regulator Approval of Final Remedy Review						
	TOTAL	$1,942,922	$1,942,922	$15,946	$71,065	$1,855,911	4%

Invoice Summary

Total Approved Budget:	$1,942,922
Total Earned to Date:	$87,011
Total Billed Previously:	$71,065
Total Amount Due This Estimate:	$15,946

April 2010

CH2M HILL
Northpark 400
1000 Abernathy Road
Suite 1600
Atlanta, GA 30328
Tel 770-604-9095 x54320
Fax 770-604-9183

15 May 2010

Mr. William Woodall
U.S. Army Corps of Engineers, Mobile District
CESAM-EN-GE
109 Saint Joseph Street
Mobile, Alabama 36602-3630

RE: Revised Progress Status Report Numbers 02
Contract W91ZLK-05-D-0014-0001
Fort Rucker, Alabama

Dear Mr. Woodall:

CH2M HILL is pleased to submit this Project Status Report for your review. This status report covers the period from 27 March 2010 to 04 May 2010. The major project activities conducted during this reporting period and projected for the next reporting period (05 May 2010 to 28 May 2010) are summarized below.

PROJECT ACTIVITIES AND MEETINGS FOR REPORTING PERIOD

- Received Army review comments on Draft Final Explosives Site Plan (ESP) for *FTRU-001-R-01 Anti-Tank/Rocket Grenade Range and FTRU-003-R-01 Infiltration/Grenade Range* from Huntsville CX on April 27, 2010.
- Initiated response to Huntsville CX comments on Draft Final ESP and revisions to Draft Final ESP.
- Submitted Final RFI Technical Memorandum Work Plan Addendum (describing installation of additional wells) for AOC-S on April 5, 2010.
- Attended conference call with Army team on April 29, 2010 to discuss: 1) Right-of-Entry (ROE) issues regarding McLin property (AOC-S), potential impact to work, and potential solutions; 2) establishment of corrective measures at AOC-S based on risk to human health and the environment, which may preclude installation of zero valent iron (ZVI) wall as corrective measure; and 3) data needs to perform ARBCA evaluation at AOC-S. It was agreed that Jim Swift will set up meeting with ADEM to discuss these issues.
- Attended meeting at ADEM on May 4, 2010 as part of Army team to discuss: 1) ROE issues; 2) ARBCA data needs; and 3) status of new RCRA permit. ADEM is understanding of ROE issues for McLin property and concurs that pushing for ROE to install off-post well is not in the best interest of the Army. ADEM concurs that the RFI for AOC-S can be finalized without installation of off-post well at this time. ADEM requires that Final RFI Technical Memorandum Work Plan Addendum be

revised to discuss ROE issues and that the Army will install the off-post well on McLin property at a future date when ROE can be obtained. Regarding ARBCA data needs, the guidance states that four rounds of data are needed, however, ADEM may be agreeable to three rounds of data, if plume can be demonstrated to be stable. The new RCRA permit is under review by upper ADEM management and will be submitted back to Fort Rucker for another round of review.

PLANNED PROJECT ACTIVITIES AND MEETINGS FOR NEXT REPORTING PERIOD (05 MAY 2010 – 28 MAY 2010)

- Obtain dig permit for installation of additional wells at AOC-S.
- Install three additional wells (on-post) at AOC-S.
- Incorporate Huntsville CX comments and submit new version of ESP for FTRU-001-R-01 Anti-Tank/Rocket Grenade Range and FTRU-003-R-01 Infiltration/Grenade Range
- Submit Draft RFI Work Plan for FTRU-001-R-01 Anti-Tank/Rocket Grenade Range, FTRU-003-R-01 Infiltration/Grenade Range, and FTRU-004-R-01 .22-Caliber Target Butt.
- Submit revised insert page to Final RFI Technical Memorandum Work Plan Addendum discussing ROE issues and proposed schedule for installation of off-post groundwater monitoring well.

PLANNED PROJECT ACTIVITIES AND MEETINGS FOR JUNE 2010

- Collect groundwater samples from AOC-S wells.

TECHNICAL ISSUES ENCOUNTERED FOR REPORTING PERIOD

- ROE issues for McLin property. See discussion above.
- To perform ARBCA evaluation at AOC-S, multiple rounds of groundwater sample collection are needed.
- Based on the results of the ARBCA evaluation at AOC-S, installation of the ZVI PRB may not be necessary to address site risks. Corrective measures will be evaluated during preparation of the Corrective Measures Study (CMS), submitted as part of the Corrective Measures Implementation Plan (CMIP), submitted at a later date. If monitored natural attenuation is selected as the corrective measure, the estimated date to achieve Remedy in Place (RIP) is December 27, 2011 (Army/ADEM Approval of Final CMS/CMIP).

SCHEDULE

The revised project schedule is attached. The project schedule has been revised to allow for collection of multiple rounds of groundwater sample collection at AOC-S in order to prepare the ARBCA evaluation and subsequent CMS/CMIP. Based on the revised schedule, achievement of Remedy in Place (RIP) for AOC-S will be achieved on November 01, 2012

(Army/ADEM approval of Final AOC-S Corrective Measures Implementation Report) and not on February 28, 2011 as specified in the PWS and achievement of Record of Decision/Decision Documents (ROD/DD) for the MMRP sites will be achieved on July 10, 2012 (Army/ADEM acceptance of Final Statement of Basis) and not on September 30, 2011 as specified in the PWS.

Variance to Schedule

Performance Objective	Performance Objective Date (PWS)	Proposed Performance Objective Date	Increase in Days
Achieve RIP at AOC-S	February 28, 2011	November 01, 2012	610
Achieve ROD/DD for MMRP Sites	September 30, 2011	July 10, 2012	283

<u>SUMMARY OF PAYMENT MILESTONES COMPLETED DURING THIS REPORTING PERIOD</u>

- None.

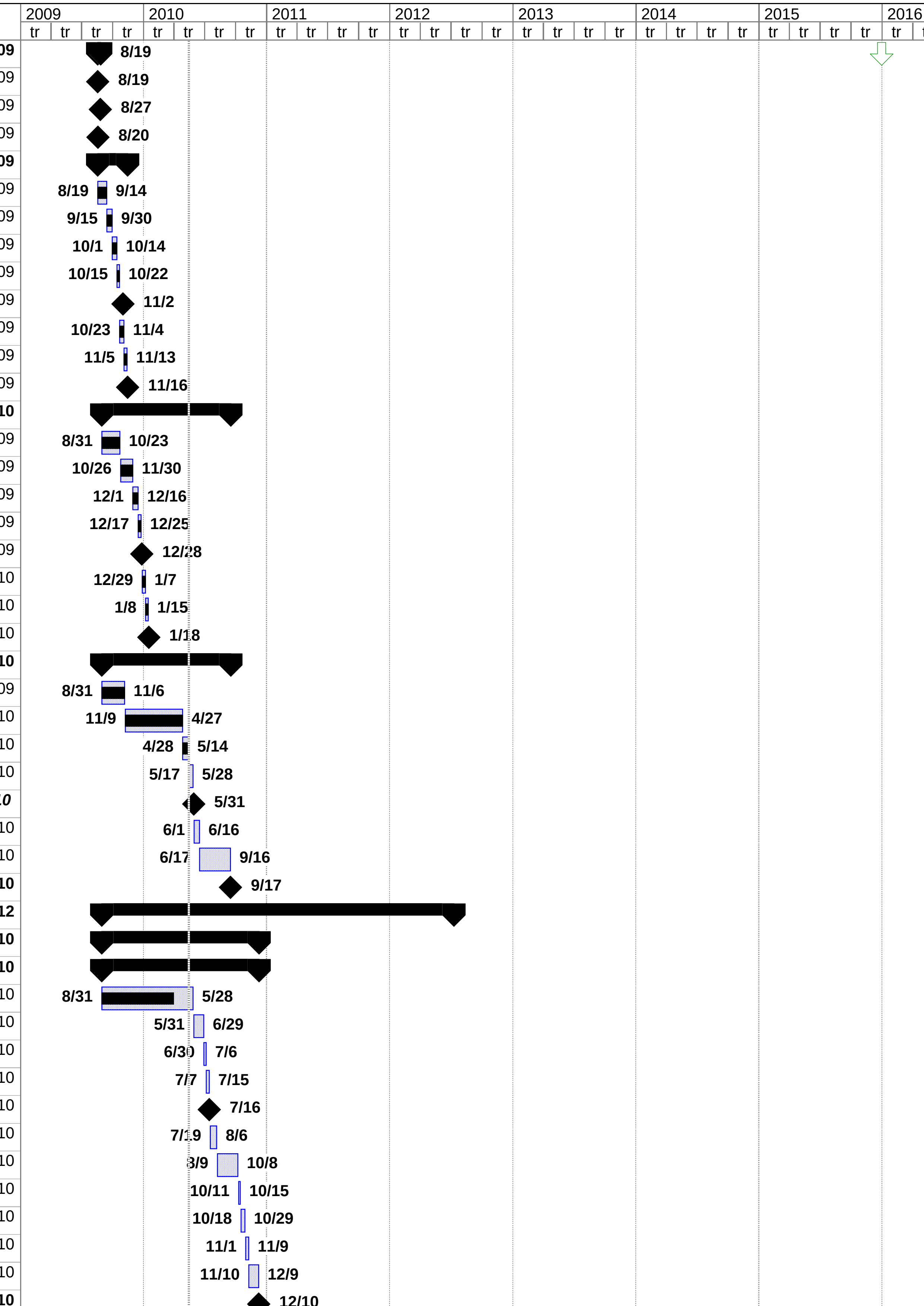
If you have any questions, please do not hesitate to contact me at (678) 938-0923.

Sincerely,

CH2M HILL

Mark Sherrill, P.G.
Project Manager

ID	Info	WBS	Task Name	Duration	Start	Finish
1	✓	**2004**	**ENVIRONMENTAL REMEDIATION SERVICES AT FT. RUCKER**	**7 days**	**Wed 8/19/09**	**Thu 8/27/09**
2	✓	2004A	Award Date	1 day	Wed 8/19/09	Wed 8/19/09
3	✓	2004B	Site Recon Visit	1 day	Thu 8/27/09	Thu 8/27/09
4	✓	2004C	Project Kick-Off Meeting	1 day	Thu 8/20/09	Thu 8/20/09
5	✓	**2004AA**	**PMP/QASP**	**63 days**	**Wed 8/19/09**	**Mon 11/16/09**
6	✓	2004AA1	Draft PMP/QASP Preparation and Submittal	19 days	Wed 8/19/09	Mon 9/14/09
7	✓	2004AA2	Army Review/Comments	12 days	Tue 9/15/09	Wed 9/30/09
8	✓	2004AA3	Prepare Response to Army Comments and Response Submittal	10 days	Thu 10/1/09	Wed 10/14/09
9	✓	2004AA4	Army Review/Acceptance of Response to Comments	6 days	Thu 10/15/09	Thu 10/22/09
10	✓	2004AA5	***Army Approval of Draft PMP/QASP***	0 days	Mon 11/2/09	Mon 11/2/09
11	✓	2004AA6	Final PMP Preparation and Submittal	9 days	Fri 10/23/09	Wed 11/4/09
12	✓	2004AA7	Army Review of Final PMP	7 days	Thu 11/5/09	Fri 11/13/09
13	✓	2004AA8	***Army Approval of Final PMP/QASP***	0 days	Mon 11/16/09	Mon 11/16/09
14		**2004BA**	**ADDITIONAL SITE-WIDE PLANS**	**275 days**	**Mon 8/31/09**	**Fri 9/17/10**
15	✓	2004BA1	Draft SSHP/SAP/WMP Preparation and Submittal	40 days	Mon 8/31/09	Fri 10/23/09
16	✓	2004BA2	Army Review/Comments	26 days	Mon 10/26/09	Mon 11/30/09
17	✓	2004BA3	Prepare Response to Army Comments and Response Submittal	12 days	Tue 12/1/09	Wed 12/16/09
18	✓	2004BA4	Army Review/Acceptance of Response to Comments	7 days	Thu 12/17/09	Fri 12/25/09
19	✓	2004BA5	***Army Approval of Draft SSHP/SAP//WMP***	1 day	Mon 12/28/09	Mon 12/28/09
20	✓	2004BA6	Final SSHP/SAP/WMP Preparation and Submittal	8 days	Tue 12/29/09	Thu 1/7/10
21	✓	2004BA7	Army Review of Final SSHP/SAP/WMP	6 days	Fri 1/8/10	Fri 1/15/10
22	✓	2004BA8	***Army Approval of Final SSHP/SAP/WMP***	1 day	Mon 1/18/10	Mon 1/18/10
23		**2004BA9**	**Explosives Site Plan (includes all MMRP Sites)**	**275 days**	**Mon 8/31/09**	**Fri 9/17/10**
24	✓	2004BA10	Draft Explosives Siting Plan Preparation and Submittal	50 days	Mon 8/31/09	Fri 11/6/09
25	✓	2004BA11	Army Review/Comments	122 days	Mon 11/9/09	Tue 4/27/10
26		2004BA12	Prepare Response to Army Comments and Response Submittal	13 days	Wed 4/28/10	Fri 5/14/10
27		2004BA13	Army Review/Acceptance of Response to Comments	10 days	Mon 5/17/10	Fri 5/28/10
28		***2004BA14***	***Army Approval of Draft Explosives Siting Plan***	***1 day***	***Mon 5/31/10***	***Mon 5/31/10***
29		2004BA15	Final Explosives Siting Plan Preparation and Submittal	12 days	Tue 6/1/10	Wed 6/16/10
30		2004BA16	Army Review of Final Explosives Siting Plan	66 days	Thu 6/17/10	Thu 9/16/10
31		**2004BA17**	***Army Approval of Final Explosives Siting Plan***	**1 day**	**Fri 9/17/10**	**Fri 9/17/10**
32		**2004CA**	**MMRP SITES**	**747 days**	**Mon 8/31/09**	**Tue 7/10/12**
33		**2004CA1**	**RFI/CMS WORK PLAN**	**335 days**	**Mon 8/31/09**	**Fri 12/10/10**
34		**2004CA2**	**RFI/CMS Work Plan (includes all MMRP Sites)**	**335 days**	**Mon 8/31/09**	**Fri 12/10/10**
35		2004CA3	Draft RFI/CMS Work Plan Preparation and Submittal	195 days	Mon 8/31/09	Fri 5/28/10
36		2004CA4	Army Review/Comments	22 days	Mon 5/31/10	Tue 6/29/10
37		2004CA5	Prepare Response to Army Comments and Response Submittal	5 days	Wed 6/30/10	Tue 7/6/10
38		2004CA6	Army Review/Acceptance of Response to Comments	7 days	Wed 7/7/10	Thu 7/15/10
39		**2004CA7**	***Army Approval of Draft Final RFI/CMS Work Plan***	1 day	Fri 7/16/10	Fri 7/16/10
40		2004CA8	Draft Final RFI/CMS Work Plan Preparation and Submittal	15 days	Mon 7/19/10	Fri 8/6/10
41		2004CA9	ADEM/Army Review/Comments	45 days	Mon 8/9/10	Fri 10/8/10
42		2004CA10	Prepare Response to ADEM/Army Comments and Response Submittal	5 days	Mon 10/11/10	Fri 10/15/10
43		2004CA11	ADEM/Army Review/Acceptance of Response to Comments	10 days	Mon 10/18/10	Fri 10/29/10
44		2004CA12	Final RFI/CMS Work Plan Preparation and Submittal	7 days	Mon 11/1/10	Tue 11/9/10
45		2004CA13	ADEM/Army Review of Final RFI/CMS Work Plan	22 days	Wed 11/10/10	Thu 12/9/10
46		**2004CA14**	***Army/ADEM Approval of Final RFI/CMS Work Plan***	**1 day**	**Fri 12/10/10**	**Fri 12/10/10**



Project: FORT RUCKER PROJECT S
Date: 05/14/2010

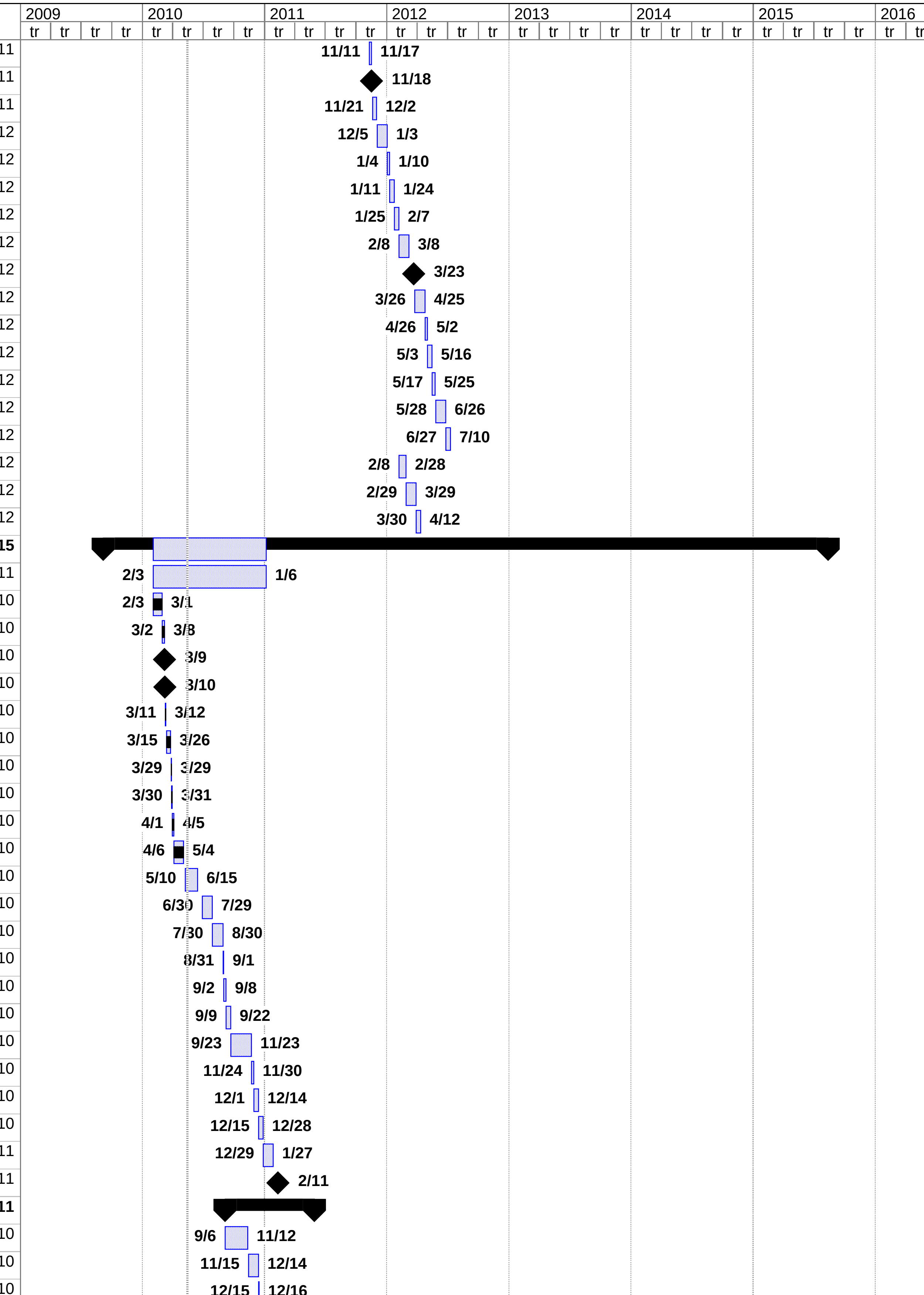
Task	Milestone	Rolled Up Task	Rolled Up Progress	External Tasks	Group By Summary
Progress	Summary	Rolled Up Milestone	Split	Project Summary	Deadline

ID		WBS	Task Name	Duration	Start	Finish
47		**2004CA15**	**RCRA FACILITY INVESTIGATION**	**37 days**	**Mon 12/13/10**	**Tue 2/1/11**
48		2004CA16	DGM/Instrusive Investigation-Ant-Tank/Rocket Grenade Range	20 days	Mon 12/13/10	Fri 1/7/11
49		2004CA17	DGM/Intrusive Investigation - Infiltration/Grenade Range	19 days	Wed 12/15/10	Mon 1/10/11
50		2004CA18	DGM/Intrusive Investigation - .22-Caliber Target Butt	4 days	Mon 12/20/10	Thu 12/23/10
51		***2004CA19***	***Army Acceptance of Total LF of Geophysical Transects/Instrusive Inv. TM***	1 day	Tue 2/1/11	Tue 2/1/11
52		**2004CA20**	**RCRA FACILITY INVESTIGATION REPORT / CMS**	**181 days**	**Tue 1/11/11**	**Tue 9/20/11**
53		2004CA21	Draft RFI/CMS Report (includes all MMRP Sites) Preparation and Submittal	30 days	Tue 1/11/11	Mon 2/21/11
54		2004CA22	Army Review/Comments	22 days	Tue 2/22/11	Wed 3/23/11
55		2004CA23	Prepare Response to Army Comments and Response Submittal	5 days	Thu 3/24/11	Wed 3/30/11
56		2004CA24	Army Review/Acceptance of Response to Comments	5 days	Thu 3/31/11	Wed 4/6/11
57		***2004CA25***	***Army Approval of Draft Final RFI/CMS Report***	***1 day***	***Thu 4/7/11***	***Thu 4/7/11***
58		2004CA26	Draft Final RFI/CMS Report Preparation and Submittal	15 days	Fri 4/8/11	Thu 4/28/11
59		2004CA27	ADEM/Army Review/Comment	45 days	Fri 4/29/11	Thu 6/30/11
60		2004CA28	Response to ADEM/Army Comments and Response Submittal	5 days	Fri 7/1/11	Thu 7/7/11
61		2004CA29	ADEM/Army Review/Acceptance of Response to Comments	10 days	Fri 7/8/11	Thu 7/21/11
62		2004CA30	Final RFI/CMS Report Preparation and Submittal	10 days	Fri 7/22/11	Thu 8/4/11
63		2004CA31	ADEM/Army Review of Final RFI/CMS Report	22 days	Fri 8/5/11	Mon 9/5/11
64		**2004CA32**	***Army/ADEM Approval of Final RFI/CMS Report***	1 day	Tue 9/20/11	Tue 9/20/11
65		**2004CA33**	**STATEMENT OF BASIS**	**210 days**	**Wed 9/21/11**	**Tue 7/10/12**
66		2004CA34	Draft Statement of Basis - Anti-Tank/Rocket Grenade Range Prep and Submittal	10 days	Wed 9/21/11	Tue 10/4/11
67		2004CA35	Army Review/Comments	22 days	Wed 10/5/11	Thu 11/3/11
68		2004CA36	Prepare Response to Army Comments and Response Submitttal	5 days	Fri 11/4/11	Thu 11/10/11
69		2004CA37	Army Review/Acceptance of Response to Comments	5 days	Fri 11/11/11	Thu 11/17/11
70		*2004CA38*	Army Approval of Draft SB-Anti-Tank/Rocket Grenade Range	***1 day***	***Fri 11/18/11***	***Fri 11/18/11***
71		2004CA39	Draft Final Statement of Basis - Anti-Tank/Rocket Grenade Range Prep and Submittal	10 days	Mon 11/21/11	Fri 12/2/11
72		2004CA40	ADEM/Army Review/Comment	22 days	Mon 12/5/11	Tue 1/3/12
73		2004CA41	Response to ADEM/Army Comments and Response Submittal	5 days	Wed 1/4/12	Tue 1/10/12
74		2004CA42	ADEM/Army Review/Acceptance of Response to Comments	10 days	Wed 1/11/12	Tue 1/24/12
75		2004CA43	Final Statement of Basis - Anti-Tank/Rocket Grenade Range Prep and Submittal	10 days	Wed 1/25/12	Tue 2/7/12
76		2004CA44	ADEM/Army Review of Final Statement of Basis - Anti-Tank/Rocket Grenade Rg	22 days	Wed 2/8/12	Thu 3/8/12
77		**2004CA45**	***Army/ADEM Approval of Final SB-Anti-Tank/Rocket Grenade***	1 day	Fri 3/23/12	Fri 3/23/12
78		2004CA46	Draft Statement of Basis - Infiltration/Grenade Range Preparation and Submittal	10 days	Wed 9/21/11	Tue 10/4/11
79		2004CA47	Army Review/Comments	22 days	Wed 10/5/11	Thu 11/3/11
80		2004CA48	Prepare Response to Army Comments and Response Submittal	5 days	Fri 11/4/11	Thu 11/10/11
81		2004CA49	Army Review/Acceptance of Response to Comments	5 days	Fri 11/11/11	Thu 11/17/11
82		2004CA50	Army Approval of Draft SB-Infiltration/Grenade Range	1 day	Fri 11/18/11	Fri 11/18/11
83		2004CA51	Draft Final Statement of Basis - Infiltration/Grenade Range Prep and Submittal	10 days	Mon 11/21/11	Fri 12/2/11
84		2004CA52	ADEM/Army Review/Comments	22 days	Mon 12/5/11	Tue 1/3/12
85		2004CA53	Prepare Response to ADEM/Army Comments and Response Submittal	5 days	Wed 1/4/12	Tue 1/10/12
86		2004CA54	ADEM/Army Review/Acceptance of Response to Comments	10 days	Wed 1/11/12	Tue 1/24/12
87		2004CA55	Final Statement of Basis - Infiltration/ Grenade Range Prep and Submittal	10 days	Wed 1/25/12	Tue 2/7/12
88		2004CA56	ADEM/Army Review of Final Statement of Basis - Infiltration/Grenade Range	22 days	Wed 2/8/12	Thu 3/8/12
89		**2004CA57**	***Army/ADEM Approval of Final SB-Infiltration/Grenade Range***	1 day	Fri 3/23/12	Fri 3/23/12
90		2004CA658	Draft Statement of Basis - .22-Caliber Target Butt Preparation and Submittal	10 days	Wed 9/21/11	Tue 10/4/11
91		2004CA59	Army Review/Comments	22 days	Wed 10/5/11	Thu 11/3/11
92		2004CA60	Prepare Response to Army Comments and Response Submittal	5 days	Fri 11/4/11	Thu 11/10/11

Project: FORT RUCKER PROJECT S
Date: 05/14/2010

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

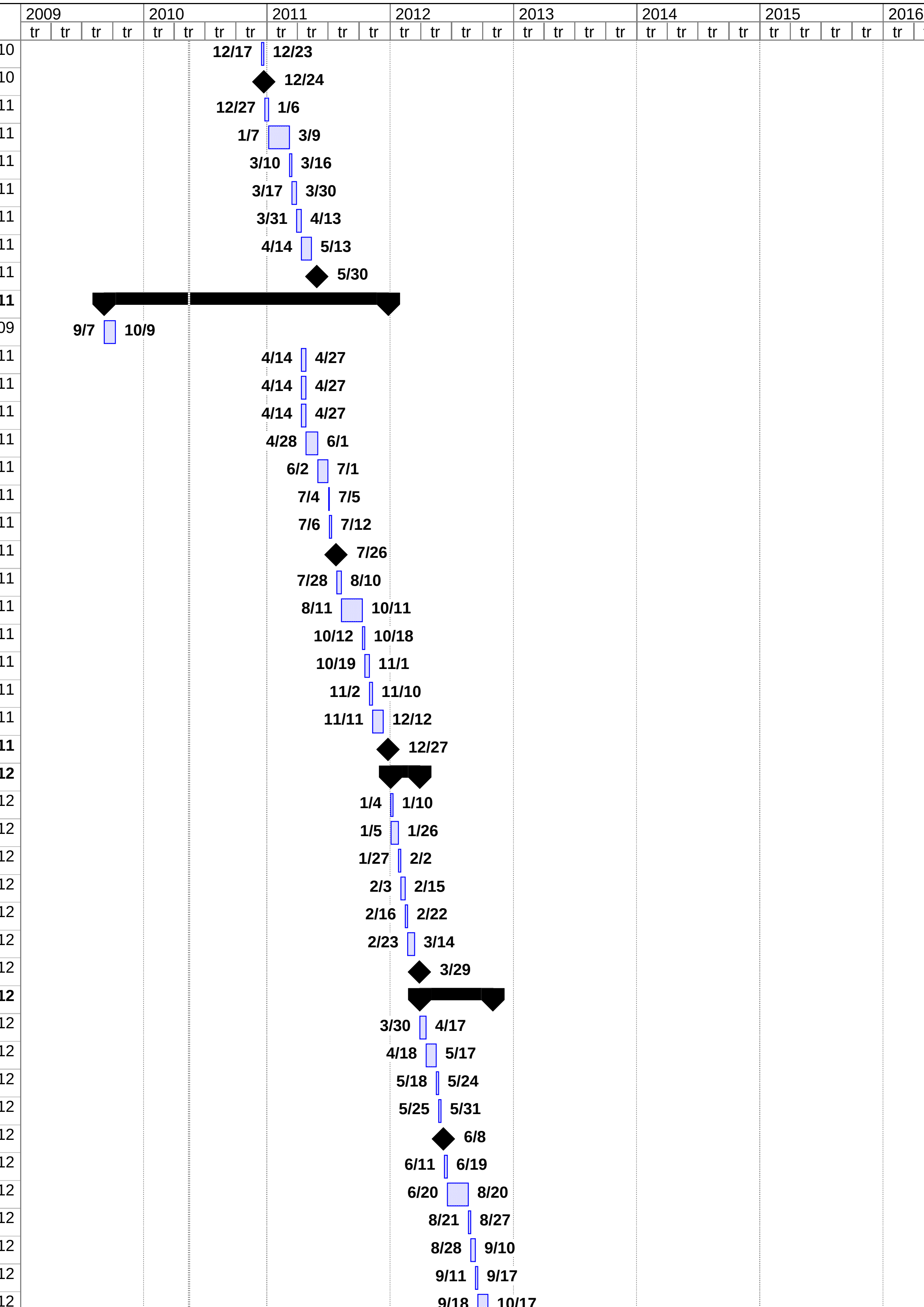
ID		WBS	Task Name	Duration	Start	Finish
93		2004CA61	Army Review/Acceptance of Response to Comments	5 days	Fri 11/11/11	Thu 11/17/11
94		2004CA62	Army Approval of Draft SB-.22-Caliber Target Butt	1 day	Fri 11/18/11	Fri 11/18/11
95		2004CA63	Draft Final Statement of Basis - .22-Caliber Target Butt Prep and Submittal	10 days	Mon 11/21/11	Fri 12/2/11
96		2004CA64	ADEM/Army Review/Comment	22 days	Mon 12/5/11	Tue 1/3/12
97		2004CA65	Prepare Response to ADEM/Army Comments and Response Submittal	5 days	Wed 1/4/12	Tue 1/10/12
98		2004CA66	ADEM/Army Review/Acceptance of Response to Comments	10 days	Wed 1/11/12	Tue 1/24/12
99		2004CA67	Final Statement of Basis - .22-Caliber Target Butt Prep and Submittal	10 days	Wed 1/25/12	Tue 2/7/12
100		2004CA68	ADEM/Army Review of Final Statement of Basis - .22-Caliber Target Butt	22 days	Wed 2/8/12	Thu 3/8/12
101		**2004CA69**	***Army/ADEM Approval of Final SB-.22-Caliber Target Butt***	1 day	Fri 3/23/12	Fri 3/23/12
102		2004CA70	Public Comment Period (All MMRP Sites)	23 days	Mon 3/26/12	Wed 4/25/12
103		2004CA71	Prepare Response to Public Comments	5 days	Thu 4/26/12	Wed 5/2/12
104		2004CA72	Army/ADEM Review/Acceptance of Response to Public Comments	10 days	Thu 5/3/12	Wed 5/16/12
105		2004CA73	Revise Statement of Basis (If Needed Based on Public Comment)	7 days	Thu 5/17/12	Fri 5/25/12
106		2004CA74	ADEM/Army Review of Final Statement fo Basis	22 days	Mon 5/28/12	Tue 6/26/12
107		2004CA75	Final Statement of Basis - Acceptance of Ranges	10 days	Wed 6/27/12	Tue 7/10/12
108		2004CA76	Draft MMRP Scores Update and Submittal	15 days	Wed 2/8/12	Tue 2/28/12
109		2004CA77	Army Review/Comments	22 days	Wed 2/29/12	Thu 3/29/12
110		2004CA78	Final MMRP Scores Update and Submittal	10 days	Fri 3/30/12	Thu 4/12/12
111		**2004DA**	**IRP SITE AOC-S**	**1549 days**	**Mon 9/7/09**	**Thu 8/13/15**
112		**2004DA1**	**FINAL RFI**	242 days	Wed 2/3/10	Thu 1/6/11
113	✓	2004DA2	Draft RFI Technical Memorandum Work Plan Preparation and Submittal	19 days	Wed 2/3/10	Mon 3/1/10
114	✓	2004DA3	Army Review/Comment	5 days	Tue 3/2/10	Mon 3/8/10
115	✓	2004DA4	Prepare Response to Army Comments and Submittal	1 day	Tue 3/9/10	Tue 3/9/10
116	✓	2004DA5	Army Review/Acceptance of Response to Comments	1 day	Wed 3/10/10	Wed 3/10/10
117	✓	2004DA6	Draft Final RFI Technical Memorandum Work Plan Preparation and Submittal	2 days	Thu 3/11/10	Fri 3/12/10
118	✓	2004DA7	ADEM/Army Review/Comment	10 days	Mon 3/15/10	Fri 3/26/10
119	✓	2004DA8	Prepare Response to ADEM/Army Comments and Response Submittal	1 day	Mon 3/29/10	Mon 3/29/10
120	✓	2004DA9	ADEM/Army Review/Acceptance of Response to Comments	2 days	Tue 3/30/10	Wed 3/31/10
121	✓	2004DA10	Final RFI Technical Memorandum Work Plan Preparation and Submittal	3 days	Thu 4/1/10	Mon 4/5/10
122	✓	2004DA11	Army/ADEM Approval of Final RFI Technical Memorandum Work Plan	21 days	Tue 4/6/10	Tue 5/4/10
123		2004DA12	RFI Field Work-Well Installation/Sampling	27 days	Mon 5/10/10	Tue 6/15/10
124		2004DA13	Final (Draft) RFI Report Preparation and Submittal	22 days	Wed 6/30/10	Thu 7/29/10
125		2004DA14	Army Review/Comment	22 days	Fri 7/30/10	Mon 8/30/10
126		2004DA15	Prepare Response to Army Comments and Submittal	2 days	Tue 8/31/10	Wed 9/1/10
127		2004DA16	Army Review/Acceptance of Response to Comments	5 days	Thu 9/2/10	Wed 9/8/10
128		2004DA17	Final (Draft Final) RFI Report Preparation and Submittal	10 days	Thu 9/9/10	Wed 9/22/10
129		2004DA18	Army/ADEM Review/Comment	44 days	Thu 9/23/10	Tue 11/23/10
130		2004DA19	Prepare Response to ADEM/Army Comments and Response Submittal	5 days	Wed 11/24/10	Tue 11/30/10
131		2004DA20	ADEM/Army Review/Acceptance of Response to Comments	10 days	Wed 12/1/10	Tue 12/14/10
132		2004DA21	Final RFI Report Preparation and Submittal	10 days	Wed 12/15/10	Tue 12/28/10
133		2004DA22	ADEM/Army Review of Final RFI Report	22 days	Wed 12/29/10	Thu 1/27/11
134		**2004DA23**	***Army/ADEM Approval of Final RFI Report***	1 day	Fri 2/11/11	Fri 2/11/11
135		**2004DA24**	**ARBCA EVALUATION**	**191 days**	**Mon 9/6/10**	**Mon 5/30/11**
136		2004DA25	Draft AOC-S ARBCA Technical Memorandum Preparation and Submittal (including GW M	50 days	Mon 9/6/10	Fri 11/12/10
137		2004DA26	Army Review/Comment	22 days	Mon 11/15/10	Tue 12/14/10
138		2004DA27	Prepare Response to Army Comments and Submittal	2 days	Wed 12/15/10	Thu 12/16/10



Project: FORT RUCKER PROJECT S(
Date: 05/14/2010

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

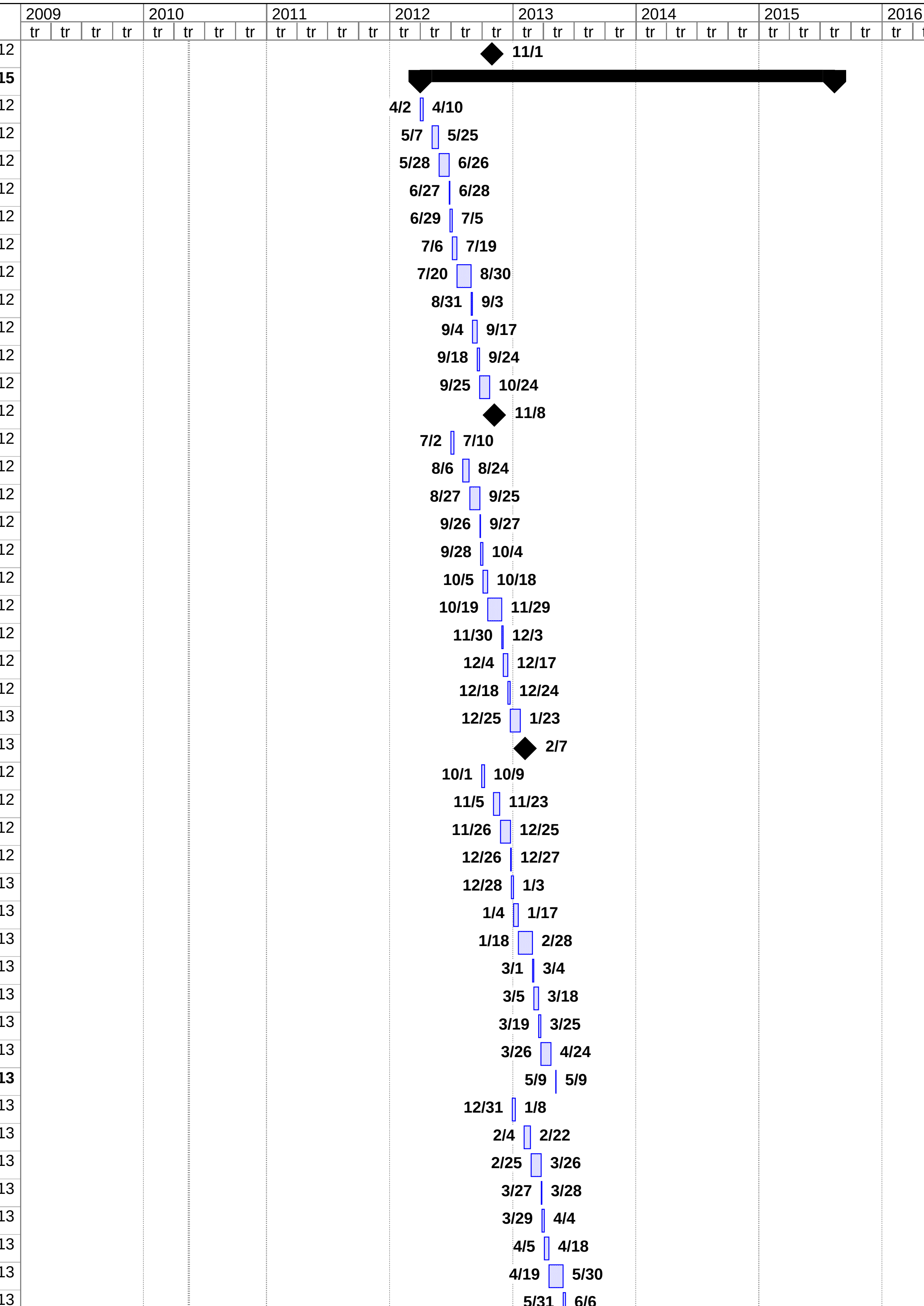
ID	WBS	Task Name	Duration	Start	Finish
139	2004DA28	Army Review/Acceptance of Response to Comments	5 days	Fri 12/17/10	Thu 12/23/10
140	**2004DA29**	***Army Approval of Draft Final AOC-S ARBCA Technical Memorandum***	1 day	Fri 12/24/10	Fri 12/24/10
141	2004DA30	Draft Final AOC-S ARBCA Technical Memorandum Preparation and Submittal	9 days	Mon 12/27/10	Thu 1/6/11
142	2004DA31	ADEM/Army Review/Comment	44 days	Fri 1/7/11	Wed 3/9/11
143	2004DA32	Prepare Response to ADEM/Army Comments and Submittal	5 days	Thu 3/10/11	Wed 3/16/11
144	2004DA33	ADEM/Army Review/Acceptance of Response to Comments	10 days	Thu 3/17/11	Wed 3/30/11
145	2004DA34	Final AOC-S ARBCA Technical Memorandum Preparation and Submittal	10 days	Thu 3/31/11	Wed 4/13/11
146	2004DA35	ADEM/Army Review of Final AOC-S ARBCA Technical Memorandum	22 days	Thu 4/14/11	Fri 5/13/11
147	**2004DA36**	***Army/ADEM Approval of Final AOC-S ARBCA Technical Memorandum***	1 day	Mon 5/30/11	Mon 5/30/11
148	**2004DA37**	**CMS/CMIP**	**602 days**	**Mon 9/7/09**	**Tue 12/27/11**
149	2004DA38	Pre-Construction Survey	25 days	Mon 9/7/09	Fri 10/9/09
150	2004DA39	PRB Remedial Design	10 days	Thu 4/14/11	Wed 4/27/11
151	2004DA40	CMS	10 days	Thu 4/14/11	Wed 4/27/11
152	2004DA41	LTM Plan	10 days	Thu 4/14/11	Wed 4/27/11
153	2004DA42	Draft CMS/CMIP Preparation and Submittal	25 days	Thu 4/28/11	Wed 6/1/11
154	2004DA43	Army Review/Comment	22 days	Thu 6/2/11	Fri 7/1/11
155	2004DA44	Prepare Response to Army Comments and Submittal	2 days	Mon 7/4/11	Tue 7/5/11
156	2004DA45	Army Review/Acceptance of Response to Comments	5 days	Wed 7/6/11	Tue 7/12/11
157	**2004DA46**	***Army Approval of Draft Final CMS/CMIP***	1 day	Tue 7/26/11	Tue 7/26/11
158	2004DA47	Draft Final CMS/CMIP Preparation and Submittal	10 days	Thu 7/28/11	Wed 8/10/11
159	2004DA48	ADEM/Army Review/Comment	44 days	Thu 8/11/11	Tue 10/11/11
160	2004DA49	Prepare Response to ADEM/Army Comments and Submittal	5 days	Wed 10/12/11	Tue 10/18/11
161	2004DA50	ADEM/Army Review/Acceptance of Response to Comments	10 days	Wed 10/19/11	Tue 11/1/11
162	2004DA51	Final CMS/CMIP Preparation and Submittal	7 days	Wed 11/2/11	Thu 11/10/11
163	2004DA52	ADEM/Army Review of Final CMS/CMIP	22 days	Fri 11/11/11	Mon 12/12/11
164	**2004DA53**	***Army/ADEM Approval of Final CMS/CMIP***	**1 day**	**Tue 12/27/11**	**Tue 12/27/11**
165	**2004DA54**	**CMI**	**62 days**	**Wed 1/4/12**	**Thu 3/29/12**
166	2004DA55	Site Preparation Mobilization	5 days	Wed 1/4/12	Tue 1/10/12
167	2004DA56	Site Preparation (clearing, work platform)	16 days	Thu 1/5/12	Thu 1/26/12
168	2004DA57	PRB Mobilization	5 days	Fri 1/27/12	Thu 2/2/12
169	2004DA58	PRB Installation	9 days	Fri 2/3/12	Wed 2/15/12
170	2004DA59	PRB Monitoring Well Network Installation	5 days	Thu 2/16/12	Wed 2/22/12
171	2004DA60	Post-Construction Survey	15 days	Thu 2/23/12	Wed 3/14/12
172	***2004DA61***	***Army Acceptance of Installation of ZVI/Sand TM***	1 day	Thu 3/29/12	Thu 3/29/12
173	**2004DA62**	**CMI Report**	**155 days**	**Fri 3/30/12**	**Thu 11/1/12**
174	2004DA63	Draft AOC-S CMI Report Preparation and Submittal	13 days	Fri 3/30/12	Tue 4/17/12
175	2004DA64	Army Review/Comment	22 days	Wed 4/18/12	Thu 5/17/12
176	2004DA65	Prepare Response to Army Comments and Submittal	5 days	Fri 5/18/12	Thu 5/24/12
177	2004DA66	Army Review/Acceptance of Response to Comments	5 days	Fri 5/25/12	Thu 5/31/12
178	**2004DA67**	***Army Approval of Draft Final AOC-S CMI Report***	1 day	Fri 6/8/12	Fri 6/8/12
179	2004DA68	Draft Final AOC-S CMI Report Preparation and Submittal	7 days	Mon 6/11/12	Tue 6/19/12
180	2004DA69	ADEM/Army Review/Comment	44 days	Wed 6/20/12	Mon 8/20/12
181	2004DA70	Prepare Response to ADEM/Army Comments and Submittal	5 days	Tue 8/21/12	Mon 8/27/12
182	2004DA71	ADEM/Army Review/Acceptance of Response to Comments	10 days	Tue 8/28/12	Mon 9/10/12
183	2004DA72	Final AOC-S CMI Report Preparation and Submittal	5 days	Tue 9/11/12	Mon 9/17/12
184	2004DA73	ADEM/Army Review of Final AOC-S CMI Report	22 days	Tue 9/18/12	Wed 10/17/12



Project: FORT RUCKER PROJECT S
Date: 05/14/2010

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

ID		WBS	Task Name	Duration	Start	Finish
185		**2004DA74**	***Army/ADEM Approval of Final AOC-S CMI Report***	1 day	Thu 11/1/12	Thu 11/1/12
186		**2004DB**	**LTM**	**879 days**	**Mon 4/2/12**	**Thu 8/13/15**
187		2004DB1	AOC-S LTM Q1 (2012) Monitoring Event	7 days	Mon 4/2/12	Tue 4/10/12
188		2004DB2	AOC-S LTM Q1 (2012) LTM Draft Report Preparation and Submittal	15 days	Mon 5/7/12	Fri 5/25/12
189		2044DB3	Army Review/Comment	22 days	Mon 5/28/12	Tue 6/26/12
190		2044DB4	Prepare Response to Army Comments and Submittal	2 days	Wed 6/27/12	Thu 6/28/12
191		2004DB5	Army Review/Acceptance of Response to Comments	5 days	Fri 6/29/12	Thu 7/5/12
192		2004DB6	AOC-S LTM Q1 (2012) LTM Draft Final Report Preparation and Submittal	10 days	Fri 7/6/12	Thu 7/19/12
193		2004DB7	ADEM/Army Review/Comment	30 days	Fri 7/20/12	Thu 8/30/12
194		2004DB8	Prepare Response to ADEM/Army Comments and Submittal	2 days	Fri 8/31/12	Mon 9/3/12
195		2004DB9	ADEM/Army Review/Acceptance of Response to Comments	10 days	Tue 9/4/12	Mon 9/17/12
196		2004DB10	AOC-S LTM Q1 (2012) LTM Final Report Preparation and Submittal	5 days	Tue 9/18/12	Mon 9/24/12
197		2004DB11	ADEM/Army Review of AOC-S LTM Q1 (2012) Final Report	22 days	Tue 9/25/12	Wed 10/24/12
198		**2004DB12**	***Army/ADEM Approval of AOC-S LTM Q1 (2012) LTM Final Report***	1 day	Thu 11/8/12	Thu 11/8/12
199		2004DB13	AOC-S LTM Q2 (2012) Monitoring Event	7 days	Mon 7/2/12	Tue 7/10/12
200		2004DB14	AOC-S LTM Q2 (2012) LTM Draft Report Preparation and Submittal	15 days	Mon 8/6/12	Fri 8/24/12
201		2004DB15	Army Review/Comment	22 days	Mon 8/27/12	Tue 9/25/12
202		2004DB16	Prepare Response to Army Comments and Submittal	2 days	Wed 9/26/12	Thu 9/27/12
203		2004DB17	Army Review/Acceptance of Response to Comments	5 days	Fri 9/28/12	Thu 10/4/12
204		2004DB18	AOC-S LTM Q2 (2012) LTM Draft Final Report Preparation and Submittal	10 days	Fri 10/5/12	Thu 10/18/12
205		2004DB19	ADEM/Army Review/Comment	30 days	Fri 10/19/12	Thu 11/29/12
206		2004DB20	Prepare Response to ADEM/Army Comments and Submittal	2 days	Fri 11/30/12	Mon 12/3/12
207		2004DB21	ADEM/Army Review/Acceptance of Response to Comments	10 days	Tue 12/4/12	Mon 12/17/12
208		2004DB22	AOC-S LTM Q2 (2012) LTM Final Report Preparation and Submittal	5 days	Tue 12/18/12	Mon 12/24/12
209		2004DB23	ADEM/Army Review of AOC-S LTM Q2 (2012) LTM Final Report	22 days	Tue 12/25/12	Wed 1/23/13
210		**2004DB24**	***Army/ADEM Approval of AOC-S LTM Q2 (2012) LTM Final Report***	1 day	Thu 2/7/13	Thu 2/7/13
211		2004DB25	AOC-S LTM Q3 (2012) Monitoring Event	7 days	Mon 10/1/12	Tue 10/9/12
212		2004DB26	AOC-S LTM Q3 (2012) LTM Draft Report Preparation and Submittal	15 days	Mon 11/5/12	Fri 11/23/12
213		2004DB27	Army Review/Comment	22 days	Mon 11/26/12	Tue 12/25/12
214		2004DB28	Prepare Response to Army Comments and Submittal	2 days	Wed 12/26/12	Thu 12/27/12
215		2004DB29	Army Review/Acceptance of Response to Comments	5 days	Fri 12/28/12	Thu 1/3/13
216		2004DB30	AOC-S LTM Q3 (2012) LTM Draft Final Report Preparation and Submittal	10 days	Fri 1/4/13	Thu 1/17/13
217		2004DB31	ADEM/Army Review/Comment	30 days	Fri 1/18/13	Thu 2/28/13
218		2004DB32	Prepare Response to ADEM/Army Comments and Submittal	2 days	Fri 3/1/13	Mon 3/4/13
219		2004DB33	ADEM/Army Review/Acceptance of Response to Comments	10 days	Tue 3/5/13	Mon 3/18/13
220		2004DB34	AOC-S LTM Q3 (2012) LTM Final Report Preparation and Submittal	5 days	Tue 3/19/13	Mon 3/25/13
221		2004DB35	ADEM/Army Review of AOC-S LTM Q3 (2012) LTM Final Report	22 days	Tue 3/26/13	Wed 4/24/13
222		**2004DB36**	***Army/ADEM Approval of AOC-S LTM Q3 (2012) LTM Final Report***	**1 day**	**Thu 5/9/13**	**Thu 5/9/13**
223		2004DB37	AOC-S LTM Q4 (2012) Monitoring Event	7 days	Mon 12/31/12	Tue 1/8/13
224		2004DB38	AOC-S LTM Q4 (2012) LTM Draft Report Preparation and Submittal	15 days	Mon 2/4/13	Fri 2/22/13
225		2004DB39	Army Review/Comment	22 days	Mon 2/25/13	Tue 3/26/13
226		2004DB40	Prepare Response to Army Comments and Submittal	2 days	Wed 3/27/13	Thu 3/28/13
227		2004DB41	Army Review/Acceptance of Response to Comments	5 days	Fri 3/29/13	Thu 4/4/13
228		2004DB42	AOC-S LTM Q4 (2012) LTM Draft Final Report Preparation and Submittal	10 days	Fri 4/5/13	Thu 4/18/13
229		2004DB43	ADEM/Army Review/Comment	30 days	Fri 4/19/13	Thu 5/30/13
230		2004DB44	Prepare Response to ADEM/Army Comments and Submittal	5 days	Fri 5/31/13	Thu 6/6/13



Project: FORT RUCKER PROJECT S
Date: 05/14/2010

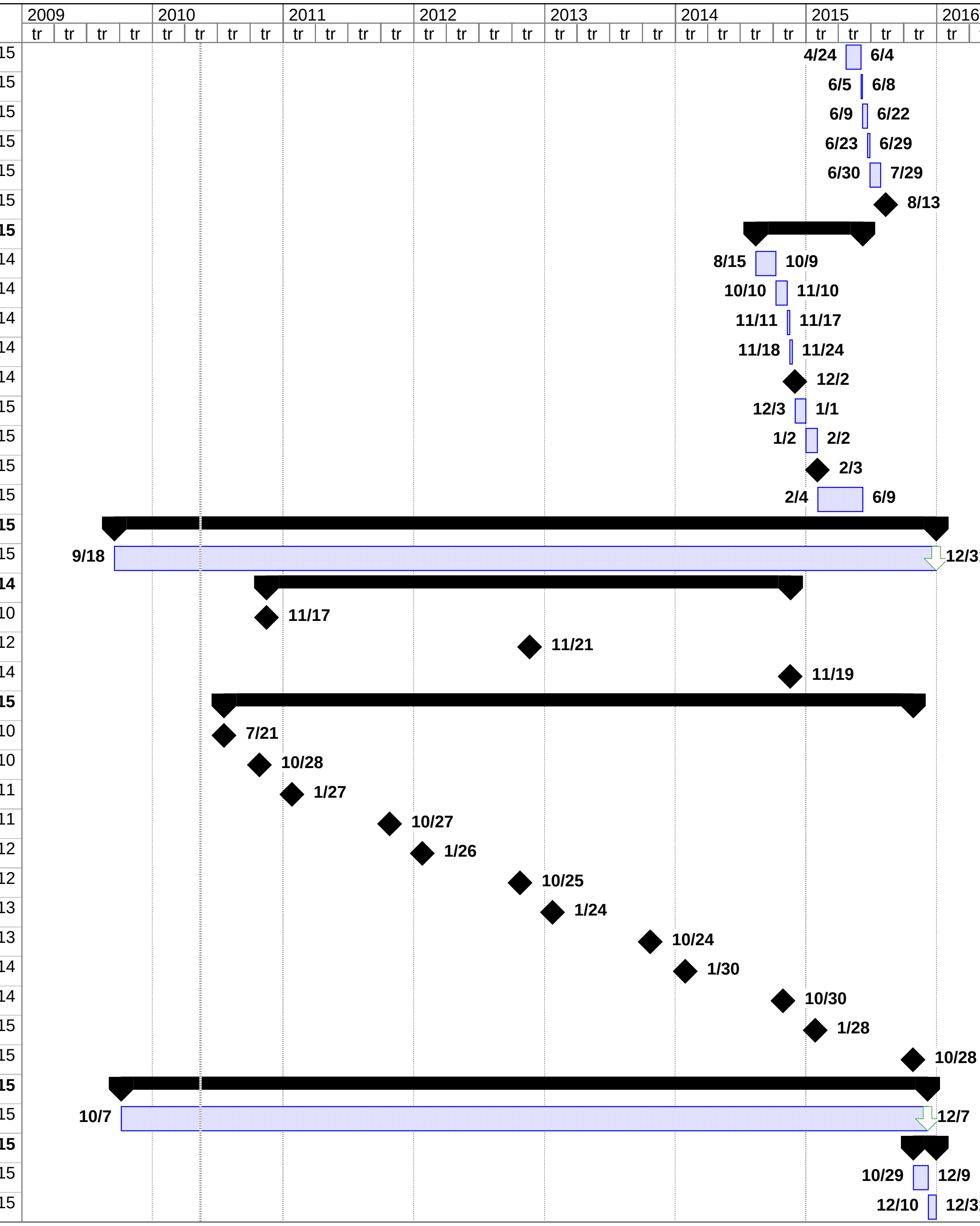
Task | Milestone | Rolled Up Task | Rolled Up Progress | External Tasks | Group By Summary
Progress | Summary | Rolled Up Milestone | Split | Project Summary | Deadline

ID		WBS	Task Name	Duration	Start	Finish
231		2004DB45	ADEM/Army Review/Acceptance of Response to Comments	10 days	Fri 6/7/13	Thu 6/20/13
232		2004DB446	AOC-S LTM Q4 (2012) LTM Final Report Preparation and Submittal	5 days	Fri 6/21/13	Thu 6/27/13
233		2004DB47	ADEM/Army Review of AOC-S LTM Q4 (2012) LTM Final Report	22 days	Fri 6/28/13	Mon 7/29/13
234		**2004DB48**	***Army/ADEM Approval of AOC-S LTM Q4 (2012) LTM Final Report***	1 day	Tue 8/13/13	Tue 8/13/13
235		2004DC1	AOC-S LTM SA1 (2013) Monitoring Event	7 days	Mon 4/22/13	Tue 4/30/13
236		2004DC2	AOC-S LTM SA1 (2013) LTM Draft Report Preparation and Submittal	15 days	Mon 5/27/13	Fri 6/14/13
237		2004DC3	Army Review/Comment	22 days	Wed 8/14/13	Thu 9/12/13
238		2004DC4	Prepare Response to Army Comments and Submittal	2 days	Fri 9/13/13	Mon 9/16/13
239		2004DC5	Army Review/Acceptance of Response to Comments	5 days	Tue 9/17/13	Mon 9/23/13
240		2004DC6	AOC-S LTM SA1 (2013) LTM Draft Final Report Preparation and Submittal	10 days	Tue 9/24/13	Mon 10/7/13
241		2004DC7	ADEM/Army Review/Comment	30 days	Tue 10/8/13	Mon 11/18/13
242		2004DC8	Prepare Response to ADEM/Army Comments and Submittal	2 days	Tue 11/19/13	Wed 11/20/13
243		2004DC9	ADEM/Army Review/Acceptance of Response to Comments	10 days	Thu 11/21/13	Wed 12/4/13
244		2004DC10	AOC-S LTM SA1 (2013) LTM Final Report Preparation and Submittal	5 days	Thu 12/5/13	Wed 12/11/13
245		2004DC11	ADEM/Army Review of AOC-S LTM SA1 (2013) LTM Final Report	22 days	Thu 12/12/13	Fri 1/10/14
246		**2004DC12**	***Army/ADEM Approval of AOC-S LTM SA1 (2013) LTM Final Report***	1 day	Mon 1/27/14	Mon 1/27/14
247		2004DC13	AOC-S LTM SA2 (2013) Monitoring Event	7 days	Mon 9/2/13	Tue 9/10/13
248		2004DC14	AOC-S LTM SA2 (2013) LTM Draft Report Preparation and Submittal	15 days	Mon 10/7/13	Fri 10/25/13
249		2004DC15	Army Review/Comment	22 days	Mon 10/28/13	Tue 11/26/13
250		2004DC16	Prepare Response to Army Comments and Submittal	2 days	Wed 11/27/13	Thu 11/28/13
251		2004DC17	Army Review/Acceptance of Response to Comments	5 days	Fri 11/29/13	Thu 12/5/13
252		2004DC18	AOC-S LTM SA2 (2013) LTM Draft Final Report Preparation and Submittal	10 days	Fri 12/6/13	Thu 12/19/13
253		2004DC19	ADEM/Army Review/Comment	30 days	Fri 12/20/13	Thu 1/30/14
254		2004DC20	Prepare Response to ADEM/Army Comments and Submittal	2 days	Fri 1/31/14	Mon 2/3/14
255		2004DC21	ADEM/Army Review/Acceptance of Response to Comments	10 days	Tue 2/4/14	Mon 2/17/14
256		2004DC22	AOC-S LTM SA2 (2013) LTM Final Report Preparation and Submittal	5 days	Tue 2/18/14	Mon 2/24/14
257		2004DC23	ADEM/Army Review of AOC-S LTM SA2 (2013) LTM Final Report	22 days	Tue 2/25/14	Wed 3/26/14
258		**2004DC24**	***Army/ADEM Approval of AOC-S LTM SA2 (2013) LTM Final Report***	10 days	Thu 3/27/14	Wed 4/9/14
259		2004DD1	AOC-S LTM A1 (2014) Monitoring Event	7 days	Mon 1/6/14	Tue 1/14/14
260		2004DD2	AOC-S LTM A1 (2014) LTM Draft Report Preparation and Submittal	15 days	Mon 2/10/14	Fri 2/28/14
261		2004DD3	Army Review/Comment	22 days	Mon 3/3/14	Tue 4/1/14
262		2004DD4	Prepare Response to Army Comments and Submittal	2 days	Wed 4/2/14	Thu 4/3/14
263		2004DD5	Army Review/Acceptance of Response to Comments	5 days	Fri 4/4/14	Thu 4/10/14
264		2004DD6	AOC-S LTM A1 (2014) LTM Draft Final Report Preparation and Submittal	10 days	Fri 4/11/14	Thu 4/24/14
265		2004DD7	ADEM/Army Review/Comment	30 days	Fri 4/25/14	Thu 6/5/14
266		2004DD8	Prepare Response to ADEM/Army Comments and Submittal	2 days	Fri 6/6/14	Mon 6/9/14
267		2004DD9	ADEM/Army Review/Acceptance of Response to Comments	10 days	Tue 6/10/14	Mon 6/23/14
268		2004DD10	AOC-S LTM A1 (2014) LTM Final Report Preparation and Submittal	5 days	Tue 6/24/14	Mon 6/30/14
269		2004DD11	ADEM/Army Review of AOC-S LTM A1 (2014) LTM Final Report	22 days	Tue 7/1/14	Wed 7/30/14
270		**2004DD12**	***Army/ADEM Approval of AOC-S LTM A1 (2014) LTM Final Report***	1 day	Thu 8/14/14	Thu 8/14/14
271		2004DE1	AOC-S LTM A2 (2015) Monitoring Event	7 days	Mon 1/5/15	Tue 1/13/15
272		2004DE2	AOC-S LTM A2 (2015) LTM Draft Report Preparation and Submittal	15 days	Mon 2/9/15	Fri 2/27/15
273		2004DE3	Army Review/Comment	22 days	Mon 3/2/15	Tue 3/31/15
274		2004DE4	Prepare Response to Army Comments and Submittal	2 days	Wed 4/1/15	Thu 4/2/15
275		2004DE5	Army Review/Acceptance of Response to Comments	5 days	Fri 4/3/15	Thu 4/9/15
276		2004DE6	AOC-S LTM A2 (2015) LTM Draft Final Report Preparation and Submittal	10 days	Fri 4/10/15	Thu 4/23/15

Project: FORT RUCKER PROJECT S
Date: 05/14/2010

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

ID		WBS	Task Name	Duration	Start	Finish
277		2004DE7	ADEM/Army Review/Comment	30 days	Fri 4/24/15	Thu 6/4/15
278		2004DE8	Prepare Response to ADEM/Army Comments and Submittal	2 days	Fri 6/5/15	Mon 6/8/15
279		2004DE9	ADEM/Army Review/Acceptance of Response to Comments	10 days	Tue 6/9/15	Mon 6/22/15
280		2004DE10	AOC-S LTM A2 (2015) LTM Final Report Preparation and Submittal	5 days	Tue 6/23/15	Mon 6/29/15
281		2004DE11	ADEM/Army Review of AOC-S LTM A2 (2015) LTM Final Report	22 days	Tue 6/30/15	Wed 7/29/15
282		**2004DE12**	***Army/ADEM Approval of AOC-S LTM A2 (2015) LTM Final Report***	1 day	Thu 8/13/15	Thu 8/13/15
283		**2004DH**	**REMEDY REVIEW**	**213 days**	**Fri 8/15/14**	**Tue 6/9/15**
284		2004DH1	Preparation of Remedy Review Draft Document and Submittal	40 days	Fri 8/15/14	Thu 10/9/14
285		2004DH2	Army Review/Comment	22 days	Fri 10/10/14	Mon 11/10/14
286		2004DH3	Prepare Response to Army Comments and Submittal	5 days	Tue 11/11/14	Mon 11/17/14
287		2004DH4	Army Review/Acceptance of Response to Comments	5 days	Tue 11/18/14	Mon 11/24/14
288		**2004DH5**	***Remedy Review Draft Final Report Acceptance***	1 day	Tue 12/2/14	Tue 12/2/14
289		2004DH6	Remedy Review Final Report Preparation and Submittal	22 days	Wed 12/3/14	Thu 1/1/15
290		2004DH7	Army/ADEM Review of Remedy Review Final Report	22 days	Fri 1/2/15	Mon 2/2/15
291		**2004DH8**	***Remedy Review Final Report Acceptance***	1 day	Tue 2/3/15	Tue 2/3/15
292		2004DH8	Successful Correction of Deficiencies Noted in Remedy Review	90 days	Wed 2/4/15	Tue 6/9/15
293		**2004DI**	**PROJECT REPOSITORY/ADMINISTRATIVE RECORD**	**1640 days**	**Fri 9/18/09**	**Thu 12/31/15**
294		2004DI1	PROJECT REPOSITORY/ADMINISTRATIVE RECORD	1640 days	Fri 9/18/09	Thu 12/31/15
295		**2004DJ**	**BIANNUAL PUBLIC INTEREST ASSESSMENT**	**1046 days**	**Wed 11/17/10**	**Wed 11/19/14**
296		2004DJ1	August 2010	1 day	Wed 11/17/10	Wed 11/17/10
297		2004DJ2	August 2012	1 day	Wed 11/21/12	Wed 11/21/12
298		2004DJ3	August 2014	1 day	Wed 11/19/14	Wed 11/19/14
299		**2004DK**	**STAKEHOLDER PRESENTATIONS**	**1376 days**	**Wed 7/21/10**	**Wed 10/28/15**
300		2004DK1	July 2010	1 day	Wed 7/21/10	Wed 7/21/10
301		2004DK2	October 2010	1 day	Thu 10/28/10	Thu 10/28/10
302		2004DK3	January 2011	1 day	Thu 1/27/11	Thu 1/27/11
303		2004DK4	October 2011	1 day	Thu 10/27/11	Thu 10/27/11
304		2004DK5	January 2012	1 day	Thu 1/26/12	Thu 1/26/12
305		2004DK6	October 2012	1 day	Thu 10/25/12	Thu 10/25/12
306		2004DK7	January 2013	1 day	Thu 1/24/13	Thu 1/24/13
307		2004DK8	October 2013	1 day	Thu 10/24/13	Thu 10/24/13
308		2004DK9	January 2014	1 day	Thu 1/30/14	Thu 1/30/14
309		2004DK10	October 2014	1 day	Thu 10/30/14	Thu 10/30/14
310		2004DK11	January 2015	1 day	Wed 1/28/15	Wed 1/28/15
311		2004DK12	October 2015	1 day	Wed 10/28/15	Wed 10/28/15
312		**2004DL**	**STATUS REPORTS (MONTHLY)**	**1609 days**	**Wed 10/7/09**	**Mon 12/7/15**
313		2004DL1	STATUS REPORTS (MONTHLY)	1609 days	Wed 10/7/09	Mon 12/7/15
314		**2004DM**	**PROJECT CLOSEOUT**	**46 days**	**Thu 10/29/15**	**Thu 12/31/15**
315		2004DM1	Close Out Prep	30 days	Thu 10/29/15	Wed 12/9/15
316		2004DM2	Final Close Out	16 days	Thu 12/10/15	Thu 12/31/15



Project: FORT RUCKER PROJECT S
Date: 05/14/2010

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

May 2010

CH2M HILL
Northpark 400
1000 Abernathy Road
Suite 1600
Atlanta, GA 30328
Tel 770-604-9095 x54320
Fax 770-604-9183

16 June 2010

Mr. William Woodall
U.S. Army Corps of Engineers, Mobile District
CESAM-EN-GE
109 Saint Joseph Street
Mobile, Alabama 36602-3630

RE: Revised Progress Status Report Numbers 03
Contract W91ZLK-05-D-0014-0001
Fort Rucker, Alabama

Dear Mr. Woodall:

CH2M HILL is pleased to submit this Project Status Report for your review. This status report covers the period from 05 May 2010 to 28 May 2010. The major project activities conducted during this reporting period and projected for the next reporting period (29 May 2010 to 25 June 2010) are summarized below.

PROJECT ACTIVITIES AND MEETINGS FOR REPORTING PERIOD

- Submitted revised version of Explosive Siting Plan (ESP) to Army team on May 14, 2010.
- Installed three additional groundwater monitoring wells (S-MW19, S-MW20, S-MW22) at Area of Concern (AOC)-S starting on May 10 and finishing on May 17, 2010.
- Submitted revised insert pages to Final RFI Technical Memorandum Work Plan Addendum discussing right of entry (ROE) issues and proposed schedule for installation of off-post groundwater monitoring well on May 25, 2010.

PLANNED PROJECT ACTIVITIES AND MEETINGS FOR NEXT REPORTING PERIOD (29 MAY 2010 – 25 JUNE 2010)

- Complete survey of horizontal and vertical position of S-MW19, S-MW20, and S-MW22 on June 8, 2010.
- Collect groundwater samples at AOC-S monitoring wells from June 7 through June 11, 2010.
- Submit Draft RFI Work Plan for FTRU-001-R-01 Anti-Tank/Rocket Grenade Range, FTRU-003-R-01 Infiltration/Grenade Range, and FTRU-004-R-01 .22-Caliber Target Butt.

- Prepare and submit request to modify performance objective dates to achieve Remedy in Place (AOC-S) and record of decision (ROD)/decision document (DD) for FTRU-001-R-01 Anti-Tank/Rocket Grenade Range, FTRU-003-R-01 Infiltration /Grenade Range, and FTRU-004-R-01 .22-Caliber Target Butt and request to shift $103,760 in funding from payment milestone 2004DA61 (Army Acceptance of Technical Memorandum Summarizing Installation of ZVI/Sand Based on Specifications in Accordance with the Army/ADEM Approved CMIP) to payment milestone 2004DA23 (Army and Regulator Approval of Final RFI).

PLANNED PROJECT ACTIVITIES AND MEETINGS FOR JULY 2010

- Facilitate stakeholder presentation on July 22, 2010.
- Provide electronic version of Administrative Record.

TECHNICAL ISSUES ENCOUNTERED FOR REPORTING PERIOD

- Still need to obtain ROE to install off-post monitoring well as discussed in April 2010 Monthly Status Report.

SCHEDULE

The revised project schedule is attached. The project schedule has been revised to allow for collection of multiple rounds of groundwater sample collection at AOC-S in order to prepare the ARBCA evaluation and subsequent CMS/CMIP. Based on the revised schedule, achievement of Remedy in Place (RIP) for AOC-S will be achieved on October 30, 2012 (Army/ADEM approval of Final AOC-S Corrective Measures Implementation Report) and not on February 28, 2011 as specified in the PWS and achievement of Record of Decision/Decision Documents (ROD/DD) for the MMRP sites will be achieved on August 10, 2012 (Army/ADEM acceptance of Final Statement of Basis) and not on September 30, 2011 as specified in the PWS.

Variance to Schedule

Performance Objective	Performance Objective Date (PWS)	Proposed Performance Objective Date	Increase in Days
Achieve RIP at AOC-S	February 28, 2011	October 30, 2012	608
Achieve ROD/DD for MMRP Sites	September 30, 2011	August 10, 2012	314

SUMMARY OF PAYMENT MILESTONES COMPLETED DURING THIS REPORTING PERIOD

- None.

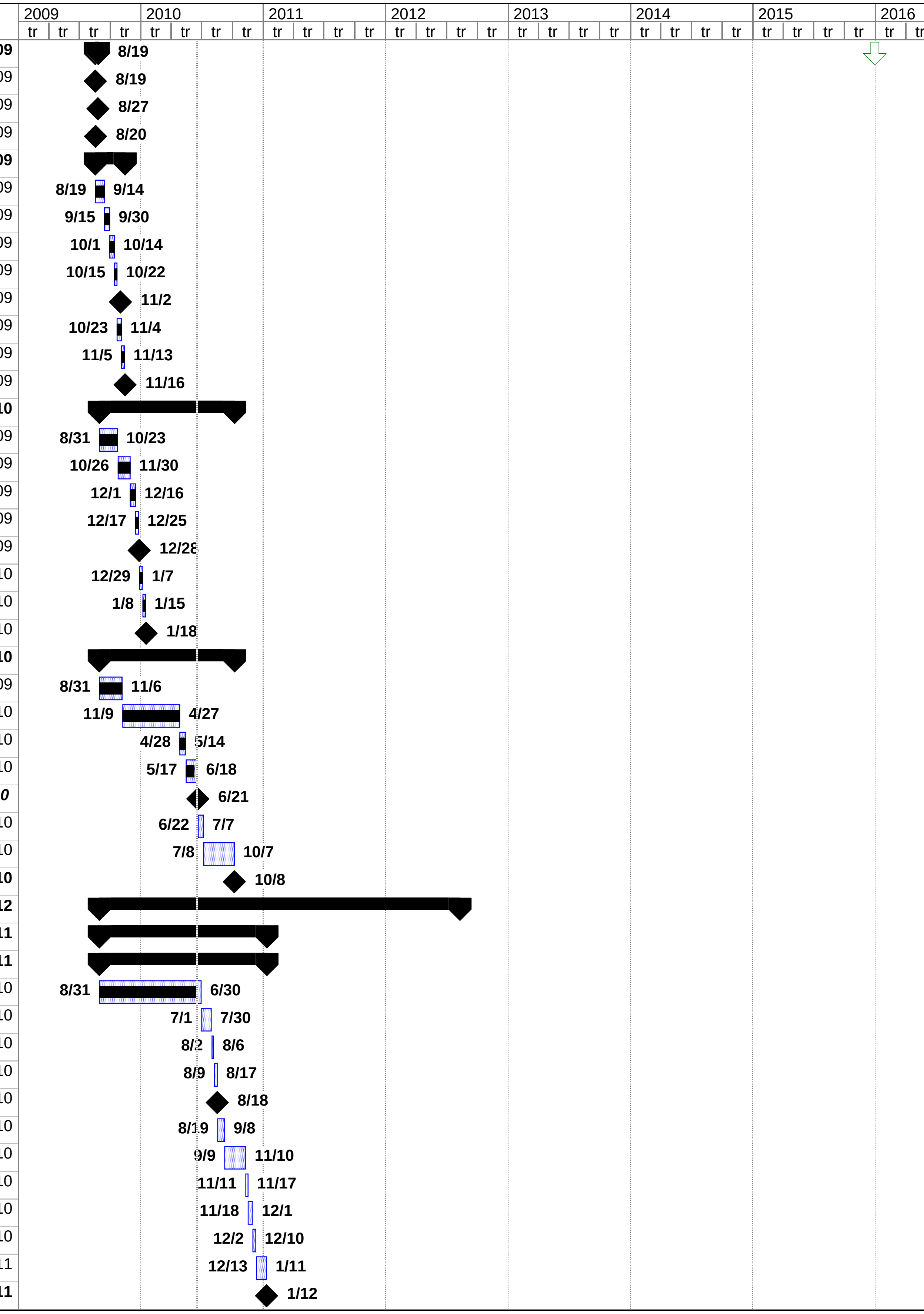
If you have any questions, please do not hesitate to contact me at (678) 938-0923.

Sincerely,

CH2M HILL

Mark Sherrill, P.G.
Project Manager

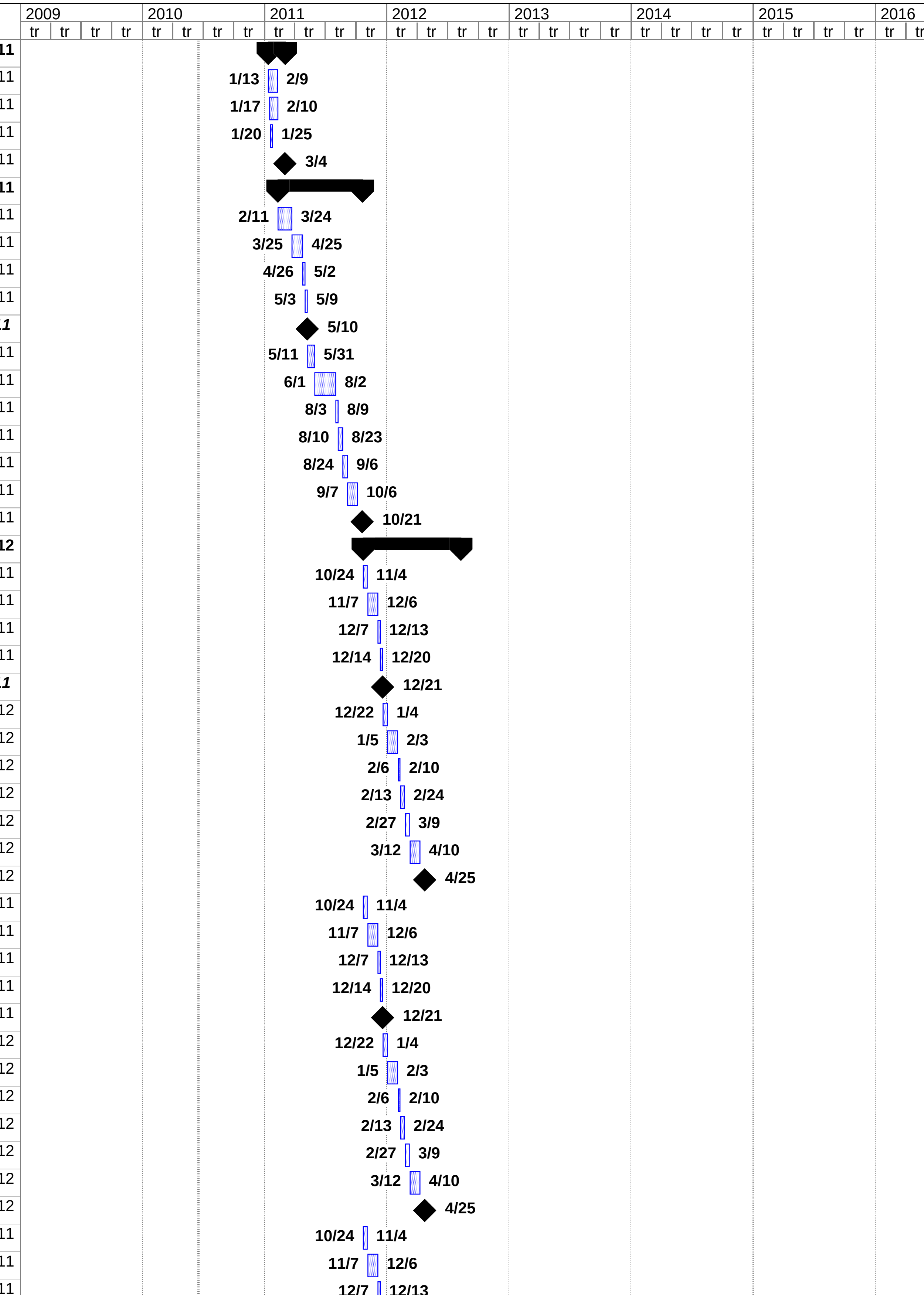
ID	Indicators	WBS	Task Name	Duration	Start	Finish
1	✓	**2004**	**ENVIRONMENTAL REMEDIATION SERVICES AT FT. RUCKER**	**7 days**	**Wed 8/19/09**	**Thu 8/27/09**
2	✓	2004A	Award Date	1 day	Wed 8/19/09	Wed 8/19/09
3	✓	2004B	Site Recon Visit	1 day	Thu 8/27/09	Thu 8/27/09
4	✓	2004C	Project Kick-Off Meeting	1 day	Thu 8/20/09	Thu 8/20/09
5	✓	**2004AA**	**PMP/QASP**	**63 days**	**Wed 8/19/09**	**Mon 11/16/09**
6	✓	2004AA1	Draft PMP/QASP Preparation and Submittal	19 days	Wed 8/19/09	Mon 9/14/09
7	✓	2004AA2	Army Review/Comments	12 days	Tue 9/15/09	Wed 9/30/09
8	✓	2004AA3	Prepare Response to Army Comments and Response Submittal	10 days	Thu 10/1/09	Wed 10/14/09
9	✓	2004AA4	Army Review/Acceptance of Response to Comments	6 days	Thu 10/15/09	Thu 10/22/09
10	✓	2004AA5	***Army Approval of Draft PMP/QASP***	0 days	Mon 11/2/09	Mon 11/2/09
11	✓	2004AA6	Final PMP Preparation and Submittal	9 days	Fri 10/23/09	Wed 11/4/09
12	✓	2004AA7	Army Review of Final PMP	7 days	Thu 11/5/09	Fri 11/13/09
13	✓	2004AA8	***Army Approval of Final PMP/QASP***	0 days	Mon 11/16/09	Mon 11/16/09
14		**2004BA**	**ADDITIONAL SITE-WIDE PLANS**	**290 days**	**Mon 8/31/09**	**Fri 10/8/10**
15	✓	2004BA1	Draft SSHP/SAP/WMP Preparation and Submittal	40 days	Mon 8/31/09	Fri 10/23/09
16	✓	2004BA2	Army Review/Comments	26 days	Mon 10/26/09	Mon 11/30/09
17	✓	2004BA3	Prepare Response to Army Comments and Response Submittal	12 days	Tue 12/1/09	Wed 12/16/09
18	✓	2004BA4	Army Review/Acceptance of Response to Comments	7 days	Thu 12/17/09	Fri 12/25/09
19	✓	2004BA5	***Army Approval of Draft SSHP/SAP//WMP***	1 day	Mon 12/28/09	Mon 12/28/09
20	✓	2004BA6	Final SSHP/SAP/WMP Preparation and Submittal	8 days	Tue 12/29/09	Thu 1/7/10
21	✓	2004BA7	Army Review of Final SSHP/SAP/WMP	6 days	Fri 1/8/10	Fri 1/15/10
22	✓	2004BA8	***Army Approval of Final SSHP/SAP/WMP***	1 day	Mon 1/18/10	Mon 1/18/10
23		**2004BA9**	**Explosives Site Plan (includes all MMRP Sites)**	**290 days**	**Mon 8/31/09**	**Fri 10/8/10**
24	✓	2004BA10	Draft Explosives Siting Plan Preparation and Submittal	50 days	Mon 8/31/09	Fri 11/6/09
25	✓	2004BA11	Army Review/Comments	122 days	Mon 11/9/09	Tue 4/27/10
26	✓	2004BA12	Prepare Response to Army Comments and Response Submittal	13 days	Wed 4/28/10	Fri 5/14/10
27		2004BA13	Army Review/Acceptance of Response to Comments	25 days	Mon 5/17/10	Fri 6/18/10
28		***2004BA14***	***Army Approval of Draft Explosives Siting Plan***	***1 day***	***Mon 6/21/10***	***Mon 6/21/10***
29		2004BA15	Final Explosives Siting Plan Preparation and Submittal	12 days	Tue 6/22/10	Wed 7/7/10
30		2004BA16	Army Review of Final Explosives Siting Plan	66 days	Thu 7/8/10	Thu 10/7/10
31		**2004BA17**	***Army Approval of Final Explosives Siting Plan***	**1 day**	**Fri 10/8/10**	**Fri 10/8/10**
32		**2004CA**	**MMRP SITES**	**770 days**	**Mon 8/31/09**	**Fri 8/10/12**
33		**2004CA1**	**RFI/CMS WORK PLAN**	**358 days**	**Mon 8/31/09**	**Wed 1/12/11**
34		**2004CA2**	**RFI/CMS Work Plan (includes all MMRP Sites)**	**358 days**	**Mon 8/31/09**	**Wed 1/12/11**
35		2004CA3	Draft RFI/CMS Work Plan Preparation and Submittal	218 days	Mon 8/31/09	Wed 6/30/10
36		2004CA4	Army Review/Comments	22 days	Thu 7/1/10	Fri 7/30/10
37		2004CA5	Prepare Response to Army Comments and Response Submittal	5 days	Mon 8/2/10	Fri 8/6/10
38		2004CA6	Army Review/Acceptance of Response to Comments	7 days	Mon 8/9/10	Tue 8/17/10
39		**2004CA7**	***Army Approval of Draft Final RFI/CMS Work Plan***	1 day	Wed 8/18/10	Wed 8/18/10
40		2004CA8	Draft Final RFI/CMS Work Plan Preparation and Submittal	15 days	Thu 8/19/10	Wed 9/8/10
41		2004CA9	ADEM/Army Review/Comments	45 days	Thu 9/9/10	Wed 11/10/10
42		2004CA10	Prepare Response to ADEM/Army Comments and Response Submittal	5 days	Thu 11/11/10	Wed 11/17/10
43		2004CA11	ADEM/Army Review/Acceptance of Response to Comments	10 days	Thu 11/18/10	Wed 12/1/10
44		2004CA12	Final RFI/CMS Work Plan Preparation and Submittal	7 days	Thu 12/2/10	Fri 12/10/10
45		2004CA13	ADEM/Army Review of Final RFI/CMS Work Plan	22 days	Mon 12/13/10	Tue 1/11/11
46		**2004CA14**	***Army/ADEM Approval of Final RFI/CMS Work Plan***	**1 day**	**Wed 1/12/11**	**Wed 1/12/11**



Project: FORT RUCKER PROJECT S
Date: 06/16/2010

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

ID		WBS	Task Name	Duration	Start	Finish
47		**2004CA15**	**RCRA FACILITY INVESTIGATION**	**37 days**	**Thu 1/13/11**	**Fri 3/4/11**
48		2004CA16	DGM/Instrusive Investigation-Ant-Tank/Rocket Grenade Range	20 days	Thu 1/13/11	Wed 2/9/11
49		2004CA17	DGM/Intrusive Investigation - Infiltration/Grenade Range	19 days	Mon 1/17/11	Thu 2/10/11
50		2004CA18	DGM/Intrusive Investigation - .22-Caliber Target Butt	4 days	Thu 1/20/11	Tue 1/25/11
51		***2004CA19***	***Army Acceptance of Total LF of Geophysical Transects/Instrusive Inv. TM***	1 day	Fri 3/4/11	Fri 3/4/11
52		**2004CA20**	**RCRA FACILITY INVESTIGATION REPORT / CMS**	**181 days**	**Fri 2/11/11**	**Fri 10/21/11**
53		2004CA21	Draft RFI/CMS Report (includes all MMRP Sites) Preparation and Submittal	30 days	Fri 2/11/11	Thu 3/24/11
54		2004CA22	Army Review/Comments	22 days	Fri 3/25/11	Mon 4/25/11
55		2004CA23	Prepare Response to Army Comments and Response Submittal	5 days	Tue 4/26/11	Mon 5/2/11
56		2004CA24	Army Review/Acceptance of Response to Comments	5 days	Tue 5/3/11	Mon 5/9/11
57		***2004CA25***	***Army Approval of Draft Final RFI/CMS Report***	***1 day***	***Tue 5/10/11***	***Tue 5/10/11***
58		2004CA26	Draft Final RFI/CMS Report Preparation and Submittal	15 days	Wed 5/11/11	Tue 5/31/11
59		2004CA27	ADEM/Army Review/Comment	45 days	Wed 6/1/11	Tue 8/2/11
60		2004CA28	Response to ADEM/Army Comments and Response Submittal	5 days	Wed 8/3/11	Tue 8/9/11
61		2004CA29	ADEM/Army Review/Acceptance of Response to Comments	10 days	Wed 8/10/11	Tue 8/23/11
62		2004CA30	Final RFI/CMS Report Preparation and Submittal	10 days	Wed 8/24/11	Tue 9/6/11
63		2004CA31	ADEM/Army Review of Final RFI/CMS Report	22 days	Wed 9/7/11	Thu 10/6/11
64		**2004CA32**	***Army/ADEM Approval of Final RFI/CMS Report***	1 day	Fri 10/21/11	Fri 10/21/11
65		**2004CA33**	**STATEMENT OF BASIS**	**210 days**	**Mon 10/24/11**	**Fri 8/10/12**
66		2004CA34	Draft Statement of Basis - Anti-Tank/Rocket Grenade Range Prep and Submittal	10 days	Mon 10/24/11	Fri 11/4/11
67		2004CA35	Army Review/Comments	22 days	Mon 11/7/11	Tue 12/6/11
68		2004CA36	Prepare Response to Army Comments and Response Submitttal	5 days	Wed 12/7/11	Tue 12/13/11
69		2004CA37	Army Review/Acceptance of Response to Comments	5 days	Wed 12/14/11	Tue 12/20/11
70		*2004CA38*	Army Approval of Draft SB-Anti-Tank/Rocket Grenade Range	***1 day***	***Wed 12/21/11***	***Wed 12/21/11***
71		2004CA39	Draft Final Statement of Basis - Anti-Tank/Rocket Grenade Range Prep and Submittal	10 days	Thu 12/22/11	Wed 1/4/12
72		2004CA40	ADEM/Army Review/Comment	22 days	Thu 1/5/12	Fri 2/3/12
73		2004CA41	Response to ADEM/Army Comments and Response Submittal	5 days	Mon 2/6/12	Fri 2/10/12
74		2004CA42	ADEM/Army Review/Acceptance of Response to Comments	10 days	Mon 2/13/12	Fri 2/24/12
75		2004CA43	Final Statement of Basis - Anti-Tank/Rocket Grenade Range Prep and Submittal	10 days	Mon 2/27/12	Fri 3/9/12
76		2004CA44	ADEM/Army Review of Final Statement of Basis - Anti-Tank/Rocket Grenade Rg	22 days	Mon 3/12/12	Tue 4/10/12
77		**2004CA45**	***Army/ADEM Approval of Final SB-Anti-Tank/Rocket Grenade***	1 day	Wed 4/25/12	Wed 4/25/12
78		2004CA46	Draft Statement of Basis - Infiltration/Grenade Range Preparation and Submittal	10 days	Mon 10/24/11	Fri 11/4/11
79		2004CA47	Army Review/Comments	22 days	Mon 11/7/11	Tue 12/6/11
80		2004CA48	Prepare Response to Army Comments and Response Submittal	5 days	Wed 12/7/11	Tue 12/13/11
81		2004CA49	Army Review/Acceptance of Response to Comments	5 days	Wed 12/14/11	Tue 12/20/11
82		2004CA50	Army Approval of Draft SB-Infiltration/Grenade Range	1 day	Wed 12/21/11	Wed 12/21/11
83		2004CA51	Draft Final Statement of Basis - Infiltration/Grenade Range Prep and Submittal	10 days	Thu 12/22/11	Wed 1/4/12
84		2004CA52	ADEM/Army Review/Comments	22 days	Thu 1/5/12	Fri 2/3/12
85		2004CA53	Prepare Response to ADEM/Army Comments and Response Submittal	5 days	Mon 2/6/12	Fri 2/10/12
86		2004CA54	ADEM/Army Review/Acceptance of Response to Comments	10 days	Mon 2/13/12	Fri 2/24/12
87		2004CA55	Final Statement of Basis - Infiltration/ Grenade Range Prep and Submittal	10 days	Mon 2/27/12	Fri 3/9/12
88		2004CA56	ADEM/Army Review of Final Statement of Basis - Infiltration/Grenade Range	22 days	Mon 3/12/12	Tue 4/10/12
89		**2004CA57**	***Army/ADEM Approval of Final SB-Infiltration/Grenade Range***	1 day	Wed 4/25/12	Wed 4/25/12
90		2004CA658	Draft Statement of Basis - .22-Caliber Target Butt Preparation and Submittal	10 days	Mon 10/24/11	Fri 11/4/11
91		2004CA59	Army Review/Comments	22 days	Mon 11/7/11	Tue 12/6/11
92		2004CA60	Prepare Response to Army Comments and Response Submittal	5 days	Wed 12/7/11	Tue 12/13/11



Project: FORT RUCKER PROJECT S
Date: 06/16/2010

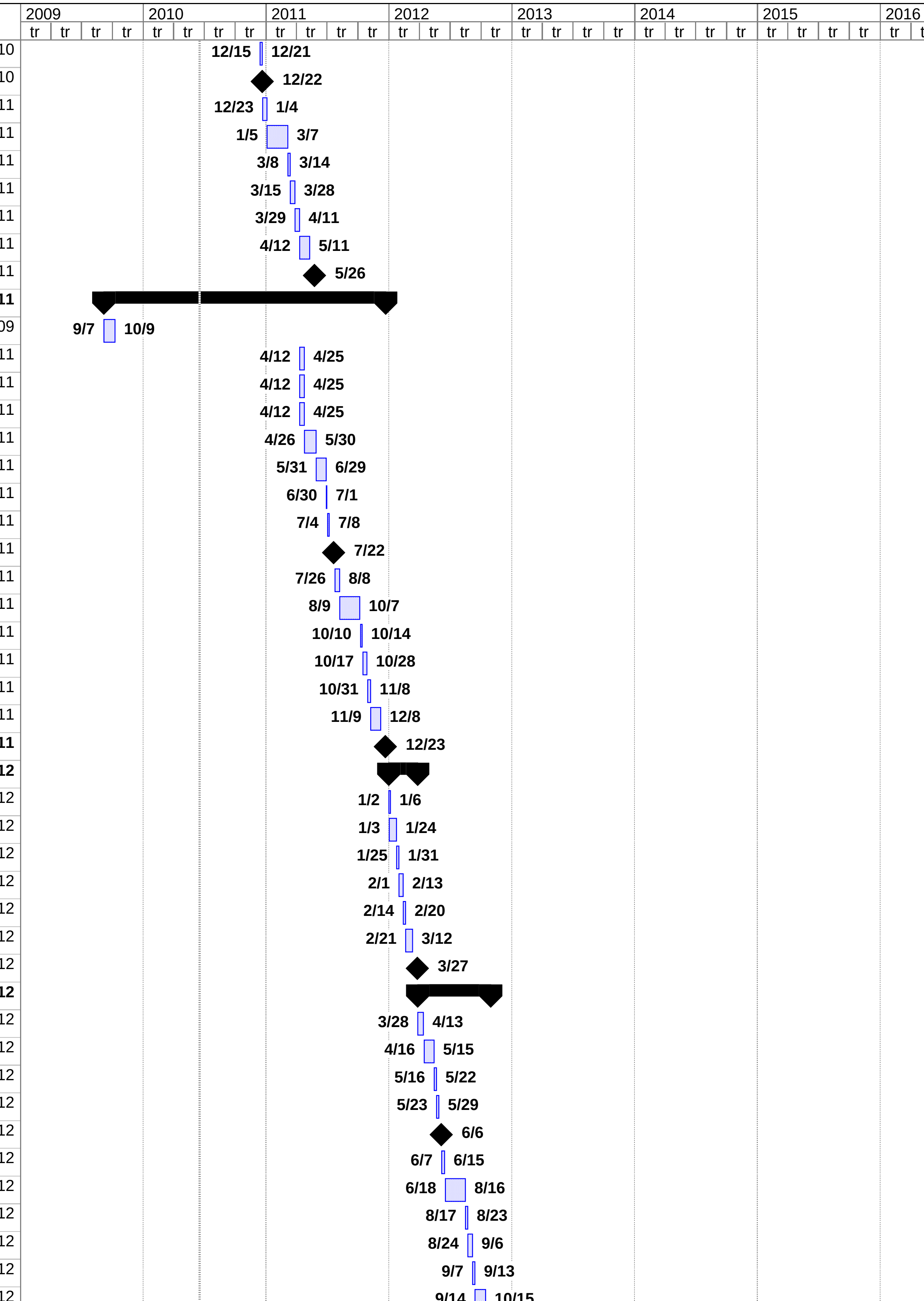
Task	Milestone	Rolled Up Task	Rolled Up Progress	External Tasks	Group By Summary
Progress	Summary	Rolled Up Milestone	Split	Project Summary	Deadline

ID		WBS	Task Name	Duration	Start	Finish
93		2004CA61	Army Review/Acceptance of Response to Comments	5 days	Wed 12/14/11	Tue 12/20/11
94		2004CA62	Army Approval of Draft SB-.22-Caliber Target Butt	1 day	Wed 12/21/11	Wed 12/21/11
95		2004CA63	Draft Final Statement of Basis - .22-Caliber Target Butt Prep and Submittal	10 days	Thu 12/22/11	Wed 1/4/12
96		2004CA64	ADEM/Army Review/Comment	22 days	Thu 1/5/12	Fri 2/3/12
97		2004CA65	Prepare Response to ADEM/Army Comments and Response Submittal	5 days	Mon 2/6/12	Fri 2/10/12
98		2004CA66	ADEM/Army Review/Acceptance of Response to Comments	10 days	Mon 2/13/12	Fri 2/24/12
99		2004CA67	Final Statement of Basis - .22-Caliber Target Butt Prep and Submittal	10 days	Mon 2/27/12	Fri 3/9/12
100		2004CA68	ADEM/Army Review of Final Statement of Basis - .22-Caliber Target Butt	22 days	Mon 3/12/12	Tue 4/10/12
101		**2004CA69**	***Army/ADEM Approval of Final SB-.22-Caliber Target Butt***	1 day	Wed 4/25/12	Wed 4/25/12
102		2004CA70	Public Comment Period (All MMRP Sites)	23 days	Thu 4/26/12	Mon 5/28/12
103		2004CA71	Prepare Response to Public Comments	5 days	Tue 5/29/12	Mon 6/4/12
104		2004CA72	Army/ADEM Review/Acceptance of Response to Public Comments	10 days	Tue 6/5/12	Mon 6/18/12
105		2004CA73	Revise Statement of Basis (If Needed Based on Public Comment)	7 days	Tue 6/19/12	Wed 6/27/12
106		2004CA74	ADEM/Army Review of Final Statement fo Basis	22 days	Thu 6/28/12	Fri 7/27/12
107		2004CA75	Final Statement of Basis - Acceptance of Ranges	10 days	Mon 7/30/12	Fri 8/10/12
108		2004CA76	Draft MMRP Scores Update and Submittal	15 days	Mon 3/12/12	Fri 3/30/12
109		2004CA77	Army Review/Comments	22 days	Mon 4/2/12	Tue 5/1/12
110		2004CA78	Final MMRP Scores Update and Submittal	10 days	Wed 5/2/12	Tue 5/15/12
111		**2004DA**	**IRP SITE AOC-S**	**1547 days**	**Mon 9/7/09**	**Tue 8/11/15**
112		**2004DA1**	**FINAL RFI**	242 days	Wed 2/3/10	Thu 1/6/11
113	✓	2004DA2	Draft RFI Technical Memorandum Work Plan Preparation and Submittal	19 days	Wed 2/3/10	Mon 3/1/10
114	✓	2004DA3	Army Review/Comment	5 days	Tue 3/2/10	Mon 3/8/10
115	✓	2004DA4	Prepare Response to Army Comments and Submittal	1 day	Tue 3/9/10	Tue 3/9/10
116	✓	2004DA5	Army Review/Acceptance of Response to Comments	1 day	Wed 3/10/10	Wed 3/10/10
117	✓	2004DA6	Draft Final RFI Technical Memorandum Work Plan Preparation and Submittal	2 days	Thu 3/11/10	Fri 3/12/10
118	✓	2004DA7	ADEM/Army Review/Comment	10 days	Mon 3/15/10	Fri 3/26/10
119	✓	2004DA8	Prepare Response to ADEM/Army Comments and Response Submittal	1 day	Mon 3/29/10	Mon 3/29/10
120	✓	2004DA9	ADEM/Army Review/Acceptance of Response to Comments	2 days	Tue 3/30/10	Wed 3/31/10
121	✓	2004DA10	Final RFI Technical Memorandum Work Plan Preparation and Submittal	3 days	Thu 4/1/10	Mon 4/5/10
122	✓	2004DA11	Army/ADEM Approval of Final RFI Technical Memorandum Work Plan	21 days	Tue 4/6/10	Tue 5/4/10
123	✓	2004DA12	RFI Field Work-Well Installation/Sampling	25 days	Mon 5/10/10	Fri 6/11/10
124		2004DA13	Final (Draft) RFI Report Preparation and Submittal	22 days	Wed 6/30/10	Thu 7/29/10
125		2004DA14	Army Review/Comment	22 days	Fri 7/30/10	Mon 8/30/10
126		2004DA15	Prepare Response to Army Comments and Submittal	2 days	Tue 8/31/10	Wed 9/1/10
127		2004DA16	Army Review/Acceptance of Response to Comments	5 days	Thu 9/2/10	Wed 9/8/10
128		2004DA17	Final (Draft Final) RFI Report Preparation and Submittal	10 days	Thu 9/9/10	Wed 9/22/10
129		2004DA18	Army/ADEM Review/Comment	44 days	Thu 9/23/10	Tue 11/23/10
130		2004DA19	Prepare Response to ADEM/Army Comments and Response Submittal	5 days	Wed 11/24/10	Tue 11/30/10
131		2004DA20	ADEM/Army Review/Acceptance of Response to Comments	10 days	Wed 12/1/10	Tue 12/14/10
132		2004DA21	Final RFI Report Preparation and Submittal	10 days	Wed 12/15/10	Tue 12/28/10
133		2004DA22	ADEM/Army Review of Final RFI Report	22 days	Wed 12/29/10	Thu 1/27/11
134		**2004DA23**	***Army/ADEM Approval of Final RFI Report***	1 day	Fri 2/11/11	Fri 2/11/11
135		**2004DA24**	**ARBCA EVALUATION**	**191 days**	**Thu 9/2/10**	**Thu 5/26/11**
136		2004DA25	Draft AOC-S ARBCA Technical Memorandum Preparation and Submittal (including GW M	50 days	Thu 9/2/10	Wed 11/10/10
137		2004DA26	Army Review/Comment	22 days	Thu 11/11/10	Fri 12/10/10
138		2004DA27	Prepare Response to Army Comments and Submittal	2 days	Mon 12/13/10	Tue 12/14/10

Project: FORT RUCKER PROJECT S
Date: 06/16/2010

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

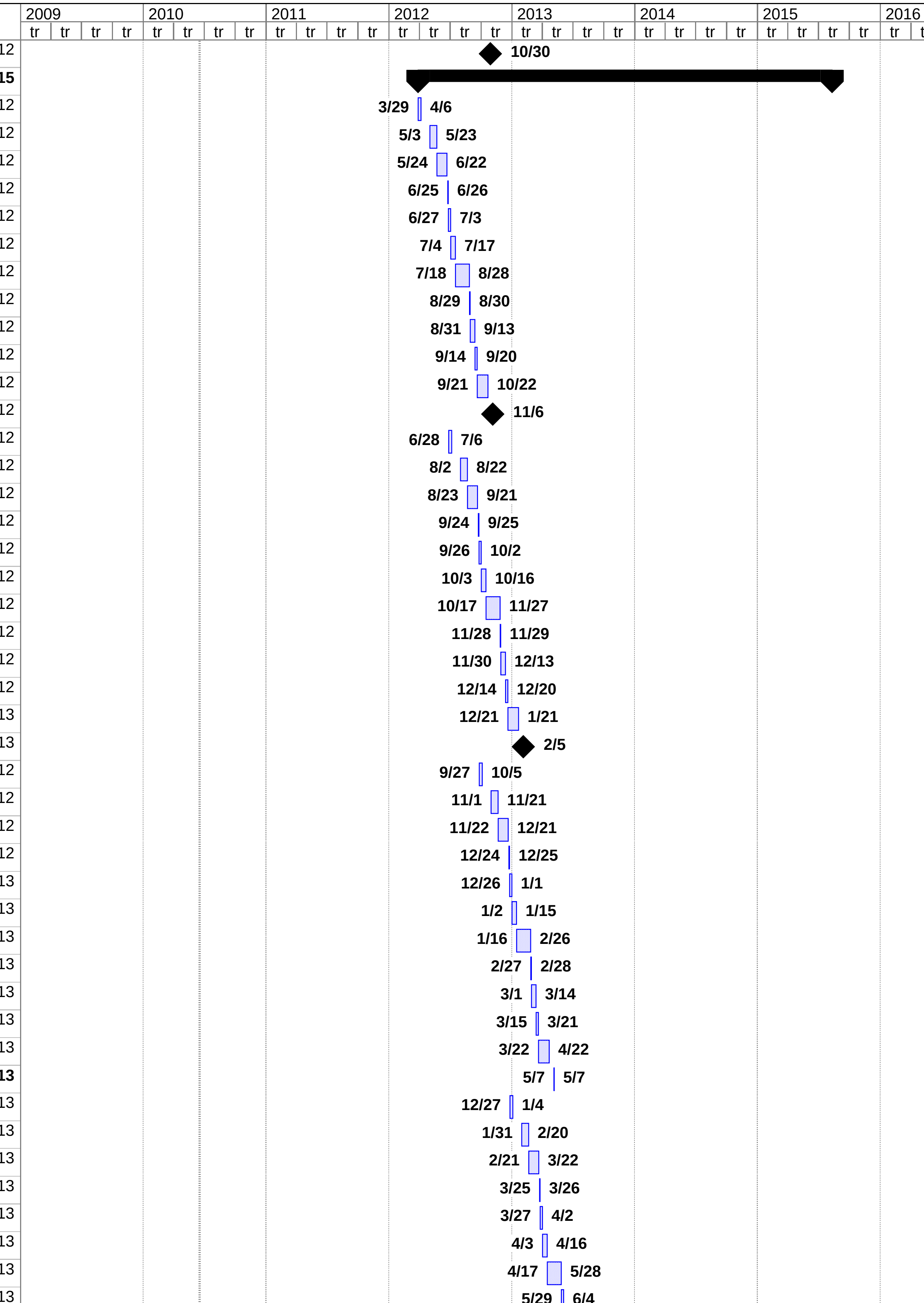
ID		WBS	Task Name	Duration	Start	Finish
139		2004DA28	Army Review/Acceptance of Response to Comments	5 days	Wed 12/15/10	Tue 12/21/10
140		**2004DA29**	***Army Approval of Draft Final AOC-S ARBCA Technical Memorandum***	1 day	Wed 12/22/10	Wed 12/22/10
141		2004DA30	Draft Final AOC-S ARBCA Technical Memorandum Preparation and Submittal	9 days	Thu 12/23/10	Tue 1/4/11
142		2004DA31	ADEM/Army Review/Comment	44 days	Wed 1/5/11	Mon 3/7/11
143		2004DA32	Prepare Response to ADEM/Army Comments and Submittal	5 days	Tue 3/8/11	Mon 3/14/11
144		2004DA33	ADEM/Army Review/Acceptance of Response to Comments	10 days	Tue 3/15/11	Mon 3/28/11
145		2004DA34	Final AOC-S ARBCA Technical Memorandum Preparation and Submittal	10 days	Tue 3/29/11	Mon 4/11/11
146		2004DA35	ADEM/Army Review of Final AOC-S ARBCA Technical Memorandum	22 days	Tue 4/12/11	Wed 5/11/11
147		**2004DA36**	***Army/ADEM Approval of Final AOC-S ARBCA Technical Memorandum***	1 day	Thu 5/26/11	Thu 5/26/11
148		**2004DA37**	**CMS/CMIP**	**600 days**	**Mon 9/7/09**	**Fri 12/23/11**
149		2004DA38	Pre-Construction Survey	25 days	Mon 9/7/09	Fri 10/9/09
150		2004DA39	PRB Remedial Design	10 days	Tue 4/12/11	Mon 4/25/11
151		2004DA40	CMS	10 days	Tue 4/12/11	Mon 4/25/11
152		2004DA41	LTM Plan	10 days	Tue 4/12/11	Mon 4/25/11
153		2004DA42	Draft CMS/CMIP Preparation and Submittal	25 days	Tue 4/26/11	Mon 5/30/11
154		2004DA43	Army Review/Comment	22 days	Tue 5/31/11	Wed 6/29/11
155		2004DA44	Prepare Response to Army Comments and Submittal	2 days	Thu 6/30/11	Fri 7/1/11
156		2004DA45	Army Review/Acceptance of Response to Comments	5 days	Mon 7/4/11	Fri 7/8/11
157		**2004DA46**	***Army Approval of Draft Final CMS/CMIP***	1 day	Fri 7/22/11	Fri 7/22/11
158		2004DA47	Draft Final CMS/CMIP Preparation and Submittal	10 days	Tue 7/26/11	Mon 8/8/11
159		2004DA48	ADEM/Army Review/Comment	44 days	Tue 8/9/11	Fri 10/7/11
160		2004DA49	Prepare Response to ADEM/Army Comments and Submittal	5 days	Mon 10/10/11	Fri 10/14/11
161		2004DA50	ADEM/Army Review/Acceptance of Response to Comments	10 days	Mon 10/17/11	Fri 10/28/11
162		2004DA51	Final CMS/CMIP Preparation and Submittal	7 days	Mon 10/31/11	Tue 11/8/11
163		2004DA52	ADEM/Army Review of Final CMS/CMIP	22 days	Wed 11/9/11	Thu 12/8/11
164		**2004DA53**	***Army/ADEM Approval of Final CMS/CMIP***	**1 day**	**Fri 12/23/11**	**Fri 12/23/11**
165		**2004DA54**	**CMI**	**62 days**	**Mon 1/2/12**	**Tue 3/27/12**
166		2004DA55	Site Preparation Mobilization	5 days	Mon 1/2/12	Fri 1/6/12
167		2004DA56	Site Preparation (clearing, work platform)	16 days	Tue 1/3/12	Tue 1/24/12
168		2004DA57	PRB Mobilization	5 days	Wed 1/25/12	Tue 1/31/12
169		2004DA58	PRB Installation	9 days	Wed 2/1/12	Mon 2/13/12
170		2004DA59	PRB Monitoring Well Network Installation	5 days	Tue 2/14/12	Mon 2/20/12
171		2004DA60	Post-Construction Survey	15 days	Tue 2/21/12	Mon 3/12/12
172		***2004DA61***	***Army Acceptance of Installation of ZVI/Sand TM***	1 day	Tue 3/27/12	Tue 3/27/12
173		**2004DA62**	**CMI Report**	**155 days**	**Wed 3/28/12**	**Tue 10/30/12**
174		2004DA63	Draft AOC-S CMI Report Preparation and Submittal	13 days	Wed 3/28/12	Fri 4/13/12
175		2004DA64	Army Review/Comment	22 days	Mon 4/16/12	Tue 5/15/12
176		2004DA65	Prepare Response to Army Comments and Submittal	5 days	Wed 5/16/12	Tue 5/22/12
177		2004DA66	Army Review/Acceptance of Response to Comments	5 days	Wed 5/23/12	Tue 5/29/12
178		**2004DA67**	***Army Approval of Draft Final AOC-S CMI Report***	1 day	Wed 6/6/12	Wed 6/6/12
179		2004DA68	Draft Final AOC-S CMI Report Preparation and Submittal	7 days	Thu 6/7/12	Fri 6/15/12
180		2004DA69	ADEM/Army Review/Comment	44 days	Mon 6/18/12	Thu 8/16/12
181		2004DA70	Prepare Response to ADEM/Army Comments and Submittal	5 days	Fri 8/17/12	Thu 8/23/12
182		2004DA71	ADEM/Army Review/Acceptance of Response to Comments	10 days	Fri 8/24/12	Thu 9/6/12
183		2004DA72	Final AOC-S CMI Report Preparation and Submittal	5 days	Fri 9/7/12	Thu 9/13/12
184		2004DA73	ADEM/Army Review of Final AOC-S CMI Report	22 days	Fri 9/14/12	Mon 10/15/12



Project: FORT RUCKER PROJECT S
Date: 06/16/2010

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

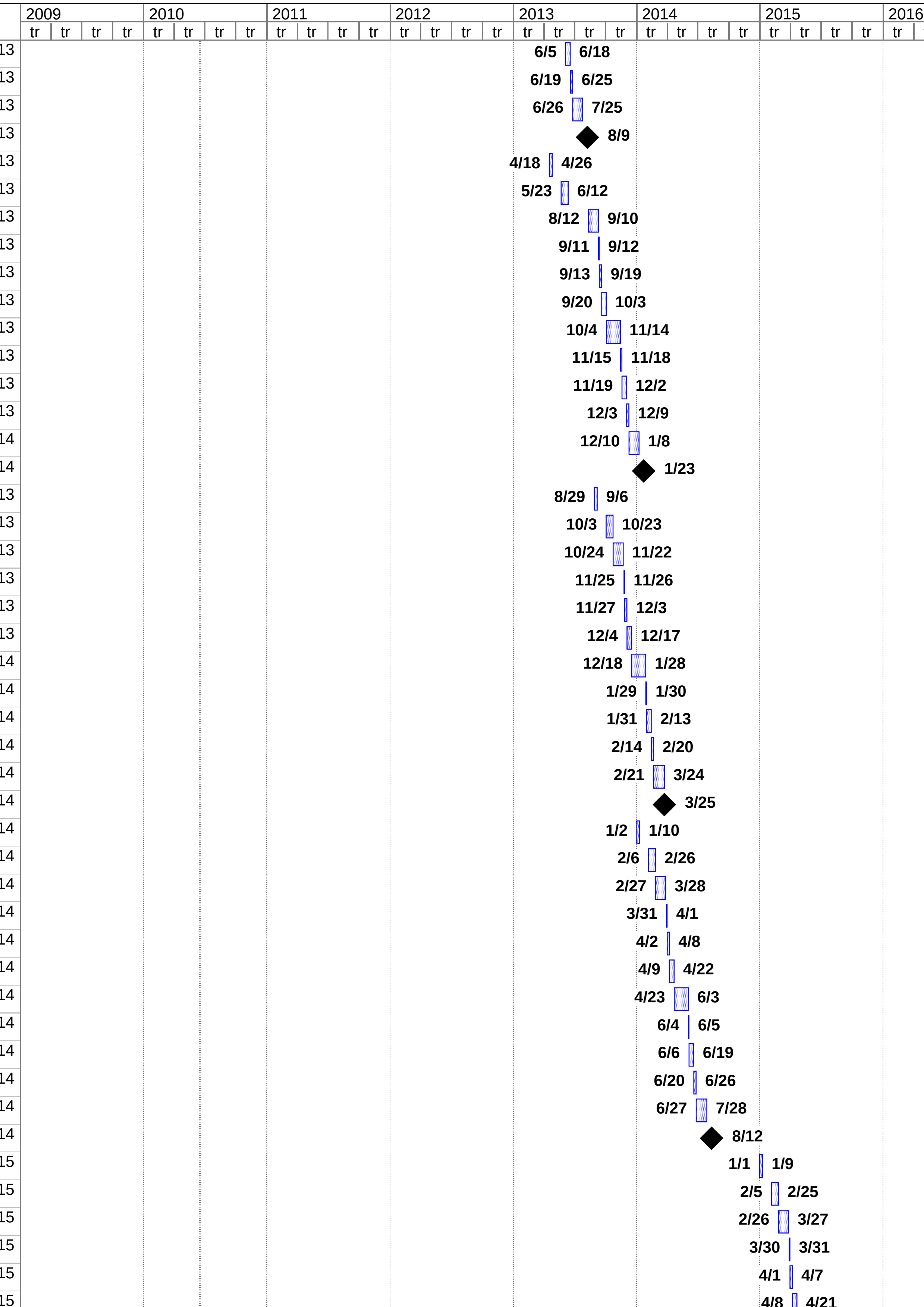
ID	WBS	Task Name	Duration	Start	Finish
185	**2004DA74**	***Army/ADEM Approval of Final AOC-S CMI Report***	1 day	Tue 10/30/12	Tue 10/30/12
186	**2004DB**	**LTM**	**879 days**	**Thu 3/29/12**	**Tue 8/11/15**
187	2004DB1	AOC-S LTM Q1 (2012) Monitoring Event	7 days	Thu 3/29/12	Fri 4/6/12
188	2004DB2	AOC-S LTM Q1 (2012) LTM Draft Report Preparation and Submittal	15 days	Thu 5/3/12	Wed 5/23/12
189	2044DB3	Army Review/Comment	22 days	Thu 5/24/12	Fri 6/22/12
190	2044DB4	Prepare Response to Army Comments and Submittal	2 days	Mon 6/25/12	Tue 6/26/12
191	2004DB5	Army Review/Acceptance of Response to Comments	5 days	Wed 6/27/12	Tue 7/3/12
192	2004DB6	AOC-S LTM Q1 (2012) LTM Draft Final Report Preparation and Submittal	10 days	Wed 7/4/12	Tue 7/17/12
193	2004DB7	ADEM/Army Review/Comment	30 days	Wed 7/18/12	Tue 8/28/12
194	2004DB8	Prepare Response to ADEM/Army Comments and Submittal	2 days	Wed 8/29/12	Thu 8/30/12
195	2004DB9	ADEM/Army Review/Acceptance of Response to Comments	10 days	Fri 8/31/12	Thu 9/13/12
196	2004DB10	AOC-S LTM Q1 (2012) LTM Final Report Preparation and Submittal	5 days	Fri 9/14/12	Thu 9/20/12
197	2004DB11	ADEM/Army Review of AOC-S LTM Q1 (2012) Final Report	22 days	Fri 9/21/12	Mon 10/22/12
198	**2004DB12**	***Army/ADEM Approval of AOC-S LTM Q1 (2012) LTM Final Report***	1 day	Tue 11/6/12	Tue 11/6/12
199	2004DB13	AOC-S LTM Q2 (2012) Monitoring Event	7 days	Thu 6/28/12	Fri 7/6/12
200	2004DB14	AOC-S LTM Q2 (2012) LTM Draft Report Preparation and Submittal	15 days	Thu 8/2/12	Wed 8/22/12
201	2004DB15	Army Review/Comment	22 days	Thu 8/23/12	Fri 9/21/12
202	2004DB16	Prepare Response to Army Comments and Submittal	2 days	Mon 9/24/12	Tue 9/25/12
203	2004DB17	Army Review/Acceptance of Response to Comments	5 days	Wed 9/26/12	Tue 10/2/12
204	2004DB18	AOC-S LTM Q2 (2012) LTM Draft Final Report Preparation and Submittal	10 days	Wed 10/3/12	Tue 10/16/12
205	2004DB19	ADEM/Army Review/Comment	30 days	Wed 10/17/12	Tue 11/27/12
206	2004DB20	Prepare Response to ADEM/Army Comments and Submittal	2 days	Wed 11/28/12	Thu 11/29/12
207	2004DB21	ADEM/Army Review/Acceptance of Response to Comments	10 days	Fri 11/30/12	Thu 12/13/12
208	2004DB22	AOC-S LTM Q2 (2012) LTM Final Report Preparation and Submittal	5 days	Fri 12/14/12	Thu 12/20/12
209	2004DB23	ADEM/Army Review of AOC-S LTM Q2 (2012) LTM Final Report	22 days	Fri 12/21/12	Mon 1/21/13
210	**2004DB24**	***Army/ADEM Approval of AOC-S LTM Q2 (2012) LTM Final Report***	1 day	Tue 2/5/13	Tue 2/5/13
211	2004DB25	AOC-S LTM Q3 (2012) Monitoring Event	7 days	Thu 9/27/12	Fri 10/5/12
212	2004DB26	AOC-S LTM Q3 (2012) LTM Draft Report Preparation and Submittal	15 days	Thu 11/1/12	Wed 11/21/12
213	2004DB27	Army Review/Comment	22 days	Thu 11/22/12	Fri 12/21/12
214	2004DB28	Prepare Response to Army Comments and Submittal	2 days	Mon 12/24/12	Tue 12/25/12
215	2004DB29	Army Review/Acceptance of Response to Comments	5 days	Wed 12/26/12	Tue 1/1/13
216	2004DB30	AOC-S LTM Q3 (2012) LTM Draft Final Report Preparation and Submittal	10 days	Wed 1/2/13	Tue 1/15/13
217	2004DB31	ADEM/Army Review/Comment	30 days	Wed 1/16/13	Tue 2/26/13
218	2004DB32	Prepare Response to ADEM/Army Comments and Submittal	2 days	Wed 2/27/13	Thu 2/28/13
219	2004DB33	ADEM/Army Review/Acceptance of Response to Comments	10 days	Fri 3/1/13	Thu 3/14/13
220	2004DB34	AOC-S LTM Q3 (2012) LTM Final Report Preparation and Submittal	5 days	Fri 3/15/13	Thu 3/21/13
221	2004DB35	ADEM/Army Review of AOC-S LTM Q3 (2012) LTM Final Report	22 days	Fri 3/22/13	Mon 4/22/13
222	**2004DB36**	***Army/ADEM Approval of AOC-S LTM Q3 (2012) LTM Final Report***	**1 day**	**Tue 5/7/13**	**Tue 5/7/13**
223	2004DB37	AOC-S LTM Q4 (2012) Monitoring Event	7 days	Thu 12/27/12	Fri 1/4/13
224	2004DB38	AOC-S LTM Q4 (2012) LTM Draft Report Preparation and Submittal	15 days	Thu 1/31/13	Wed 2/20/13
225	2004DB39	Army Review/Comment	22 days	Thu 2/21/13	Fri 3/22/13
226	2004DB40	Prepare Response to Army Comments and Submittal	2 days	Mon 3/25/13	Tue 3/26/13
227	2004DB41	Army Review/Acceptance of Response to Comments	5 days	Wed 3/27/13	Tue 4/2/13
228	2004DB42	AOC-S LTM Q4 (2012) LTM Draft Final Report Preparation and Submittal	10 days	Wed 4/3/13	Tue 4/16/13
229	2004DB43	ADEM/Army Review/Comment	30 days	Wed 4/17/13	Tue 5/28/13
230	2004DB44	Prepare Response to ADEM/Army Comments and Submittal	5 days	Wed 5/29/13	Tue 6/4/13



Project: FORT RUCKER PROJECT S
Date: 06/16/2010

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

ID	WBS	Task Name	Duration	Start	Finish
231	2004DB45	ADEM/Army Review/Acceptance of Response to Comments	10 days	Wed 6/5/13	Tue 6/18/13
232	2004DB446	AOC-S LTM Q4 (2012) LTM Final Report Preparation and Submittal	5 days	Wed 6/19/13	Tue 6/25/13
233	2004DB47	ADEM/Army Review of AOC-S LTM Q4 (2012) LTM Final Report	22 days	Wed 6/26/13	Thu 7/25/13
234	**2004DB48**	***Army/ADEM Approval of AOC-S LTM Q4 (2012) LTM Final Report***	1 day	Fri 8/9/13	Fri 8/9/13
235	2004DC1	AOC-S LTM SA1 (2013) Monitoring Event	7 days	Thu 4/18/13	Fri 4/26/13
236	2004DC2	AOC-S LTM SA1 (2013) LTM Draft Report Preparation and Submittal	15 days	Thu 5/23/13	Wed 6/12/13
237	2004DC3	Army Review/Comment	22 days	Mon 8/12/13	Tue 9/10/13
238	2004DC4	Prepare Response to Army Comments and Submittal	2 days	Wed 9/11/13	Thu 9/12/13
239	2004DC5	Army Review/Acceptance of Response to Comments	5 days	Fri 9/13/13	Thu 9/19/13
240	2004DC6	AOC-S LTM SA1 (2013) LTM Draft Final Report Preparation and Submittal	10 days	Fri 9/20/13	Thu 10/3/13
241	2004DC7	ADEM/Army Review/Comment	30 days	Fri 10/4/13	Thu 11/14/13
242	2004DC8	Prepare Response to ADEM/Army Comments and Submittal	2 days	Fri 11/15/13	Mon 11/18/13
243	2004DC9	ADEM/Army Review/Acceptance of Response to Comments	10 days	Tue 11/19/13	Mon 12/2/13
244	2004DC10	AOC-S LTM SA1 (2013) LTM Final Report Preparation and Submittal	5 days	Tue 12/3/13	Mon 12/9/13
245	2004DC11	ADEM/Army Review of AOC-S LTM SA1 (2013) LTM Final Report	22 days	Tue 12/10/13	Wed 1/8/14
246	**2004DC12**	***Army/ADEM Approval of AOC-S LTM SA1 (2013) LTM Final Report***	1 day	Thu 1/23/14	Thu 1/23/14
247	2004DC13	AOC-S LTM SA2 (2013) Monitoring Event	7 days	Thu 8/29/13	Fri 9/6/13
248	2004DC14	AOC-S LTM SA2 (2013) LTM Draft Report Preparation and Submittal	15 days	Thu 10/3/13	Wed 10/23/13
249	2004DC15	Army Review/Comment	22 days	Thu 10/24/13	Fri 11/22/13
250	2004DC16	Prepare Response to Army Comments and Submittal	2 days	Mon 11/25/13	Tue 11/26/13
251	2004DC17	Army Review/Acceptance of Response to Comments	5 days	Wed 11/27/13	Tue 12/3/13
252	2004DC18	AOC-S LTM SA2 (2013) LTM Draft Final Report Preparation and Submittal	10 days	Wed 12/4/13	Tue 12/17/13
253	2004DC19	ADEM/Army Review/Comment	30 days	Wed 12/18/13	Tue 1/28/14
254	2004DC20	Prepare Response to ADEM/Army Comments and Submittal	2 days	Wed 1/29/14	Thu 1/30/14
255	2004DC21	ADEM/Army Review/Acceptance of Response to Comments	10 days	Fri 1/31/14	Thu 2/13/14
256	2004DC22	AOC-S LTM SA2 (2013) LTM Final Report Preparation and Submittal	5 days	Fri 2/14/14	Thu 2/20/14
257	2004DC23	ADEM/Army Review of AOC-S LTM SA2 (2013) LTM Final Report	22 days	Fri 2/21/14	Mon 3/24/14
258	**2004DC24**	***Army/ADEM Approval of AOC-S LTM SA2 (2013) LTM Final Report***	10 days	Tue 3/25/14	Mon 4/7/14
259	2004DD1	AOC-S LTM A1 (2014) Monitoring Event	7 days	Thu 1/2/14	Fri 1/10/14
260	2004DD2	AOC-S LTM A1 (2014) LTM Draft Report Preparation and Submittal	15 days	Thu 2/6/14	Wed 2/26/14
261	2004DD3	Army Review/Comment	22 days	Thu 2/27/14	Fri 3/28/14
262	2004DD4	Prepare Response to Army Comments and Submittal	2 days	Mon 3/31/14	Tue 4/1/14
263	2004DD5	Army Review/Acceptance of Response to Comments	5 days	Wed 4/2/14	Tue 4/8/14
264	2004DD6	AOC-S LTM A1 (2014) LTM Draft Final Report Preparation and Submittal	10 days	Wed 4/9/14	Tue 4/22/14
265	2004DD7	ADEM/Army Review/Comment	30 days	Wed 4/23/14	Tue 6/3/14
266	2004DD8	Prepare Response to ADEM/Army Comments and Submittal	2 days	Wed 6/4/14	Thu 6/5/14
267	2004DD9	ADEM/Army Review/Acceptance of Response to Comments	10 days	Fri 6/6/14	Thu 6/19/14
268	2004DD10	AOC-S LTM A1 (2014) LTM Final Report Preparation and Submittal	5 days	Fri 6/20/14	Thu 6/26/14
269	2004DD11	ADEM/Army Review of AOC-S LTM A1 (2014) LTM Final Report	22 days	Fri 6/27/14	Mon 7/28/14
270	**2004DD12**	***Army/ADEM Approval of AOC-S LTM A1 (2014) LTM Final Report***	1 day	Tue 8/12/14	Tue 8/12/14
271	2004DE1	AOC-S LTM A2 (2015) Monitoring Event	7 days	Thu 1/1/15	Fri 1/9/15
272	2004DE2	AOC-S LTM A2 (2015) LTM Draft Report Preparation and Submittal	15 days	Thu 2/5/15	Wed 2/25/15
273	2004DE3	Army Review/Comment	22 days	Thu 2/26/15	Fri 3/27/15
274	2004DE4	Prepare Response to Army Comments and Submittal	2 days	Mon 3/30/15	Tue 3/31/15
275	2004DE5	Army Review/Acceptance of Response to Comments	5 days	Wed 4/1/15	Tue 4/7/15
276	2004DE6	AOC-S LTM A2 (2015) LTM Draft Final Report Preparation and Submittal	10 days	Wed 4/8/15	Tue 4/21/15



Project: FORT RUCKER PROJECT S
Date: 06/16/2010

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

ID		WBS	Task Name	Duration	Start	Finish
277		2004DE7	ADEM/Army Review/Comment	30 days	Wed 4/22/15	Tue 6/2/15
278		2004DE8	Prepare Response to ADEM/Army Comments and Submittal	2 days	Wed 6/3/15	Thu 6/4/15
279		2004DE9	ADEM/Army Review/Acceptance of Response to Comments	10 days	Fri 6/5/15	Thu 6/18/15
280		2004DE10	AOC-S LTM A2 (2015) LTM Final Report Preparation and Submittal	5 days	Fri 6/19/15	Thu 6/25/15
281		2004DE11	ADEM/Army Review of AOC-S LTM A2 (2015) LTM Final Report	22 days	Fri 6/26/15	Mon 7/27/15
282		**2004DE12**	***Army/ADEM Approval of AOC-S LTM A2 (2015) LTM Final Report***	1 day	Tue 8/11/15	Tue 8/11/15
283		**2004DH**	**REMEDY REVIEW**	**213 days**	**Wed 8/13/14**	**Fri 6/5/15**
284		2004DH1	Preparation of Remedy Review Draft Document and Submittal	40 days	Wed 8/13/14	Tue 10/7/14
285		2004DH2	Army Review/Comment	22 days	Wed 10/8/14	Thu 11/6/14
286		2004DH3	Prepare Response to Army Comments and Submittal	5 days	Fri 11/7/14	Thu 11/13/14
287		2004DH4	Army Review/Acceptance of Response to Comments	5 days	Fri 11/14/14	Thu 11/20/14
288		**2004DH5**	***Remedy Review Draft Final Report Acceptance***	1 day	Fri 11/28/14	Fri 11/28/14
289		2004DH6	Remedy Review Final Report Preparation and Submittal	22 days	Mon 12/1/14	Tue 12/30/14
290		2004DH7	Army/ADEM Review of Remedy Review Final Report	22 days	Wed 12/31/14	Thu 1/29/15
291		**2004DH8**	***Remedy Review Final Report Acceptance***	1 day	Fri 1/30/15	Fri 1/30/15
292		2004DH8	Successful Correction of Deficiencies Noted in Remedy Review	90 days	Mon 2/2/15	Fri 6/5/15
293		**2004DI**	**PROJECT REPOSITORY/ADMINISTRATIVE RECORD**	**1640 days**	**Fri 9/18/09**	**Thu 12/31/15**
294		2004DI1	PROJECT REPOSITORY/ADMINISTRATIVE RECORD	1640 days	Fri 9/18/09	Thu 12/31/15
295		**2004DJ**	**BIANNUAL PUBLIC INTEREST ASSESSMENT**	**1046 days**	**Wed 11/17/10**	**Wed 11/19/14**
296		2004DJ1	August 2010	1 day	Wed 11/17/10	Wed 11/17/10
297		2004DJ2	August 2012	1 day	Wed 11/21/12	Wed 11/21/12
298		2004DJ3	August 2014	1 day	Wed 11/19/14	Wed 11/19/14
299		**2004DK**	**STAKEHOLDER PRESENTATIONS**	**1376 days**	**Thu 7/22/10**	**Thu 10/29/15**
300		2004DK1	July 2010	1 day	Thu 7/22/10	Thu 7/22/10
301		2004DK2	October 2010	1 day	Fri 10/29/10	Fri 10/29/10
302		2004DK3	January 2011	1 day	Fri 1/28/11	Fri 1/28/11
303		2004DK4	October 2011	1 day	Fri 10/28/11	Fri 10/28/11
304		2004DK5	January 2012	1 day	Fri 1/27/12	Fri 1/27/12
305		2004DK6	October 2012	1 day	Fri 10/26/12	Fri 10/26/12
306		2004DK7	January 2013	1 day	Fri 1/25/13	Fri 1/25/13
307		2004DK8	October 2013	1 day	Fri 10/25/13	Fri 10/25/13
308		2004DK9	January 2014	1 day	Fri 1/31/14	Fri 1/31/14
309		2004DK10	October 2014	1 day	Fri 10/31/14	Fri 10/31/14
310		2004DK11	January 2015	1 day	Thu 1/29/15	Thu 1/29/15
311		2004DK12	October 2015	1 day	Thu 10/29/15	Thu 10/29/15
312		**2004DL**	**STATUS REPORTS (MONTHLY)**	**1609 days**	**Wed 10/7/09**	**Mon 12/7/15**
313		2004DL1	STATUS REPORTS (MONTHLY)	1609 days	Wed 10/7/09	Mon 12/7/15
314		**2004DM**	**PROJECT CLOSEOUT**	**46 days**	**Fri 10/30/15**	**Fri 1/1/16**
315		2004DM1	Close Out Prep	30 days	Fri 10/30/15	Thu 12/10/15
316		2004DM2	Final Close Out	16 days	Fri 12/11/15	Fri 1/1/16

Project: FORT RUCKER PROJECT S
Date: 06/16/2010

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

Project Management Plans

Project Management Plan

Environmental Remediation Services Fort Rucker, Alabama

FINAL

Contract No. W91ZLK-05-D-0014
Contract Task Order No. 0001

Prepared for:

U.S. Army Environmental Command

Prepared by:

CH2MHILL

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October 2009

Contents

Tables

Figures

Acronyms and Abbreviations

ACSIM	Assistant Chief of Staff Installation Management
ADEM	Alabama Department of Environmental Management
AEDB-R	Army Environmental Database-Restoration Module
AOC	Area of Concern
ARBCA	Alabama Risk-Based Corrective Action
CD	compact disk
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLIN	Contract Line Item Number
CMI	Corrective Measures Implementation
CMIP	Corrective Measures Implementation Plan
CMS	Corrective Measures Study
COR	Contracting Officer's Representative
CVOC	Chlorinated Volatile Organic Compound
CWM	Chemical Warfare Materiel
DD	Decision Document
DDESB	Defense of Defense Explosives Safety Board
DFOW	Definable Features of Work
DGM	Digital Geophysical Mapping
DoD	U.S. Department of Defense
DQO	Data Quality Objective
ELAP	Environmental Laboratory Accreditation Program
EPA	U.S. Environmental Protection Agency
ERIS	Environmental Restoration Information System
ERM	Environmental Restoration Manager
ESP	Explosives Siting Plan
ETI	EnviroMetal Technologies, Inc.
FSP	Field Sampling Plan
GSV	Geophysical System Verification

H&S	Health and Safety
HRR	Historical Records Review
HSWA	Hazardous and Solid Waste Amendments
IRP	Installation Restoration Program
KO	Contracting Officer
LTM	Long-Term Management or Monitoring
MC	Munitions Constituent
MCL	Maximum Contaminant Level
MD	Munitions Debris
MDL	Method Detection Level
MEC	Munitions and Explosives of Concern
MM	Military Munitions
MMRP	Military Munitions Response Program
MR	Munitions Response
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
NCR	Non-Conformance Report
NELAP	National Environmental Laboratory Accreditation Program
OD	Open Detonation
PA	Preliminary Assessment
PCE	Tetrachloroethene
PM	Project Manager
PMP	Project Management Plan
PRB	Permeable Reactive Barrier
QA	Quality Assurance
QASP	Quality Assurance and Surveillance Plan
QC	Quality Control
QAPP	Quality Assurance Project Plan
QSM	Quality Systems Manual
RAB	Restoration Advisory Board
RBTL	Risk-Based Target Level

RC	Response Complete
RCRA	Resource Conservation and Recovery Act
READ	Repository of Environmental Army Documents
RFI	RCRA Facility Investigation
RIP	Remedy in Place
RL	Reporting Limit
ROD	Record of Decision
RPM	Remedial Project Manager
SAP	Sampling and Analysis Plan
SB	Statement of Basis
SI	Site Investigation
SME	Subject Matter Expert
SOPs	Standard Operating Procedures
SSHP	Site Safety and Health Plan
TM	Technical Manager
TO	Task Order
TPP	Technical Project Planning
μg/L	Micrograms per Liter
USACE	U.S. Army Corps of Engineers
USAEC	U.S. Army Environmental Command
USATCES	U.S. Army Technical Center for Explosives Safety
VSP	Visual Sample Plan
WAWF	Wide Area Workflow
WMP	Waste Management Plan
XRF	X-Ray Fluorescence
ZVI	Zero Valent Iron

1. Introduction

1.1 Authorization

This Project Management Plan (PMP), which has been prepared for the U.S. Army Environmental Command (USAEC), describes the management approach to be used by CH2M HILL Constructor's, Inc. (CH2M HILL) during the performance of environmental remediation services at Fort Rucker, Alabama. This project was awarded 17 August 2009 by the USAEC as Task Order (TO) 0001 under Contract W91ZLK-05-D-0014. This TO is a performance-based remediation project.

The purpose of the PMP is to set forth the management approach for environmental remediation services including project scope and objectives, performance payment milestones, deliverables, identification of key project team members, project schedule, procedures for communications, and data management. The PMP will be updated as needed throughout the duration of the project to reflect the status and strategies for the site remediation actions at Fort Rucker.

1.2 Project Overview

Fort Rucker is located in southeast Alabama, approximately 20 miles northwest of the city of Dothan. It occupies 62,430 total acres with 57,885 acres at the main installation and 4,545 acres of satellite airfields, leases, and easements. In 1973, Fort Rucker became the center for all United States Army aviation flight training. Since then, its mission had been to maintain and operate facilities and to provide services and material to support the helicopter pilot training for the Army. In addition to Fort Rucker's role as the Army's Aviation Center, it houses several tenant activities and directorates. Fort Rucker is the home to the Army Safety Center, the United States Army Aviation Development Test Activity, the Aeromedical Center and Aeromedical Research Laboratory, and a Human Engineering Laboratory.

This PMP addresses environmental remediation activities at four sites. One site, Area of Concern (AOC)–S, is being addressed under the Installation Restoration Program (IRP). The remaining three sites (FTRU-001-R-01, FTRU-003-R-01, and FTRU-004-R-01) are addressed under the Military Munitions Response Program (MMRP).

Remediation at AOC-S is being conducted under a Resource Conservation and Recovery Act (RCRA) Hazardous and Solid Waste Amendments (HSWA) Permit, with regulatory coordination, as appropriate, by the Alabama Department of Environmental Management (ADEM) and the U.S. Environmental Protection Agency (EPA) Region 4.

Under this TO, CH2M HILL will perform munitions response actions for military munitions (MM) and munitions debris (MD) at the MMRP sites. To perform munitions responses, the U.S. Department of Defense (DoD) primarily operates under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). However, ADEM has identified the MMRP sites as AOCs for corrective action under Fort Rucker's HSWA permit.

1.3 Performance Objectives

The performance objectives and standards for this TO are summarized in Table 1-1.

TABLE 1-1
Performance Requirement Summary

Performance Objective	Performance Standard
Approved Project Management Plan (PMP) and Quality Assurance and Surveillance Plan (QASP): • Draft PMP and QASP due within 30 calendar days of Task Order (TO) award • Final PMP due within 30 days of receipt of Contracting Officer's Representative (COR) comments on draft	Army approval through the Contracting Officer's Representative (COR).
Achieve Record of Decision (ROD)/Decision Document (DD) at the following sites by September 30, 2011: • FTRU-001-R-01 – Anti-Tank/Rocket Grenade • FTRU-003-R-01 – Infiltration/Grenade Range • FTRU-004-R-01 – .22 Caliber Target Butt	Army approval through the COR and Alabama Department of Environmental Management (ADEM) acceptance. Department of Defense Explosives Safety Board (DDESB) approval of CH2M HILL Explosives Site Plan (ESP)
Achieve Remedy in Place (RIP) at the following site by February 28, 2011: • Area of Concern (AOC)-S Upon achievement of RIP, perform Remedial Action Operations at AOC-S for the duration of the TO or until achievement of Response Comment (RC), whichever comes first. Upon achievement of RC, perform necessary Long-Term Management (LTM) at AOC-S for the duration of the TO.	Army approval through the COR and ADEM acceptance.
Complete all Remedy Reviews required for the duration of the TO. Correct any deficiencies noted in Remedy Review(s). Consolidate Remedy Reviews into a single installation-wide review conducted at conclusion of the TO.	Army approval through the COR and ADEM acceptance.

1.4 Performance Payment Milestones

During the Army's August 6, 2009, award notification e-mail, the Army asked CH2M HILL to consider a revised Contract Line Item Number (CLIN)/Payment Milestone Structure. In response to the Army's request, CH2M HILL proposes alternatives to the Army's CLIN/Payment Milestone Structure as follows:

1. Payment milestone 2004CA: CH2M HILL requests payment under a new sub-CLIN (Army Acceptance of Technical Memorandum Summarizing Total Linear Footage of Geophysical Transects/Intrusive Investigations Have Been Completed in

Accordance with Army/ADEM Approved RCRA Facility Investigation (RFI)/Corrective Measures Study (CMS) Work Plan). The Technical Memorandum will include daily field reports and maps depicting the geophysical transects and intrusive investigations completed. The payment milestone will ensure sufficient cash flow to pay our subcontractor costs incurred during the RFI fieldwork.

2. Payment milestone 2004DA: CH2M HILL requests payment under a new sub-CLIN (Army Acceptance of Technical Memorandum Summarizing Installation of Zero Valent Iron (ZVI)/Sand Based on Specifications in Accordance with the Army/ADEM Approved Corrective Measures Implementation Plan {CMIP}) to ensure sufficient cash flow to pay our subcontractor costs, but does not increase the Army's risk of not meeting remedy in place (RIP). The payment will equate to the subcontractor costs incurred during corrective measures implementation (CMI).

3. Payment milestone 2004DA: CH2M HILL requests payment under a new sub-CLIN (Army and ADEM Approval of Final RFI) to ensure sufficient cash flow to pay our subcontractor costs for fieldwork (drilling, well installation, analytical, surveying) to finalize the AOC-S RFI.

Table 1-2 lists the performance payment milestones for this project. As shown, CH2M HILL proposes 34 performance payment milestones. The proposed sub-CLINs discussed above are shaded in Table 1-2. In addition, Table 1-2 shows the payment amount for each milestone, cumulative percent of total CLIN value, and projected CLIN exercise date.

Table 1-2
Proposed CLIN and Payment Milestone Structure
Fort Rucker, Alabama
Contract W91ZLK-05-D-0014, Task Order 0001

CLIN/SUB-CLIN	CLIN/SUB-CLIN OR PAYMENT MILESTONE DESCRIPTION	CLIN/SUB-CLIN AMOUNT	PAYMENT MILESTONE AMOUNT	CUMULATIVE PERCENT OF TOTAL CLIN VALUE	PROJECTED CLIN EXERCISE DATE
2004	**ENVIRONMENTAL REMEDIATION SERVICES AT FORT RUCKER, ALABAMA in accordance with the attached Performance Work Statement**				
2004AA		**$33,228**			**At Award**
2004AA5	Army Approval of Draft PMP and Draft QASP		$21,428	64%	
2004AA8	Army Approval of Final PMP		$11,800	100%	
2004BA	**Additional Site-Wide Plans prior to Start of Field Work**	**$79,445**			**At Award**
2004BA5	Army Approval of Draft HASP/SAP/QAPP/WMP		$37,837	48%	
2004BA8	Army Approval of Final HASP/SAP/QAPP/WMP		$15,946	68%	
2004BA14	Army Approval of Draft ESP		$16,501	88%	
2004BA17	Army Approval of Final ESP		$9,161	100%	
2004CA	**FTRU-001-R-01 - Anti-Tank/Rocket Grenade Range, FTRU-003-R-01 - Infiltration Course and FTRU-004-R-01 - .22 Caliber Target Butt: Achieve Record of Decision/Decision Document by 30 September 2011**	**$605,246**			**At Award**
2004CA7	Army Approval of Draft Final RFI/CMS Work Plan/HASP		$36,315	6%	
2004CA14	Army and Regulator Approval of Final RFI/CMS Work Plan/HASP		$24,210	10%	
2004CA19	Army Acceptance of Technical Memorandum Summarizing Total Linear Footage of Geophysical Transects/Instrusive Investigations Has Been Completed in Accordance with Army/ADEM approved RFI/CMS Work Plan		$221,563	47%	
2004CA25	Army Approval of Draft Final RFI/CMS Report		$137,478	69%	
2004CA32	Army and Regulator Approval of Final RFI/CMS Report		$64,631	80%	
2004CA45	Army and Regulator Approval of Final Statement of Basis for FTRU-001-R-01		$40,350	87%	
2004CA57	Army and Regulator Approval of Final Statement of Basis for FTRU-003-R-01		$40,350	93%	
2004CA69	Army and Regulator Approval of Final Statement of Basis for FTRU-004-R-01		$40,349	100%	
2004DA	**AOC-S: PCE in GW near SWMU 8: Achieve Remedy in Place (RIP) by 28 February 2011**	**$1,225,003**			**At Award**
2004DA29	Army Approval of Draft Final ARBCA Technical Memorandum		$9,740	1%	
2004DA36	Army and Regulator Approval of Final ARBCA Technical Memorandum		$4,695	1%	
2004DA23	Army and Regulator Approval of Final RFI		$80,957	8%	
2004DA46	Army Approval of Draft Final CMS/CMIP		$42,753	11%	
2004DA53	Army and Regulator Approval of Final CMS/CMIP		$20,420	13%	
2004DA61	Army Acceptance of Technical Memorandum Summarizing Installation of ZVI/Sand Based on Specifications in Accordance with the Army/ADEM Approved CMIP		$590,760	61%	
2004DA67	Army Approval of Draft Final CMI Report		$230,677	80%	
2004DA74	Army and Regulator Approval of Final CMI Report		$245,001	100%	

Table 1-2
Proposed CLIN and Payment Milestone Structure
Fort Rucker, Alabama
Contract W91ZLK-05-D-0014, Task Order 0001

CLIN/SUB-CLIN	CLIN/SUB-CLIN OR PAYMENT MILESTONE DESCRIPTION	CLIN/SUB-CLIN AMOUNT	PAYMENT MILESTONE AMOUNT	CUMULATIVE PERCENT OF TOTAL CLIN VALUE	PROJECTED CLIN EXERCISE DATE
2004DB	**AOC-S: PCE in GW near SWMU 8: Exit/Ramp Down Strategy, Optimization and RAO/LTM - Year 1**	**$206,674**			**Upon Army Acceptance of Installation of ZVI/Sand within PRB**
2004DB12	Army and Regulator Approval of Final 1st Qtr RAO/LTM Report		$51,034	25%	
2004DB24	Army and Regulator Approval of Final 2nd Qtr RAO/LTM Report		$51,880	50%	
2004DB36	Army and Regulator Approval of Final 3rd Qtr RAO/LTM Report		$51,880	75%	
2004DB48	Army and Regulator Approval of Final 4th Qtr RAO/LTM Report		$51,880	100%	
2004DC	**AOC-S: PCE in GW near SWMU 8: Exit/Ramp Down Strategy, Optimization and RAO/LTM - Year 2**	**$86,592**			**Approximately 1 year from Exercise of 2004DB**
2004DC12	Army and Regulator Approval of Final 1st Semi-Annual RAO/LTM Report		$43,296	50%	
2004DC24	Army and Regulator Approval of Final 2nd Semi-Annual RAO/LTM Report		$43,296	100%	
2004DD	**AOC-S: PCE in GW near SWMU 8: Exit/Ramp Down Strategy, Optimization and RAO/LTM - Year 3**	**$48,261**			**Approximately 1 year from Exercise of 2004DC**
2004DD12	Army and Regulator Approval of Final Annual RAO/LTM Report		$48,261	100%	
2004DE	**AOC-S: PCE in GW near SWMU 8: Exit/Ramp Down Strategy, Optimization and RAO/LTM - Year 4**	**$49,866**			**Approximately 1 year from Exercise of 2004DD**
2004DE12	Army and Regulator Approval of Final Annual RAO/LTM Report		$49,866	100%	
2004DF	**AOC-S: PCE in GW near SWMU 8: Exit/Ramp Down Strategy, Optimization and RAO/LTM - Year 5**	**$51,035**			**Approximately 1 year from Exercise of 2004DE**
2004DF12	Army and Regulator Approval of Final Annual RAO/LTM Report		$51,035	100%	
2004DG	**AOC-S: PCE in GW near SWMU 8: Exit/Ramp Down Strategy, Optimization and RAO/LTM - Year 6**	**$52,128**			**Approximately 1 year from Exercise of 2004DG**
-	Army and Regulator Approval of Final Annual RAO/LTM Report		$52,128	100%	
2004DH	**AOC-S: PCE in GW near SWMU 8: Remedy Review**	**$31,005**			**FY2014**
2004DH5	Army Approval of Draft Final Remedy Review		$21,190	68%	
2004DH8	Army and Regulator Approval of Final Remedy Review		$9,815	100%	
	TOTAL	**$2,468,483**	**$2,468,483**		

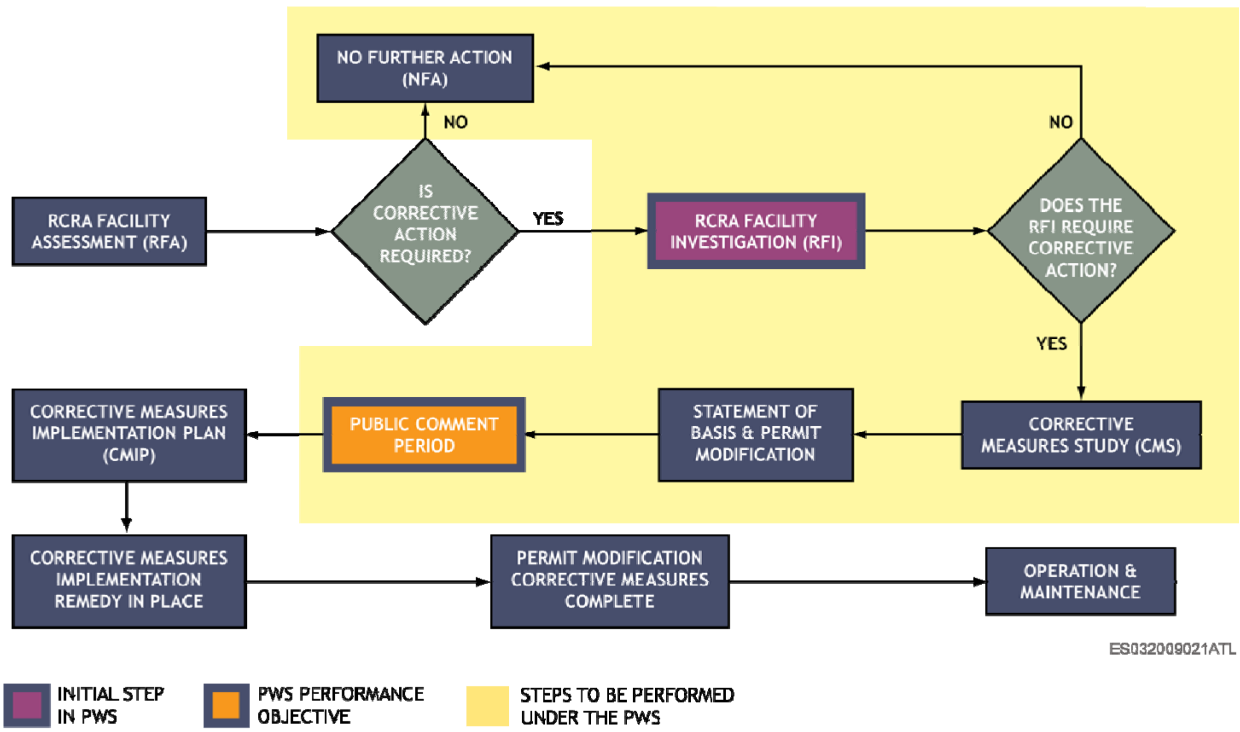
Shaded sub-CLIN/Payment Milestone Indicates Proposed sub-CLIN/Payment Milestone
Revised 10/26/09

1.5 Regulatory Process

1.5.1 Military Munitions Response Program Sites

Because ADEM has identified the MMRP sites as AOCs for corrective action under Fort Rucker's HSWA permit, the three MMRP sites will be managed under the RCRA corrective action process. Execution of the work to achieve Statement of Basis (SB) approval will be initiated at the RFI phase. The required regulatory process to achieve the performance objective of SB approval is shown in **Figure 1-1**.

FIGURE 1-1
Fort Rucker's MMRP Sites' Regulatory Process



1.5.2 Area of Concern–S

AOC-S is managed under the RCRA corrective action program. Corrective action implementation to achieve RIP will begin with finalization of the RFI. The required regulatory process to achieve RIP is shown in **Figure 1-2.**

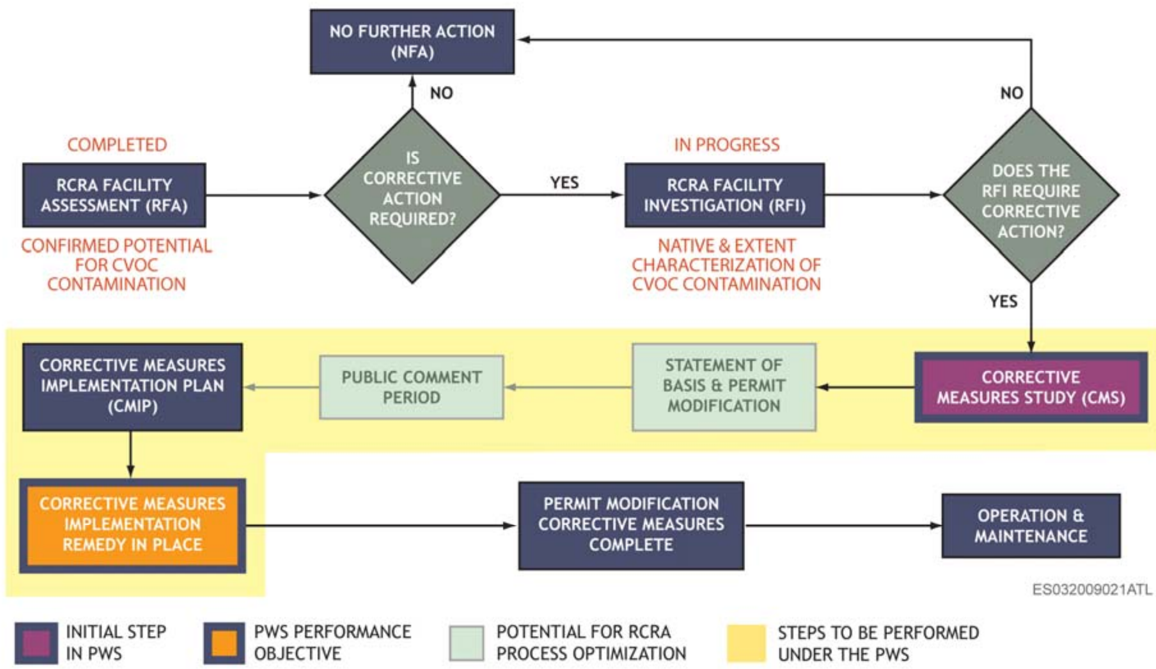


FIGURE 1-2
AOC-S Regulatory Process

1.6 Health and Safety Requirements

Prior to beginning any fieldwork, CH2M HILL will implement a written Safety and Health Program and Site Safety and Health Plan (SSHP) in accordance with Section C.4.1.6 of the basic contract. Additionally, CH2M HILL will adhere to the applicable DoD policies, procedures, and regulations for munitions response. These include, but are not limited to, DoD 6055.9-STD, DoD Ammunition and Explosives Safety Standards; Army Regulation 385-10, the Army Safety Program; Department of Army Pamphlet 385-63, Range Safety; Department of Army Pamphlet 385-64, Ammunition and Explosives Safety Standards; EM 385-1-1 and EM 385-1-97; and training and medical screening per 29 *Code of Federal Regulations* 1910.120(e).

None of the sites to be addressed under this TO are suspected to contain chemical warfare materiel (CWM). However, if suspected CWM is encountered during any phase of site activities, CH2M HILL will immediately halt operations, retreat upwind, and contact the COR and Fort Rucker Environmental Manager for assistance and guidance.

All activities involving work in areas potentially containing MEC hazards will be conducted in compliance with Department of Army, state, and local requirements regarding personnel, equipment, and procedures, as well as with DoD Standard Operating Procedures (SOPs) and safety regulations.

1.7 Additional Site Plans

Additional site plans will be prepared on a site-wide basis and encompass both AOC-S and the three MMRP sites. The site-wide documents to be prepared will include the Sampling and Analysis Plan (SAP) consisting of a Field Sampling Plan (FSP) and a Quality Assurance Project Plan (QAPP), SSHP, and the Waste Management Plan (WMP). Because of the numerous health and safety requirements for MEC sites, CH2M HILL will prepare a separate HASP for each of the three MMRP sites as part of the development of the RFI/Corrective Measures Study (CMS) Work Plan for the three MMRP sites. Contents of each site-wide plan are summarized as follows:

- FSP – Will provide standard field sampling procedures for various activities that will be conducted during the course of the project.
- QAPP – Will provide quality assurance (QA)/quality control (QC) procedures that will be implemented to ensure that all environmental analytical data meet the data quality objectives (DQOs) for each site.
- SSHP – Will provide standard health and safety procedures to be followed while conducting fieldwork at each site.
- WMP – Will provide details regarding temporary waste storage, handling, transportation and disposal procedures for each site.

1.8 Quality Control

CH2M HILL will use a comprehensive QC program throughout the project to verify the completeness and effectiveness of processes and procedures. These QC procedures will be included in the work plan submitted to the Army. The purpose of the QC program is to ensure that the project team:

- Understands the process required to achieve project objectives
- Establishes and documents consistent DQOs
- Provides measurable criteria to assess DQOs

Definable Features of Work (DFOWs) will be established and the 3 phases of control (preparatory, initial, and follow-up) implemented on each DFOW to verify that work has been performed in accordance with project plans, specifications, and drawings.

1.8.1 Geophysical Data Quality Control

CH2M HILL will develop procedures for the following:

- Geophysical instrument tests (Geophysical System Verification [GSV] and pre- and post-operations QC tests)
- Quality inspections of field operations (verification of procedures compliance)
- Examination of geophysical data for DQO compliance
- Verification and documentation of personnel training and qualifications to operate geophysical instrumentation.

- Confirmation that "blind" QC seeds emplaced throughout project areas have been detected, selected, and appropriately investigated/removed (if selected for investigation)
- Document database review and approval process

CH2M HILL will define a corrective action process to be implemented in the event that a discrepancy or DQO failure is discovered during QC activities. The process will include the following steps:

1. Deficiencies or nonconforming items are identified and documented in a Non-Conformance Report (NCR).
2. An investigation is undertaken to identify the root and contributing causes.
3. Corrective Action Plan is developed and implemented to address the root and contributing causes; and
4. Follow-up is executed by the Unexploded Ordnance Quality Officer and Munitions Response Geophysicist (as applicable) to ensure that the corrective actions have both short- and long-term effectiveness.

A final acceptance inspection is performed at the conclusion of a DFOW prior to closeout to verify that project requirements relevant to the particular DFOW are satisfied. Outstanding and non-conforming items are identified and documented on the Final Inspection Checklist contained within the QC Plan (part of the RFI/CMS Work Plan). Each item that is resolved is noted on the checklist. Army acceptance and closeout of each DFOW is a prerequisite to project closeout.

1.8.2 Chemical Data Quality Control

Sampling and Analysis Requirements

During the planning and preparation of the RFI/CMS WP, CH2M HILL will develop DQOs and the types of sampling methods to be used. During this process, CH2M HILL also will outline data uses and the decisions to be made from the data. Soil samples will be collected from areas that indicate a potential for munitions constituent (MC) release or from areas as identified through the Visual Sample Plan (VSP), the accepted industry standard software for statistical sampling determinations).

Laboratory Qualifications

CH2M HILL has selected Empirical Laboratories, a National Environmental Laboratory Accreditation Program (NELAP)-certified lab that routinely works with CH2M HILL on other projects of a similar nature. CH2M HILL understands that environmental laboratory services are to be provided only by laboratories compliant with the most recently published version of the DoD Quality Systems Manual (QSM) and those holding a current NELAP accreditation or equivalent for all appropriate fields of testing. In addition to NELAP certification, the laboratory will hold current certification in Alabama for all appropriate fields of testing.

The selected laboratory will also undergo a DoD Environmental Laboratory Accreditation (ELAP) and transition out of the NELAP accreditation.

Data Reporting Requirements

CH2M HILL will provide data reporting elements for definitive data in accordance with Data Item Description (DID) MR-005-7, DID MR005-10, and Section 1.13.4.2 of EM 200-1-3. The laboratory will report all analytical results greater than the Method Detection Limit (MDL), which, in the analyst's professional judgment, are believed to be reliably detected. Concentrations reported between the MDL and the Method Quantitation Limit/ Reporting Limit (RL) will be flagged as estimated. RLs will be at least 3 times MDLs for all analytes.

Hard Copy Data Deliverables

Data will be assembled in a package to be validated in accordance with EPA requirements (.clp-like format). The data packages will be submitted as part of the RFI report/CMS and subsequent long-term monitoring (LTM) reports. At a minimum, CH2M HILL will submit two types of data tables: analytical results for all samples collected and a subset detailing all analytical results greater than MDL.

Electronic Data Deliverables

All electronic data submitted by the contract laboratory will be error-free and in agreement with the hard copy data. The laboratory data will be merged with the sampling data and delivered on high-density compact disk(s) (CD[s])—accompanying the hardcopy data reports—and uploaded to the project repository and the Environmental Restoration Information System (ERIS).

Data Validation

CH2M HILL will perform 100 percent data validation as specified in the EPA Protocols. The data validation process will be conducted according to the method-specific SOPs, project-specific QAPP, and DoD QSM and will be verified and qualified. The data validation documentation will address review of the results and data qualifiers of laboratory samples.

1.9 Project Deliverables

Project deliverables will be produced in draft, draft-final, and final versions, with the exception of this PMP, QASP, ESP and Site-Wide Work Plans, which are for Army review only and will be produced in draft and final versions. In accordance with Section C.1.13.1 of the Assistant Chief of Staff for Installation Management (ACSIM) contract, the Army will provide comments within 20 business days. Once initial comments are addressed, the Army will review draft-final documents before submission to ADEM. To achieve primary milestones, CH2M HILL has assumed that ADEM review will be completed within 30 days. This assumption is based on CH2M HILL's solid track record of submitting documents that gain ADEM approval within a 30-day period. Specific project deliverables are presented in the technical approach **Sections 2 and 3**.

2. Achieve ROD/DD at MMRP Sites by September 30, 2011

2.1 General Approach

CH2M HILL will use the Technical Project Planning (TPP) structured approach, as defined in EM 200-1-2, to:

- Identify the site, munitions and explosives of concern (MEC) and MC concerns, data gaps, and data needs.
- Develop strategies to meet mutually acceptable DQOs.
- Coordinate proposed MMRP site activities with potentially impacted facility personnel and operations during the pre-planning stage to allow for schedule modifications.

The CH2M HILL RFI approach will be flexible with regard to sequencing of site activities and accommodating of schedules that are compatible with recreation and operations at Fort Rucker.

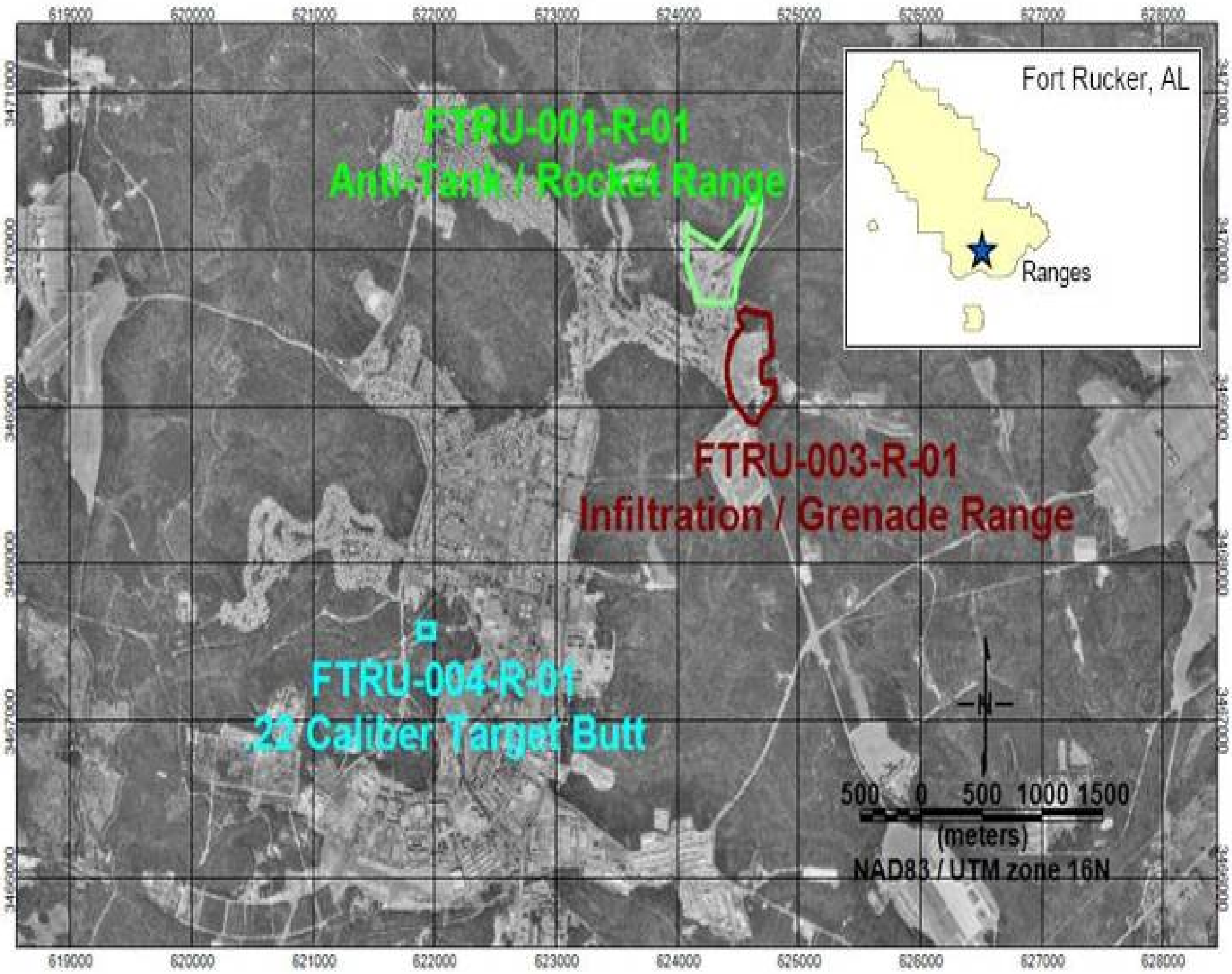
2.2 Site Descriptions

In the following sections, CH2M HILL will provide a brief description of each of the MMRP sites (shown in **Figure 2-1**).

2.2.1 FTRU-001-R-01 Anti-Tank/Rocket Grenade Range

Site FTRU-001-R-01 (shown in **Figure 2-2**), which covers approximately 57 acres northeast of the cantonment area, was historically used as an anti-tank rocket and grenade range. The site is made up of three distinct sub-ranges, including Anti-Tank Rocket Range No.1, Anti-Tank Grenade Range No. 1, and an unnamed Range. The area has been developed as part of the post's golf course

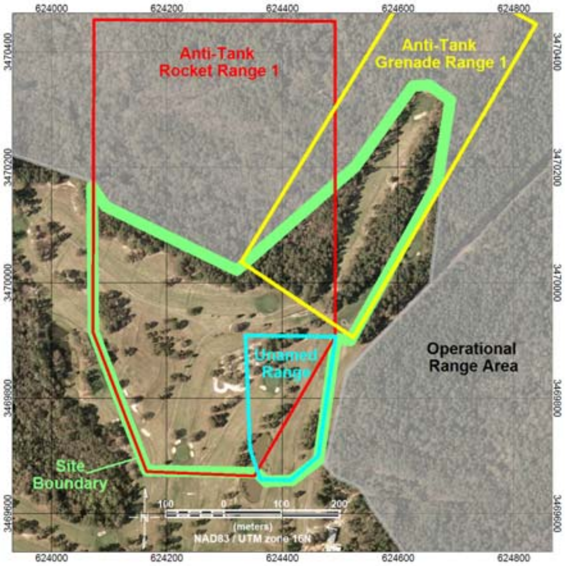
FIGURE 2-1
Locations of the MMRP Sites



During the site investigation (SI), four MD items were discovered on the Anti-Tank/Rocket Range. The MD consisted of a fragment from a practice rifle grenade, a fragment of an expended 2.36″ rocket, and fragments from two expended M28 3.5″ rockets. No M28 3.5″ rockets were expected to be present onsite based on the Historical Research Review (HRR), but their presence is consistent with other activities known to have taken place in the area. The HRR identified several munitions that could be present at the site: 2.36″ Rocket, M6A1, M9A1 HEAT, MII A1-MII A4 Practice, and M17 Fragmentation. A World War I-era tank hull with numerous holes and pockmarks resulting from the use of live armor-piercing ammunition was located just outside of the non-operational range boundary inside the operational portion of the post (which is outside the area subject to the RFI). The orientation of the range and the orientation of the tank hull relative to the range indicate that the tank may have been fired at from the non-operational portion of the range.

FTRU-001-R-01 (the site being investigated under this TO) is that portion of the ranges that is within the "other than operational" area of Fort Rucker. Historical records clearly indicate that portions of the ranges extend into the operational area (shown in **Figure 2-2**).

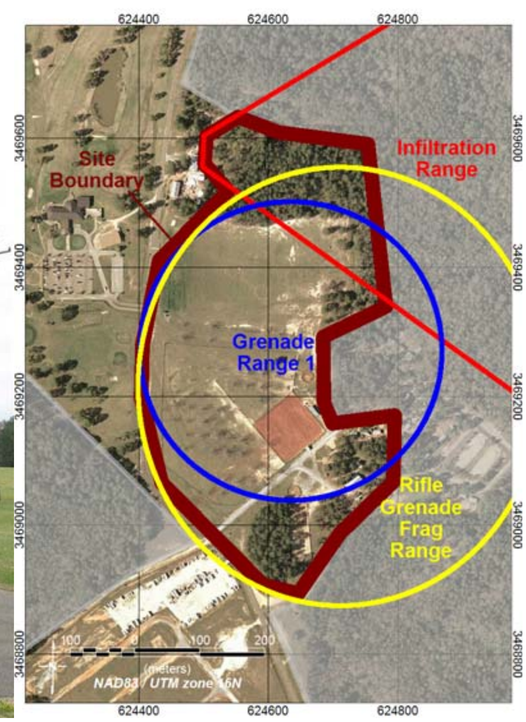
FIGURE 2-2
Anti-Tank/Rocket Range



2.2.2 FTRU-003-R-01 Infiltration/Grenade Range

Site FTRU-003-R-01 (shown in **Figure 2-3**) is adjacent to, but not contiguous with, the Anti-Tank Rocket/ Grenade Range and occupies approximately 44 acres of other than operational range designated area (northeast of the cantonment area).

FIGURE 2-3
Infiltration/Grenade Range



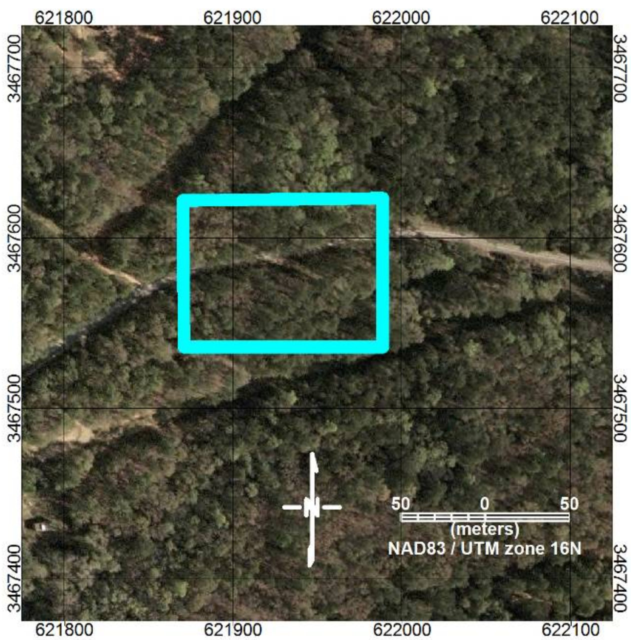
The site was historically used as an infiltration and grenade range and is made up of three distinct sub-ranges: Infiltration Range No. 2, Grenade Range No. 1, and the Rifle Grenade Fragmentation Range. The Infiltration/Grenade Range has been developed as part of the post's equestrian center and golf course driving range.

No MEC or MD items were observed during SI activities at the Infiltration/Grenade Range. Information received from Fort Rucker Range Control identified two Explosive Ordnance Disposal (EOD) responses to MEC items identified within the area in 2003. Both items (rifle grenades) were destroyed by EOD personnel. The HRR identified several munitions that could be present at the site: M II A1-MII A4 Practice and M17 Fragmentation. Small arms (.30-caliber) may also be present.

2.2.3 FTRU-004-R-01 .22-Caliber Target Butt

Site FTRU-004-R-01 (shown in **Figure 2-4**) covers approximately 2.4 acres in the central portion of the cantonment area and is the reported site of a .22 Caliber Target Butt.

FIGURE 2-4
.22 Caliber Target Butt



The only indication that the Target Butt existed is a 1944 map. During the SI, no surface features were found that would indicate the presence of a former small arms range. The area is heavily wooded and hilly (with some steep slopes) and does not appear to have been significantly disturbed over the years. During the site reconnaissance walk conducted as part of SI activities, an expended empty M48 Trip Flare (a non-frag-producing munition designed to illuminate enemy forces) was identified along the northwestern edge but within the identified “limits” of the site. The flare was found on the ground and appeared to have been undisturbed since its use: the base of a tree had grown around the item. Only small arms (.22-caliber) were otherwise identified in the HRR as potentially being located at this site.

2.3 Project Execution

The fieldwork will be performed in accordance with the approved RFI/CMS Work Plan and will characterize the nature and extent of MEC and MC at the MMRP sites. The sampling approach, which was developed using available information on each site, industry standard approaches, and VSP, is presented in **Table 2-1**; however, CH2M HILL understands that the approach is subject to stakeholder acceptance and modification through the TPP process.

TABLE 2-1
Summary of Sampling Approach for Each MMRP Site

Site	Sampling Approach
Anti-Tank/Rocket Grenade Range	3% DGM transect coverage and intrusive investigation Investigate statistically representative set of anomalies (TBD based on DGM results) Biased MC sampling based on DGM and intrusive results
Infiltration/Grenade Range	3% DGM transect coverage and intrusive investigation Investigate statistically representative set of anomalies (TBD based on DGM results) Biased MC sampling based on DGM and intrusive results
.22 Caliber Target Butt	10% instrument-assisted site walkabout Biased XRF screening and soil sampling for metals based on walkabout results

2.4 MMRP Deliverables

Specific deliverables to be generated in support of achievement of ROD/DD at the MMRP sites include the following:

- ESP
- RFI/CMS Work Plan
- MEC GIS and DGM/Intrusive Investigation Summary Technical Memorandum
- RFI/CMS Report
- Statement of Basis
- Revise Munitions Response Site Prioritization Protocol (MRSPP) Scores

3. Achieve RIP at AOC-S by February 28, 2011

3.1 Site Description

AOC-S is located within the southern portion of Fort Rucker's cantonment area. Land use within this portion of Fort Rucker consists of various industrial buildings and vehicle maintenance yards.

CH2M HILL performed an RFI for AOC-S in 2007 and 2008. The RFI showed that groundwater within the investigation area has been impacted with tetrachloroethene (PCE) at concentrations exceeding its maximum contaminant level (MCL) of 5 micrograms per liter (µg/L). The apparent source of the PCE in groundwater was a wash rack that was operated from the 1950s to the late 1980s. PCE was not detected in soil in the vicinity of the wash rack, indicating that the source may have been removed during removal of the wash rack.

The PCE plume's dimensions are approximately 2,900 feet by 900 feet, and it covers approximately 60 acres. The plume has migrated southward, following groundwater flow past the Fort Rucker boundary. PCE concentrations range from 120 µg/L at approximately 500 feet downgradient of the apparent source to 17 µg/L at the Installation boundary. The maximum PCE concentration off-post is 4 µg/L, which is below the MCL.

3.2 Project Execution

The CH2M HILL approach for AOC-S is to complete the following steps to achieve RIP by February 28, 2011, and to perform LTM during the period of performance:

1. Finalize RFI.
2. Perform an ARBCA evaluation to establish a site-specific risk-based target level (RBTL) for PCE at AOC-S based on a point of exposure location downgradient of the site.
3. Prepare CMS/CMIP.
4. Implement corrective action consisting of installation of the PRB.
5. Perform LTM activities and document effectiveness in LTM reports.

The proposed location of the PRB is presented in Figure 3-1.

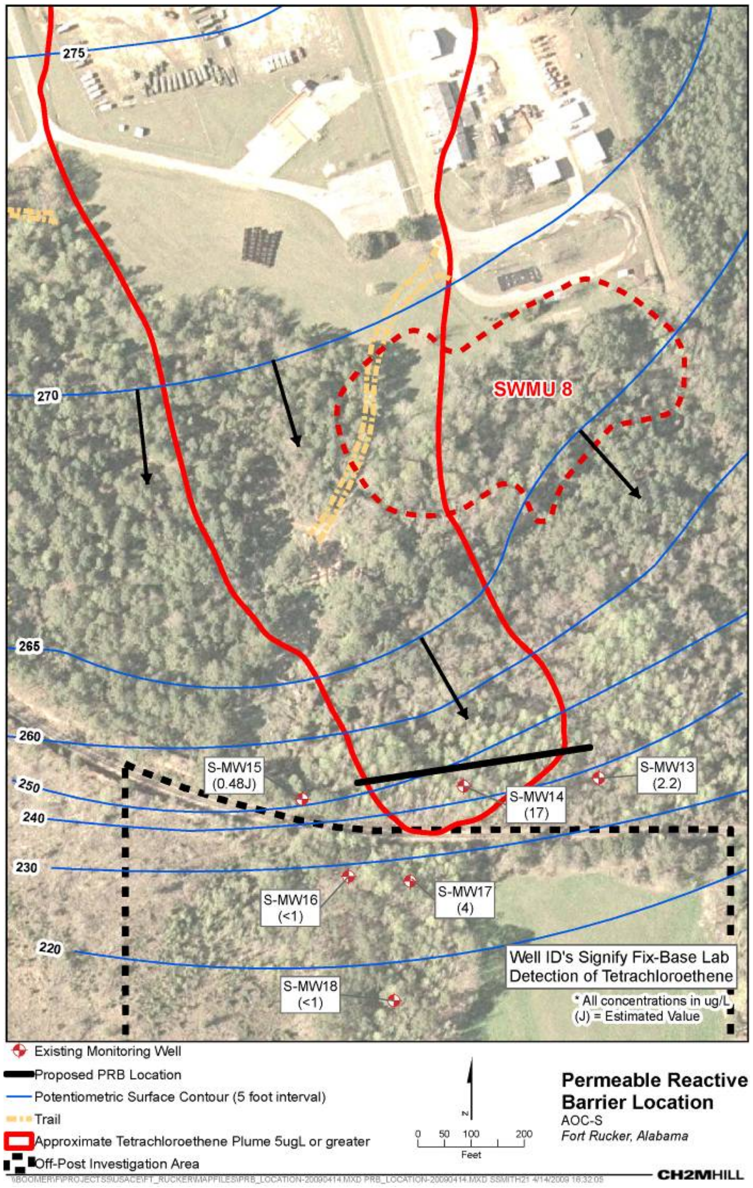
3.3 AOC-S Deliverables

Specific deliverables to be generated in support of achievement of RIP at the AOC-S include:

- Final RFI Report
- ARBCA Technical Memorandum
- CMS/CMIP
- LTM Groundwater Monitoring Report/CMI Effectiveness Reports

- CMI Report

Figure 3-1
Location of PRB at AOC-S



4. Remedy Reviews

Fort Rucker is currently conducting Installation-wide remedy reviews every 5 years, with the next scheduled review in 2014. By 2014, each of the four sites will be managed on a consolidated schedule with the other sites managed at the Installation. The 5-year remedy review performed by CH2M HILL will evaluate the implementation and performance of the remedy(ies) to evaluate whether the remedy(ies) is or will be protective of human health and the environment. Evaluation of the remedy(ies) and the determination of protectiveness, by way of a risk assessment or through the ARBCA guidance, will be based on and sufficiently supported by data and observations.

Annual reports will document the performance of the implemented remedy at AOC-S. As part of the performance evaluation, optimization strategies will be considered to improve remedy effectiveness while promoting beneficial results.

5. Project Management

CH2M HILL has overall responsibility for the execution of this TO. All work will be performed in accordance with federal, state, local statues, regulations, and guidance. Activities will conform to environmental permits, decision document requirements, and any other relevant requirements that are identified in the course of this project. Fort Rucker is an active facility with operational and security requirements for various activities. Applicable requirements will be discussed during fieldwork kickoff meetings. All work will be performed in compliance with these requirements.

5.1 Project Team

The organizational structure for this project includes personnel from the USAEC, USACE, Fort Rucker, CH2M HILL, and subcontractors. The structure of the project organization is summarized below in **Figure 5-1**.

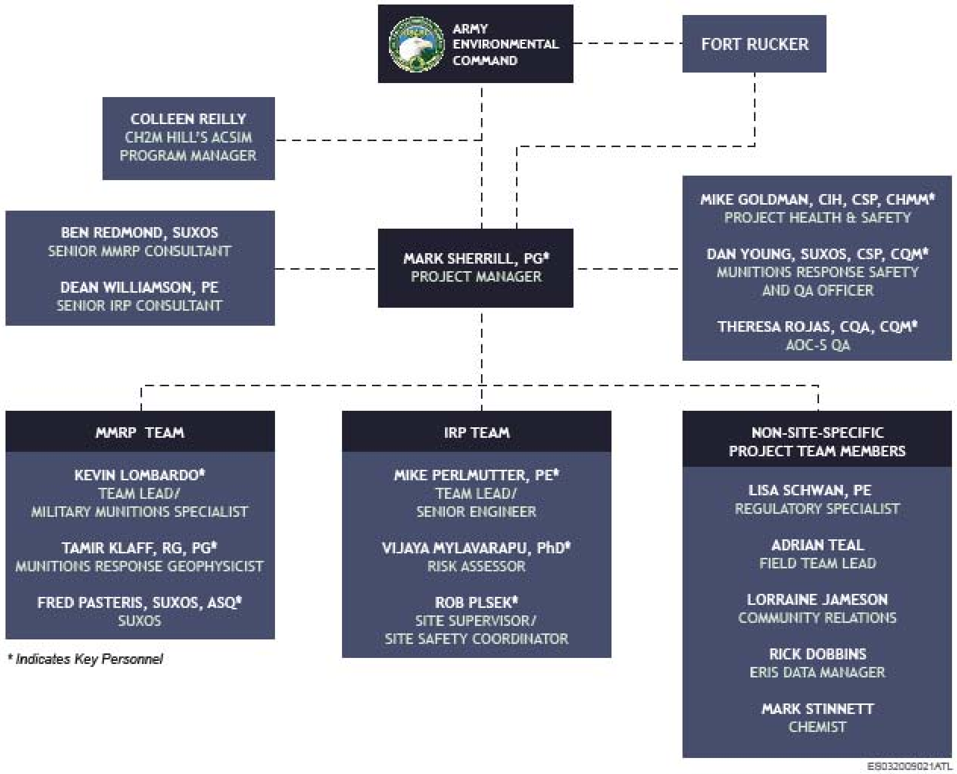
5.1.1 CH2M HILL

The following presents the CH2M HILL key team member's roles, responsibilities, and accountabilities. As described previously, all team members are chartered at the initiation of each project. All team members sign the charter, which clearly provides their roles, responsibilities, and accountabilities. In addition to roles and responsibilities, CH2M HILL has identified the authorities for the key positions.

Mark Sherrill, PG, Project Manager (PM)

- Serves as the primary point of contact for all CH2M HILL communication to the Army
- Ultimately responsible for the success of the project including quality, budget, and schedule
- Establishes team roles, responsibilities, and accountabilities
- Creates and tracks a resource- and activity-based schedule that is distributed to all team members; develops plan of the day and work task assignments
- Develops communication links and establishes weekly communication actions and protocols to ensure all team members (including subcontractors) are coordinated across all Installation activities
- Oversees and is responsible for the safety of the team, subcontractors, and surrounding "community"
- **Authorities:** makes technical and managerial decisions regarding specific project issues; negotiates with subcontractors; approves subcontractor deliverable performance; approves subcontractor invoices; approves and implements health and safety (H&S) and QC plans

FIGURE 5-1
Organizational Chart



Kevin Lombardo, MMRP Sites Team Lead/Military Munitions Specialist

- Technical lead for military response program conformance to processes and procedures; tracks performance against established resource- and activity-based schedule; develops plan of the day and work task assignments for MMRP work
- Develops MEC technical information for ESP requirements and prepares submission, corrections, or amendments
- Assignment of MEC resources, selection of techniques, scheduling personnel, managing risks, and coordinating with QC and Safety to achieve conformance and ensure capabilities to deliver a safe and effective suite of services
- **Authorities:** determines acceptance or rejection of all MR fieldwork in process and completed work activities; issues stop work orders on MR field activities for quality-related reasons

Tamir Klaff, RG, PG, Munitions Response Geophysicist

- Develops geophysical sampling approach
- Manages, designs, and oversees geophysical operations including subcontractor work
- Provides QC of all geophysical operations and data deliverables
- **Authorities:** approves deliverables in specialty area; approves geophysical staff assignments to the project

Theresa Rojas, AOC-S AND MMRP SITES QA

- Establishes and distributes QA/QC protocols and procedures for all field and office-level work activities
- Conducts QC audits to ensure quality control checks are being conducted at the field- and office-level, reports results to team
- Charged with corrective action implementation, as needed
- **Authorities:** determines acceptance or rejection of all fieldwork (related to AOC-S) in process and completed work activities; issues stop work orders on field activities for quality-related reasons

Fred Pasteris, SUXOS

- Develops and implements written Accident Prevention Plan program in accordance with guidelines specified in DID MR-005-06 for conventional MR
- Plans, coordinates, and supervises all explosives operations; supervises all personnel who are inside the exclusion zone
- Coordinates MEC avoidance, construction, removal activities
- Certifies that munitions debris and range-related debris are ready for final disposition
- **Authorities:** issues stop work orders on MR field activities; signs for receipt of explosives; signs explosives inventories; signs DD-1348-1

Mike Perlmutter, PE, IRP Team Lead/Senior Engineer

- Leads the development of the design and implementation of the ZVI barrier wall
- Provides QC of the system installation
- Verifies system effectiveness based on downgradient sampling
- **Authorities:** approves deliverables related to remedial design and construction for AOC-S

Vijaya Mylavarapu, PhD, Risk Assessor

- Provides sampling and analysis design to meet requirements for risk-based evaluations
- Conducts data screening evaluations per ARBCA and prepares site closure recommendations that are cost-effective and that fulfill regulatory requirements
- Develops site-media-specific target levels based on ARBCA and CERCLA-RAGS guidance appropriate for Region 4 that also meet the Army's land-use-based requirements
- **Authorities:** approves deliverables within risk assessment area

Michael Goldman, Project Health & Safety

- Develops and provides health and safety SOPs and conducts job hazards risk analyses for project activities
- Provides and verifies training, medical surveillance, and the use of personal protective equipment specific to site conditions and planned operations
- Prequalifies (non MMRP) subcontractors and ensures that selected subcontractors carry, at a minimum, the CH2M HILL level of health and safety requirements
- Conducts initial tailgate meetings as well as health and safety audits to verify procedures and safety measures are implemented in the field
- **Authorities:** approves SSHP for the TO; stops work for H&S reasons

Dan Young, Munitions Response Safety and QA Officer

- Reviews and approves ESP submission
- Implements CH2M HILL standard munitions QC procedures and provides monthly audits to ensure QC protocols are being followed
- Develops safety plans that include detailed descriptions of the ESQD arcs, exclusion zones, and the explosives operations areas
- Prequalifies MEC subcontractors and verifies that selected subcontractors carry, at a minimum, the CH2M HILL level of health and safety requirements
- **Authorities:** issues stop work orders for H&S-related reasons; approves Accident Prevention Plan and SSHP; approves safety and quality documents; approves ORE for safety

Rob Plsek, Site Superintendent/Site Safety Coordinator

- Coordinates field level H&S activities and ensures that prescribed safety equipment is being used and established procedures and protocols are being followed
- Conducts daily safety tailgate meetings; works with Dan Young (MR Safety and QA Officer) to develop daily safety topics and lessons-learned

- Includes subcontractors into the CH2M HILL safety program to ensure their safety procedures and protocols meet CH2M HILL minimum requirements
- **Authorities:** Approves SHSP for each TO in absence of the Safety Manager; stops work for H&S reasons

Note: All personnel have the authority to temporarily stop work based on unsafe work conditions.

5.1.2 Army

The USAEC is administering this contract through the USACE Mobile District offices. Members of the project team include the Contracting Officer (KO), USAEC Environmental Restoration Manager (ERM), COR, USACE Project Manager (PM), and other Army officials and subject matter experts (SME).

Contracting Officer

The KO has overall responsibility for overseeing the Contractor's performance. The KO is responsible for the day-to-day monitoring of the Contractor's performance in the areas of contract compliance and contract administration; reviewing the COR's assessment of the Contractor's performance; and resolving all differences between the COR's assessment and the Contractor's assessment of performance. The KO is ultimately responsible for the final determination of the adequacy of the Contractor's performance.

The KO for this contract is Alison W. Gannon at the Aberdeen Installation Contracting Division, CCRD-AI-MC.

Contracting Officer's Representative and USACE Project Manager

The COR is responsible for technical administration of the project and ensures proper Army surveillance of the Contractor's performance. The COR for this contract is William L. Woodall at the USACE, Mobile District. Dennis Mayton will act as the USACE Technical Manager (TM) in support of the COR and is responsible for monitoring, assessing, recording, and reporting on the technical performance of CH2M HILL on a day-to-day basis.

Other Army Officials and Subject Matter Experts

The KO and COR may call upon the technical expertise of other Army officials and SME as required. These Army officials and SMEs may be called upon to review technical documents and products generated by the Contractor. For this contract, the following Army officials and SMEs have been identified:

- Army Environmental Command — Paul Higgs
AEC ERM
- USACE, Mobile District — Dennis Mayton
USACE TM
- USACE, Mobile District — Karl Blankinship
USACE Project Manager (MEC)

- USACE, Huntsville District — Chris Cochrane
USACE Program Manager (MEC)
- USACE, Mobile District — Richard Kinsella
USACE Chemist
- USACE Environmental and Munitions Center of Expertise
- U.S. Army Technical Center for Explosives Safety (USATCES)
- DoD DDESB

If additional Army officials and SMEs are identified as work progresses, the PMP will be modified.

5.1.3 Fort Rucker

Mr. Jim Swift, Fort Rucker IRP Manager, is the primary point of contact for Fort Rucker and will provide project oversight and direction, assist with coordination of project activities between CH2M HILL and base operations personnel, provide technical review of deliverables, and serve as primary regulatory interface for the Army and project team.

5.1.4 ADEM

Mr. Mark Harrison will serve as the Remedial Project Manager (RPM) for ADEM. Mr. Bob Barnwell will serve as Lead Hydrogeologist/Technical Reviewer for ADEM in support of Mr. Harrison. If additional ADEM officials and SMEs are identified as work progresses, the PMP will be modified.

5.1.5 Subcontractors

The major subcontractors anticipated during the performance of this TO are as follows:

AOC-S

- Empirical Laboratories (Analytical)
- AE Drilling (Borings/Wells)
- Donaldson, Garrett & Associates (Surveying)
- Capitol Environmental (Transportation and Disposal)
- Jacklett Construction (Civil Works)
- DeWind One-Pass Trenching LLC (PRB Installation)
- Singley Environmental and Remediation Services (Waste Handling)

MMRP Sites

- NAEVA (Digital Geophysical Mapping)
- OneVision Utility Services (Utility Locator)
- Jacklett Construction (Vegetation Removal)
- UXB (MEC Activities)
- Donaldson, Garrett & Associates (Surveying)

5.2 Communication

The CH2M HILL PM will serve as the single CH2M HILL point of contact to the Army and Fort Rucker. All communication from CH2M HILL with the Army and Fort Rucker will be conducted by the CH2M HILL PM. All directives, guidance, and communication will flow from the CH2M HILL PM to the CH2M HILL project team. All written correspondence pertaining to this TO will be addressed to the COR unless otherwise directed by the COR. Questions and requests for information may be directed to the COR or the USACE PM; however written directions or clarifications for work on this project may be given only to CH2M HILL by the COR. TO submittals (e.g., work plans and reports) will be submitted to the USACE PM and the Fort Rucker IRP Manager.

File records of all key communications will be maintained throughout the entire project duration. The file will include records of conferences, meetings, discussions, verbal directions, telephone conversations, site visits, facsimile transmissions, letters, and other forms of communications pertinent to the project in which decisions are made. All communications will be made available for the COR and Fort Rucker.

CH2M HILL will provide, in a timely manner, the COR and Fort Rucker POC with all correspondence to/for/from all regulatory personnel, public interest groups, and private citizens resulting from performance of this TO. CH2M HILL will not meet with regulators or other public groups without first providing the COR and Fort Rucker with notification for such actions and with government personnel having the opportunity to attend such meetings. In general, CH2M HILL will not converse with the public on issues relating to this TO or to Fort Rucker without prior approval of the COR.

Because only the United States Army has legal standing with the regulatory agencies, all of CH2M HILL's submissions, responses, etc. to these agencies (i.e., formal actions) will require Army approval. Additionally, any documents, letters, or other official correspondence will be submitted under Army signature.

CH2M HILL will respect the confidential nature of the work performed at Fort Rucker. CH2M HILL, its personnel, subsidiaries, associates, subcontractors, or authorized representatives will not release any information regarding this project without authorization or permission from the COR.

5.3 Meetings

CH2M HILL proposes to hold meetings on a regularly scheduled basis through the duration of this TO. The proposed meetings are as follows:

- Kickoff Meeting (scheduled September 22, 2009)
- Stakeholder Presentations (scheduled semi-annually from years 2010 – 2015)

5.4 Status Reports

CH2M HILL will prepare and submit monthly project status reports that document technical progress to date, describe upcoming work, describe any technical issues, and provide an updated schedule. These monthly project status reports will be provided to the USACE PM and will commence upon approval of this PMP.

5.5 Change Management

Potential changes to work or to the work approaches used may originate with the Army or with CH2M HILL. Changes originating with the Army will be communicated to the CH2M HILL PM by Army COR and will then be disseminated to the project team by the CH2M HILL PM. For changes originating with CH2M HILL, a technical memorandum describing the requested change will be submitted to the Army PM for consideration and acceptance/rejection. Any changes to the planned and approved approaches to regulatory compliance issues will require Army and ADEM approval. CH2M HILL will be responsible for initiating communications and/or actions (if any) with appropriate regulatory entities to facilitate the proposed approach. For changes to time critical items that require fast resolution, CH2M HILL will initiate communications using conference calls, e-mails, or face-to-face meetings.

5.6 Community Involvement

CH2M HILL will conduct a biannual public interest assessment beginning in 2010. If the assessment indicates adequate public interest, CH2M HILL will assist the Army, as necessary, in chartering and holding Restoration Advisory Board (RAB) meetings and preparing community communications, as needed. CH2M HILL will develop an approved community involvement plan, as appropriate, if a RAB is formed.

5.7 Project Repository and Administrative Record

The project repository will be maintained at the Fort Rucker Environmental Office and updated monthly (both hard copy and electronic) for the length of the project. Final electronic files will be in text-searchable portable document format/PDF and will be accompanied by the metadata for upload into the Repository of Environmental Army Documents (READ).

5.8 Army Environmental Database and ERIS

Upon completion of the RFI for each Munitions Response Site (MRS), CH2M HILL will provide the COR with the data and documentation necessary for each MRS in the Army Environmental Database-Restoration Module (AEDB-R).

Additionally, CH2M HILL will upload, quarterly, all generated analytical data into ERIS. CH2M HILL is uploading Fort Rucker IRP data to ERIS under the current contract; this process will require no learning curve to complete this task.

6. Project Contact Information/Document Distribution

Contact information for key members of the project team and the document distribution list are presented below in **Table 6-1**.

TABLE 6-1
Key Project Team Members Contact Information/Document Distribution List

Name and Contact Information	Telephone/E-mail	Project Function	Number of Copies
Ms. Alison Gannon Research Development and Engineering Command Contracting Center Aberdeen Installation Contracting Division USAEC E4460 Beal Road APG-EA, MD 21010	(410) 436-1661/Alison.gannon@us.army.mil	KO	0
Mr. Paul Higgs U.S. Army Environmental Command2280 Highway 104ESuite 1Milan, TN 38358	(731) 686-6614/Paul.a.higgs@us.army.mil	USAEC ERM	1 (Draft, Draft Final, Final)
Mr. William Woodall U.S. Army Corps of Engineers, Mobile District Attn: EN-GE 109 Saint Joseph Street Mobile, AL 36602	(251) 694-4364/William.l.woodall@usace.army.mil	COR	1 (Draft, Draft Final, Final)
Mr. Dennis Mayton U.S. Army Corps of Engineers, Mobile District Attn: EN-GG 109 Saint Joseph Street Mobile, AL 36602	(251) 694-3684/Dennis.H.Mayton@usace.army.mil	USACE TM	2 (Draft, Draft Final, Final)
Mr. Karl Blankinship U.S. Army Corps of Engineers, Mobile District 106 Highland Place Sheffield, AL 35660	(256) 682-7546/karl.e.blankinship@usace.army.mil	USACE PM (MEC)	1 (Draft, Draft Final, Final)
Mr. Chris Cochrane U.S. Army Corps of Engineers Ordnance and Explosives Design Center Huntsville Center 4820 University Square Huntsville, AL 35816-1822	(256) 895-1696/Chris.cochrane@usace.army.mil	USACE Program Manager (MEC)	1 (Draft, Draft Final, Final)

TABLE 6-1
Key Project Team Members Contact Information/Document Distribution List

Name and Contact Information	Telephone/E-mail	Project Function	Number of Copies
Mr. Jim Swift IMSE-RCK-PWE Building 1121 Fort Rucker, AL 36362	(334) 255-1899/jim.swift@us.army.mil	Fort Rucker IRP Manager	2 (Draft, Draft Final, Final)
Mr. Mark Harrison Alabama Department of Environmental Management Hazardous Waste Branch-Land Division 1400 Coliseum Blvd. Montgomery, AL 36110	(334) 270-5610/mdharrison@adem.state.al.us	ADEM RPM	3 (Draft Final, Final)
Mr. Mark Sherrill CH2M HILL 3534 Morningwood Court Suwanee, GA 30024	(678) 938-0923/msherril@ch2m.com	CH2M HILL PM	Not Applicable

7. Performance/Payment Milestones and Project Schedule

7.1 Performance/Payment Milestones

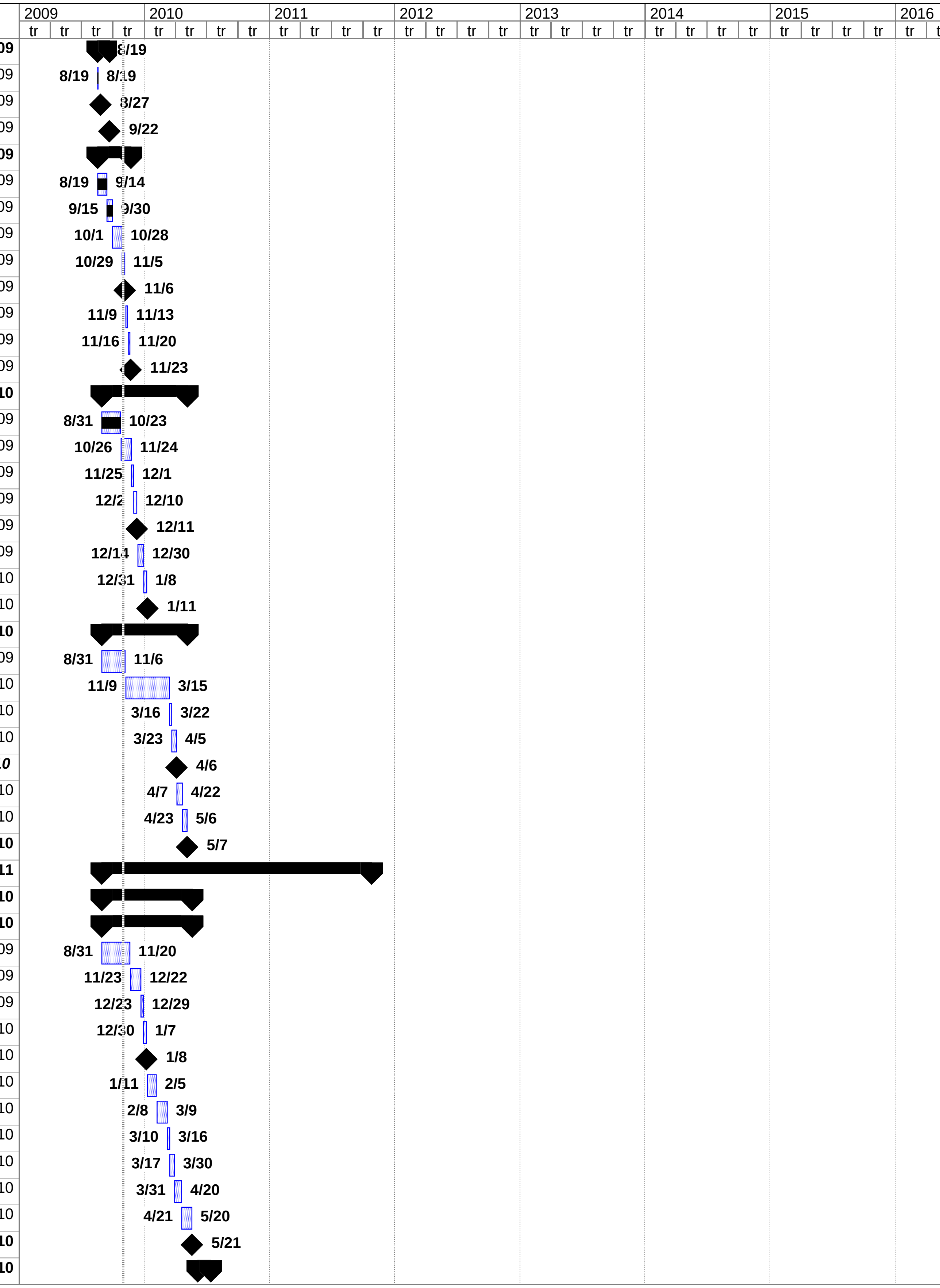
Progress in completion of this TO is measured through the achievement of performance milestones. Table 1-2 depicts the Performance Milestone and Payment Schedule proposed for this project. According to the Performance Work Statement (PWS), completion of a performance milestone is considered successful if it meets the performance acceptance standards according to the designated approval authority. The performance acceptance standard and approval authority for all performance milestones indicated in Table 1-2 is written government approval/ acceptance. Invoices and corresponding documentation will be submitted as discussed below upon completion of one or more performance milestones:

- Submit invoice to COR for approval.
- After approval by COR, CH2M HILL will enter invoice into Wide Area Workflow (WAWF) and include a copy of the COR approval as an attachment.
- Include email for KO in the distribution in WAWF.

7.2 Project Schedule

The estimated project schedule for the Fort Rucker Environmental Remediation Services is presented in **Figure 7-1**.

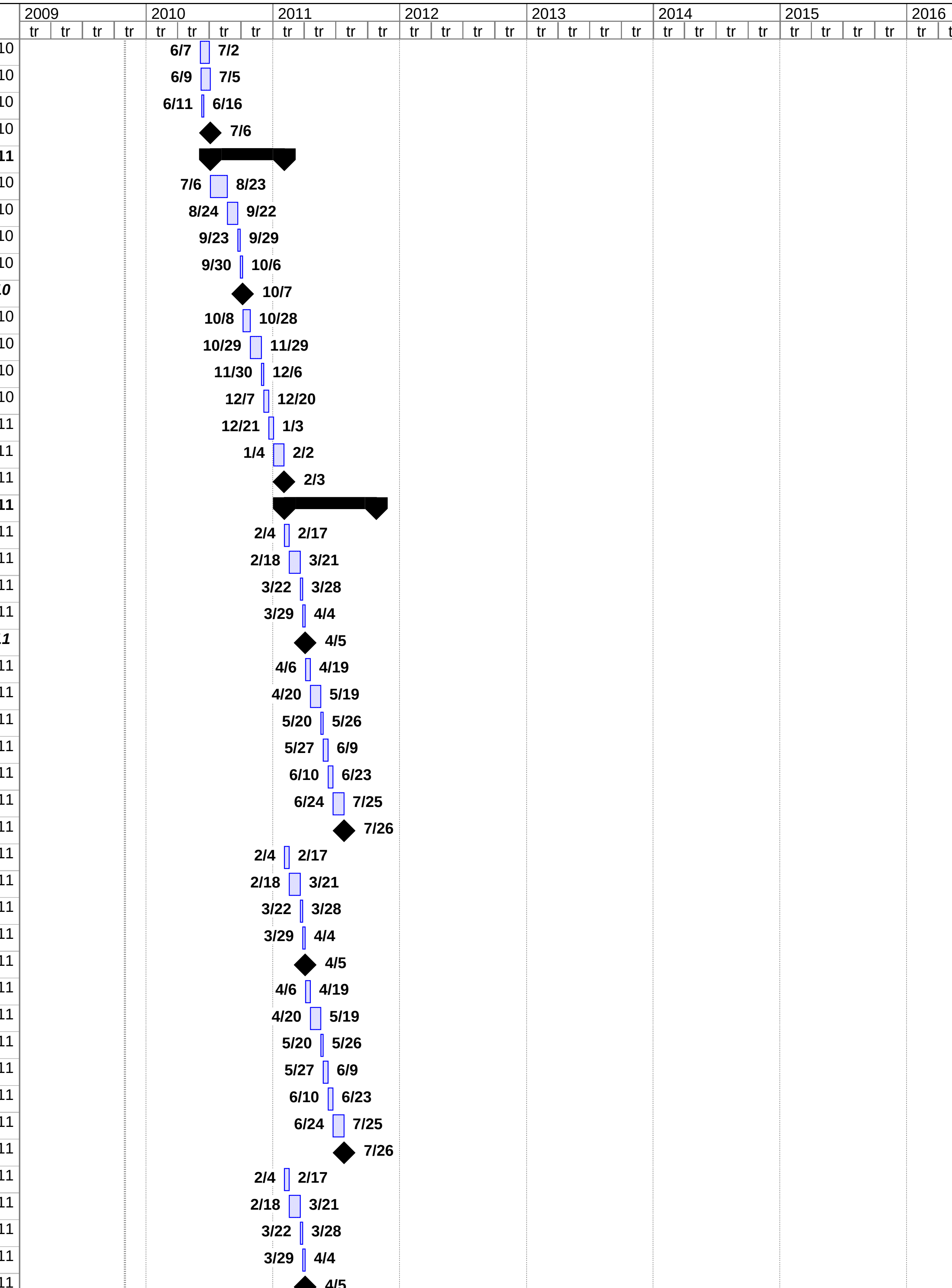
ID	Info	WBS	Task Name	Duration	Start	Finish
1	✓	2004	ENVIRONMENTAL REMEDIATION SERVICES AT FT. RUCKER	25 days	Wed 8/19/09	Tue 9/22/09
2	✓	2004A	Award Date	1 day	Wed 8/19/09	Wed 8/19/09
3	✓	2004B	Site Recon Visit	1 day	Thu 8/27/09	Thu 8/27/09
4	✓	2004C	Project Kick-Off Meeting	1 day	Tue 9/22/09	Tue 9/22/09
5		2004AA	PMP/QASP	69 days	Wed 8/19/09	Mon 11/23/09
6	✓	2004AA1	Draft PMP/QASP Preparation and Submittal	19 days	Wed 8/19/09	Mon 9/14/09
7	✓	2004AA2	Army Review/Comments	12 days	Tue 9/15/09	Wed 9/30/09
8		2004AA3	Prepare Response to Army Comments and Response Submittal	20 days	Thu 10/1/09	Wed 10/28/09
9		2004AA4	Army Review/Acceptance of Response to Comments	6 days	Thu 10/29/09	Thu 11/5/09
10		2004AA5	Army Approval of Draft PMP/QASP	1 day	Fri 11/6/09	Fri 11/6/09
11		2004AA6	Final PMP Preparation and Submittal	5 days	Mon 11/9/09	Fri 11/13/09
12		2004AA7	Army Review of Final PMP	5 days	Mon 11/16/09	Fri 11/20/09
13		2004AA8	Army Approval of Final PMP/QASP	1 day	Mon 11/23/09	Mon 11/23/09
14		2004BA	ADDITIONAL SITE-WIDE PLANS	180 days	Mon 8/31/09	Fri 5/7/10
15	✓	2004BA1	Draft SSHP/SAP/WMP Preparation and Submittal	40 days	Mon 8/31/09	Fri 10/23/09
16		2004BA2	Army Review/Comments	22 days	Mon 10/26/09	Tue 11/24/09
17		2004BA3	Prepare Response to Army Comments and Response Submittal	5 days	Wed 11/25/09	Tue 12/1/09
18		2004BA4	Army Review/Acceptance of Response to Comments	7 days	Wed 12/2/09	Thu 12/10/09
19		2004BA5	Army Approval of Draft SSHP/SAP//WMP	1 day	Fri 12/11/09	Fri 12/11/09
20		2004BA6	Final SSHP/SAP/WMP Preparation and Submittal	13 days	Mon 12/14/09	Wed 12/30/09
21		2004BA7	Army Review of Final SSHP/SAP/WMP	7 days	Thu 12/31/09	Fri 1/8/10
22		2004BA8	Army Approval of Final SSHP/SAP/WMP	1 day	Mon 1/11/10	Mon 1/11/10
23		2004BA9	Explosives Site Plan (includes all MMRP Sites)	180 days	Mon 8/31/09	Fri 5/7/10
24		2004BA10	Draft Explosives Siting Plan Preparation and Submittal	50 days	Mon 8/31/09	Fri 11/6/09
25		2004BA11	Army Review/Comments	91 days	Mon 11/9/09	Mon 3/15/10
26		2004BA12	Prepare Response to Army Comments and Response Submittal	5 days	Tue 3/16/10	Mon 3/22/10
27		2004BA13	Army Review/Acceptance of Response to Comments	10 days	Tue 3/23/10	Mon 4/5/10
28		2004BA14	Army Approval of Draft Explosives Siting Plan	1 day	Tue 4/6/10	Tue 4/6/10
29		2004BA15	Final Explosives Siting Plan Preparation and Submittal	12 days	Wed 4/7/10	Thu 4/22/10
30		2004BA16	Army Review of Final Explosives Siting Plan	10 days	Fri 4/23/10	Thu 5/6/10
31		2004BA17	Army Approval of Final Explosives Siting Plan	1 day	Fri 5/7/10	Fri 5/7/10
32		2004CA	MMRP SITES	563 days	Mon 8/31/09	Wed 10/26/11
33		2004CA1	RFI/CMS WORK PLAN	190 days	Mon 8/31/09	Fri 5/21/10
34		2004CA2	RFI/CMS Work Plan (includes all MMRP Sites)	190 days	Mon 8/31/09	Fri 5/21/10
35		2004CA3	Draft RFI/CMS Work Plan Preparation and Submittal	60 days	Mon 8/31/09	Fri 11/20/09
36		2004CA4	Army Review/Comments	22 days	Mon 11/23/09	Tue 12/22/09
37		2004CA5	Prepare Response to Army Comments and Response Submittal	5 days	Wed 12/23/09	Tue 12/29/09
38		2004CA6	Army Review/Acceptance of Response to Comments	7 days	Wed 12/30/09	Thu 1/7/10
39		2004CA7	Army Approval of Draft Final RFI/CMS Work Plan	1 day	Fri 1/8/10	Fri 1/8/10
40		2004CA8	Draft Final RFI/CMS Work Plan Preparation and Submittal	20 days	Mon 1/11/10	Fri 2/5/10
41		2004CA9	ADEM/Army Review/Comments	22 days	Mon 2/8/10	Tue 3/9/10
42		2004CA10	Prepare Response to ADEM/Army Comments and Response Submittal	5 days	Wed 3/10/10	Tue 3/16/10
43		2004CA11	ADEM/Army Review/Acceptance of Response to Comments	10 days	Wed 3/17/10	Tue 3/30/10
44		2004CA12	Final RFI/CMS Work Plan Preparation and Submittal	15 days	Wed 3/31/10	Tue 4/20/10
45		2004CA13	ADEM/Army Review of Final RFI/CMS Work Plan	22 days	Wed 4/21/10	Thu 5/20/10
46		2004CA14	Army/ADEM Approval of Final RFI/CMS Work Plan	1 day	Fri 5/21/10	Fri 5/21/10
47		2004CA15	RCRA FACILITY INVESTIGATION	28 days	Mon 6/7/10	Wed 7/14/10



Project: FIGURE 7-1 FORT RUCKER
Date: 10/27/09

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

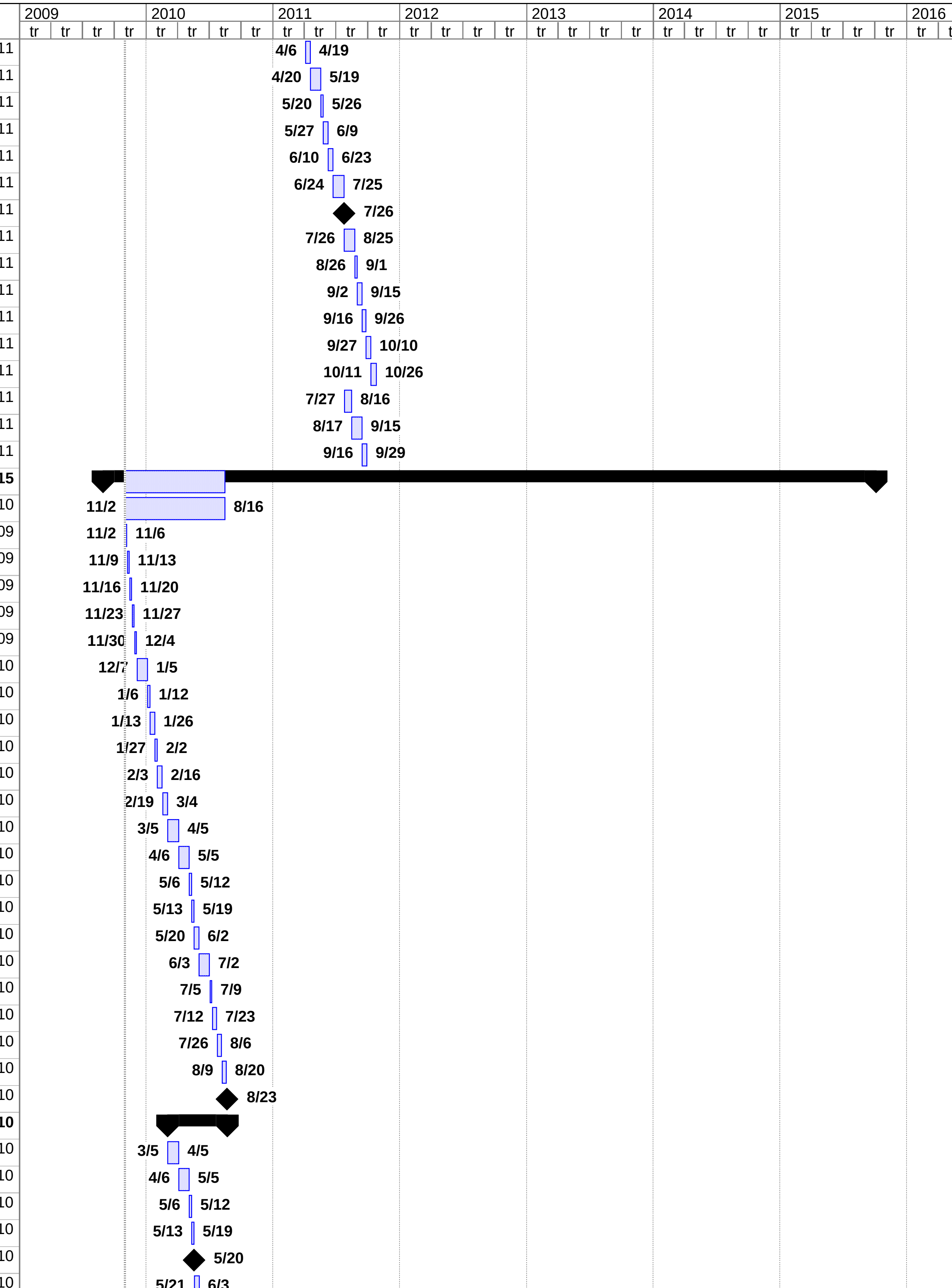
ID	WBS	Task Name	Duration	Start	Finish
48	2004CA16	DGM/Intrusive Investigation - Anti-Tank/Rocket Grenade Range	20 days	Mon 6/7/10	Fri 7/2/10
49	2004CA17	DGM/Intrusive Investigation - Infiltration/Grenade Range	19 days	Wed 6/9/10	Mon 7/5/10
50	2004CA18	DGM/Intrusive Investigation - .22-Caliber Target Butt	4 days	Fri 6/11/10	Wed 6/16/10
51	***2004CA19***	***Army Acceptance of Total LF of Geophysical Transects/Instrusive Inv. TM***	7 days	Tue 7/6/10	Wed 7/14/10
52	**2004CA20**	**RCRA FACILITY INVESTIGATION REPORT / CMS**	**153 days**	**Tue 7/6/10**	**Thu 2/3/11**
53	2004CA21	Draft RFI/CMS Report (includes all MMRP Sites) Preparation and Submittal	35 days	Tue 7/6/10	Mon 8/23/10
54	2004CA22	Army Review/Comments	22 days	Tue 8/24/10	Wed 9/22/10
55	2004CA23	Prepare Response to Army Comments and Response Submittal	5 days	Thu 9/23/10	Wed 9/29/10
56	2004CA24	Army Review/Acceptance of Response to Comments	5 days	Thu 9/30/10	Wed 10/6/10
57	***2004CA25***	***Army Approval of Draft Final RFI/CMS Report***	***1 day***	***Thu 10/7/10***	***Thu 10/7/10***
58	2004CA26	Draft Final RFI/CMS Report Preparation and Submittal	15 days	Fri 10/8/10	Thu 10/28/10
59	2004CA27	ADEM/Army Review/Comment	22 days	Fri 10/29/10	Mon 11/29/10
60	2004CA28	Response to ADEM/Army Comments and Response Submittal	5 days	Tue 11/30/10	Mon 12/6/10
61	2004CA29	ADEM/Army Review/Acceptance of Response to Comments	10 days	Tue 12/7/10	Mon 12/20/10
62	2004CA30	Final RFI/CMS Report Preparation and Submittal	10 days	Tue 12/21/10	Mon 1/3/11
63	2004CA31	ADEM/Army Review of Final RFI/CMS Report	22 days	Tue 1/4/11	Wed 2/2/11
64	**2004CA32**	***Army/ADEM Approval of Final RFI/CMS Report***	1 day	Thu 2/3/11	Thu 2/3/11
65	**2004CA33**	**STATEMENT OF BASIS**	**189 days**	**Fri 2/4/11**	**Wed 10/26/11**
66	2004CA34	Draft Statement of Basis - Anti-Tank/Rocket Grenade Range Prep and Submittal	10 days	Fri 2/4/11	Thu 2/17/11
67	2004CA35	Army Review/Comments	22 days	Fri 2/18/11	Mon 3/21/11
68	2004CA36	Prepare Response to Army Comments and Response Submitttal	5 days	Tue 3/22/11	Mon 3/28/11
69	2004CA37	Army Review/Acceptance of Response to Comments	5 days	Tue 3/29/11	Mon 4/4/11
70	***2004CA38***	Army Approval of Draft SB-Anti-Tank/Rocket Grenade Range	***1 day***	***Tue 4/5/11***	***Tue 4/5/11***
71	2004CA39	Draft Final Statement of Basis - Anti-Tank/Rocket Grenade Range Prep and Submittal	10 days	Wed 4/6/11	Tue 4/19/11
72	2004CA40	ADEM/Army Review/Comment	22 days	Wed 4/20/11	Thu 5/19/11
73	2004CA41	Response to ADEM/Army Comments and Response Submittal	5 days	Fri 5/20/11	Thu 5/26/11
74	2004CA42	ADEM/Army Review/Acceptance of Response to Comments	10 days	Fri 5/27/11	Thu 6/9/11
75	2004CA43	Final Statement of Basis - Anti-Tank/Rocket Grenade Range Prep and Submittal	10 days	Fri 6/10/11	Thu 6/23/11
76	2004CA44	ADEM/Army Review of Final Statement of Basis - Anti-Tank/Rocket Grenade Rg	22 days	Fri 6/24/11	Mon 7/25/11
77	**2004CA45**	***Army/ADEM Approval of Final SB-Anti-Tank/Rocket Grenade***	1 day	Tue 7/26/11	Tue 7/26/11
78	2004CA46	Draft Statement of Basis - Infiltration/Grenade Range Preparation and Submittal	10 days	Fri 2/4/11	Thu 2/17/11
79	2004CA47	Army Review/Comments	22 days	Fri 2/18/11	Mon 3/21/11
80	2004CA48	Prepare Response to Army Comments and Response Submittal	5 days	Tue 3/22/11	Mon 3/28/11
81	2004CA49	Army Review/Acceptance of Response to Comments	5 days	Tue 3/29/11	Mon 4/4/11
82	2004CA50	Army Approval of Draft SB-Infiltration/Grenade Range	1 day	Tue 4/5/11	Tue 4/5/11
83	2004CA51	Draft Final Statement of Basis - Infiltration/Grenade Range Prep and Submittal	10 days	Wed 4/6/11	Tue 4/19/11
84	2004CA52	ADEM/Army Review/Comments	22 days	Wed 4/20/11	Thu 5/19/11
85	2004CA53	Prepare Response to ADEM/Army Comments and Response Submittal	5 days	Fri 5/20/11	Thu 5/26/11
86	2004CA54	ADEM/Army Review/Acceptance of Response to Comments	10 days	Fri 5/27/11	Thu 6/9/11
87	2004CA55	Final Statement of Basis - Infiltration/ Grenade Range Prep and Submittal	10 days	Fri 6/10/11	Thu 6/23/11
88	2004CA56	ADEM/Army Review of Final Statement of Basis - Infiltration/Grenade Range	22 days	Fri 6/24/11	Mon 7/25/11
89	**2004CA57**	***Army/ADEM Approval of Final SB-Infiltration/Grenade Range***	1 day	Tue 7/26/11	Tue 7/26/11
90	2004CA658	Draft Statement of Basis - .22-Caliber Target Butt Preparation and Submittal	10 days	Fri 2/4/11	Thu 2/17/11
91	2004CA59	Army Review/Comments	22 days	Fri 2/18/11	Mon 3/21/11
92	2004CA60	Prepare Response to Army Comments and Response Submittal	5 days	Tue 3/22/11	Mon 3/28/11
93	2004CA61	Army Review/Acceptance of Response to Comments	5 days	Tue 3/29/11	Mon 4/4/11
94	2004CA62	Army Approval of Draft SB-.22-Caliber Target Butt	1 day	Tue 4/5/11	Tue 4/5/11



Project: FIGURE 7-1 FORT RUCKER
Date: 10/27/09

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

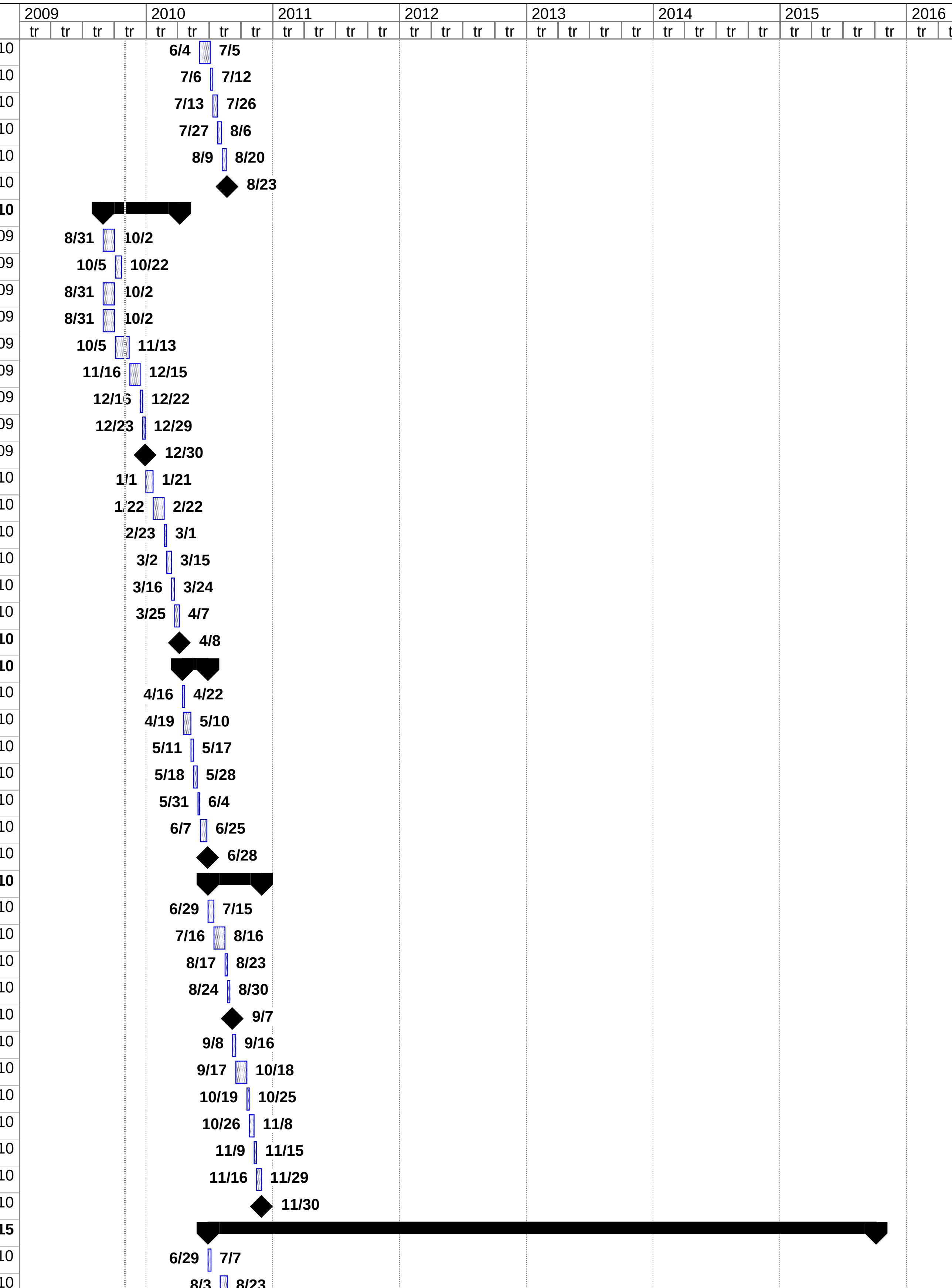
ID		WBS	Task Name	Duration	Start	Finish
95		2004CA63	Draft Final Statement of Basis - .22-Caliber Target Butt Prep and Submittal	10 days	Wed 4/6/11	Tue 4/19/11
96		2004CA64	ADEM/Army Review/Comment	22 days	Wed 4/20/11	Thu 5/19/11
97		2004CA65	Prepare Response to ADEM/Army Comments and Response Submittal	5 days	Fri 5/20/11	Thu 5/26/11
98		2004CA66	ADEM/Army Review/Acceptance of Response to Comments	10 days	Fri 5/27/11	Thu 6/9/11
99		2004CA67	Final Statement of Basis - .22-Caliber Target Butt Prep and Submittal	10 days	Fri 6/10/11	Thu 6/23/11
100		2004CA68	ADEM/Army Review of Final Statement of Basis - .22-Caliber Target Butt	22 days	Fri 6/24/11	Mon 7/25/11
101		**2004CA69**	***Army/ADEM Approval of Final SB-.22-Caliber Target Butt***	1 day	Tue 7/26/11	Tue 7/26/11
102		2004CA70	Public Comment Period (All MMRP Sites)	23 days	Tue 7/26/11	Thu 8/25/11
103		2004CA71	Prepare Response to Public Comments	5 days	Fri 8/26/11	Thu 9/1/11
104		2004CA72	Army/ADEM Review/Acceptance of Response to Public Comments	10 days	Fri 9/2/11	Thu 9/15/11
105		2004CA73	Revise Statement of Basis (If Needed Based on Public Comment)	7 days	Fri 9/16/11	Mon 9/26/11
106		2004CA74	ADEM/Army Review of Final Statement fo Basis	10 days	Tue 9/27/11	Mon 10/10/11
107		2004CA75	Final Statement of Basis - Acceptance of Ranges	12 days	Tue 10/11/11	Wed 10/26/11
108		2004CA76	Draft MMRP Scores Update and Submittal	15 days	Wed 7/27/11	Tue 8/16/11
109		2004CA77	Army Review/Comments	22 days	Wed 8/17/11	Thu 9/15/11
110		2004CA78	Final MMRP Scores Update and Submittal	10 days	Fri 9/16/11	Thu 9/29/11
111		**2004DA**	**IRP SITE AOC-S**	**1591 days**	**Mon 8/31/09**	**Mon 10/5/15**
112		**2004DA1**	**FINAL RFI**	206 days	Mon 11/2/09	Mon 8/16/10
113		2004DA2	Draft RFI Technical Memorandum Work Plan Preparation and Submittal	5 days	Mon 11/2/09	Fri 11/6/09
114		2004DA3	Army Review/Comment	5 days	Mon 11/9/09	Fri 11/13/09
115		2004DA4	Prepare Response to Army Comments and Submittal	5 days	Mon 11/16/09	Fri 11/20/09
116		2004DA5	Army Review/Acceptance of Response to Comments	5 days	Mon 11/23/09	Fri 11/27/09
117		2004DA6	Draft Final RFI Technical Memorandum Work Plan Preparation and Submittal	5 days	Mon 11/30/09	Fri 12/4/09
118		2004DA7	ADEM/Army Review/Comment	22 days	Mon 12/7/09	Tue 1/5/10
119		2004DA8	Prepare Response to ADEM/Army Comments and Response Submittal	5 days	Wed 1/6/10	Tue 1/12/10
120		2004DA9	ADEM/Army Review/Acceptance of Response to Comments	10 days	Wed 1/13/10	Tue 1/26/10
121		2004DA10	Final RFI Technical Memorandum Work Plan Preparation and Submittal	5 days	Wed 1/27/10	Tue 2/2/10
122		2004DA11	Army/ADEM Approval of Final RFI Technical Memorandum Work Plan	10 days	Wed 2/3/10	Tue 2/16/10
123		2004DA12	RFI Field Work	10 days	Fri 2/19/10	Thu 3/4/10
124		2004DA13	Final (Draft) RFI Report Preparation and Submittal	22 days	Fri 3/5/10	Mon 4/5/10
125		2004DA14	Army Review/Comment	22 days	Tue 4/6/10	Wed 5/5/10
126		2004DA15	Prepare Response to Army Comments and Submittal	5 days	Thu 5/6/10	Wed 5/12/10
127		2004DA16	Army Review/Acceptance of Response to Comments	5 days	Thu 5/13/10	Wed 5/19/10
128		2004DA17	Final (Draft Final) RFI Report Preparation and Submittal	10 days	Thu 5/20/10	Wed 6/2/10
129		2004DA18	Army/ADEM Review/Comment	22 days	Thu 6/3/10	Fri 7/2/10
130		2004DA19	Prepare Response to ADEM/Army Comments and Response Submittal	5 days	Mon 7/5/10	Fri 7/9/10
131		2004DA20	ADEM/Army Review/Acceptance of Response to Comments	10 days	Mon 7/12/10	Fri 7/23/10
132		2004DA21	Final RFI Report Preparation and Submittal	10 days	Mon 7/26/10	Fri 8/6/10
133		2004DA22	ADEM/Army Review of Final RFI Report	10 days	Mon 8/9/10	Fri 8/20/10
134		**2004DA23**	***Army/ADEM Approval of Final RFI Report***	1 day	Mon 8/23/10	Mon 8/23/10
135		**2004DA24**	**ARBCA EVALUATION**	**122 days**	**Fri 3/5/10**	**Mon 8/23/10**
136		2004DA25	Draft AOC-S ARBCA Technical Memorandum Preparation and Submittal	22 days	Fri 3/5/10	Mon 4/5/10
137		2004DA26	Army Review/Comment	22 days	Tue 4/6/10	Wed 5/5/10
138		2004DA27	Prepare Response to Army Comments and Submittal	5 days	Thu 5/6/10	Wed 5/12/10
139		2004DA28	Army Review/Acceptance of Response to Comments	5 days	Thu 5/13/10	Wed 5/19/10
140		**2004DA29**	***Army Approval of Draft Final AOC-S ARBCA Technical Memorandum***	1 day	Thu 5/20/10	Thu 5/20/10
141		2004DA30	Draft Final AOC-S ARBCA Technical Memorandum Preparation and Submittal	10 days	Fri 5/21/10	Thu 6/3/10



Project: FIGURE 7-1 FORT RUCKER
Date: 10/27/09

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

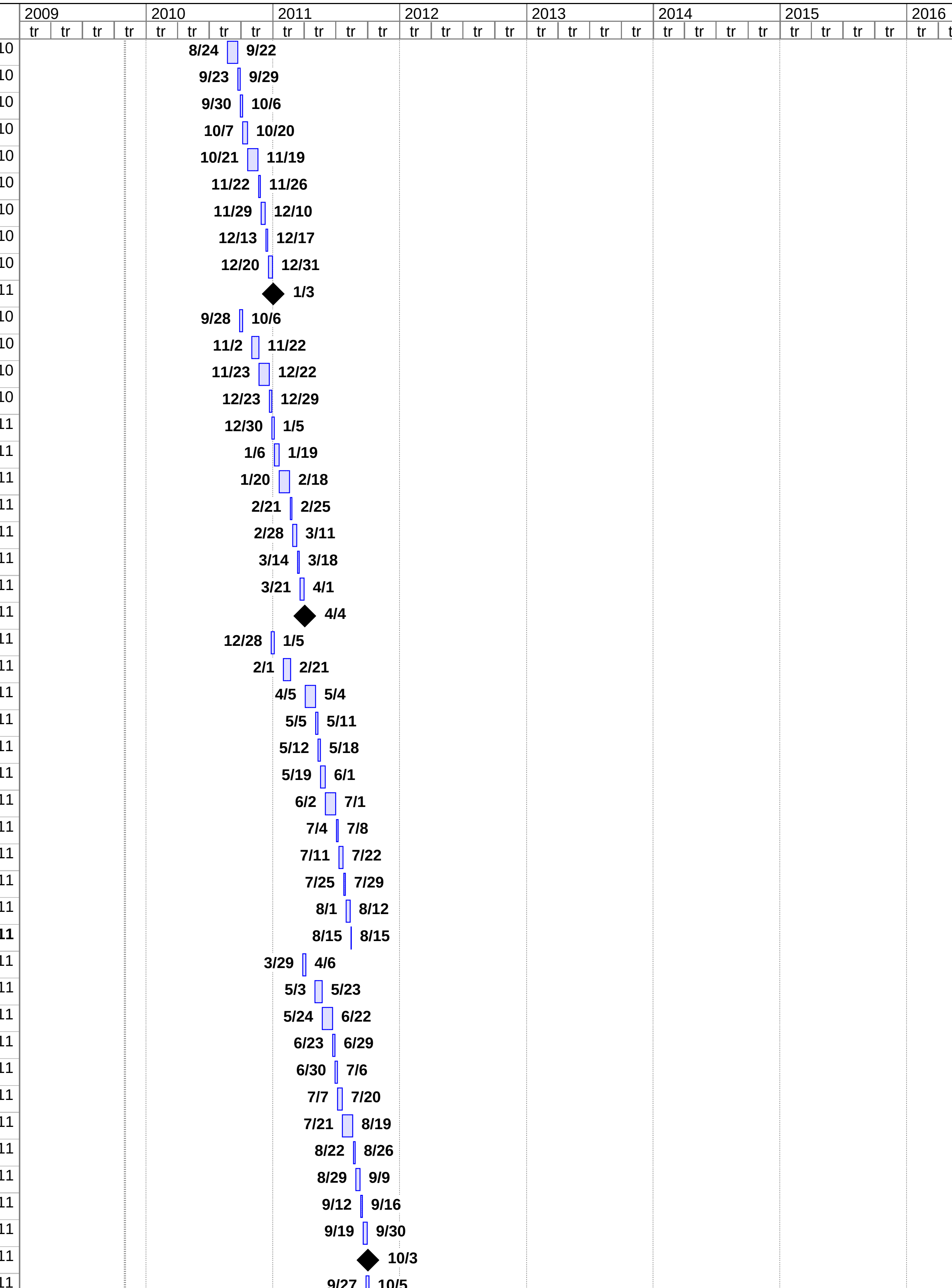
ID		WBS	Task Name	Duration	Start	Finish
142		2004DA31	ADEM/Army Review/Comment	22 days	Fri 6/4/10	Mon 7/5/10
143		2004DA32	Prepare Response to ADEM/Army Comments and Submittal	5 days	Tue 7/6/10	Mon 7/12/10
144		2004DA33	ADEM/Army Review/Acceptance of Response to Comments	10 days	Tue 7/13/10	Mon 7/26/10
145		2004DA34	Final AOC-S ARBCA Technical Memorandum Preparation and Submittal	9 days	Tue 7/27/10	Fri 8/6/10
146		2004DA35	ADEM/Army Review of Final AOC-S ARBCA Technical Memorandum	10 days	Mon 8/9/10	Fri 8/20/10
147		**2004DA36**	***Army/ADEM Approval of Final AOC-S ARBCA Technical Memorandum***	1 day	Mon 8/23/10	Mon 8/23/10
148		**2004DA37**	**CMS/CMIP**	**159 days**	**Mon 8/31/09**	**Thu 4/8/10**
149		2004DA38	Pre-Construction Survey	25 days	Mon 8/31/09	Fri 10/2/09
150		2004DA39	PRB Remedial Design	14 days	Mon 10/5/09	Thu 10/22/09
151		2004DA40	CMS	25 days	Mon 8/31/09	Fri 10/2/09
152		2004DA41	LTM Plan	25 days	Mon 8/31/09	Fri 10/2/09
153		2004DA42	Draft CMS/CMIP Preparation and Submittal	30 days	Mon 10/5/09	Fri 11/13/09
154		2004DA43	Army Review/Comment	22 days	Mon 11/16/09	Tue 12/15/09
155		2004DA44	Prepare Response to Army Comments and Submittal	5 days	Wed 12/16/09	Tue 12/22/09
156		2004DA45	Army Review/Acceptance of Response to Comments	5 days	Wed 12/23/09	Tue 12/29/09
157		**2004DA46**	***Army Approval of Draft Final CMS/CMIP***	1 day	Wed 12/30/09	Wed 12/30/09
158		2004DA47	Draft Final CMS/CMIP Preparation and Submittal	15 days	Fri 1/1/10	Thu 1/21/10
159		2004DA48	ADEM/Army Review/Comment	22 days	Fri 1/22/10	Mon 2/22/10
160		2004DA49	Prepare Response to ADEM/Army Comments and Submittal	5 days	Tue 2/23/10	Mon 3/1/10
161		2004DA50	ADEM/Army Review/Acceptance of Response to Comments	10 days	Tue 3/2/10	Mon 3/15/10
162		2004DA51	Final CMS/CMIP Preparation and Submittal	7 days	Tue 3/16/10	Wed 3/24/10
163		2004DA52	ADEM/Army Review of Final CMS/CMIP	10 days	Thu 3/25/10	Wed 4/7/10
164		**2004DA53**	***Army/ADEM Approval of Final CMS/CMIP***	**1 day**	**Thu 4/8/10**	**Thu 4/8/10**
165		**2004DA54**	**CMI**	**52 days**	**Fri 4/16/10**	**Mon 6/28/10**
166		2004DA55	Site Preparation Mobilization	5 days	Fri 4/16/10	Thu 4/22/10
167		2004DA56	Site Preparation (clearing, work platform)	16 days	Mon 4/19/10	Mon 5/10/10
168		2004DA57	PRB Mobilization	5 days	Tue 5/11/10	Mon 5/17/10
169		2004DA58	PRB Installation	9 days	Tue 5/18/10	Fri 5/28/10
170		2004DA59	PRB Monitoring Well Network Installation	5 days	Mon 5/31/10	Fri 6/4/10
171		2004DA60	Post-Construction Survey	15 days	Mon 6/7/10	Fri 6/25/10
172		***2004DA61***	***Army Acceptance of Installation of ZVI/Sand TM***	1 day	Mon 6/28/10	Mon 6/28/10
173		**2004DA62**	**CMI Report**	**111 days**	**Tue 6/29/10**	**Tue 11/30/10**
174		2004DA63	Draft AOC-S CMI Report Preparation and Submittal	13 days	Tue 6/29/10	Thu 7/15/10
175		2004DA64	Army Review/Comment	22 days	Fri 7/16/10	Mon 8/16/10
176		2004DA65	Prepare Response to Army Comments and Submittal	5 days	Tue 8/17/10	Mon 8/23/10
177		2004DA66	Army Review/Acceptance of Response to Comments	5 days	Tue 8/24/10	Mon 8/30/10
178		**2004DA67**	***Army Approval of Draft Final AOC-S CMI Report***	1 day	Tue 9/7/10	Tue 9/7/10
179		2004DA68	Draft Final AOC-S CMI Report Preparation and Submittal	7 days	Wed 9/8/10	Thu 9/16/10
180		2004DA69	ADEM/Army Review/Comment	22 days	Fri 9/17/10	Mon 10/18/10
181		2004DA70	Prepare Response to ADEM/Army Comments and Submittal	5 days	Tue 10/19/10	Mon 10/25/10
182		2004DA71	ADEM/Army Review/Acceptance of Response to Comments	10 days	Tue 10/26/10	Mon 11/8/10
183		2004DA72	Final AOC-S CMI Report Preparation and Submittal	5 days	Tue 11/9/10	Mon 11/15/10
184		2004DA73	ADEM/Army Review of Final AOC-S CMI Report	10 days	Tue 11/16/10	Mon 11/29/10
185		**2004DA74**	***Army/ADEM Approval of Final AOC-S CMI Report***	1 day	Tue 11/30/10	Tue 11/30/10
186		**2004DB**	**LTM**	**1375 days**	**Tue 6/29/10**	**Mon 10/5/15**
187		2004DB1	AOC-S LTM Q1 (2010) Monitoring Event	7 days	Tue 6/29/10	Wed 7/7/10
188		2004DB2	AOC-S LTM Q1 (2010) LTM Draft Report Preparation and Submittal	15 days	Tue 8/3/10	Mon 8/23/10



Project: FIGURE 7-1 FORT RUCKER
Date: 10/27/09

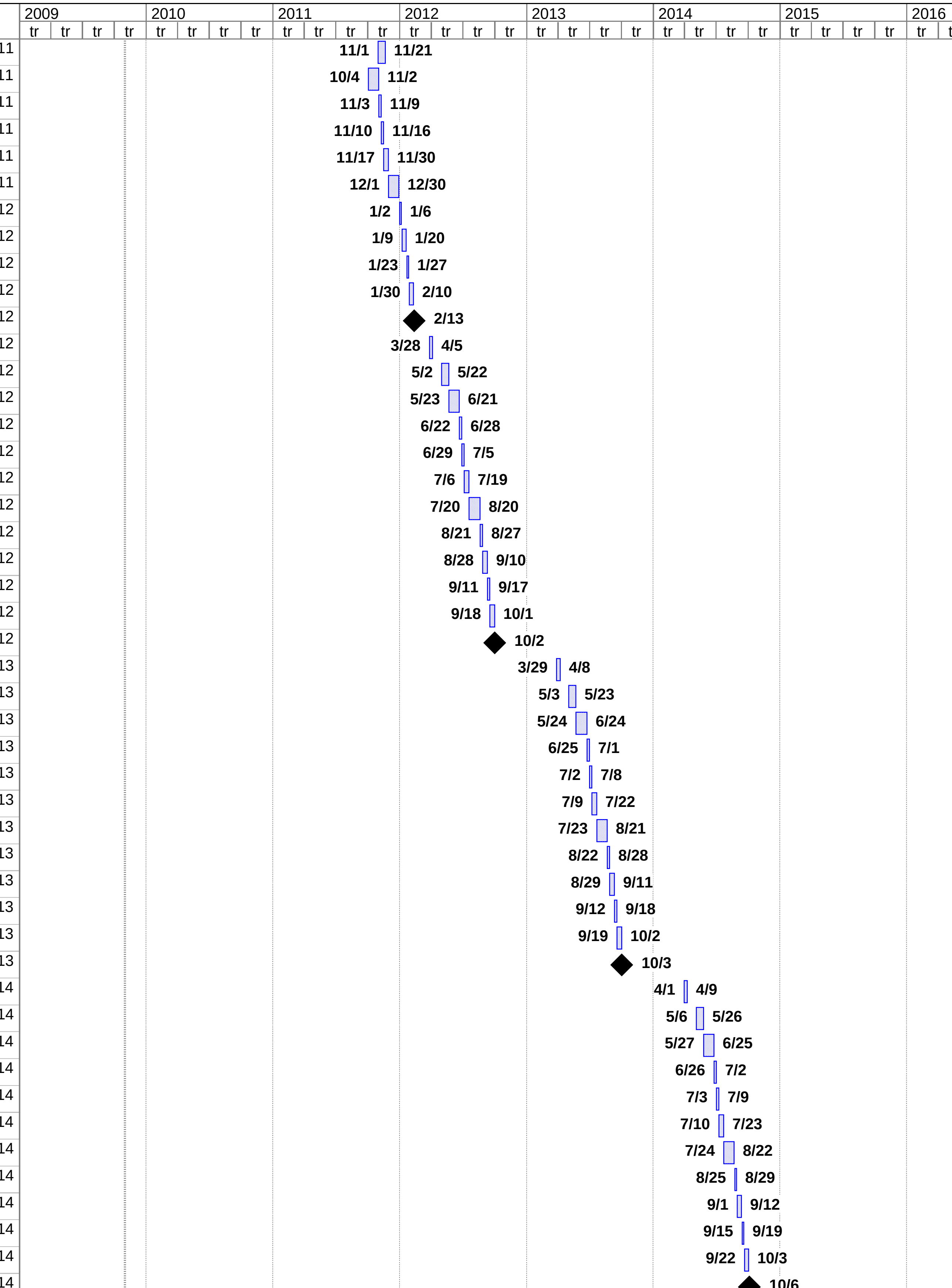
Task | Milestone | Rolled Up Task | Rolled Up Progress | External Tasks | Group By Summary
Progress | Summary | Rolled Up Milestone | Split | Project Summary | Deadline

ID		WBS	Task Name	Duration	Start	Finish
189		2044DB3	Army Review/Comment	22 days	Tue 8/24/10	Wed 9/22/10
190		2044DB4	Prepare Response to Army Comments and Submittal	5 days	Thu 9/23/10	Wed 9/29/10
191		2004DB5	Army Review/Acceptance of Response to Comments	5 days	Thu 9/30/10	Wed 10/6/10
192		2004DB6	AOC-S LTM Q1 (2010) LTM Draft Final Report Preparation and Submittal	10 days	Thu 10/7/10	Wed 10/20/10
193		2004DB7	ADEM/Army Review/Comment	22 days	Thu 10/21/10	Fri 11/19/10
194		2004DB8	Prepare Response to ADEM/Army Comments and Submittal	5 days	Mon 11/22/10	Fri 11/26/10
195		2004DB9	ADEM/Army Review/Acceptance of Response to Comments	10 days	Mon 11/29/10	Fri 12/10/10
196		2004DB10	AOC-S LTM Q1 (2010) LTM Final Report Preparation and Submittal	5 days	Mon 12/13/10	Fri 12/17/10
197		2004DB11	ADEM/Army Review of AOC-S LTM Q1 (2010) Final Report	10 days	Mon 12/20/10	Fri 12/31/10
198		**2004DB12**	***Army/ADEM Approval of AOC-S LTM Q1 (2010) LTM Final Report***	1 day	Mon 1/3/11	Mon 1/3/11
199		2004DB13	AOC-S LTM Q2 (2010) Monitoring Event	7 days	Tue 9/28/10	Wed 10/6/10
200		2004DB14	AOC-S LTM Q2 (2010) LTM Draft Report Preparation and Submittal	15 days	Tue 11/2/10	Mon 11/22/10
201		2004DB15	Army Review/Comment	22 days	Tue 11/23/10	Wed 12/22/10
202		2004DB16	Prepare Response to Army Comments and Submittal	5 days	Thu 12/23/10	Wed 12/29/10
203		2004DB17	Army Review/Acceptance of Response to Comments	5 days	Thu 12/30/10	Wed 1/5/11
204		2004DB18	AOC-S LTM Q2 (2010) LTM Draft Final Report Preparation and Submittal	10 days	Thu 1/6/11	Wed 1/19/11
205		2004DB19	ADEM/Army Review/Comment	22 days	Thu 1/20/11	Fri 2/18/11
206		2004DB20	Prepare Response to ADEM/Army Comments and Submittal	5 days	Mon 2/21/11	Fri 2/25/11
207		2004DB21	ADEM/Army Review/Acceptance of Response to Comments	10 days	Mon 2/28/11	Fri 3/11/11
208		2004DB22	AOC-S LTM Q2 (2010) LTM Final Report Preparation and Submittal	5 days	Mon 3/14/11	Fri 3/18/11
209		2004DB23	ADEM/Army Review of AOC-S LTM Q2 (2010) LTM Final Report	10 days	Mon 3/21/11	Fri 4/1/11
210		**2004DB24**	***Army/ADEM Approval of AOC-S LTM Q2 (2010) LTM Final Report***	1 day	Mon 4/4/11	Mon 4/4/11
211		2004DB25	AOC-S LTM Q3 (2010) Monitoring Event	7 days	Tue 12/28/10	Wed 1/5/11
212		2004DB26	AOC-S LTM Q3 (2010) LTM Draft Report Preparation and Submittal	15 days	Tue 2/1/11	Mon 2/21/11
213		2004DB27	Army Review/Comment	22 days	Tue 4/5/11	Wed 5/4/11
214		2004DB28	Prepare Response to Army Comments and Submittal	5 days	Thu 5/5/11	Wed 5/11/11
215		2004DB29	Army Review/Acceptance of Response to Comments	5 days	Thu 5/12/11	Wed 5/18/11
216		2004DB30	AOC-S LTM Q3 (2010) LTM Draft Final Report Preparation and Submittal	10 days	Thu 5/19/11	Wed 6/1/11
217		2004DB31	ADEM/Army Review/Comment	22 days	Thu 6/2/11	Fri 7/1/11
218		2004DB32	Prepare Response to ADEM/Army Comments and Submittal	5 days	Mon 7/4/11	Fri 7/8/11
219		2004DB33	ADEM/Army Review/Acceptance of Response to Comments	10 days	Mon 7/11/11	Fri 7/22/11
220		2004DB34	AOC-S LTM Q3 (2010) LTM Final Report Preparation and Submittal	5 days	Mon 7/25/11	Fri 7/29/11
221		2004DB35	ADEM/Army Review of AOC-S LTM Q3 (2010) LTM Final Report	10 days	Mon 8/1/11	Fri 8/12/11
222		**2004DB36**	***Army/ADEM Approval of AOC-S LTM Q3 (2010) LTM Final Report***	**1 day**	**Mon 8/15/11**	**Mon 8/15/11**
223		2004DB37	AOC-S LTM Q4 (2011) Monitoring Event	7 days	Tue 3/29/11	Wed 4/6/11
224		2004DB38	AOC-S LTM Q4 (2011) LTM Draft Report Preparation and Submittal	15 days	Tue 5/3/11	Mon 5/23/11
225		2004DB39	Army Review/Comment	22 days	Tue 5/24/11	Wed 6/22/11
226		2004DB40	Prepare Response to Army Comments and Submittal	5 days	Thu 6/23/11	Wed 6/29/11
227		2004DB41	Army Review/Acceptance of Response to Comments	5 days	Thu 6/30/11	Wed 7/6/11
228		2004DB42	AOC-S LTM Q4 (2011) LTM Draft Final Report Preparation and Submittal	10 days	Thu 7/7/11	Wed 7/20/11
229		2004DB43	ADEM/Army Review/Comment	22 days	Thu 7/21/11	Fri 8/19/11
230		2004DB44	Prepare Response to ADEM/Army Comments and Submittal	5 days	Mon 8/22/11	Fri 8/26/11
231		2004DB45	ADEM/Army Review/Acceptance of Response to Comments	10 days	Mon 8/29/11	Fri 9/9/11
232		2004DB446	AOC-S LTM Q4 (2011) LTM Final Report Preparation and Submittal	5 days	Mon 9/12/11	Fri 9/16/11
233		2004DB47	ADEM/Army Review of AOC-S LTM Q4 (2011) LTM Final Report	10 days	Mon 9/19/11	Fri 9/30/11
234		**2004DB48**	***Army/ADEM Approval of AOC-S LTM Q4 (2011) LTM Final Report***	1 day	Mon 10/3/11	Mon 10/3/11
235		2004DC1	AOC-S LTM SA1 (2011) Monitoring Event	7 days	Tue 9/27/11	Wed 10/5/11



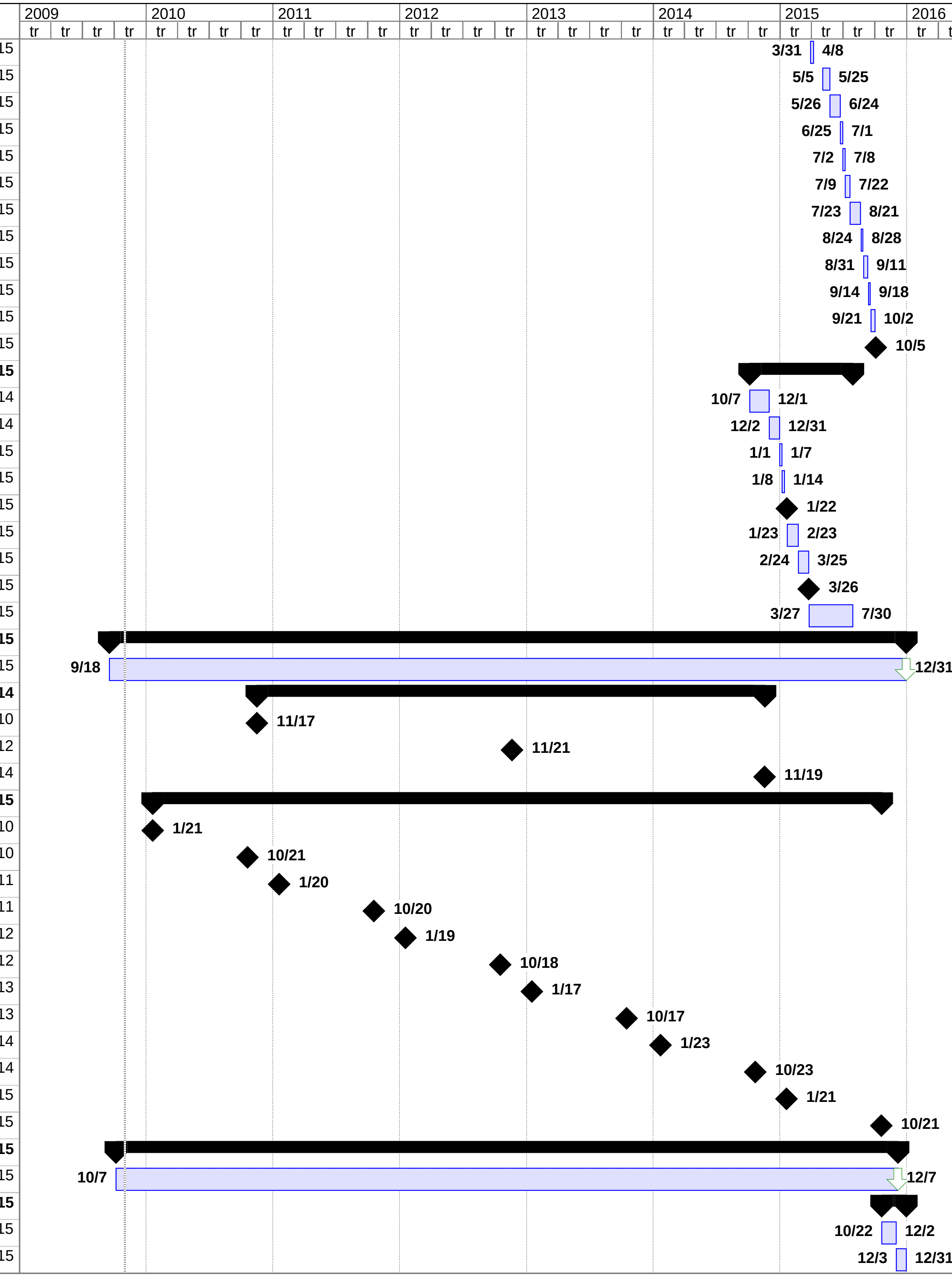
Project: FIGURE 7-1 FORT RUCKER Date: 10/27/09	Task		Milestone		Rolled Up Task		Rolled Up Progress		External Tasks		Group By Summary
	Progress		Summary		Rolled Up Milestone		Split		Project Summary		Deadline

ID		WBS	Task Name	Duration	Start	Finish
236		2004DC2	AOC-S LTM SA1 (2011) LTM Draft Report Preparation and Submittal	15 days	Tue 11/1/11	Mon 11/21/11
237		2004DC3	Army Review/Comment	22 days	Tue 10/4/11	Wed 11/2/11
238		2004DC4	Prepare Response to Army Comments and Submittal	5 days	Thu 11/3/11	Wed 11/9/11
239		2004DC5	Army Review/Acceptance of Response to Comments	5 days	Thu 11/10/11	Wed 11/16/11
240		2004DC6	AOC-S LTM SA1 (2011) LTM Draft Final Report Preparation and Submittal	10 days	Thu 11/17/11	Wed 11/30/11
241		2004DC7	ADEM/Army Review/Comment	22 days	Thu 12/1/11	Fri 12/30/11
242		2004DC8	Prepare Response to ADEM/Army Comments and Submittal	5 days	Mon 1/2/12	Fri 1/6/12
243		2004DC9	ADEM/Army Review/Acceptance of Response to Comments	10 days	Mon 1/9/12	Fri 1/20/12
244		2004DC10	AOC-S LTM SA1 (2011) LTM Final Report Preparation and Submittal	5 days	Mon 1/23/12	Fri 1/27/12
245		2004DC11	ADEM/Army Review of AOC-S LTM SA1 (2011) LTM Final Report	10 days	Mon 1/30/12	Fri 2/10/12
246		**2004DC12**	***Army/ADEM Approval of AOC-S LTM SA1 (2011) LTM Final Report***	1 day	Mon 2/13/12	Mon 2/13/12
247		2004DC13	AOC-S LTM SA2 (2012) Monitoring Event	7 days	Wed 3/28/12	Thu 4/5/12
248		2004DC14	AOC-S LTM SA2 (2012) LTM Draft Report Preparation and Submittal	15 days	Wed 5/2/12	Tue 5/22/12
249		2004DC15	Army Review/Comment	22 days	Wed 5/23/12	Thu 6/21/12
250		2004DC16	Prepare Response to Army Comments and Submittal	5 days	Fri 6/22/12	Thu 6/28/12
251		2004DC17	Army Review/Acceptance of Response to Comments	5 days	Fri 6/29/12	Thu 7/5/12
252		2004DC18	AOC-S LTM SA2 (2012) LTM Draft Final Report Preparation and Submittal	10 days	Fri 7/6/12	Thu 7/19/12
253		2004DC19	ADEM/Army Review/Comment	22 days	Fri 7/20/12	Mon 8/20/12
254		2004DC20	Prepare Response to ADEM/Army Comments and Submittal	5 days	Tue 8/21/12	Mon 8/27/12
255		2004DC21	ADEM/Army Review/Acceptance of Response to Comments	10 days	Tue 8/28/12	Mon 9/10/12
256		2004DC22	AOC-S LTM SA2 (2012) LTM Final Report Preparation and Submittal	5 days	Tue 9/11/12	Mon 9/17/12
257		2004DC23	ADEM/Army Review of AOC-S LTM SA2 (2012) LTM Final Report	10 days	Tue 9/18/12	Mon 10/1/12
258		**2004DC24**	***Army/ADEM Approval of AOC-S LTM SA2 (2012) LTM Final Report***	1 day	Tue 10/2/12	Tue 10/2/12
259		2004DD1	AOC-S LTM A1 (2013) Monitoring Event	7 days	Fri 3/29/13	Mon 4/8/13
260		2004DD2	AOC-S LTM A1 (2013) LTM Draft Report Preparation and Submittal	15 days	Fri 5/3/13	Thu 5/23/13
261		2004DD3	Army Review/Comment	22 days	Fri 5/24/13	Mon 6/24/13
262		2004DD4	Prepare Response to Army Comments and Submittal	5 days	Tue 6/25/13	Mon 7/1/13
263		2004DD5	Army Review/Acceptance of Response to Comments	5 days	Tue 7/2/13	Mon 7/8/13
264		2004DD6	AOC-S LTM A1 (2013) LTM Draft Final Report Preparation and Submittal	10 days	Tue 7/9/13	Mon 7/22/13
265		2004DD7	ADEM/Army Review/Comment	22 days	Tue 7/23/13	Wed 8/21/13
266		2004DD8	Prepare Response to ADEM/Army Comments and Submittal	5 days	Thu 8/22/13	Wed 8/28/13
267		2004DD9	ADEM/Army Review/Acceptance of Response to Comments	10 days	Thu 8/29/13	Wed 9/11/13
268		2004DD10	AOC-S LTM A1 (2013) LTM Final Report Preparation and Submittal	5 days	Thu 9/12/13	Wed 9/18/13
269		2004DD11	ADEM/Army Review of AOC-S LTM A1 (2013) LTM Final Report	10 days	Thu 9/19/13	Wed 10/2/13
270		**2004DD12**	***Army/ADEM Approval of AOC-S LTM A1 (2013) LTM Final Report***	1 day	Thu 10/3/13	Thu 10/3/13
271		2004DE1	AOC-S LTM A2 (2014) Monitoring Event	7 days	Tue 4/1/14	Wed 4/9/14
272		2004DE2	AOC-S LTM A2 (2014) LTM Draft Report Preparation and Submittal	15 days	Tue 5/6/14	Mon 5/26/14
273		2004DE3	Army Review/Comment	22 days	Tue 5/27/14	Wed 6/25/14
274		2004DE4	Prepare Response to Army Comments and Submittal	5 days	Thu 6/26/14	Wed 7/2/14
275		2004DE5	Army Review/Acceptance of Response to Comments	5 days	Thu 7/3/14	Wed 7/9/14
276		2004DE6	AOC-S LTM A2 (2014) LTM Draft Final Report Preparation and Submittal	10 days	Thu 7/10/14	Wed 7/23/14
277		2004DE7	ADEM/Army Review/Comment	22 days	Thu 7/24/14	Fri 8/22/14
278		2004DE8	Prepare Response to ADEM/Army Comments and Submittal	5 days	Mon 8/25/14	Fri 8/29/14
279		2004DE9	ADEM/Army Review/Acceptance of Response to Comments	10 days	Mon 9/1/14	Fri 9/12/14
280		2004DE10	AOC-S LTM A2 (2014) LTM Final Report Preparation and Submittal	5 days	Mon 9/15/14	Fri 9/19/14
281		2004DE11	ADEM/Army Review of AOC-S LTM A2 (2014) LTM Final Report	10 days	Mon 9/22/14	Fri 10/3/14
282		**2004DE12**	***Army/ADEM Approval of AOC-S LTM A2 (2014) LTM Final Report***	1 day	Mon 10/6/14	Mon 10/6/14



Project: FIGURE 7-1 FORT RUCKER Date: 10/27/09	Task		Milestone		Rolled Up Task		Rolled Up Progress		External Tasks		Group By Summary
	Progress		Summary		Rolled Up Milestone		Split		Project Summary		Deadline

ID		WBS	Task Name	Duration	Start	Finish
283		2004DF1	AOC-S LTM A3 (2015) Monitoring Event	7 days	Tue 3/31/15	Wed 4/8/15
284		2004DF2	AOC-S LTM A3 (2015) LTM Draft Report Preparation and Submittal	15 days	Tue 5/5/15	Mon 5/25/15
285		2004DF3	Army Review/Comment	22 days	Tue 5/26/15	Wed 6/24/15
286		2004DF4	Prepare Response to Army Comments and Submittal	5 days	Thu 6/25/15	Wed 7/1/15
287		2004DF5	Army Review/Acceptance of Response to Comments	5 days	Thu 7/2/15	Wed 7/8/15
288		2004DF6	AOC-S LTM A3 (2015) LTM Draft Final Report Preparation and Submittal	10 days	Thu 7/9/15	Wed 7/22/15
289		2004DF7	ADEM/Army Review/Comment	22 days	Thu 7/23/15	Fri 8/21/15
290		2004DF8	Prepare Response to ADEM/Army Comments and Submittal	5 days	Mon 8/24/15	Fri 8/28/15
291		2004DF9	ADEM/Army Review/Acceptance of Response to Comments	10 days	Mon 8/31/15	Fri 9/11/15
292		2004DF10	AOC-S LTM A3 (2015) LTM Final Report Preparation and Submittal	5 days	Mon 9/14/15	Fri 9/18/15
293		2004DF11	ADEM/Army Review of AOC-S LTM A3 (2015) LTM Final Report	10 days	Mon 9/21/15	Fri 10/2/15
294		**2004DF12**	***Army/ADEM Approval of AOC-S LTM A3 (2015) LTM Final Report***	1 day	Mon 10/5/15	Mon 10/5/15
295		**2004DH**	**REMEDY REVIEW**	**213 days**	**Tue 10/7/14**	**Thu 7/30/15**
296		2004DH1	Preparation of Remedy Review Draft Document and Submittal	40 days	Tue 10/7/14	Mon 12/1/14
297		2004DH2	Army Review/Comment	22 days	Tue 12/2/14	Wed 12/31/14
298		2004DH3	Prepare Response to Army Comments and Submittal	5 days	Thu 1/1/15	Wed 1/7/15
299		2004DH4	Army Review/Acceptance of Response to Comments	5 days	Thu 1/8/15	Wed 1/14/15
300		**2004DH5**	***Remedy Review Draft Final Report Acceptance***	1 day	Thu 1/22/15	Thu 1/22/15
301		2004DH6	Remedy Review Final Report Preparation and Submittal	22 days	Fri 1/23/15	Mon 2/23/15
302		2004DH7	Army/ADEM Review of Remedy Review Final Report	22 days	Tue 2/24/15	Wed 3/25/15
303		**2004DH8**	***Remedy Review Final Report Acceptance***	1 day	Thu 3/26/15	Thu 3/26/15
304		2004DH8	Successful Correction of Deficiencies Noted in Remedy Review	90 days	Fri 3/27/15	Thu 7/30/15
305		**2004DI**	**PROJECT REPOSITORY/ADMINISTRATIVE RECORD**	**1640 days**	**Fri 9/18/09**	**Thu 12/31/15**
306		2004DI1	PROJECT REPOSITORY/ADMINISTRATIVE RECORD	1640 days	Fri 9/18/09	Thu 12/31/15
307		**2004DJ**	**BIANNUAL PUBLIC INTEREST ASSESSMENT**	**1046 days**	**Wed 11/17/10**	**Wed 11/19/14**
308		2004DJ1	August 2010	1 day	Wed 11/17/10	Wed 11/17/10
309		2004DJ2	August 2012	1 day	Wed 11/21/12	Wed 11/21/12
310		2004DJ3	August 2014	1 day	Wed 11/19/14	Wed 11/19/14
311		**2004DK**	**STAKEHOLDER PRESENTATIONS**	**1500 days**	**Thu 1/21/10**	**Wed 10/21/15**
312		2004DK1	January 2010	1 day	Thu 1/21/10	Thu 1/21/10
313		2004DK2	October 2010	1 day	Thu 10/21/10	Thu 10/21/10
314		2004DK3	January 2011	1 day	Thu 1/20/11	Thu 1/20/11
315		2004DK4	October 2011	1 day	Thu 10/20/11	Thu 10/20/11
316		2004DK5	January 2012	1 day	Thu 1/19/12	Thu 1/19/12
317		2004DK6	October 2012	1 day	Thu 10/18/12	Thu 10/18/12
318		2004DK7	January 2013	1 day	Thu 1/17/13	Thu 1/17/13
319		2004DK8	October 2013	1 day	Thu 10/17/13	Thu 10/17/13
320		2004DK9	January 2014	1 day	Thu 1/23/14	Thu 1/23/14
321		2004DK10	October 2014	1 day	Thu 10/23/14	Thu 10/23/14
322		2004DK11	January 2015	1 day	Wed 1/21/15	Wed 1/21/15
323		2004DK12	October 2015	1 day	Wed 10/21/15	Wed 10/21/15
324		**2004DL**	**STATUS REPORTS (MONTHLY)**	**1609 days**	**Wed 10/7/09**	**Mon 12/7/15**
325		2004DL1	STATUS REPORTS (MONTHLY)	1609 days	Wed 10/7/09	Mon 12/7/15
326		**2004DM**	**PROJECT CLOSEOUT**	**51 days**	**Thu 10/22/15**	**Thu 12/31/15**
327		2004DM1	Close Out Prep	30 days	Thu 10/22/15	Wed 12/2/15
328		2004DM2	Final Close Out	21 days	Thu 12/3/15	Thu 12/31/15



Project: FIGURE 7-1 FORT RUCKER
Date: 10/27/09

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

8. References

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Quality Assurance Surveillance Plan

Quality Assurance Surveillance Plan

Environmental Remediation Services Fort Rucker, Alabama

FINAL

Contract No. W91ZLK-05-D-0014
Contract Task Order No. 0001

Prepared for:

U.S. Army Environmental Command

Prepared by:

CH2MHILL

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October 2009

Contents

Appendixes

Tables

Acronyms and Abbreviations

ADEM	Alabama Department of Environmental Management
AOC	Area of Concern
ARBCA	Alabama Risk-Based Corrective Action
CMI	Corrective Measures Implementation
CMIP	Corrective Measures Implementation Plan
CMS	Corrective Measures Study
COR	Contracting Officer's Representative
DDESB	DoD Explosives Safety Board
DoD	Department of Defense
ERM	Environmental Restoration Manager
ESP	Explosives Siting Plan
HASP	Health and Safety Plan
KO	Contracting Officer
LTM	Long Term Monitoring
MEC	Munitions and Explosives of Concern
MRSPP	Munitions Response Site Prioritization Protocol
PCE	Tetrachloroethene
PMP	Project Management Plan
POC	Point of Contact
PRB	Permeable Reactive Barrier
PWS	Performance Work Statement
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QASP	Quality Assurance and Surveillance Plan
RAB	Restoration Advisory Board
RAO	Remedial Action Operation
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SAP	Sampling and Analysis Plan
SB	Statement of Basis
SME	Subject Matter Expert
TM	Technical Manager
USACE	United States Army Corps of Engineers
USATCES	United States Army Technical Center for Explosives Safety
WMP	Waste Management Plan

1. Overview

1.1 Introduction

The performance-based Quality Assurance Surveillance Plan (QASP) provides the procedures and guidance that the Contracting Officer's Representative (COR) will use in evaluating the technical and quality performance of CH2M HILL in accordance with the terms and conditions of the performance work statement (PWS). A copy of the signed final QASP will be furnished to CH2M HILL, so that CH2M HILL, will be aware of the methods that the COR will use in evaluating performance of this contract.

1.2 Purpose

The purpose of the QASP is to assure the performance of specific activities and the completion of project milestones are accomplished in accordance with all requirements provided in the PWS and outlined in the Project Management Plan (PMP) for Army Quality Assurance. This QASP describes the mechanism for documenting noteworthy accomplishments or discrepancies for work performed by CH2M HILL. Information generated from the COR's surveillance activities will facilitate performance discussions with CH2M HILL . The intent is to ensure that CH2M HILL performs in accordance with performance metrics set forth in the contract documents, the Army receives the quality of services called for in the contract, and the Army only pays for acceptable services received.

The QASP is intended to accomplish the following:

1. Define the role and responsibilities of participating Army officials.
2. Define the key milestones, deliverables, and standards that will be assessed.
3. Define superior, acceptable, and unacceptable performance standards for key milestones, deliverables, and standards.
4. Describe the surveillance methodology that will be employed by the Army in assessing CH2M HILL 's performance.
5. Describe the surveillance documentation process and provide copies of the forms that the Army will use in evaluating CH2M HILL's performance.
6. Outline corrective action and payment procedures.

2. Roles and Responsibilities of Army Officials

2.1 Contracting Officer

The Contracting Officer (KO) has overall responsibility for overseeing CH2M HILL's performance. The KO is responsible for the day-to-day monitoring of CH2M HILL's performance in the areas of contract compliance, and contract administration; reviewing the COR's assessment of CH2M HILL's performance; and resolving all differences between the COR's assessment and CH2M HILL 's assessment of performance. It is the KO that assures CH2M HILL receives impartial, fair, and equitable treatment under the contract. The KO is ultimately responsible for the final determination of the adequacy of CH2M HILL's performance.

The KO for this contract is Alison W. Gannon at the Aberdeen Installation ContractingDivision, CCRD-AI-MC. Questions for the KO should be directed to Ms. Gannon at (410) 436-1661 or alison.gannon@us.army.mil.

2.2 Contracting Officer's Representative

The COR is responsible for technical administration of the project and assures proper Army surveillance of the CH2M HILL's performance. The COR is responsible for monitoring, assessing, recording, and reporting on the technical performance of the CH2M HILL on a day-to-day basis.

The COR for this contract is William L. Woodall at the United States Army Corps of Engineers (USACE), Mobile District. Dennis Mayton will act as the USACE Technical Manager (TM) in support of the COR and is responsible for monitoring, assessing, recording, and reporting on the technical performance of CH2M HILL on a day-to-day basis. Questions for the COR should be directed to Dennis Mayton at (251) 694-3684 or Dennis.H.Mayton@usace.army.mil.

Certification and approval of project milestones by the COR of the Delivery Order is necessary before distribution of progress payments.

2.3 Other Army Officials and Subject Matter Experts

The KO and COR may call upon the technical expertise of other Army officials and subject matter experts (SME) as required. These Army officials and SMEs may be called upon to review technical documents and products generated by the CH2M HILL. For this contract, the following Army officials and SMEs have been identified:

- Army Environmental Command — Paul Higgs
AEC Environmental Restoration Manager (ERM)
- USACE, Mobile District — Dennis Mayton
USACE Technical Manager

- USACE, Mobile District — Karl Blankinship, USACE Project Manager (MEC)
- USACE, Huntsville District — Chris Cochrane, USACE Program Manager (MEC)
- USACE, Mobile District — Richard Kinsella, USACE Chemist
- USACE Environmental and Munitions Center of Expertise
- U.S. Army Technical Center for Explosives Safety (USATCES)
- Department of Defense (DoD) Explosives Safety Board (DDESB)

If additional Army officials and SMEs are identified as work progresses, the QASP will be modified to capture this information. Representatives of the USAEC and the CH2M HILL shall meet with the COR at a site and time designated by the COR after receipt of each status report to:

- Formally review the quantity and quality of services;
- Inspect work for compliance with the PWS, the associated CH2M HILL proposal, and project documentation;
- Accept or reject deliverables completed since the previous review;
- Approve or disapprove the CH2M HILL's performance on the Delivery Order; and
- Prepare, approve, and submit DD Form 250 "Material Inspection and Receiving Report" for partial payments in accordance with milestone completions and approvals.

3. Methods of Performance Assessment

3.1 Key Milestones/Deliverables

The following milestones and associated deliverables will be evaluated in accordance with this QASP.

3.1.1 Key Milestones

Project Management Plan (PMP) and Quality Assurance Surveillance Plan (QASP):

- Army approval of Draft PMP and Draft QASP
- Army approval of Final PMP

Additional Site-Wide Plans:

- Army approval of Draft Site Safety and Health Plan (SSHP)/Sampling and Analysis Plan (SAP)Waste Management Plan (WMP)
- Army approval of Final SSHP/SAP/WMP
- Army approval of Draft Explosive Site Plan (ESP)
- Army approval of Final ESP

FTRU-001-R-01 Anti-Tank/Rocket Grenade Range, FTRU-003-R-01 Infiltration Course, and FTRU-004-R-001 .22-Caliber Target Butt:

- Army approval of Draft Final Resource Conservation Recovery Act (RCRA) Facility Investigation (RFI)/Corrective Measures Study (CMS) Work Plan and SSHP
- Army and Alabama Department of Environmental Management (ADEM) approval of Final RFI/CMS Work Plan and HASP
- Army acceptance of Technical Memorandum summarizing total linear footage of geophysical transects/intrusive investigations have been completed in accordance with Army/ADEM approved RFI/CMS Work Plan
- Army approval of Draft RFI/CMS Report
- Army and ADEM approval of Final RFI/CMS Report
- Army and ADEM approval of Final SB for FTRU-001-R-01
- Army and ADEM approval of Final SB for FTRU-003-R-01
- Army and ADEM approval of Final SB for FTRU-004-R-01

Area of Concern (AOC)-S: Tetrachloroethene (PCE) in Groundwater:

- Army approval of Draft Final Alabama Risk-Based Corrective Action (ARBCA) Technical Memorandum
- Army and ADEM approval of Final ARBCA Technical Memorandum
- Army and ADEM approval of Final RFI
- Army approval of Draft Final CMS/Corrective Measures Implementation Plan (CMIP)
- Army and ADEM approval of Final CMS/CMIP
- Army acceptance of Technical Memorandum summarizing installation of zero valent iron (ZVI)/sand based on specifications in accordance with Army/ADEM approved CMIP
- Army approval of Draft Final Corrective Measures Implementation (CMI) Report
- Army and ADEM approval of Final CMI Report

AOC-S: PCE in Groundwater near Solid Waste Management Unit (SWMU) 8: Exit/Ramp Down Strategy, Optimization and Remedial Action Operation (RAO)/Long Term Monitoring (LTM):

- Army and ADEM approval of Final 1st Quarter RAO/LTM Report
- Army and ADEM approval of Final 2nd Quarter RAO/LTM Report
- Army and ADEM approval of Final 3rd Quarter RAO/LTM Report
- Army and ADEM approval of Final 4th Quarter RAO/LTM Report

AOC-S: PCE in Groundwater near SWMU 8: Exit/Ramp Down Strategy, Optimization and RAO/LTM – Year 2:

- Army and ADEM approval of Final 1st Semi-annual RAO/LTM Report
- Army and ADEM approval of Final 2nd Semi-annual RAO/LTM Report

AOC-S: PCE in Groundwater near SWMU 8: Exit/Ramp Down Strategy, Optimization and RAO/LTM – Year 3:

- Army and ADEM approval of Final Annual RAO/LTM Report

AOC-S: PCE in Groundwater near SWMU 8: Exit/Ramp Down Strategy, Optimization and RAO/LTM – Year 4:

- Army and ADEM approval of Final Annual RAO/LTM Report

AOC-S: PCE in Groundwater near SWMU 8: Exit/Ramp Down Strategy, Optimization and RAO/LTM – Year 5:

- Army and ADEM approval of Final Annual RAO/LTM Report

AOC-S: PCE in Groundwater near SWMU 8: Exit/Ramp Down Strategy, Optimization and RAO/LTM – Year 6:

- Army and ADEM approval of Final Annual RAO/LTM Report

AOC-S: PCE in Groundwater near SWMU 8: Remedy Review:

- Army approval of Draft Final Remedy Review
- Army and ADEM approval of Final Remedy Review

3.1.2 Key Deliverables

- PMP
- QASP
- Site-Wide SSHP/SAPWMP
- ESP
- FTRU-001-R-01, FTRU-003-R-01, and FTRU-004-R-01 RFI/CMS Work Plan and HASP
- FTRU-001-R-01, FTRU-003-R-01, and FTRU-004-R-01 Summary of Field Activities Technical Memorandum
- FTRU-001-R-01, FTRU-003-R-01, and FTRU-004-R-01 RFI/CMS Report
- FTRU-001-R-01 Statement of Basis
- FTRU-003-R-01 Statement of Basis
- FTRU-004-R-01 Statement of Basis
- FTRU-001-R-01, FTRU-003-R-01, and FTRU-004-R-01 Revised Munitions Response Site Prioritization Protocol Scores
- AOC-S ARBCA Technical Memorandum
- AOC-S Final RFI Report
- AOC-S CMS/CMIP
- AOC-S Summary of ZVI/sand installation Technical Memorandum
- AOC-S CMI Report
- AOC-S 1st Quarter RAO/LTM Report
- AOC-S 2nd Quarter RAO/LTM Report
- AOC-S 3rd Quarter RAO/LTM Report
- AOC-S 4th Quarter RAO/LTM Report
- AOC-S 1st Semi-annual RAO/LTM Report
- AOC-S 2nd Semi-annual RAO/LTM Report
- AOC-S Annual RAO/LTM Reports

- AOC-S Remedy Review
- Status Reports
- Stakeholder Presentations

Additional Government surveillance activities may include, but are not limited to, the following:

- Review and approval of meeting minutes from kickoff meetings, Restoration Advisory Board (RAB) or public involvement meetings
- Oversight of field work activities
- Review of uploaded electronic deliverables
- Review of CH2M HILL's quality control documentation
- Review of CH2M HILL's safety records

3.2 Performance Standards

Since cost is fixed in this Delivery Order, the CH2M HILL's performance will be evaluated by assessing the key deliverables above according to the standards of Quality, Timeliness, and Stakeholder Concurrence. In addition, the CH2M HILL's performance will be evaluated for the standard of Safety during any fieldwork. For each of these performance standards, the COR will assign one of three ratings of the CH2M HILL's performance: superior, acceptable, or unacceptable as shown in **Table 3-1**.

TABLE 3-1
Evaluation Standards
Fort Rucker Quality Assurance and Surveillance Plan

Performance Standard	Superior Performance	Acceptable Performance	Unacceptable Performance
Basic Definition	CH2M HILL exceeds the performance requirements for the milestone, deliverable, or standard.	CH2M HILL meets the performance requirements for the milestone, deliverable, or standard.	CH2M HILL does not meet the performance requirements for the milestone, deliverable, or standard.

TABLE 3-1
Evaluation Standards
Fort Rucker Quality Assurance and Surveillance Plan

Performance Standard	Superior Performance	Acceptable Performance	Unacceptable Performance
Quality	Deliverables are approved after one round of Army comments through acceptance of response to comments table and backcheck of report against original comments. No further revisions are required. Army audit of work does not identify any deficiencies that compromise the quality of data collected or work performed.	Deliverables are approved after two rounds of Army comments (e.g., changes are required to the Final document due to inadequate incorporation of comments). No further revisions are required. Army audit of work identifies deficiencies that do not compromise the quality of the data collected or work performed, and can be corrected.	Deliverables require more than two rounds of Army comments before being approved. Army audit of work identifies deficiencies that compromise the quality of the data performed, and cannot be corrected.
Timeliness	CH2M HILL achieves milestone ahead of schedule (unless the COR waives this requirement), per criteria established in the PWS and this QASP.	CH2M HILL achieves milestone according to the schedule (unless the COR waives this requirement), per criteria established in the PWS and this QASP.	CH2M HILL does not achieve milestone until after the schedule (unless the COR waives this requirement), per criteria established in the PWS.
Stakeholder Concurrence	CH2M HILL obtains concurrence on deliverables from lead regulator (ADEM) (unless the COR waives this requirement), and from interested reviewers to include: USACE, USAEC, Fort Rucker, and EPA.	CH2M HILL obtains concurrence on deliverables from lead regulator (ADEM), and no more than one other interested party withholds concurrence on the deliverable.	CH2M HILL does not obtain concurrence on deliverables from lead regulator (ADEM), or two or more interested parties withhold concurrence on the deliverable.
Safety	No significant safety deficiencies are reported during QA inspection of fieldwork. No lost time accidents or injuries are recorded during the fieldwork.	No more than two serious safety deficiencies are reported during QA inspection of fieldwork. If any serious safety deficiency is noted during the project, appropriate investigation, corrective action, implementation, and written verification of the corrective action are provided to the Army. No lost time accidents or injuries are recorded during the fieldwork.	More than two serious safety deficiencies are reported during QA inspection of the field activities, or a serious safety deficiency is reported but not properly investigated and corrected, or a lost time accident or injury is recorded during field activities.

3.3 Performance Assessment Process

If a deliverable is rated as being incomplete for quality or stakeholder concurrence at the time the approved PMP deadline for the milestone expires, the CH2M HILL will automatically receive an unacceptable rating for timeliness, unless there is an Army-approved delay that extends the PWS performance objective.

3.3.1 Army-Approved Delays

At the discretion of the COR, the performance standards of Timeliness may be waived in accordance with the criteria outlined in Table 3-1. Army-approved delays will be tracked by the CH2M HILL and reported to the COR monthly.

3.3.2 Stakeholder Concurrence Waiver

At the discretion of the COR, the performance standards of Stakeholder Concurrence may be waived in accordance with the criteria outlined in Table 3-1.

3.3.3 Overall Rating

A superior rating will be achieved only if more than 50 percent of the thirty-seven (37) milestone ratings (as shown on **Table 3-2**) for the Delivery Order are superior, with no unacceptable ratings allowed. An acceptable rating is achieved only if there are no more than four (4) unacceptable ratings for all key milestone/deliverable ratings for the Delivery Order. An unacceptable rating will be given if there are five (5) or more unacceptable ratings for any of the key deliverables/milestones.

TABLE 3-2
Key Milestones/Deliverables
Fort Rucker Quality Assurance and Surveillance Plan

Milestone	Quality	Timeliness	Stakeholder Concurrence	Safety
Army approval of Draft PMP/QASP	x	x		
Army approval of Final PMP	x	x		
Army approval of Draft SSHP/SAPWMP	x	x		
Army approval of Final SSHP/SAP/WMP	x	x		
Army approval of Draft ESP	x	x		
Army approval of Final ESP	x	x		
Army approval of Draft RFI/CMS Workplan/SSHP – FTRU-001-R-01, FTRU-003-R-01, FTRU-004-R-01	x	x		
Army/ADEM approval of Final RFI/CMS Workplan/SSHP– FTRU-001-R-01, FTRU-003-R-01, FTRU-004-R-01	x	x	x	
Army approval of Delineation of MEC Impacts Technical Memorandum	x	x		x
Army approval of Draft RFI/CMS Report– FTRU-001-R-01, FTRU-003-R-01, FTRU-004-R-01	x	x		

TABLE 3-2
Key Milestones/Deliverables
Fort Rucker Quality Assurance and Surveillance Plan

Milestone	Quality	Timeliness	Stakeholder Concurrence	Safety
Army/ADEM approval of Final RFI/CMS Report– FTRU-001-R-01, FTRU-003-R-01, FTRU-004-R-01	x	x	x	
Army approval of Draft SB – FTRU-001-R-01	x	x		
Army and ADEM approval of Final SB - FTRU-001-R-01	x	x	x	
Army approval of Draft SB – FTRU-003-R-01	x	x		
Army/ADEM approval of Final SB – FTRU-003-R-001	x	x	x	
Army approval of Draft SB – FTRU-004-R-01	x	x		
Army/ADEM approval of Final SB – FTRU-004-R-01	x	x	x	
Army approval of Draft ARBCA – AOC-S	x	x		
Army/ADEM approval of Final ARBCA – AOC-S	x	x	x	
Army/ADEM approval of Final RFI Report – AOC-S	x	x	x	x
Army approval of Draft CMS/CMIP – AOC-S	x	x		
Army/ADEM approval of Final CMS/CMIP – AOC-S	x	x	x	
Army approval of Successful PRB Installation Technical Memorandum – AOC-S	x	x		x
Army approval of Draft CMI Report – AOC-S	x	x		
Army/ADEM approval of Final CMI Report – AOC-S	x	x	x	
Army/ADEM approval of Final 1st Quarter RAO/LTM Report	x	x	x	x
Army/ADEM approval of Final 2nd Quarter RAO/LTM Report	x	x	x	x
Army/ADEM approval of Final 3rd Quarter RAO/LTM Report	x	x	x	x
Army/ADEM approval of Final 4th Quarter RAO/LTM Report	x	x	x	x
Army/ADEM approval of Final 1st Semi-annual RAO/LTM Report	x	x	x	x
Army/ADEM approval of Final 2nd Semi-annual RAO/LTM Report	x	x	x	x
Army/ADEM approval of Final Annual RAO/LTM Report – Year 3	x	x	x	x
Army/ADEM approval of Final Annual RAO/LTM Report – Year 4	x	x	x	x
Army/ADEM approval of Final Annual RAO/LTM Report – Year 5	x	x	x	x
Army/ADEM approval of Final Annual RAO/LTM Report – Year 6	x	x	x	x

TABLE 3-2
Key Milestones/Deliverables
Fort Rucker Quality Assurance and Surveillance Plan

Milestone	Quality	Timeliness	Stakeholder Concurrence	Safety
Army approval of Draft Remedy Review	x	x		
Army/ADEM approval of Final Remedy Review	x	x	x	
Total Number of Ratings:	37	37	20	13

The surveillance activities are summarized in **Table 3-3**.

TABLE 3-3
Surveillance Activities - Key Milestones/Deliverables
Fort Rucker Quality Assurance and Surveillance Plan

Milestone	Indicator	Evaluation Standard	Performance Measure	Monitoring Method	Document
Army approval of Draft PMP/QASP	COR approval of Draft PMP/QASP	Quality Timeliness	Army review of deliverable milestone	100% Inspection	USACE PM completion of QA Monitoring Form
Army approval of Final PMP	COR approval of Draft PMP/QASP	Quality Timeliness	Army review of deliverable milestone	100% Inspection	USACE PM completion of QA Monitoring Form
Army approval of Draft SSHP/SAP/QAPP/WMP/QCP	COR approval of Draft SSHP/SAP/QAPP/WMP/QCP	Quality Timeliness	Army review of deliverable milestone	100% Inspection	USACE PM completion of QA Monitoring Form
Army approval of Final SSHP/SAP/QAPP/WMP/QCP	COR approval of Final SSHP/SAP/QAPP/WMP/QCP	Quality Timeliness	Army review of deliverable milestone	100% Inspection	USACE PM completion of QA Monitoring Form
Army approval of Draft ESP	COR approval of Draft ESP	Quality Timeliness	Army review of deliverable milestone	100% Inspection	USACE PM completion of QA Monitoring Form
Army approval of Final ESP	COR approval of Final ESP after DDESB approval	Quality Timeliness	Army review of deliverable milestone	100% Inspection	USACE PM completion of QA Monitoring Form
Army approval of Draft RFI/CMS Workplan/SSHP – FTRU-001-R-01, FTRU-003-R-01, FTRU-004-R-01	COR approval of Draft RFI/CMS/SSHP	Quality Timeliness	Army review of deliverable milestone	100% Inspection	USACE PM completion of QA Monitoring Form
Army/ADEM approval of Final RFI/CMS Workplan/HASP– FTRU-001-R-01, FTRU-003-R-01, FTRU-004-R-01	COR/ADEM approval of Final RFI/CMS	Quality Timeliness Stakeholder Concurrence	Army/ADEM review of deliverable milestone	100% Inspection	USACE PM completion of QA Monitoring Form; ADEM letter
Army approval of Delineation of MEC Impacts Technical Memorandum	COR approval of Delineation of MEC Impacts Technical Memorandum	Quality Timeliness Safety	Army review of deliverable milestone	100% Inspection Field Inspection	USACE PM completion of QA Monitoring Form

TABLE 3-3
Surveillance Activities - Key Milestones/Deliverables
Fort Rucker Quality Assurance and Surveillance Plan

Milestone	Indicator	Evaluation Standard	Performance Measure	Monitoring Method	Document
Army approval of Draft RFI/CMS Report– FTRU-001-R-01, FTRU-003-R-01, FTRU-004-R-01	COR approval of Draft RFI/CMS Report	Quality Timeliness	Army review of deliverable milestone	100% Inspection	USACE PM completion of QA Monitoring Form
Army/ADEM approval of Final RFI/CMS Report– FTRU-001-R-01, FTRU-003-R-01, FTRU-004-R-01	COR/ADEM approval of Final RFI/CMS Report	Quality Timeliness Stakeholder Concurrence	Army/ADEM review of deliverable milestone	100% Inspection	USACE PM completion of QA Monitoring Form; ADEM letter
Army approval of Draft SB – FTRU-001-R-01	COR approval of Draft SB	Quality Timeliness	Army review of deliverable milestone	100% Inspection	USACE PM completion of QA Monitoring Form
Army and ADEM approval of Final SB - FTRU-001-R-01	COR/ADEM approval of Final SB	Quality Timeliness Stakeholder Concurrence	Army/ADEM review of deliverable milestone	100% Inspection	USACE PM completion of QA Monitoring Form; ADEM letter
Army approval of Draft SB – FTRU-003-R-01	COR approval of Draft SB	Quality Timeliness	Army review of deliverable milestone	100% Inspection	USACE PM completion of QA Monitoring Form
Army/ADEM approval of Final SB – FTRU-003-R-001	COR/ADEM approval of Final SB	Quality Timeliness Stakeholder Concurrence	Army/ADEM review of deliverable milestone	100% Inspection	USACE PM completion of QA Monitoring Form; ADEM letter
Army approval of Draft SB – FTRU-004-R-01	COR approval of Draft SB	Quality Timeliness	Army review of deliverable milestone	100% Inspection	USACE PM completion of QA Monitoring Form
Army/ADEM approval of Final SB – FTRU-004-R-01	COR/ADEM approval of Final SB	Quality Timeliness Stakeholder Concurrence	Army/ADEM review of deliverable milestone	100% Inspection	USACE PM completion of QA Monitoring Form; ADEM letter

TABLE 3-3
Surveillance Activities - Key Milestones/Deliverables
Fort Rucker Quality Assurance and Surveillance Plan

Milestone	Indicator	Evaluation Standard	Performance Measure	Monitoring Method	Document
Army approval of Draft ARBCA – AOC-S	COR approval of Draft ARBCA	Quality Timeliness	Army review of deliverable milestone	100% Inspection	USACE PM completion of QA Monitoring Form
Army/ADEM approval of Final ARBCA – AOC-S	COR/ADEM approval of Final ARBCA	Quality Timeliness Stakeholder Concurrence	Army/ADEM review of deliverable milestone	100% Inspection	USACE PM completion of QA Monitoring Form; ADEM letter
Army/ADEM approval of Final RFI Report – AOC-S	COR/ADEM approval of Final RFI Report	Quality Timeliness Stakeholder Concurrence Safety	Army/ADEM review of deliverable milestone	100% Inspection Field Inspection	USACE PM completion of QA Monitoring Form; ADEM letter
Army approval of Draft CMS/CMIP – AOC-S	COR approval of Draft CMS/CMIP	Quality Timeliness	Army review of deliverable milestone	100% Inspection	USACE PM completion of QA Monitoring Form
Army/ADEM approval of Final CMS/CMIP – AOC-S	COR/ADEM approval of Final CMS/CMIP	Quality Timeliness Stakeholder Concurrence	Army/ADEM review of deliverable milestone	100% Inspection	USACE PM completion of QA Monitoring Form; ADEM letter
Army approval of Successful PRB Installation Technical Memorandum – AOC-S	COR approval of Successful PRB Installation Technical Memorandum	Quality Timeliness Safety	Army review of deliverable milestone	100% Inspection Field Inspection	USACE PM completion of QA Monitoring Form
Army approval of Draft CMI Report – AOC-S	COR approval of Draft CMI Report	Quality Timeliness	Army review of deliverable milestone	100% Inspection	USACE PM completion of QA Monitoring Form

TABLE 3-3
Surveillance Activities - Key Milestones/Deliverables
Fort Rucker Quality Assurance and Surveillance Plan

Milestone	Indicator	Evaluation Standard	Performance Measure	Monitoring Method	Document
Army/ADEM approval of Final CMI Report – AOC-S	COR/ADEM approval of Final CMI Report	Quality Timeliness Stakeholder Concurrence	Army/ADEM review of deliverable milestone	100% Inspection	USACE PM completion of QA Monitoring Form; ADEM letter
Army/ADEM approval of Final 1st Quarter RAO/LTM Report	COR/ADEM approval of Final 1st Quarter RAO/LTM Report	Quality Timeliness Stakeholder Concurrence Safety	Army/ADEM review of deliverable milestone	100% Inspection Field Inspection	USACE PM completion of QA Monitoring Form; ADEM letter
Army/ADEM approval of Final 2nd Quarter RAO/LTM Report	COR/ADEM approval of Final 2nd Quarter RAO/LTM Report	Quality Timeliness Stakeholder Concurrence Safety	Army/ADEM review of deliverable milestone	100% Inspection Field Inspection	USACE PM completion of QA Monitoring Form; ADEM letter
Army/ADEM approval of Final 3rd Quarter RAO/LTM Report	COR/ADEM approval of Final 3rd Quarter RAO/LTM Report	Quality Timeliness Stakeholder Concurrence Safety	Army/ADEM review of deliverable milestone	100% Inspection Field Inspection	USACE PM completion of QA Monitoring Form; ADEM letter
Army/ADEM approval of Final 4th Quarter RAO/LTM Report	COR/ADEM approval of Final 4th Quarter RAO/LTM Report	Quality Timeliness Stakeholder Concurrence Safety	Army/ADEM review of deliverable milestone	100% Inspection Field Inspection	USACE PM completion of QA Monitoring Form; ADEM letter

TABLE 3-3
Surveillance Activities - Key Milestones/Deliverables
Fort Rucker Quality Assurance and Surveillance Plan

Milestone	Indicator	Evaluation Standard	Performance Measure	Monitoring Method	Document
Army/ADEM approval of Final 1st Semi-annual RAO/LTM Report	COR/ADEM approval of Final 1st Semi-annual RAO/LTM Report	Quality Timeliness Stakeholder Concurrence Safety	Army/ADEM review of deliverable milestone	100% Inspection Field Inspection	USACE PM completion of QA Monitoring Form; ADEM letter
Army/ADEM approval of Final 2nd Semi-annual RAO/LTM Report	COR/ADEM approval of Final 2nd Semi-annual RAO/LTM Report	Quality Timeliness Stakeholder Concurrence Safety	Army/ADEM review of deliverable milestone	100% Inspection Field Inspection	USACE PM completion of QA Monitoring Form; ADEM letter
Army/ADEM approval of Final Annual RAO/LTM Report – Year 3	COR/ADEM approval of Final Annual RAO/LTM Report – Year 3	Quality Timeliness Stakeholder Concurrence Safety	Army/ADEM review of deliverable milestone	100% Inspection Field Inspection	USACE PM completion of QA Monitoring Form; ADEM letter
Army/ADEM approval of Final Annual RAO/LTM Report – Year 4	COR/ADEM approval of Final Annual RAO/LTM Report – Year 4	Quality Timeliness Stakeholder Concurrence Safety	Army/ADEM review of deliverable milestone	100% Inspection Field Inspection	USACE PM completion of QA Monitoring Form; ADEM letter
Army/ADEM approval of Final Annual RAO/LTM Report – Year 5	COR/ADEM approval of Final Annual RAO/LTM Report – Year 5	Quality Timeliness Stakeholder Concurrence Safety	Army/ADEM review of deliverable milestone	100% Inspection Field Inspection	USACE PM completion of QA Monitoring Form; ADEM letter

TABLE 3-3
Surveillance Activities - Key Milestones/Deliverables
Fort Rucker Quality Assurance and Surveillance Plan

Milestone	Indicator	Evaluation Standard	Performance Measure	Monitoring Method	Document
Army/ADEM approval of Final Annual RAO/LTM Report – Year 6	COR/ADEM approval of Final Annual RAO/LTM Report – Year 6	Quality Timeliness Stakeholder Concurrence Safety	Army/ADEM review of deliverable milestone	100% Inspection Field Inspection	USACE PM completion of QA Monitoring Form; ADEM letter
Army approval of Draft Remedy Review	COR approval of Draft Remedy Review	Quality Timeliness	Army review of deliverable milestone	100% Inspection	USACE PM completion of QA Monitoring Form
Army/ADEM approval of Final Remedy Review	COR/ADEM approval of Final Remedy Review	Quality Timeliness Stakeholder Concurrence	Army/ADEM review of deliverable milestone	100% Inspection	USACE PM completion of QA Monitoring Form; ADEM letter
Status Reports*	COR approval of Status Report	Not Applicable	Army review of deliverable	100% Inspection	COR approval
Stakeholder Presentations*	COR approval of Status Report	Not Applicable	Army review of deliverable	100% Inspection	COR approval

Notes:
* These interim milestones/deliverables are not identified as payment milestones

4. Surveillance Methodology

Tables 3-1, 3-2, and 3-3 summarized the surveillance activities planned for the QASP. The surveillance methods listed below will be used in the administration of this QASP.

4.1 100 Percent Inspection/Review

All project milestones and deliverables will be evaluated through 100 percent inspection onsite or document review. The USACE Project Manager will document performance for each completed milestone or deliverable prior to payment, as described in **Section 5**.

4.2 Field Inspection

At the USACE Project Manager's discretion, periodic inspections will be conducted to evaluate progress toward key milestones and deliverables. This will include quality assurance (QA) Safety Inspections by a government representative during any fieldwork. The USACE Project Manager may also complete a periodic progress inspection if he/she believes that deficiencies exist that must be addressed prior to milestone or deliverable completion. While corrective action or additional work will be required if necessary, the CH2M HILL will not be financially penalized for unacceptable performance recorded in periodic progress reports, provided the final performance evaluation of the milestone or deliverable is deemed acceptable.

4.3 Customer Feedback

CH2M HILL performance feedback will be obtained through periodic inquiries by the USACE Project Manager with project stakeholders. The purpose of these inquiries would be to supplement the other forms of evaluation and to also provide the CH2M HILL with constructive criticism and/or recognition for the project deliverables or milestones completed. Customer feedback received will be validated thoroughly to ensure that it relates to the requirements of the PWS and will be used in a prudent manner by the COR. Customer feedback will also be solicited by the CH2M HILL from appropriate stakeholders in the form of a concurrence letter for each key deliverable.

To be considered valid, customer complaints must be set forth clearly and in writing, the detailed nature of the feedback, must be signed, and must be forwarded to the KO. The KO will maintain a summary log of all formally received customer feedback as well as a copy of each feedback in a documentation file.

5. Surveillance Documentation

5.1 Quality Assurance Monitoring Form

The USACE Project Manager will use the QA monitoring form presented in **Appendix A** to record evaluation of the CH2M HILL's performance for each payment milestone for final deliverable in accordance with the methodology described in **Sections 3 and 4**. The USACE Project Manager must substantiate, through narratives on the form, all superior and unacceptable ratings. Performance at the acceptable level is expected from the CH2M HILL. At a minimum, the evaluation form will indicate actual and scheduled delivery times and number of reviews required to achieve the final product. The USACE Project Manager will forward copies of all completed QA monitoring forms to the USACE COR within 1 week of performing the inspection. The USACE Project Manager will forward all completed QA monitoring forms to the AEC ERM and CH2M HILL.

5.2 Corrective Action Process

When a key milestone/deliverable receives an unacceptable rating, the CH2M HILL will, within 15 days, explain in writing to the USACE COR and USACE Project Manager why performance was unacceptable, how performance will be returned to acceptable levels, and how recurrence of the problem will be prevented in the future. The CH2M HILL shall use the attached corrective action form presented in **Appendix B** as part of this process. The USACE COR will review the proposed corrective action with the AEC ERM and USACE Project Manager, and the Installation Point of Contact (POC), as necessary, to determine if it will be accepted.

5.3 KO and COR Roles and Surveillance Process

The USACE Project Manager will provide the COR and KO with copies of all completed QA monitoring forms. When appropriate, the COR and/or KO may investigate further to determine whether all the facts and circumstances surrounding the event were considered in the USACE Project Manager opinions outlined on the form. The COR and/or KO will immediately discuss any unacceptable rating with the CH2M HILL's Program Manager to assure that corrective action is initiated promptly. At the end of the contract performance period, the USACE Project Manager will prepare a written report for the COR and KO summarizing the overall results of the surveillance of the CH2M HILL's performance during the contract. This report will become part of the formal QA documentation. The USACE Project Manager will maintain a complete QA file. This file will contain copies of all performance evaluation forms and any other related documentation. The USACE Project Manager will forward these records to the COR and KO at termination or completion of the contract.

6. Payment

Full payment for a milestone will be provided upon verification of overall acceptable performance as included on the QA monitoring form. The CH2M HILL will submit a standard request for progress payment (invoice) to the USACE Project Manager. If a QA monitoring form is not provided to the CH2M HILL within 5 days of completion of the milestone, the CH2M HILL will submit an invoice. The CH2M HILL will also be required to perform a milestone presentation per the PWS. At the discretion of the COR, these milestone presentations may be conducted as part of scheduled Project Meetings.

If a milestone or deliverable receives an unacceptable rating for either the quality or stakeholder concurrence performance standard, additional works required until the deliverable receives an acceptable rating. This additional work is required regardless of cost or schedule constraints that may result from the unacceptable performance, unless the USACE Project Manager waives the timeliness or stakeholder concurrence requirement for that specific deliverable or the KO has opted to terminate the contract.

7. QASP Approval

QASP Approval:

William L. Woodall **Date**
Contracting Officer's Representative

APPENDIX A

Quality Assurance Monitoring Form

Quality Assurance Monitoring Form

Date:

Installation:

Milestone/Deliverable/Standard:

Survey Period:

Method of Surveillance:

Author's Name and Phone Number:

Evaluation of CH2M HILL's Performance:

Corrective Action Required: Yes _____ No _____

Narrative Discussion of CH2M HILL's Performance During Survey Period:

APPENDIX B

Corrective Action Form

Corrective Action Form

1) Date:

2) Installation:

3) Milestone/Deliverable/Standard:

4) Survey Period:

5) Author's Name and Phone Number:

6) Description of the Failure/Deficiency that Precipitated the Corrective Action:

7) Description of the Criterion that the Failure/Deficiency was Evaluated Against:

8) Personnel Involved in Identification of the Failure/Deficiency, Determination of the Appropriate Corrective Action, Approval of the Corrective Action, and Implementation of the Corrective Action:

9) Description of the Corrective Action that was Required:

10) Date/Time of Implementation of the Corrective Action:

11) Follow Up Information to Prevent Recurrence of Failure/ Deficiency (i.e., Need For Revision of Procedures or Specifications):

12) Personnel Responsible for Follow-Up Work:

13) Planned Date for Follow Up Surveillance:

14) Other Notes:

Site Wide Plans

Field Sampling Plan

Site-Wide Sampling and Analysis Plan

Environmental Remediation Services
Fort Rucker, Alabama

FINAL

Contract No. W91ZLK-05-D-0014
Contract Task Order No. 0001

Prepared for:

U.S. Army Environmental Command

Prepared by:

CH2MHILL

Northpark 400
1000 Abernathy Road
Suite 1600
Atlanta, GA 30328

January 2010

Introduction

This Sampling and Analysis Plan (SAP), which has been prepared for the U.S. Army Environmental Command (USAEC), describes the procedures and methodology to be used by CH2M HILL Constructor's, Inc. (CH2M HILL) during field activities associated with environmental remediation services at Fort Rucker, Alabama, under Contract W91ZLK-05-D-0014, Task Order (TO) 0001.

This SAP serves as a reference document for field personnel and aids in the preparation of site-specific work plans that will address environmental remediation services at:

- Area of Concern (AOC)-S
- FTRU-001-R-01 Anti-Tank/Rocket Grenade Range
- FTRU-003-R-01 Infiltration/Grenade Range
- FTRU-004-R-01 .22-Caliber Target Butt

AOC–S is being managed under the Installation Restoration Program (IRP). The remaining three sites (FTRU-001-R-01, FTRU-003-R-01, and FTRU-004-R-01) are addressed under the Military Munitions Response Program (MMRP).

Remediation at AOC-S is being conducted under a Resource Conservation and Recovery Act (RCRA) Hazardous and Solid Waste Amendments (HSWA) Permit, with regulatory coordination, as appropriate, by the Alabama Department of Environmental Management (ADEM) and the U.S. Environmental Protection Agency (EPA) Region 4.

Under this TO, CH2M HILL will perform munitions response actions for military munitions (MM) and munitions debris (MD) at the MMRP sites. To perform munitions responses, the U.S. Department of Defense (DoD) primarily operates under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). However, ADEM has identified the MMRP sites as AOCs for corrective action under Fort Rucker's HSWA permit.

Information contained in this SAP includes:

- Volume I: Field Sampling Plan (FSP)
- Volume II: Quality Assurance Project Plan (QAPP)
- Associated appendices presenting the Waste Management Plan (WMP), Field Activity Standard Operating Procedures (SOPs), and Project Schedule

Volume I: Field Sampling Plan (FSP)

Environmental Remediation Services

Fort Rucker, Alabama

Contents

Tables

Figures

Appendices

Acronyms and Abbreviation

ADEM	Alabama Department of Environmental Management
AOC	Area of Concern
bgs	below ground surface
CCQC	Contract Chemical Quality Control
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DGM	data geophysical mapping
DQCR	Daily Quality Control Report
DPT	direct push technology
DO	dissolved oxygen
DoD	U.S. Department of Defense
EOD	explosive ordnance disposal
EPA	U.S. Environmental Protection Agency
FSP	Field Sampling Plan
HRR	Historical Records Review
HSA	hollow-stem auger
HSWA	Hazardous and Solid Waste Amendments
IDW	investigation-derived waste
IRP	Installation Restoration Program
MC	munitions constituent
MCL	maximum contaminant level
MD	munitions debris
MEC	munitions and explosives of concern
MM	military munitions
MMRP	Military Munitions Response Program
MS/MSD	matrix spike/matrix spike duplicate
NROR	Non-Routine Occurrence Report
PCE	tetrachloroethene
PM	project manager

PRB	permeable reactive barrier
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SOP	Standard operating procedure
SSHP	Site Safety and Health Plan
TCLP	Toxicity Characteristic Leaching Procedure
TO	Task Order
μg/L	micrograms per liter
USACE	U.S. Army Corps of Engineers
USAEC	U.S. Army Environmental Command
VOC	volatile organic compound
WMP	Waste Management Plan
XRF	X-ray fluorescence
ZVI	zero valent iron

1. Introduction

The Field Sampling Plan (FSP) presents the sampling methods and procedures that will be used during the field sampling activities. Subcontractors, as well as CH2M HILL personnel, will be expected to adhere to the procedures specified in this document. All field activities will be conducted by CH2M HILL or subcontractors under the supervision of CH2M HILL.

Information contained in this FSP includes:

- Project description
- Scope and objectives
- Field activities
- Waste Management Plan (WMP)
- Chemical quality control
- Data Quality Control Reports (DQCRs)
- Corrective actions
- Standard Operating Procedures
- Project schedule

2. Project Description

2.1 Site History

Fort Rucker commenced operations in 1942 in response to the United States military escalation following the attack on Pearl Harbor. It was originally named the Ozark Triangular Division Camp and became Camp Rucker in 1943. It was renamed Fort Rucker in 1955. Fort Rucker has been the site of an infantry training ground, aviation school flight training, and heliport. Since 1973, the mission at Fort Rucker has been to maintain and operate facilities and provide services and material to support rotary and fixed-wing pilot training for Army aviation enlisted specialists and related test activities.

Fort Rucker is located approximately 20 miles northwest of Dothan, Alabama, and is bounded by the towns of Enterprise on the west, Daleville on the south, and Ozark on the east. Fort Rucker totals 62,430 acres, most of which is situated in Dale and Coffee counties.

2.1.1 AOC-S

Area of Concern (AOC)-S (shown in Figure **2-1**) is located within the southern portion of Fort Rucker's cantonment area. Land use within this portion of Fort Rucker consists of various industrial buildings and vehicle maintenance yards.

CH2M HILL performed a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) for AOC-S in 2007 and 2008. The RFI showed that groundwater within the investigation area has been impacted with tetrachloroethene (PCE) at concentrations exceeding its maximum contaminant level (MCL) of 5 micrograms per liter (µg/L). The apparent source of the PCE in groundwater was a wash rack that was operated from the 1950s to the late 1980s. PCE was not detected in soil in the vicinity of the wash rack, indicating that the source may have been removed during removal of the wash rack.

The PCE plume's dimensions are approximately 2,900 feet by 900 feet, and it covers approximately 60 acres. The plume has migrated southward, following groundwater flow beyond the Fort Rucker boundary. PCE concentrations range from 120 µg/L at approximately 500 feet downgradient of the apparent source to 17 µg/L at the installation boundary. The maximum PCE concentration off-post is 4 µg/L, which is below the MCL.

2.1.2 MMRP Sites

FTRU-001-R-01—Anti-Tank/Rocket Range

Site FTRU-001-R-01 (shown in **Figures 2-2** and **2-3**) covers 57 acres northeast of the cantonment area and was historically used as an anti-tank rocket and grenade range. The site is made up of three distinct sub-ranges: (1) Anti-Tank/Rocket Range No.1, (2) Anti-Tank Grenade Range No. 1, and (3) an unnamed range. The area has been developed as part of the post's golf course.

During the site inspection (SI) (Malcolm Pirnie, 2005), four munitions debris (MD) items were discovered on the Anti-Tank/Rocket Range. The MD consisted of a fragment from a practice rifle grenade, a fragment of an expended 2.36-inch” rocket, and fragments from two expended M28 3.5-inch rockets. M28 3.5-inch rockets were not expected to be present onsite based on the historical records review (HRR) but their presence is consistent with other activities known to have taken place in the area. The HRR identified several munitions that could be present at the site: 2.36-inch Rocket, M6A1, M9A1 HEAT, MII A1-MII A4 Practice, and M17 Fragmentation. A World War I-era tank hull with numerous holes and pockmarks resulting from the use of live armor-piercing ammunition was located just outside of the non-operational range boundary and is located in the operational portion of the post, which is outside the area subject to the RFI. The orientation of the range and the orientation of the tank hull relative to the range indicate that the tank may have been fired at from the non-operational portion of the range.

FTRU-003-R-01—Infiltration/Grenade Range

Site FTRU-003-R-01 (shown in **Figures 2-2** and **2-4**) is adjacent to, but not contiguous with, the Anti-Tank Rocket/ Grenade Range and occupies 44 acres not included in the operational range designated area (northeast of the cantonment area).

The site was historically used as an infiltration and grenade range and is made up of three distinct sub-ranges: (1) Infiltration Range No. 2, (2) Grenade Range No. 1, and (3) the Rifle Grenade Fragmentation Range. The Infiltration/Grenade Range has been developed as part of the post’s equestrian center and golf course driving range.

No munitions and explosives of concern (MEC) or MD items were observed during SI activities at the Infiltration/Grenade Range. Information received from Fort Rucker Range Control identified two explosive ordnance disposal (EOD) responses to MEC items identified within the area in 2003. Both items (rifle grenades) were destroyed by EOD personnel. The HRR identified several munitions that could be present at the site: M II A1-MII A4 Practice and M17 Fragmentation. Small arms (.30-caliber) may also be present.

FTRU-004-R-01—.22 Caliber Target Butt

Site FTRU-004-R-01 (shown in **Figures 2-2** and **2-5**) covers 2.4 acres in the central portion of the cantonment area and is the reported site of a .22 Caliber Target Butt.

The only indication that the target butt existed is a 1944 map. During the SI, no surface features were found that would indicate the presence of a former small arms range. The area is heavily wooded and hilly, with some steep slopes, and does not appear have been significantly disturbed over the years. During the site reconnaissance walk conducted as part of SI activities, an expended empty M48 Trip Flare (a non-frag producing munition designed to illuminate enemy forces) was identified along the northwestern edge but within the identified “limits” of the site. The flare was found on the ground and appeared to have been undisturbed since its use; the base of a tree had grown around the item. Only small arms (.22-caliber) were identified in the HRR as potentially being located at this site.

2.2 Project Organization and Responsibilities

CH2M HILL is responsible for the following:

- Task Order Management
- Quality Assurance/Quality Control (QA/QC)
- CH2M HILL Worker Safety and Health
- Planning
- Sample Collection
- Record Keeping
- Data Validation
- Data Evaluation and Reporting
- Subcontractor Supervision

CH2M HILL personnel responsible for the above aspects of the project are identified in **Table 2-1**.

In addition to these personnel, other team members will be used on the project. Field team members will be responsible for collecting samples and performing field measurements under the supervision of the Site Superintendent and in accordance with the procedures that are set forth in Volume II Quality Assurance Project Plan (QAPP) of the Sampling and Analysis Plan (SAP), Field Activity Standard Operating Procedures (SOPs) (**Appendix B**), Site Safety and Health Plan (SSHP), as well as the procedures that will be set forth in the site-specific work plans for AOC-S and the three MMRP sites.

Subcontractors will be used for several of the field activities. The anticipated subcontracted tasks are presented in **Table 2-2**.

TABLE 2-1
CH2M HILL Project Team
Environmental Remediation Services, Fort Rucker, Alabama

Project Position	Responsible Personnel	Contact Information
Program Manager	Colleen Reilly	CH2M HILL 135 South 84th Street Suite 325 Milwaukee, WI 53214 (414) 272-2426
Project Manager	Mark Sherrill, PG	CH2M HILL Northpark 400 1000 Abernathy Road Suite 1600 Atlanta, GA 30328 (770) 604-9095 msherril@ch2m.com
Senior Technical Advisor (AOC-S)	Dean Williamson, PE	CH2M HILL 3011 S.W. Williston Road Gainesville, GA 32608-3928 (352) 384-7204 Dean.Williamson@ch2m.com

TABLE 2-1
CH2M HILL Project Team
Environmental Remediation Services, Fort Rucker, Alabama

Project Position	Responsible Personnel	Contact Information
Senior Technical Consultant (AOC-S)	Casey Hudson, PE	CH2M HILL Northpark 400 1000 Abernathy Road Suite 1600 Atlanta, GA 30328 (678) 530-4172 Casey.Hudson@ch2m.com
Senior Technical Advisor (MMRP Sites)	Ben Redmond, SUXOS	CH2M HILL 2095 Lakeside Centre Way Suite 200 Knoxville, TN 37922 (865) 560-2906 Ben.Redmond@ch2m.com
Task Manager (AOC-S)	Tom Wiley, PG	CH2M HILL Northpark 400 1000 Abernathy Road Suite 1600 Atlanta, GA 30328 (678) 530-4388 Tom.Wiley@ch2m.com
Task Manager (MMRP Sites)	Jonathan Grimes, PG	CH2M HILL Northpark 400 1000 Abernathy Road Suite 1600 Atlanta, GA 30328 (678) 530-4146 Jonathan.Grimes@ch2m.com
Project Chemist	Ward Dickens	CH2M HILL 3011 SW Williston Road Gainesville, FL 32608 (352) 384-7049 Ward.Dickens@ch2m.com
Team Lead/Military Munitions Specialist	Kevin Lombardo	CH2M HILL 15010 Conference Center Drive Suite 200 Chantilly, VA 20151 (703) 376-5175 Kevin.Lombardo@ch2m.com
Munitions Response Geophysicist	Tamir Klaff	CH2M HILL 15010 Conference Center Drive Suite 200 Chantilly, VA 20151 (703) 669-9611 Tamir.Klaff@ch2m.com
Project Quality Assurance/Quality Control Manager	Eric Burrell	CH2M HILL Northpark 400 1000 Abernathy Road Suite 1600 Atlanta, GA 30328 (770) 604-9095

TABLE 2-1
CH2M HILL Project Team
Environmental Remediation Services, Fort Rucker, Alabama

Project Position	Responsible Personnel	Contact Information
		Eric.Burrell@ch2m.com
Senior Unexploded Ordnance Supervisor	Chris Rose	CH2M HILL 2625 S. Plaza Drive Suite 300 Tempe, Arizona 85282-3397 (205) 326-8912 Chris.rose@ch2m.com
Risk Assessor	Vijaya Mylavarapu, PhD	CH2M HILL 225 East Robinson Street Suite 505 Orlando, FL (407) 423-0001 x290 Vijaya.Mylavarapu@ch2m.com
Site Superintendent / Site Safety and Health Coordinator/Onsite Quality Assurance Officer	Robert Plsek	CH2M HILL 12377 Merit Drive Suite 1000 Dallas, TX 75251 (254) 379-3932 Robert.Plsek@ch2m.com
Health and Safety Manager/Munitions Response Safety and Quality Assurance Officer	Dan Young	CH2M HILL 1766 Sea Lark Lane Navarre, FL 32566-7472 (251) 962-2963 Dan.Young@ch2m.com
Health and Safety Manager/AOC-S	Mike Goldman	CH2M HILL Northpark 400 1000 Abernathy Road Suite 1600 Atlanta, GA 30328 (770) 604-9095 mgoldman@ch2m.com

TABLE 2-2
Subcontractors for Field Activities
Environmental Remediation Services, Fort Rucker, Alabama

Services Provided	Subcontractor
Digital Geophysical Mapping	NAEVA
Laboratory Analytical Services	Empirical Laboratories
Permeable Reactive Barrier Installation	DeWind One-Pass Trenching LLC
Drilling Services	AE Drilling
Surveying Services	Donaldson and Garrett
Subsurface Utility Locator	OneVision Utility Services
Munitions Response Services	UXB
Waste Transport and Disposal	Capitol Environmental
Manage Excavated Soil and Load Excavated Soil into Dump Trucks	Singley Environmental and Remediation Services
Site Clearing	Jacklett Construction

Insert Figure 2-1

Insert Figure 2-2

Insert Figure 2-3

Insert Figure 2-4

Insert Figure 2-5

3. Scope and Objectives

The scope and objectives for sampling at the AOC-S and MMRP sites will be outlined in the site-specific work plans for AOC-S and the three MMRP sites. The procedures used in the field for meeting these objectives are provided in this section, and the Field Activity SOPs that will be used, as applicable, during the environmental remediation services are located in **Appendix B**.

Tasks associated with field sampling and/or data collection at IRP site AOC-S include:

- Documentation (see **Appendix B, SOP B.1**)
- Use and calibration of field instruments (see **Appendix B, SOP B.2**)
- Water level measurements (see **Appendix B, SOP B.3**)
- Drilling Procedures (see **Appendix B, SOP B.4**)
- Soil sampling (see **Appendix B, SOP B.5**)
- Soil classification for borehole logs (see **Appendix B, SOP B.6** and **Attachment B7**)
- Borehole abandonment (see **Appendix B, SOP B.6**)
- Monitoring well installation (see **Appendix B, SOP B.8**)
- Decontamination of sampling equipment (see **Appendix B, SOP B.9**)
- Groundwater sampling (see **Appendix B, SOP B.10**)
- Land surveying (see **Appendix B, SOP B.11**)
- Sample Management (see **Appendix B, SOP B.12**)
- Data QA/QC (see Volume II: **QAPP** and **Appendix B**, **SOP B.13**)
- Zero Valent Iron (ZVI) Permeable Reactive Barrier (PRB) installation (see **Section 4.3**)
- Investigation-derived waste (IDW) management (see **Appendix A: WMP**)

Tasks associated with the field sampling and/or data collection at the three MMRP sites include:

- Digital geophysical mapping (DGM)
- Intrusive investigations
- Instrument-assisted walkabout
- X-ray fluorescence (XRF) field-screening of soils (see **Appendix B, Attachment B4**)
- Munitions constituent (MC) soil sampling (see **Appendix B, SOP B.5** for soil sampling procedures)

DGM, intrusive investigations and/or instrument-assisted walkabout at the MMRP sites will be completed first to identify MC sample locations. XRF field screening may be used to identify locations of elevated lead in soil, the indicator parameter at the FTRU-004-R-01—.22 Caliber Target Butt site, prior to collection of MC samples for laboratory analysis.

The soil sampling and XRF field-screening procedures are presented in **Appendix B, SOP B.5** and **Appendix B, Attachment B4,** respectively. The DGM, intrusive investigations, instrument-assisted walkabout, XRF field-screening of soils, and MC soil sampling will be conducted in accordance with the procedures set forth in the site-specific work plan for the MMRP sites.

Soil and groundwater sampling will be conducted, the samples will be analyzed, and the data will be validated to provide a Level III data package. Data requirements are detailed in the Volume II: QAPP of the SAP.

4. Field Activities

The environmental remediation activities will be completed in multiple field mobilizations. Prior to mobilization, CH2M HILL will contact the Fort Rucker utilities to obtain available information regarding subsurface utilities at the AOC-S area and MMRP sites and the permits needed prior to initiating remedial action activities. Environmental activities will be performed in accordance with the *Field Branches Quality System and Technical Procedures*) and *Alabama Environmental Investigation and Remediation Guidance (ADEM, 2005).*

4.1 Soil Sampling

4.1.1 Rationale

Soil Sampling Locations at AOC-S

Soil samples will be collected from:

- Direct push technology (DPT) borings within the PCE groundwater plume to confirm/deny source areas.
- Hollow-stem auger (HSA) borings advanced for installation of additional permanent groundwater monitoring wells for PCE plume delineation.
- DPT borings advanced for the installation of ZVI PRB performance monitoring wells.
- DPT borings advanced in the proposed ZVI PRB trench area for waste characterization. One composite sample will be collected per 500 tons of trench spoil.
- An offsite borrow source to verify the inert bulking material (sand) placed in the ZVI PRB is contaminant-free. One composite sample of each offsite source will be collected for parameters listed in Table 4.8.

The proposed locations of the permanent groundwater monitoring wells, ZVI PRB performance monitoring wells, and DPT borings selected for soil sample collection will be provided in the site-specific work plan for AOC-S.

Soil Sampling Locations at the MMRP Sites

Soil samples may be collected during the RFI field activities at the .22 Caliber Target Butt MMRP site. The field activities for the MMRP sites are summarized in Section 4.5 and will be conducted in accordance with the procedures set forth in the site-specific work plan for the MMRP sites.

Sample Collection and Field and Laboratory Analysis

The soil samples collected at AOC-S will be analyzed for the laboratory analysis listed in **Table 4-1**. The soil samples collected for waste characterization at AOC-S will be analyzed for the laboratory analysis listed in Section 4.4. The MMRP sites soil samples will be analyzed for the laboratory analysis listed on **Table 4-2**.

QA/QC, and Blank Samples and Frequency

QA/QC samples will be collected in the field in conjunction with each sampling event. The types of QA/QC samples collected, the rationale behind collection of these samples, and the frequency of QA/QC sample collection are described in the QAPP (Volume II of the SAP).

4.1.2 Procedures

The SOPs that will be used, as applicable, during soil sampling activities include: documentation (**SOP B.1**) use and calibration of field instruments (**SOP B.2**), drilling procedures (**SOP B.4**), soil sampling (**SOP B.5**), soil classification for borehole logging (**SOP B.6** and **Attachment B7**), borehole abandonment (**SOP B.7**), decontamination of sampling equipment (**SOP B.9**), land surveying (**SOP B.11**), sample management (**SOP B.12**), and data QA/QC (**SOP B.13**). These SOPs are provided in **Appendix B**. The soil boring logs (**Attachment B1**) and field equipment instrument operating procedures (**Attachment B4**) are located in **Appendix B.**

4.2 Monitoring Well Installation and Groundwater Sampling

4.2.1 Rationale

Monitoring Well Locations at AOC-S

The proposed locations of additional groundwater monitoring wells to further define the PCE groundwater plume and monitor the effectiveness of the ZVI PRB will be provided in the site-specific work plan for AOC-S.

Sample Collection and Field and Laboratory Analysis

All groundwater samples collected from the monitoring wells will be analyzed by the subcontracted fixed base laboratory for the parameters listed on **Tables 4-3** through **4-5**.

QA/QC, Blank Samples, and Frequency

QA/QC samples will be collected in the field in conjunction with each sampling event. The types of QA/QC samples that will be collected, the rationale behind collection of these samples, and the frequency of QA/QC sample collection are described in the QAPP (Volume II of the SAP).

4.2.2 Procedures

The SOPs that will be used, as applicable, during the monitoring well installation and groundwater sampling include: documentation (**SOP B.1**), use and calibration of field instruments (**SOP B.2**), water level measurements (**SOP B.3**), drilling procedures (**SOP B.4**), soil sampling (**SOP B.5**), soil classification for borehole logging (**SOP B.6** and **Attachment B7**), borehole abandonment (**SOP B.7**), monitoring well installation (**SOP B.8**), decontamination of sampling equipment (**SOP B.9**), groundwater sampling (**SOP B.10**), land surveying (**SOP B.11**), sample management (**SOP B.12**), and data QA/QC (**SOP B.13**). These SOPs are provided in **Appendix B**.

The soil boring log (**Attachment B1**), well development/purge logs (**Attachment B2**), and well construction form (**Attachment B3**) are located in **Appendix B.** The field equipment instrument operating procedures **(Attachment B4)** are located in **Appendix B.**

4.3 PRB Trench Installation

The PRB trench will be installed using a one-pass trenching system or alternate method (that is, trench boxes, partial open hole, biopolymer trench method, other methods, or a combination of methods to stabilize the side slopes during PRB construction). The PRB will be filled with a mixture of ZVI fillings and sand to construct an approximate 18-inch wide, 350-foot long, and 15-foot deep PRB. The sand will be clean masonry sand that will be tested for the appropriate gradation and to verify the material is contaminant-free (see Section 4.5). If present, contaminant concentrations will be compared against the Environmental Protection Agency (EPA) Region 9 Residential Preliminary Remediation Goals (PRGs). The PRB will be installed in accordance with the procedures set forth in the site-specific work plan for AOC-S.

4.4 Waste Characterization Sampling

4.4.1 PRB Trench Spoil Sampling

Prior to the ZVI PRB installation, soil borings will be advanced to approximately 20 feet below ground surface (bgs) within the proposed trench. The soil borings will be advanced using DPT. One composite soil sample per 500 tons of trench spoil will be collected for the waste characterization analysis listed in **Table 4-6.** The trench spoil will be managed in accordance with the WMP (**Appendix A**).

4.4.2 Monitoring Well Installation and Groundwater Sampling

Soil cuttings, water accumulated during decontamination activities, and groundwater accumulated during drilling including development and well purging will be placed in 55-gallon drums and managed in accordance with the WMP (**Appendix A**). The soil and liquid waste streams will be containerized separately. One composite soil sample will be collected for every 10 drums of soil waste during the well installation using the soil sampling procedure set forth in **Appendix B, SOP B.5** and analyzed for the waste characterization parameters listed in **Table 4-6.** One liquid sample will be collected for every 10 drums of liquid waste during the groundwater monitoring events using the groundwater sampling procedures set forth in **Appendix B, SOP B.10** and analyzed for the waste characterization parameters listed in **Table 4-7**.

Details of the waste characterization and management are presented the WMP (**Appendix A**).

4.5 Permeable Reactive Barrier Sand Backfill Sampling

Prior to delivery, one representative sample from the sand to be used in the construction of the PRB will be collected using the soil sampling procedure listed in **Appendix B, SOP B.5** and analyzed for the analytical parameters listed in **Table 4-8**.

4.6 Field Sampling Activities at MMRP Sites

4.6.1 Digital Geophysical Mapping and Intrusive Investigations

A DGM survey will be performed at the Anti-Tank/Rocket Grenade Range and Infiltration/Grenade Range in accordance with the site-specific work plans for the MMRP sites. A series of transects at each site will be geophysically surveyed. Following an analysis of the DGM data, an intrusive investigation will be conducted to investigate a statistically significant percentage of the anomalies identified. Details of the DGM and intrusive investigation will be presented in the site-specific work plans for the MMRP sites.

4.6.2 Geophysical Instrument-Assisted Walkabout

A geophysical instrument-assisted walkabout will be performed over approximately 10 percent of the .22 Caliber Target Butt site to screen for the presence of munitions-related activities or items. Standard metal detectors will be used to assist in locating metallic items that may be obstructed by vegetation or the ground surface and in accordance with the site-specific work plan for the MMRP sites. Where metallic objects are found, the soil in the immediate vicinity may be selected for XRF field screening. Details of the digital geophysical instrument-assisted walkabout will be presented in the site-specific work plans for the MMRP sites.

4.6.3 XRF Field Screening of Soil

Field screening of soil using an XRF spectrometry technique may be performed at the .22 Caliber Target Butt site at locations identified after the geophysical instrument-assisted walkabout is completed. XRF field screening procedures are outlined in the manual provided in **Appendix B.** Additional XRF soil field screening rationale for the .22 Caliber Target Butt site will be presented in the site-specific work plans for the MMRP sites. The SOP for the XRF field screening is presented in **Appendix B, Attachment B4**.

4.6.4 Soil Sampling

Based on the results of the geophysical instrument-assisted walkabout and XRF field screening of soil at the .22-Caliber Target Butt site, soil samples may be collected and analyzed for the laboratory parameters listed in **Table 4-2**. If sampling is appropriate, details of the sampling program will be conducted as presented in the site-specific work plans for the MMRP sites. The soil will be collected using the soil sampling procedure set forth in **Appendix B, SOP B.5.**

TABLE 4-1
Soil Analysis Requirements – AOC-S
Environmental Remediation Services, Fort Rucker, Alabama

Parameter	EPA Method
ADEM Chapter 13, Appendix I VOCs	8260B
ADEM Chapter 13, Appendix I Metals	6010B/7471A

Notes:
ADEM = Alabama Department of Environmental Management
VOC = volatile organic compound

TABLE 4-2
Soil Analysis Requirements – .22-Caliber Target Butt Site
Environmental Remediation Services, Fort Rucker, Alabama

Parameter	EPA Method
Lead, Antimony, Copper, and Zinc	6010B

TABLE 4-3
Groundwater Analysis Requirements –Year 1 AOC-S Quarterly Sampling
Environmental Remediation Services, Fort Rucker, Alabama

Parameter	EPA Method
ADEM Chapter 13, Appendix I VOCs	8260B
ADEM Chapter 13, Appendix I Metals	6010B/7470A
Iron	6010B
Alkalinity	2320B
Nitrate	300.0
Sulfate	300.0
Total Organic Carbon	5310B

Notes:
ADEM = Alabama Department of Environmental Management
VOC = volatile organic compound

TABLE 4-4
Groundwater Analysis Requirements – Year 2 AOC-S Semiannual Sampling and Year 3 AOC-S Annual Sampling
Environmental Remediation Services, Fort Rucker, Alabama

Parameter	EPA Method
ADEM Chapter 13, Appendix I VOCs	8260B
ADEM Chapter 13, Appendix I Metals	6010B/7470A
Iron	6010B
Alkalinity	SM 2320B
Nitrate	300.0
Sulfate	300.0

Notes:
ADEM = Alabama Department of Environmental Management
VOC = volatile organic compound

TABLE 4-5
Groundwater Analysis Requirements – Years 4-6 AOC-S Annual Sampling
Environmental Remediation Services, Fort Rucker, Alabama

Parameter	EPA Method
ADEM Chapter 13, Appendix I VOCs	8260B
Iron	6010B
Alkalinity	SM 2320B
Nitrate	300.0
Sulfate	300.0

Notes:
ADEM = Alabama Department of Environmental Management
VOC = volatile organic compound

TABLE 4-6
Soil Waste Characterization Analysis – AOC-S
Environmental Remediation Services, Fort Rucker, Alabama

Parameter	EPA Method
TCLP Metals	SW846 1311/6010B/7471A (mercury analysis)
TCLP VOC	SW8461 311/8260B
TCLP SVOC	SW846 1311/8270B
TCLP Pesticide	SW846 1311/8081A
TCLP Herbicide	SW846 1311/8151A
TCLP Ignitability, Corrosivity	SW846 1030/9045C/Chap. 7

Notes:
TCLP = Toxicity Characteristic Leaching Procedure
SVOC = semivolatile organic compound
VOC = volatile organic compound

TABLE 4-7
Liquid Waste Characterization Analysis – AOC-S
Environmental Remediation Services, Fort Rucker, Alabama

Parameter	EPA Method
TCLP Metals	6010B/7470A
TCLP VOC	8260B
TCLP SVOC	8270C
TCLP Pesticide	8081A
TCLP Herbicide	8151A
TCLP Ignitability, Corrosivity	1010A, 9040C

Notes:
TCLP on liquids = Where the waste contains less than 0.5 percent filterable solids, the waste itself, after filtering using the methodology outlined in Method 1311, is considered to be the extract for the purpose of this 40 CFR 261.24.
SVOC = semivolatile organic compound
VOC = volatile organic compound

TABLE 4-8
Backfill Analysis Requirements – AOC-S
Environmental Remediation Services, Fort Rucker, Alabama

Parameter	EPA Method
TCL VOCs	8260B
TCL SVOCs	8270C
TCL Pesticide	8081A
TCL PCBs	8082
TAL Metals	6010B/7471A
Herbicides	SW-846 8151

5. Waste Management Plan

The WMP establishes minimum requirements for the management of waste generated during the field activities. Although the waste generated during the field activities is assumed to be non-hazardous, all containerized waste will be handled as hazardous waste until analytical results of characterization sampling indicate that the waste is non-hazardous. The project WMP is included as **Appendix A.**

6. Chemical Quality Control

The Contractor Chemical Quality Control (CCQC) Report will be summarized in the DQCR (see **Appendix B, Attachment B5**) and submitted to the U.S. Army Corps of Engineers (USACE) Technical Manager. The objective of CCQC is to ensure that QC is maintained through all phases of field work. The three phases of CCQC are described in the following subsections.

6.1 Preparatory Phase

A CCQC review will be conducted by the Site Superintendent prior to initiation of any field activities. The review will cover, but not be limited to, the following:

- All work requirements
- Physical examination of all project materials and equipment
- Examination of the work area to confirm the completion of preliminary work
- Discussion of all field activities

The CCQC review must be repeated when new personnel begin field work.

6.2 Initial Phase

The Site Superintendent will monitor field activities on a daily basis to confirm that all aspects of the CCQC plan are followed. Any action items identified will be included with the DQCR.

6.3 Follow-up Phase

A summary of CCQC activities including identification and resolution of non-compliant QC issues/items will be submitted with the DQCR.

7. Daily Quality Control Reports

DQCRs will be completed by the Site Superintendent for each day of field activity and forwarded to the project manager (PM). The PM will submit the DQCR to the USACE Technical Manager the following morning. If a significant problem arises during field work, the DQCR will be sent to the USACE on the day of occurrence, along with a Non-Routine Occurrence Report (NROR). The DQCR will list all of the personnel onsite that day and summarize all activities that took place. The DQCR will include, at a minimum, the following information:

- Project title
- Date and sequential DQCR number
- Contract and task order number
- Location of work
- Weather (temperature, wind speed, direction, etc.)
- Work performed
- Sampling information (location, type, identification number of samples, etc.)
- Field analyses (type, results, calibration, problems, etc.)
- Problems encountered and corrective actions taken
- QC activities
- Verbal or written instructions from USACE personnel
- Names of all personnel onsite (including affiliation, job function)
- Equipment used
- Health and safety considerations (protective equipment required, etc.)
- Deviations from this approved Work Plan
- General remarks
- Expected activities for the following day

8. Corrective Actions

A corrective action program will be implemented to verify that conditions adverse to quality are identified promptly and corrected. If conditions arise that will adversely impact the quality of the samples, the root cause of the condition will be determined, and corrective action will be taken to prevent recurrence. These actions will be documented and reported to appropriate levels of management. Corrective actions may be the result of internal audits or surveillance, laboratory analytical results that appear unusual or questionable, or through QC data or criteria outside of acceptable ranges. Follow-up action will be taken to verify implementation of all corrective action.

8.1 Reporting and Resolution Requirements

Conditions and/or situations encountered in the field that could impact quality will be identified, reported, and corrected in accordance with the following requirements:

- Existing, developing, or potential adverse quality conditions will be promptly reported to the PM for evaluation and action. The PM will notify the USACE Technical Manager verbally, as soon as possible, of all non-routine occurrences, followed by a written report of the non-routine occurrence within 48 hours. Following any corrective action, the PM will submit a report to USACE detailing the problems, corrective actions taken, and verbal or written instructions received from USACE personnel.
- Reports documenting quality concerns and their resolution, including lessons learned, will be routinely disseminated to all affected project personnel.
- Reports documenting quality problems, if they reflect data quality issues, will be included in the chemical data report packages.

8.2 Laboratory Corrective Action

The analytical data generated during the project will be reviewed to ensure that all QC samples have been analyzed as specified in the methods. Recoveries of laboratory matrix spike/matrix spike duplicate (MS/MSD) samples and surrogates will be checked for compliance with method accuracy requirements. Relative percent difference (RPD) of laboratory MS/MSDs will be checked for compliance with method precision requirements. Where sample results fall outside of the acceptable ranges for accuracy and precision associated with individual methods, discrepancies will be reported immediately to the PM. Corrective actions will be defined and documented appropriately.

The contracted laboratory will have an internal QA corrective action program. This program will include verification that QC data are not outside acceptable windows for precision and accuracy, that blanks or control samples do not contain contaminants above detection limits, and that undesirable trends detected in spike recoveries or RPDs between duplicates are corrected. The program will also ensure that there are no unusual changes in detection limits; that holding times have not been exceeded; and that deficiencies detected by the laboratory QA department during internal or external audits or from results of performance evaluation samples are corrected.

8.3 Recurring Conditions Adverse to Quality

For recurring quality problems, where corrective actions have not been effective, the PM, as needed, will do the following:

- Determine the events leading to the occurrence of the quality problems.
- Develop an understanding of the technical details and work activities associated with the quality problems.
- Ascertain the implications of the quality problem.
- Determine the extent to which similar quality problems (or precursors to the problems) have been recognized by the responsible party, the effectiveness of any corrective actions that were taken, and impacts on completed work.
- Consider stopping work associated with the applicable activity.
- Recommend actions that can be taken by the responsible party to prevent or minimize recurrence.

9. Project Schedule

The project schedule for the remedial action is presented in **Appendix C**. Included on the schedule is the anticipated duration (in days) for each task, anticipated starting and ending dates for each task, a graphical representation of the time frames for the performance of each task, and the inter-relationships between various tasks.

10. References

CH2M HILL. 2007. *Final RFI Work Plan for Area of Concern (AOC) – S*. Fort Rucker, Alabama. Contract DACA21-02-D-0005, Task Order CK28.

CH2M HILL. 2009. *Volume I – Technical and Management Factors*. Environmental Remediation Services, Fort Rucker, Alabama. Contract No. W91ZLK-05-D-0014.

Malcolm Pirnie. 2005. *Final Site Investigation Report*. Fort Rucker, Alabama.

Alabama Department of Environmental Management. 2005. *Alabama Environmental Investigation and Remediation Guidance. A Comprehensive Guidance Document Prepared for Alabama Industries or Individuals Involved in Environmental Assessment, Investigation, and Remediation Projects by the Alabama Department of Environmental Management.* Revised September 2005.

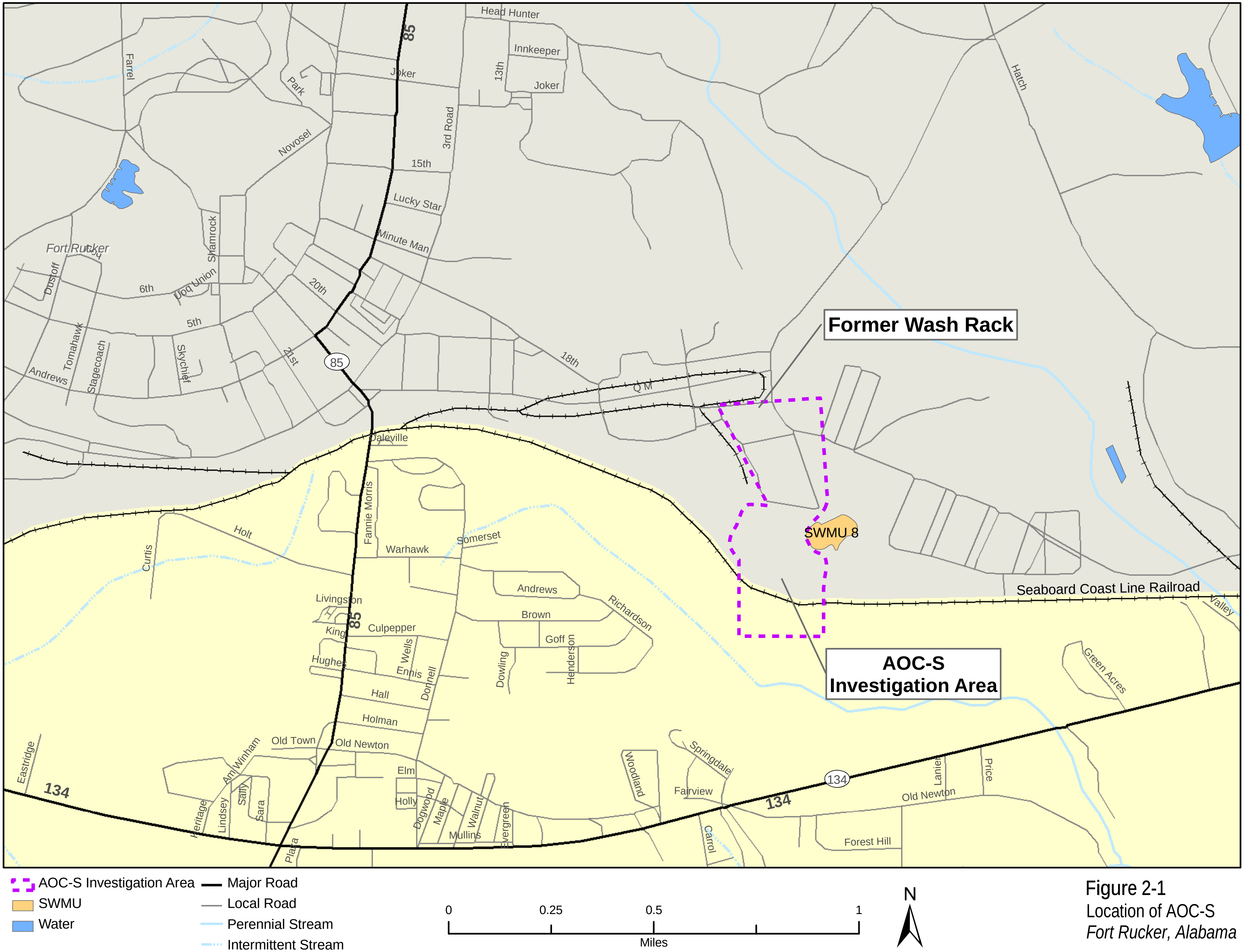
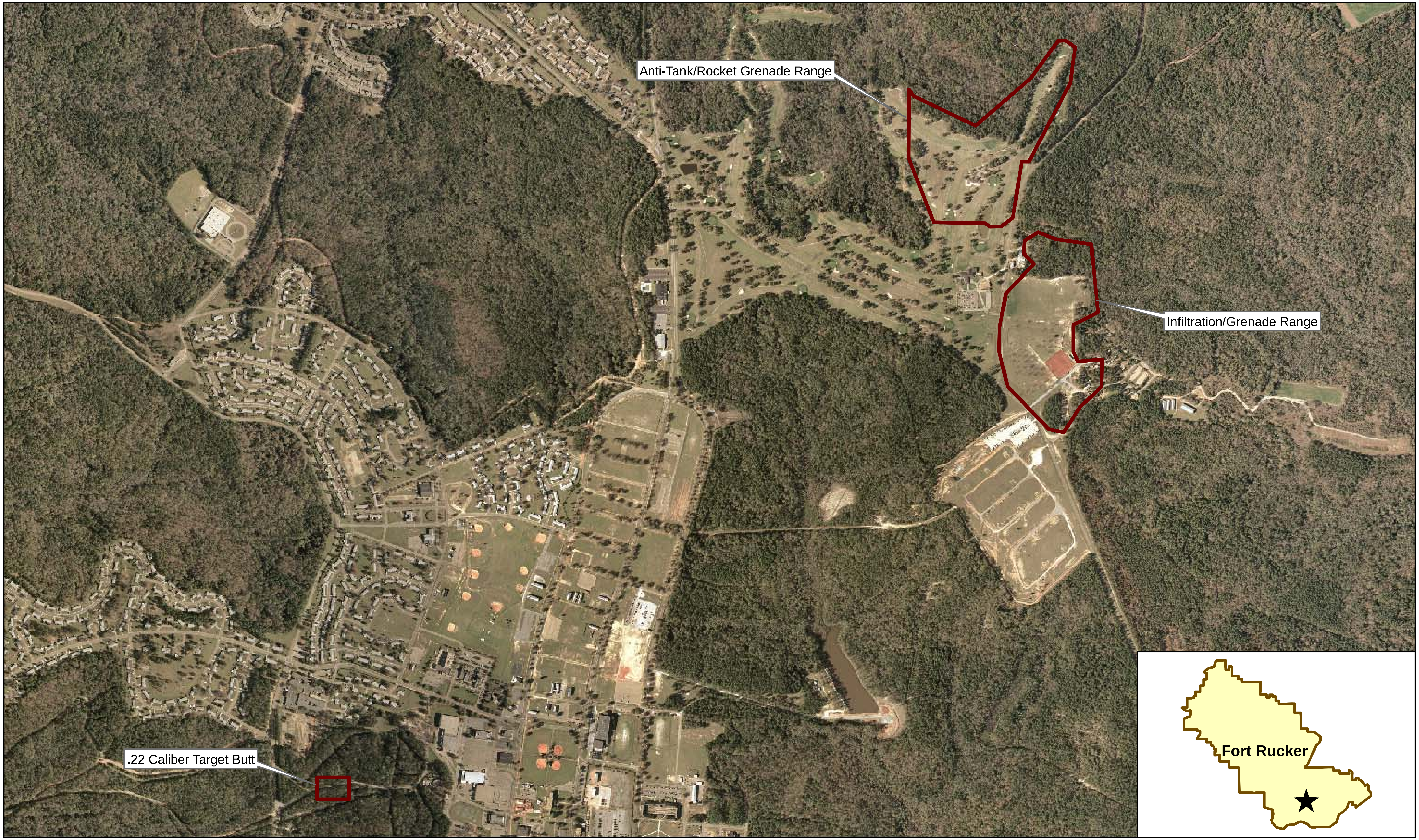


Figure 2-1
Location of AOC-S
Fort Rucker, Alabama

CH2MHILL

File Path: \\boomer\F\Projects5\USACE\FT_Rucker\MapFiles\Ft_Rucker_Location_AOC-S.mxd, Date: March 3, 2009; User: SSmith21

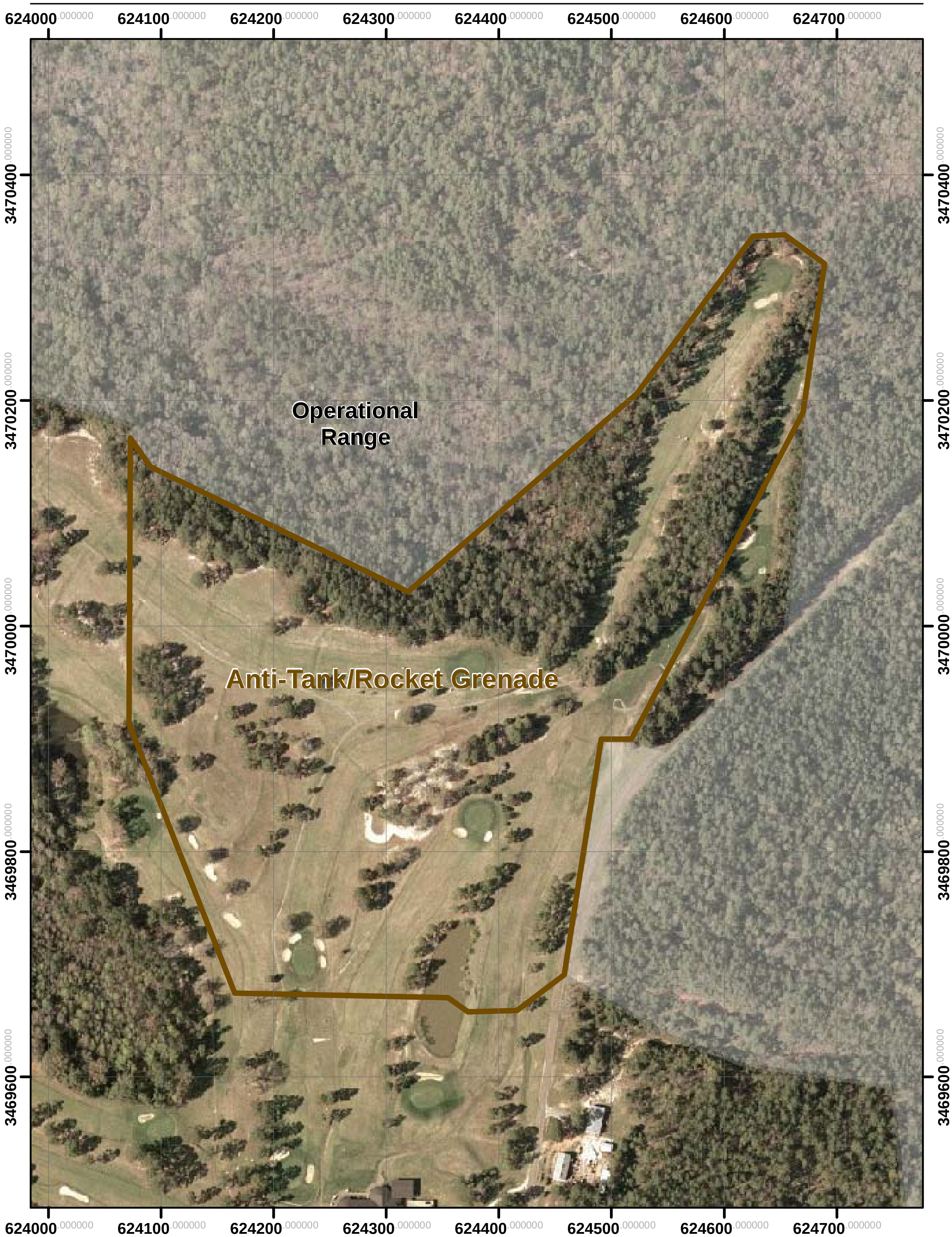


Site Boundary

0 500 1,000 2,000
Feet

FIGURE 2-2
Locations of the 3 MMRP Sites

Fort Rucker, Alabama



Site Boundary
Operational Range

N

0 100 200 400
Feet
1 inch = 400 feet

Figure 2-3
Anti-Tank/Rocket Grenade Range

Fort Rucker, Alabama

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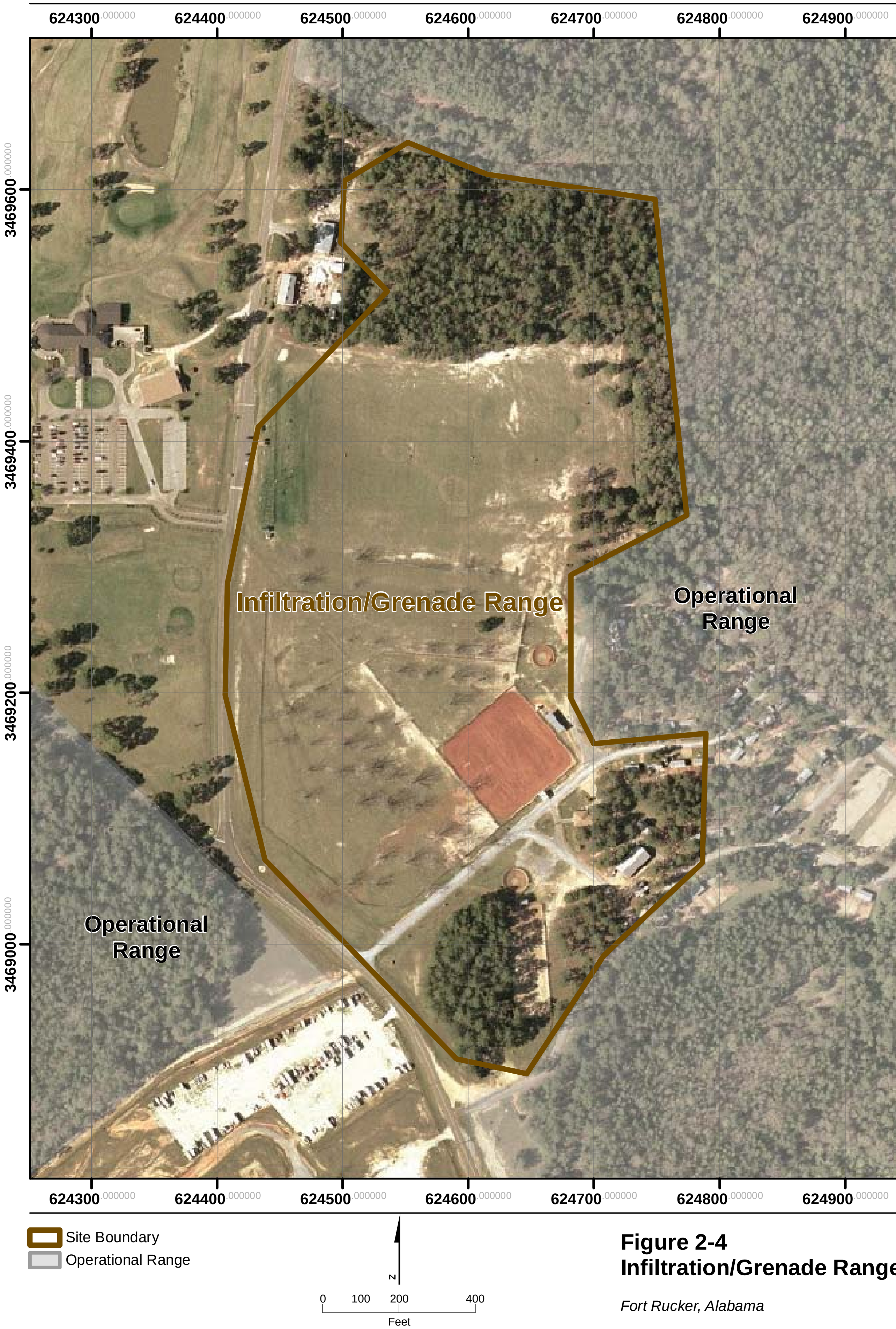

Figure 2-4
Infiltration/Grenade Range

Fort Rucker, Alabama

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Site Boundary
Operational Range

N

0 50 100 200
Feet
1 inch = 200 feet

Figure 2-5
.22 Caliber Target Butt

Fort Rucker, Alabama

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Appendix A
Waste Management Plan
for
Site-Wide Sampling and Analysis Plan
Environmental Remediation Services
Fort Rucker, Alabama

Contract No. W91ZLK-05-D-0014
Task Order No. 0001

Prepared for

U.S. ARMY ENVIRONMENTAL COMMAND

January 2010

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Contents

Acronyms and Abbreviation

ADEM	Alabama Department of Environmental Management
AOC	Area of Concern
CFR	Code of Federal Regulations
COC	chemical of concern
DOT	Department of Transportation
EOD	explosive ordnance disposal
EPA	U.S. Environmental Protection Agency
FTL	Field Team Leader
HRR	Historical Records Review
ID	identification
LDR	land disposal restriction
LTM	long-term monitoring
µg/L	microgram per liter
MCL	maximum contaminant level
MD	munitions debris
MDAS	Material Documented as Safe
MEC	munitions and explosives of concern
MMRP	Military Munitions Response Program
MPPEH	Material Potentially Presenting an Explosive Hazard
NRC	National Response Center
PCE	tetrachloroethene
PRB	permeable reactive barrier
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SI	site investigation
VOC	volatile organic compound
WMP	Waste Management Plan

1 Waste Management Plan

This document is the Waste Management Plan (WMP) for the Environmental Remediation Services at Fort Rucker, Alabama. This WMP identifies the types of wastes likely to be generated during the field activities; specifies control measures to segregate and minimize the generation of waste; and sets forth the procedures for the handling, storage, characterization, and disposal of the waste.

Compliance with the procedures specified in this WMP will be the responsibility of the onsite field team leader (FTL), who will identify and segregate waste streams generated at the project site. Waste documentation will be maintained as discussed in this WMP.

1.1 Site Descriptions

1.1.1 AOC-S

Area of Concern (AOC)-S is located within the southern portion of Fort Rucker's cantonment area. Land use within this portion of Fort Rucker consists of various industrial buildings and vehicle maintenance yards.

CH2M HILL performed a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) for AOC-S in 2007 and 2008. The RFI showed that groundwater within the investigation area has been impacted with tetrachloroethene (PCE) at concentrations exceeding its maximum contaminant level (MCL) of 5 micrograms per liter (µg/L). The apparent source of the PCE in groundwater was a wash rack that was operated from the 1950s to the late 1980s. PCE was not detected in soil in the vicinity of the wash rack, indicating that the source may have been removed during removal of the wash rack. Documentation of the actual use, types, releases or spills of chlorinated solvents (used or unused) at the wash rack are unavailable or inconclusive. Therefore, wastes from this area will be characterized in accordance with Title 40 Code of Federal Regulations (40 CFR) Part 261 Subpart C (characteristic waste regulations).

CH2M HILL intends to install a permeable reactive barrier (PRB) to prevent the migration of site chemicals of concern (COCs) (specifically PCE and its potential degradation products) to the adjacent off-post property.

1.2 MMRP Sites

In the following sections, CH2M HILL describes each of the Military Munitions Response Program (MMRP) sites. General work activities at these sites include survey, clearance, and removal of any munitions and explosives of concern (MEC)/material potentially presenting an explosive hazard (MPPEH) or material documented as safe (MDAS).

FTRU-001-R-01 Anti-Tank/Rocket Grenade Range

Site FTRU-001-R-01, which covers 57 acres northeast of the cantonment area, was historically used as an anti-tank rocket and grenade range. The site is made up of three distinct sub-ranges: (1) Anti-Tank/Rocket Range No. 1, (2) Anti-Tank Grenade Range No. 1, and (3) an unnamed range. The area has been developed as part of the post's golf course. During the site investigation (SI), four munitions debris (MD) items were discovered on the Anti-Tank/Rocket Range. The MD consisted of a fragment from a practice rifle grenade, a fragment of an expended 2.36" rocket, and fragments from two expended M28 3.5" rockets. No M28 3.5" rockets were expected to be present onsite based on the historical research review (HRR), but their presence is consistent with other activities known to have taken place in the area. The HRR identified several munitions that could be present at the site: 2.36" Rocket, M6A1, M9A1 HEAT, MII A1-MII A4 Practice, and M17 Fragmentation. A World War I-era tank hull with numerous holes and pockmarks resulting from the use of live armor-piercing ammunition was located just outside of the non-operational range boundary inside the operational portion of the post (which is outside the area subject to the RFI). The orientation of the range and the orientation of the tank hull relative to the range indicate that the tank may have been fired at from the non-operational portion of the range.

FTRU-001-R-01 (the site being investigated under this task order) is that portion of the ranges that is within the "other than operational" area of Fort Rucker.

FTRU-003-R-01 Infiltration/Grenade Range

Site FTRU-003-R-01 is adjacent to, but not contiguous with, the Anti-Tank Rocket/ Grenade Range and occupies 44 acres of other than operational range designated area (northeast of the cantonment area).

The site was historically used as an infiltration and grenade range and is made up of three distinct sub-ranges: (1) Infiltration Range No. 2, (2) Grenade Range No. 1, and (3) the Rifle Grenade Fragmentation Range. The Infiltration/Grenade Range has been developed as part of the post's equestrian center and golf course driving range.

No MEC or MD items were observed during SI activities at the Infiltration/Grenade Range. Information received from Fort Rucker Range Control identified two explosive ordnance disposal (EOD) responses to MEC items identified within the area in 2003. Both items (rifle grenades) were destroyed by EOD personnel. The HRR identified several munitions that could be present at the site: M II A1-MII A4 Practice and M17 Fragmentation. Small arms (.30-caliber) may also be present.

FTRU-004-R-01 .22-Caliber Target Butt

Site FTRU-004-R-01 covers 2.4 acres in the central portion of the cantonment area and is the reported site of a .22 caliber target butt.

The only indication that the target butt existed is a 1944 map. During the SI, no surface features were found that would indicate the presence of a former small arms range. The area is heavily wooded and hilly, with some steep slopes, and does not appear to have been significantly disturbed over the years. During the site reconnaissance walk conducted as part of SI activities, an expended empty M48 Trip Flare (a non-frag-producing munition designed to illuminate enemy forces) was identified along the northwestern edge but within the identified "limits" of the site. The flare was found on the ground and appeared to have been undisturbed since its use; the base of a tree had grown around the item. Only small arms (.22-caliber) were identified in the HRR as potentially being located at this site.

1.3 Waste Streams

It is anticipated that the following wastes will be generated during these activities:

- Soil cuttings generated during drilling of soil borings and installation of monitoring wells;
- Trench spoils generated during the installation of the PRB;
- Groundwater from monitoring well development and purging and sampling;
- Decontamination fluids;
- Used personal protective equipment (PPE) and disposable sampling materials.

1.3.1 Soil Cuttings

Soil cuttings will be generated during the drilling of soil borings and installation of the monitoring wells. All soil cuttings will be placed into Department of Transportation (DOT)-approved steel 55-gallon drums. The drums will be labeled in accordance with the **Labels** section below and stored onsite pending disposal. Approximately 35 drums of soil cutting are currently expected.

1.3.2 Trench Spoils

Trench spoils will be generated during the installation of the PRB and are expected to be contaminated with chlorinated volatile organic compounds (VOCs). Trench spoil may be temporarily stockpiled and allowed to dry or directly loaded into dump trucks. Some trench spoil from the vadose zone may be stockpiled at the construction site and disposed in a pre-approved location on Fort Rucker property. Any spoil disposed offsite will be sent to a permitted disposal facility approved by Fort Rucker. Approximately 2,000 tons of trench spoils are expected to be generated and removed from the project site.

1.3.3 Monitoring Well Development and Purge Water

During monitoring well development and long-term monitoring (LTM) sampling activities, groundwater will be generated. These liquids will be containerized in DOT-approved steel 55-gallon drums. The drums will be labeled in accordance with **Labels** section below and stored onsite pending disposal of the water. Approximately 140 drums of contaminated liquids are expected.

1.3.4 Decontamination Fluids

During the field activities, decontamination of sampling equipment (for example, bowls, spoons, and split spoons) and trenching equipment will be necessary. The decontamination activities will generate waste decontamination fluids, generally consisting of water, Alconox detergent, and soils washed from the equipment. Waste decontamination fluids will be placed into DOT-approved steel 55-gallon drums. The drums will be labeled in accordance with **Labels** section below and stored onsite pending disposal of the decontamination fluids.

1.3.5 Used PPE and Disposable Sampling Materials

Waste PPE, disposable sampling equipment, and miscellaneous contaminated materials will be generated during the field activities. Waste PPE may consist of used gloves and similar items. Waste sampling equipment may include broken (contaminated) sample containers, used groundwater sample tubing, and plastic bags. Miscellaneous contaminated materials may include items such as used paper towels and plastic sheeting.

Waste PPE, waste disposable sampling equipment, and other potentially contaminated miscellaneous waste will be placed into plastic bags, sealed, and then placed into DOT-approved steel 55-gallon drums. Each container will be labeled in accordance with this WMP and stored onsite pending disposal. PPE may be disposed of along with the soil cuttings and trench spoils.

While it is assumed that the wastes will be non-hazardous based on historical information and previous sampling data, hazardous waste management requirements are included in this plan as a contingency.

1.4 Waste Characterization

Environmental media will be characterized through sampling and laboratory analysis. Miscellaneous solid wastes such as PPE will be characterized using process knowledge. Wastes will be sampled and analyzed according to *Sampling and Analysis Plan* and characterized in accordance with 40 CFR Part 261 Subpart C.

1.4.1 RCRA and State Waste Codes

Environmental media will be characterized using federal (40 CFR 261) regulations. No required state waste codes are associated with the Alabama Department of Environmental Management (ADEM) waste regulations. Appropriate RCRA hazardous waste codes will be applied if necessary.

1.4.2 Waste Profile

Waste characterization information will be documented on a waste profile form provided by the designated offsite treatment, disposal, or recycling facility as part of the waste acceptance process. The profile will be reviewed, approved, and signed by Fort Rucker as the generator. Signed profiles will then be submitted to the offsite facility for acceptance.

The profile typically requires the following information, including, but not limited to:

- Generator information including name, address, contact, and phone number
- Site name including street/mailing address
- Process generating waste (Lilyblad Petroleum Site remediation)
- Source of contamination/historical use (petroleum storage, blending, and recycling operations)

- Waste composition (for example, 95 percent soil, 5 percent debris)
- Physical state of waste (for example, solid, liquid)
- Applicable hazardous waste codes

A copy of the approved waste profile or approval letter/email will be received prior to scheduling offsite transportation of the waste.

1.5 General Waste Management Requirements

Hazardous wastes will be segregated from non-hazardous wastes. Additionally, incompatible wastes, such as flammable and corrosive wastes, will be segregated. Wastes of the same matrix, contamination, and source may be aggregated to facilitate accumulation and disposal.

Wastes will be accumulated in containers, including drums, tanks, or roll-off boxes, or stockpiled in an area identified or approved by Fort Rucker. Good housekeeping practices will be maintained at all waste accumulation areas.

All drums, tanks, and roll-off boxes will be inspected upon arrival at the site for signs of disrepair and any contamination or contents. If any of these containers are in disrepair, contaminated, or contain waste, they will be immediately rejected and the action documented. It is recommended that photos be taken for additional documentation.

Drums/Small Containers

The following guidelines relate to drums and small containers:

- Each drum will be provided with its own label, and labels will be visible.
- Adequate aisle space will be provided for containers such as 55-gallon drums to allow the unobstructed movement of personnel and equipment. For hazardous waste, required minimum aisle space is 30 inches and no more than two drums wide.
- Drums will remain closed except when removing or adding waste to the drum. Covers will be properly secured at the end of each workday. Closed means that the lid and/or bung must be on and securely tightened (except with adding or removing waste).
- Drums will be disposed of with the contents. If the contents are removed from the drums for offsite transportation and treatment or disposal, the drums will be decontaminated prior to re-use or before leaving the site.
- Drums containing liquids or hazardous waste will be provided with secondary containment and will not be located near a storm water inlet or conveyance.

Portable Tanks

- For hazardous wastes, only non-stationary (that is, portable) tanks such as a cargo tank or wheeled tank will be used, and these tanks will be provided with secondary containment.
- Tanks will be provided with covers.

- Tanks will remain closed except when removing or adding waste to the tanks. Covers will be properly secured at the end of each workday.
- Each tank will be provided with its own label, and labels will be visible.
- Tanks will not be located near a storm water inlet or conveyance.

Roll-off Boxes

- Roll-off boxes for contaminated soil will be provided with covers and disposable liners. Liners will be disposed of as contaminated debris.
- When not in use and at the end of each workday, covers will be properly secured.
- Old labels will be removed and each box will be provided with its own label, and labels will be visible.
- Roll-off containers will be inspected by the transporter after removal of the liner and decontaminated in the event of evidence of liner failure.
- Free liquids, other than an incidental amount of liquid, may not be added to waste in a roll-off box.
- Saturated soils will be placed in a roll-off box provided with sealable containment or a container otherwise designed for free liquids, for example, a dewatering box. These boxes will also be provided with secondary containment.
- Roll-off containers will be filled until half-full or otherwise monitored to ensure that they meet DOT weight restrictions.
- Roll-off boxes should not be located near a storm water inlet or conveyance.

Soil Stockpiles

- Stockpiles of contaminated soil will be located near the trenching area and within an area of existing contamination.
- Stockpiles of contaminated soil will be provided with liner, cover, and perimeter berm to prevent release or infiltration of liquids.
  - Minimum 10- and 6-mil polyethylene sheeting will be used for liners and covers, respectively.
  - The perimeter berm will be constructed of clean materials (such as hay bales under the liner) and allow for collection of any free liquids draining from the stockpile.
  - Accumulated free liquids will be pumped to a container or tank.
- Covers and perimeter berms will be secured in place when not in use, at the end of each workday, and as necessary to prevent wind dispersion or run-off from precipitation events.
- Construction materials for the stockpiles that contact contaminated soil will be disposed of as contaminated debris.

1.6 Waste Storage Time Limit

In the event that hazardous wastes are generated, they will be removed from the site within 90 days from the date of generation. Other wastes will be removed from the site as soon as possible. The date of generation is the day that a waste is **first** placed in a container (drum, roll-off box, or tank) or stockpile.

1.7 Labels

Waste containers will be labeled in accordance with 49 CFR 172, 173, and 178. Labels will include the type of waste, location from which the waste was generated, and accumulation start date. Containers, roll-off boxes, and tanks used to store/accumulate waste (including soil and aqueous wastes) will include one of the following labels:

- "Analysis Pending" or "Waste Material" – Temporary or handwritten label until analytical results are received and reviewed. This label will include the accumulation start date.
- "Hazardous Waste" – Pre-printed hazardous waste labels with the following information:
  - Accumulation start date
  - Generator name
  - U.S. Environmental Protection Agency (EPA) identification (ID) number
  - Waste codes
  - Prior to transport, the manifest number must be added (for containers of less than 110-gallon capacity)
- "Non-Hazardous Waste" – Preprinted labels with the following information:
  - Accumulation start date
  - Generator name
  - EPA ID number
  - Waste-specific information, such as "contaminated soil"

Where applicable, the major hazards (for example, flammable, oxidizer, and carcinogen) also will be included on the label.

1.8 Inspections

Waste accumulation and equipment storage areas will be inspected **at least weekly** for malfunctions, deterioration, discharges, and leaks that could result in a release.

- Containers, tanks and roll-off containers will be inspected for leaks, signs of corrosion, or signs of general deterioration.
- Stockpiles will be inspected for liner and berm integrity.
- All areas will be inspected to ensure that good housekeeping practices are maintained.

Any deficiencies observed or noted during inspection will be corrected immediately and corrective measures documented. Appropriate measures may include transfer of waste from leaking container to new container, replacement of liner or cover, or repair of containment berm. Copies of inspection reports and corrective measures will be maintained onsite and available for review.

1.9 Security/Emergency Response

A barrier, such as barricade tape or temporary fencing, will be provided for hazardous waste accumulation areas and for other waste storage areas that are accessible to the general public. Hazardous waste storage areas will also have signs that provide 24-hour emergency contacts and telephone numbers.

Waste accumulation areas will contain emergency response equipment appropriate to the wastes' hazards. **The Health and Safety Plan identifies the project emergency response procedures and equipment, including emergency response contacts and phone numbers.**

In addition to the Health and Safety Plan procedures, hazardous waste accumulation areas will be provided with fire extinguishers (for wastes known or suspected to be flammable or ignitable), decontamination equipment, and an alarm system (if radio equipment is not available to all staff working in accumulation area). Spill control equipment such as sorbent pads will be available in the waste accumulation areas and where liquids are transferred from one vessel to another.

1.10 Employee Training

Field staff managing hazardous or potentially hazardous waste will comply with 40 CFR 265.16 through:

- OSHA 1910.120 HAZWOPER training, and
- On-the-job training, which includes:
  - Site-specific Health and Safety Plan review that requires each site worker and guests to review and sign the plan
  - Activity hazard analysis and daily "tailgate" meetings
  - Project-specific Work Plan review, for example, this WMP

Additionally, CH2M HILL staff with DOT hazardous material training (49 CFR 172.704) will oversee waste profiling and preparing shipping documentation.

1.11 Waste Transportation

1.11.1 Shipping Documentation

Prior to offsite disposal of any waste, a waste approval package for each waste stream will be prepared. This package will include a waste profile naming Fort Rucker as the generator of the waste, analytical summary table(s) applicable to the waste, land disposal restriction

(LDR) notification for hazardous wastes (as necessary), a completed waste manifest, and any other applicable information necessary for Fort Rucker to complete its review of the disposal package and signature as the generator. The signed profile will then be submitted to the offsite facility for acceptance and approval. Once the approval letter or approved profile is received from the offsite facility, transportation can be scheduled.

Each load of waste material will be manifested prior to leaving the site. At a minimum, the manifest form will include the following information:

- Generator information, including name, address, contact, and phone number, EPA ID number
- Transporter information, including name, address, contact and phone number, EPA ID number
- Designated facility information, including name, address, phone number, EPA ID number
- Site name including street/mailing address
- DOT proper shipping name
- Type and number of container
- Quantity of waste (volumetric estimate)
- Task order or job number
- Profile number
- 24-hour emergency phone number

The generator and the transporter must sign the manifest prior to the load of waste leaving the site.

If the signed **hazardous waste** manifest from the designated facility is not received within 35 days, the generator must contact the transporter or the designated facility to determine the status of the waste. If the signed hazardous waste manifest has not been received within 45 days, the generator must issue an "Exception Report" to ADEM, as required under 40 CFR 262.42.

1.12 Department of Transportation Requirements

Requirements under 49 CFR 171 will apply to all offsite shipments of hazardous materials. The information contained in this section is provided as a general guide. Requirements specific to each hazardous material will be determined in the field. It is the responsibility of a DOT-trained individual to ensure that the requirements of 49 CFR 171 are met.

1.12.1 Shipping Name

Material that exhibits one of the nine DOT hazard class characteristics (for example, explosive, flammable, poison, combustible) is regulated under DOT rules for the transportation of hazardous material. If a material is suspected to be hazardous, it will be shipped under the suspected hazard class.

Each shipment of a suspected hazardous material will be provided with a proper shipping name using the Hazardous Materials Table in 49 CFR 172.101. All determinations will be made by DOT-trained personnel.

Packaging, Marking, and Labeling

The shipping name, hazard class, identification number, technical names (if applicable), EPA markings and waste code numbers, and consignee/consignor designations will be marked on packages for shipment (49 CFR 172.301). Once a waste is characterized, reference will be made to the Hazardous Materials Table in 49 CFR 172.101 to determine the appropriate label.

Placards

Appropriate placards will be determined by DOT-trained personnel. Specific placard descriptions are found starting at 49 CFR 172.521. If a placard is required, it will be affixed on each side and each end of the vehicle.

1.13 Transporter Requirements

Each transportation vehicle and load of waste will be inspected before leaving the site and documented. The quantities of waste leaving the site will be recorded on a transportation and disposal log. A contractor licensed for commercial transportation will transport non-hazardous wastes. In the event that wastes are hazardous/dangerous, the transporter will have an EPA ID number and comply with transportation requirements outlined in 49 CFR 171-179 (DOT), 40 CFR 263.11 and 263.31 (Hazardous Waste Transportation).

The transporter will be responsible for weighing loads at a certified scale. For each load of material, weight measurements will be obtained for each full and empty container, dump truck, or tanker truck. Disposal quantities will be based on the difference of weight measurements between the full and empty container or dump truck. Weights will be recorded on the waste manifest and weight ticket.

The transporter will observe the following practices when hauling and transporting wastes offsite:

- Minimize impacts to general public traffic
- Repair road damage caused by construction and/or hauling traffic
- Line and cover trucks/trailers used for hauling hazardous or regulated waste to prevent spills or releases
- Decontaminate vehicles prior to re-use, other than hauling contaminated waste
- Ensure seals on trucks transporting liquids are in good condition
- Keep wastes or materials from other sites separated from wastes generated during this project

All personnel involved in offsite disposal activities will follow safety and spill response procedures outlined in the Health and Safety Plan.

1.13.1 Spill Reporting

In the event of a spill or release of waste, the transporter will immediately notify Fort Rucker and CH2M HILL**.** The following information about the spill will be reported and recorded:

- Type of material (for example, soil, sludge, or water) and contaminant
- Location
- Estimated volume
- Media affected (for example, spilled on concrete pad or soil)
- Time of spill/release
- Final disposal of spilled material

The transporter will also report a spill or release of hazardous waste, hazardous material above and RQ and oil, as required, to:

- National Response Center (NRC) at 800-424-8802 or 202-426-2675

The transporter will also report in writing, as required by 49 CFR 171.16, to the Director, Office of Hazardous Materials Regulations, Materials Transportation Bureau, Department of Transportation, Washington, D.C. 20590.

1.13.2 Spill Response

The transporter will clean up any spill or release of waste (including soil or water) that occurs during transportation or take such action as may be required or approved by federal, state, or local officials. Spilled waste will be immediately cleaned up, including soils on the outside of the trucks, the truck and/or container, or road surface. Where appropriate, the spilled material will be returned to the original waste container. In any case, the spilled material will be properly contained and disposed of.

1.14 Disposal of Waste Streams

Offsite treatment, disposal, or recycling facilities will use the waste profile and supporting documentation (for example, analytical data) to determine whether a waste will be accepted. ADEM requires that all waste streams disposed of in the State of Alabama also obtain ADEM approval. The disposal facility will generally handle submittal of documentation and obtain approval. The following is a summary of wastes and anticipated treatment, disposal, or recycling requirements.

1.14.1 Drill Cuttings and Trench Spoils

Drill cuttings and trench spoils are expected to be characterized as non-hazardous waste. Non-hazardous waste will be disposed of offsite at a permitted Subtitle D facility.

1.14.2 Aqueous Waste

Contaminated aqueous waste will be sent offsite for treatment and disposed of as a non-hazardous, aqueous industrial waste at an ADEM-authorized facility.

1.14.3 Miscellaneous Wastes

Other miscellaneous solid waste may include PPE and will be disposed of along with the contaminated soils or as non-hazardous waste.

1.14.4 Hazardous Waste

In the event that hazardous waste is generated, it will be transported offsite for treatment or disposal as follows:

- Hazardous waste that meets the LDR treatment standards will be transported to a permitted hazardous waste facility for direct landfill.
- Hazardous waste that does not meet LDR treatment standards will be sent to an offsite facility for treatment and disposal.
- All facilities that receive hazardous waste for treatment (incineration or other treatment) and/or disposal will be permitted under RCRA Subtitle C.

1.15 Recordkeeping

The following records and documents will be maintained:

- Transportation and offsite disposal records, including:
  - Waste Tracking Log
  - Profiles and associated characterization data
  - Manifests, LDR notifications/certifications (for hazardous/dangerous waste), bills of lading, and weight tickets
  - Offsite facility waste receipts, certificates of disposal/destruction/recycle
- Training records
- Inspection records

Appendix B
Standard Operating Procedures
for
Site-Wide Sampling and Analysis Plan
Environmental Remediation Services
Fort Rucker, Alabama

Contract No. W91ZLK-05-D-0014
Task Order No. 0001

Prepared for

U.S. ARMY ENVIRONMENTAL COMMAND

January 2010

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Contents

Attachments

APPENDIX B

Standard Operating Procedures

The following standard operating procedures (SOPs) will be used, as applicable, during the environmental remediation services to ensure that consistent methods are used and that defensible data are collected. Any deviations from these SOPs will be approved by the U.S. Army Corps of Engineers (USACE) and properly documented.

B.1 Documentation

B.1.1 Purpose and Applicability

This procedure conforms to the applicable U.S. Environmental Protection Agency (EPA) quality assurance (QA) requirements and the quality assurance project plan (QAPP). The procedure establishes the process for collecting and recording field data and entering the data into a project database. This procedure applies to all field investigations.

Included in this SOP are two methods (electronic and hard copy [logbooks and forms]) that can be used for the capture of field data and records. Singularly or used in combination, these two methods may be used for recording field data. Whichever method is selected to capture field data, it must ensure that the necessary data are recorded and that the field data recording process is acceptable to the regulatory agency.

B.1.2 Definitions

None.

B.1.3 Procedures

B.1.3.1 Logbooks

Field logbooks will be maintained continuously by field personnel responsible for executing a specific task. Only bound logbooks will be used; the logbooks must be constructed so that the only way to remove pages is by tearing them out.

All entries in the daily logbooks must show the date and time of entry. Dates should be recorded as MM/DD/YY and the time in a 24-hour format. The bottom of each page should contain the date and name of the person making the entry. Entries must be written in permanent ink. The use of whiteout and erasers is not allowed. Corrections are made by crossing out the entry, writing in the corrected entry, and then dating and initialing the change. Any pages not completely filled must have a line drawn through the unused portion and be dated and signed.

Sample collection and handling, daily field activities, and visual observations will be documented chronologically in field logbooks. At a minimum, the following information should be included when appropriate:

- The serial numbers, model numbers, and makes of the field analytical equipment, sample collection equipment, and equipment used to take physical measurements, along with the hours of operation.
- Calculations, results, and calibration data generated while using field sampling equipment, field analytical equipment, and field physical measurement equipment.
- Field measurements or analytical results traceable to the specific piece of field equipment used, and to the personnel collecting the sample or making the measurement/analyses.
- Names of personnel working on the site, including visitors, and the hours each person was present.
- Identification of problems encountered and resolutions.
- Any deviation from the work plan and USACE's corresponding approval. (Field variance forms also will have to be completed and submitted by USACE contractors for approval as specified by USACE.)
- Identification of the type and number of samples taken, cross-referenced to sample identification (ID) numbers. The entries should indicate the time of sampling, the person taking the sample, and the sample location.
- Weather conditions, including abnormal weather and its effect on the work schedule, the collection of field data, and the accuracy of field measurements.
- Any nonstandard onsite operation or activity.
- Field photograph records with the descriptions of photographs, time taken, photographer, and exposure number.

Entries in field logbooks must be legible and contain accurate documentation of project activities. Field records are the basis for written reports, so the language in the records should be objective and factual. Once completed, field logbooks and data forms become accountable documents and are maintained as part of the project files.

When necessary, the logbook should be protected from contamination and moisture by carrying it in a plastic bag or in a metal clipboard that closes over it. Entries should be made by personnel with clean hands or gloves; personnel with contaminated gloves or protective clothing should not handle the logbook. Should the logbook become contaminated, it must be decontaminated (dried, blotted) and placed in a clear plastic bag so that the entries may still be read. If the logbook is so contaminated that it cannot be removed from the site, it must be hand copied onto the appropriate data forms at the site or into another notebook. The circumstances warranting this action will be noted on the rewritten forms.

B.1.3.2 Field Forms

Loose-leaf notebooks or folders containing data collection forms are used only to supplement the daily field logbooks. Data collection forms are identified with sequential numbers and are used to record raw field data, analytical results, and any other information deemed necessary to satisfy data quality objectives (DQOs) and provide adequate quality control (QC). Data forms will be completed in the field. In the event multiple copies of the same form are needed, number each sheet consecutively.

All entries on field forms will contain the date and time of entry. Entries must be written in permanent ink. The use of whiteout and erasers is not allowed. Corrections are made by crossing out the entry, writing in the corrected entry, recording the date the change was made, and initialing the change.

Sample collection and handling and visual observations are documented chronologically on data collection forms. The following field data forms (or comparable forms) are commonly used:

- Soil Boring Log (Attachment B1)
- Monitoring Well Development Log/Purge Log/Low-Flow Sampling Log (Attachment B2)
- Monitoring Well Construction Forms (Attachment B3)

Entries on field data forms must be legible and contain accurate documentation of project activities. Once completed, field logbooks and forms become accountable documents and are maintained as part of the project files.

B.1.3.3 Data Entry

New and existing data generated by field activities or as a result of laboratory analyses will be entered into the project database through manual or electronic means. The method of entry will be determined by the source of the data.

Manual data entry will be used for (1) direct entry into the database (no handwritten copy of the actual data is made), (2) keying in data from collection forms, or (3) extracting data from reports or other available documentation. When no handwritten copies are produced prior to entry, notations will be made in the field logbook identifying the type of data obtained.

Data will be entered in a computer database using a double-data entry technique. Initial data entry will be verified by a second person, the entries will be electronically compared to the original, and any differences will be noted and corrected.

B.2 Use and Calibration of Field Instruments

B.2.1 Purpose and Applicability

This procedure conforms to the applicable EPA QA requirements and the QAPP, and it establishes standard methodologies for the use, calibration, and maintenance of field instruments. The procedure applies to all field investigations.

B.2.2 Definitions

None.

B.2.3 Procedure

Field instruments will be used for the collection of field data and measurement of various conditions observed during the site investigations. In general, take the following steps when using field instruments:

1. Before field use, remove the instrument from its container and assemble and clean it according to the manufacturer's instructions.

2. Before commencement of field activities each day, calibrate the instrument according to the manufacturer's instructions. Record the instrument's ID and serial number, along with the calibration process/results, in the field logbook and/or calibration logbook.

3. Use the instrument to make the appropriate physical/chemical measurements and clean/decontaminate the instrument, if necessary, after each measurement.

4. If erroneous measurements are observed or if changes in environmental conditions warrant recalibration, recalibrate the instrument as specified by the manufacturer. Record the recalibration information in the field logbook and/or the calibration logbook.

5. At the end of each day, clean and decontaminate the instrument then return it to the storage location. Recharge instrument as necessary.

6. Perform factory maintenance and calibration at the intervals specified by the manufacturer. Have repairs, maintenance, and calibration performed by trained individuals according to the manufacturer's requirements. Record repairs, maintenance, and calibration in the field logbook or instrument calibration/maintenance logbook.

Typical field instruments' SOPs are included in Attachment B4.

B.3 Water Level Measurements

B.3.1 Purpose and Applicability

This procedure conforms to the applicable EPA QA requirements and the QAPP, and it establishes standard methodologies to obtain measurements of the depth to groundwater and total well depth in completed wells. Measurements may be taken either under static conditions or during aquifer testing where water elevations are varying and a second phase of floating liquid (such as gasoline) is not encountered. This procedure applies to all field investigations.

B.3.2 Definitions

Discrete water level: Noncontinuous measurement of the distance from a fixed reference point to the water surface in a given well.

B.3.3 Procedure

Water levels can be measured either continuously or at discrete times in a completed well or piezometer.

B.3.3.1 Discrete Water Level Measurements

Discrete water level measurements are made by determining the depth to the water surface below a fixed and surveyed reference point. The fixed reference point is established by surveying a scribed or etched point on the northern, outer edge (lip) of the well casing.

Measurement with Electrical Sounders

The wire on electrical sounders will be marked in 0.01-foot intervals to indicate depth. Depth will be referenced to the fixed/surveyed reference point at the top of the well casing. All sounders will be weighted by the manufacturer to maintain line tension. (The spacing of the 0.01-foot interval markers on the sounder wire should be checked regularly against a steel surveyor's tape and should be accurate to 0.1 foot per 100 feet, if steel, or 0.2 foot per 100 feet, if fiberglass.)

Take measurements using the following steps:

1. Locate, unlock, and open the well. Check the reference mark for legibility before taking water level measurements.

2. Clean and decontaminate the sounder wire.

3. Lower the sounder wire until it just makes contact with the water in the well. Record the position of the wire relative to the top of the well to the nearest 0.01 foot. Record the water level reading in the logbook. Repeat measurements to confirm depth.

4. Withdraw the sounder from the well and decontaminate the portions of the sounder wire and electrode that got wet.

B.4 Drilling Procedures

B.4.1 Purpose and Applicability

This procedure conforms to the applicable EPA QA requirements and the QAPP. The procedure describes the method for installing soil borings and monitoring wells.

B.4.2 Definitions

DPT: direct push technology
HSA: hollow-stem auger

B.4.3 Procedure

All drilling activities shall conform to state and local regulations and shall be supervised by an Alabama-registered geologist, engineer, or hydrogeologist. The driller shall obtain all necessary permits, applications, and other documents required by state and local authorities.

The location of all borings shall be coordinated with USACE point of contact (POC) or equivalent before drilling commences and cleared by a utility locating company.

Before installing each boring and monitoring well, the drilling rig, equipment, and tools should be decontaminated according to the procedures described in Section B.9. The drill rig should not leak any fluids, because the fluids could enter the borehole or contaminate equipment placed in the hole. The use of rags or absorbent materials to absorb leaking fluids is unacceptable.

Lubricants with constituents that are toxic or that increase, decrease, or mask the target chemical species of the investigation shall not be permitted. The driller shall be prepared to provide chemical analyses of all lubricants proposed for downhole use. Chemical detection limits shall be equivalent to those used in analyzing project groundwater samples.

A log of drilling activities shall be kept in a bound field notebook. Information in the logbook shall include location, time onsite, personnel present, equipment present, downtime, materials used, samples collected, measurements taken, and any other observations or information that would be necessary to reconstruct field activities at a later date (Air Force Center for Engineering and the Environment [AFCEE] QAPP, March 1998).

B.4.3.1 Direct Push Technology and Geoprobe®

The direct push technology (DPT) and Geoprobe® units are rugged, lightweight hydraulic and/or hammer driven systems used to advance soil borings with minimal lithological disturbance, minimal investigation-derived waste (IDW) production, and minimal time for evaluation of contaminant extent.

Drilling and sampling procedures for DPT and Geoprobe® are similar.

- DPT and Geoprobe® units generally will be operated from a station mounted at the rear of a truck, Bobcat, or four-wheeler-mounted unit. The probing unit is hydraulically and/or hammer driven via a power takeoff pump mounted directly to the truck's transmission.

- Soil samples may be obtained by using a wide variety of devices (Section B5). Sampling devices range from 2-inch outside diameter (OD) tubes to sampling systems that allow for the collection of continuous soil samples.
- The samplers will be threaded onto the leading edge of the DPT drive rods and advanced to depth using the DPT systems.
- Soil samples will be retrieved by retracting the probe rod and sampler to the surface and disassembling the sampler.
- Samples will be obtained in sleeves made of brass, stainless steel, Teflon®, or acetate. The sleeves will be removed from the sampler, containerized, and transported to the laboratory for analysis.
- Groundwater samples will be obtained using a Hydropunch-type of dropdown sampler, covered with a stainless steel well screen. Groundwater samples will be obtained using inert nylaflow tubing and a sampling syringe, a stainless steel bailer, or a peristaltic pump. Groundwater samples also may be collected using temporary or permanent piezometer/monitoring wells installed using Geoprobe® or DPT methods. The samples can be collected at any time using bailers, jiggle tubes, pumps, or other methods.

B.4.3.2 Hollow-Stem Auger Drilling Methods

This type of drilling method consists of using a hollow, steel stem or shaft auger with a continuous, spiraled steel flight welded to its exterior and an auger bit connected to its end. The hollow-stem auger (HSA) transports cuttings to the surface when rotated. This method is best suited to soil that has a tendency to collapse when disturbed. A monitoring well can be installed inside an HSA with little or no concern for the caving potential of the soils and/or water table; however, retracting an auger in caving sand conditions while installing a monitoring well can be extremely difficult or impossible, especially since the auger has to be extracted without being rotated.

If caving sand conditions exist during monitoring well installation, a drilling rig must be used that has enough power to extract the auger from the borehole without having to rotate it. A bottom plug, trap door, or pilot bit assembly can be fastened to the bottom of the auger to keep out soil and water that have a tendency to clog the bottom of the auger during drilling. Potable water (analyzed for contaminants of concern) may be poured into the auger (where applicable) to equalize pressure so the inflow of formation materials and water will be held to a minimum when the bottom plug is released. A watertight center plug is not acceptable because it creates suction when extracted from the auger. This suction forces or pulls cuttings and formation materials into the auger, defeating the purpose of the center plug. Augering without a center plug or pilot bit assembly is permitted, provided that the soil plug formed in the bottom of the auger is removed by either washing out the plug using a side discharge rotary bit or by augering out the plug with a solid-stem auger bit sized to fit inside the HSA. Before drilling operations, the type of bottom plug, trap door, or pilot bit assembly proposed for the drilling activity should be approved by a senior field geologist and USACE. Boreholes can be augered to depths of 150 feet or more (depending on the auger size), but generally boreholes are augered to depths less than 100 feet (EPA Region 4, May 1996).

Drilling and sampling procedures for HSA are as follows:

1. The HSA will be advanced and sampled either at discrete intervals, continuously (18-inch intervals), or with "CME-type" 5-foot-long continuous sampler.
2. The HSA sampler consists of a split-spoon sampling device, which is a thick-walled, steel tube split lengthwise. A cutting shoe will be attached to the lower end of the tube; the upper end will be connected to the drill rods. The split-spoon sampler will be lowered into the hole on the bottom of the drill rods and into the soil ahead of the auger bit.
3. The density of the sampled material will be obtained by counting the blows per foot (blow count). The split spoon sampler will be driven into the soil by a 140-pound hammer, which falls at 30-inch intervals per blow.
4. Soil samples will be retrieved by retracting the split-spoon rod and split-spoon to the surface. Brass or stainless steel rings should be used in the split-spoon sampler when sampling for volatile organic compounds (VOCs).
5. Groundwater samples may be obtained using inert nylaflow tubing and sampling syringe, stainless steel bailer, a jiggle tube type of pump, or a peristaltic pump. Groundwater samples also may be taken via a temporary or permanent piezometer or monitoring well, where sampling can be accomplished at any time using bailers, jiggle tubes, pumps, or other methods.

B.5 Soil Sampling

B.5.1 Purpose and Applicability

This procedure conforms to the applicable EPA QA requirements and the QAPP. The procedure describes the guidelines for field soil screening using a flame ionization detector (FID)/photoionization detector (PID), collecting soil samples, and using an EnCore™ sampler (SW5035) to collect VOCs for analysis by Method 8260B. These procedures apply to all field investigations.

B.5.2 Definitions

FID - flame ionization detector
PID - photoionization detector
VOC - volatile organic compound

B.5.3 Procedure

Some of the procedures contained in this section of the SOP also may be applicable to the screening/sampling of the permeable reactive barrier trench sand. Soil samples are collected at established intervals in the soil profile, including at the surface. Sampling intervals will be outlined in the site-specific work plan. Standard penetration tests are usually conducted concurrent with soil sampling.

Before any drilling activities, the sampling point will be located and cleared for utilities. Before sampling begins, equipment will be cleaned and decontaminated (Section B.9) and surface debris will be cleared from the area. After sampling activities have been completed, samples will be packaged and shipped to the laboratory for analysis (Section B.12). Before moving to another sampling location, the drilling and sampling equipment will be cleaned and decontaminated.

B.5.3.1 Soil Headspace Screening Using an FID/PID

Soil headspace screening will be performed as follows:

1. Calibrate the FID/PID in accordance with the manufacturer's procedures.
2. Wear new protective gloves for each sample collected to reduce cross-contamination.
3. Fill two zipper-lock sandwich bags 25 percent full of soil and immediately seal the bags.
4. Label the bags with the appropriate soil interval and boring ID.
5. Place the soil in direct sunlight and allow the soil to adequately warm up.
6. After the temperature has equilibrated (typically after 15 minutes), insert the probe through the wall of the first sealed bag while the FID/PID is running.
7. For PID only: Record the highest reading, then headspace sampling is complete.
8. For FID only: Record the highest reading on the gauge; this is the <u>unfiltered concentration</u>. If the unfiltered measurement is nondetect, do not proceed to line 9.

Record the reading in the logbook as the measurement for that sample. If the unfiltered measurement has detection, proceed to line 9.

9. Attach an activated charcoal filter onto the FID.
10. While the FID is running, insert the probe with the attached charcoal filter through the wall of the second sealed bag.
11. Record the highest reading on the gauge; this is the <u>filtered concentration</u>.
12. Subtract the filtered reading from the unfiltered reading for the <u>total corrected hydrocarbon measurement</u>.

B.5.3.2 Soil Sampling for VOCs using an EnCore™ Sampler

EnCore™ sampling is performed as follows:

1. Wear protective gloves to reduce cross-contamination and change gloves between samples.
2. Open the EnCore™ reusable package and remove the core device and cap.
3. Twist the piston on the EnCore™ sampler, so that the piston is unlocked and can move freely.
4. Place the core device into the T-handle.
5. Access the soil sample from the sampling device (for example, split spoon, acetate liner, rotasonic core, etc.) containing the soil core.
6. Using a stainless steel spoon, scrape off the initial soil touching the soil-core sampler.
7. Push the EnCore™ core device into the soil core.
8. Twist the T-handle and pull the EnCore™ sample free of the soil. The sampler should now be full of soil. If not, repeat this step until the EnCore™ is full of soil. Confirm that the sampler is full by observing the o-ring through the viewer on the T-handle sampler.
9. Remove excess soil from the sides of the sampler and place the cap onto the sampler. Make sure both sides of the cap lock into place.
10. Twist the piston 90 degrees, so that it is locked.
11. Label and reseal in the original package.
12. Place into cooler with wet ice for shipment.

B.5.3.3 Soil Retrieved for Laboratory or Geotechnical Analyses from Boring

Soil samples taken from a soil boring for laboratory or geotechnical analysis should be collected in the following manner:

1. Advance the boring device to the appropriate depth interval for soil sample collection. Conduct a standard penetration test while the sampler is being advanced.

2. Remove the sampler from the borehole and remove the core from the sampler (Section **B**.4).
3. If the sample collected requires chemical analysis, immediately screen the core using an FID/PID (Section B.5.3.1).
4. Collect the sample from the area with the highest FID/PID reading. VOC samples should be collected first.

The following information is recorded in the field logbook and field data form (soil boring log Attachment B1) for each sample collected:

- Boring number
- Date of sampling
- Site location ID
- Sampling interval
- Recovery efficiency
- Number of samples
- Number of blows for each 6 inches of penetration

B.5.3.4 Soil Samplers

The most common devices for collecting soil samples are hand tools, split spoons (either standard size or large units used for continuous sampling), and thin-walled samplers, such as Shelby tubes. The samplers will be decontaminated (Section B.9).

Hand Tools

Disturbed soil samples at shallow depths may be taken using a decontaminated spoon, trowel, or other hand tool, generally made of stainless steel. The cutting edge, tip, or blade of the hand tool is inserted repeatedly into the soil until the desired depth and amount of sample are obtained. The hole is backfilled when sample collection is completed.

DPT/Geoprobe® Technology

DPT sampling and Geoprobe® technology involves advancing a sampling probe using direct hydraulic pressure or a slide or rotary hammer. Samples may be collected continuously or at specific depths. The samples are collected in brass/steel sleeves lined with acetate tubes. The acetate liner may be cut open to collect analytical soil samples or the ends may be capped and sealed for geotechnical analysis (see thin-walled samples below).

HSA (Split Spoons)

A split spoon is a thick-walled, steel tube split lengthwise. A cutting shoe is attached to the lower end of the tube; the upper end is connected to the drill rods. When a boring is advanced to sampling depth, the split spoon is lowered into the hole on the bottom of the drill rods.

The split-spoon is typically driven at 18-inch intervals into the ground. The density of the sampled material is obtained by counting the blows per foot (blow count). A 140-pound hammer falling 30 inches drives the split spoon.

Hand Augers

Hand augers typically are used to collect soil samples from depths up to 10 feet below ground surface (bgs), but can sometimes be used to a depth of 30 feet bgs. With the exception of cohesionless and hard or cemented soils, hand augers are useful for collecting a wide range of soil types. A hand auger is used as follows:

1. Attach a decontaminated auger bit to an auger rod extension and the crossbar.
2. Press the auger into the ground using body weight while turning the crossbar to advance the hole. Remove accumulated soil periodically to prevent loose material from falling back down into the borehole. Add additional auger flights as the hole is advanced. (Decontaminate and/or replace augers with clean augers at intervals in order to prevent downward migration of contamination.) Collect soil and handle as IDW.
3. When the desired depth is reached, slowly and carefully remove auger from the hole.
4. In direct sampling, collect the sample after the bucket is removed from the boring. Discard the top of the core (approximately 1 inch) and shave the sides of the core to obtain a representative sample of the central core. Place the core sample in the appropriate containers.

B.6 Soil Classification for Borehole Logging

B.6.1 Purpose and Applicability

This procedure conforms to the applicable EPA QA requirements and the QAPP, and it provides guidance to soil classification for borehole logging. This procedure applies to all field investigations.

B.6.2 Definitions

See Attachment B7 for soil parameter definitions and descriptions.

B.6.3 Procedure

Soil samples will be classified according to standard systems using accepted nomenclature. The standard system provides guidance for describing and logging geological conditions encountered in boreholes.

B.6.3.1 Visual Logging

Field descriptions will be recorded on boring logs (Attachment B1) and in the field logbook. Soil sample descriptions are prepared as described below.

B.6.3.2 Soil Sample Descriptions

Order of Terms

The suggested order of terms is as follows:

1. Soil types
2. Color, if appropriate
3. Consistency, relative density, or the degree of cementation
4. Structure
5. Moisture content
6. Trace components, sorting, and condition of sample
7. Contamination, if encountered

The method of describing these terms is addressed below.

Soil Types

Use the descriptions for soil in the Unified Soil Classification System and American Society for Testing and Materials (ASTM) D-2488-90 as shown in Attachment B7. Order and present the terms as follows:

1. Major soil component - That portion of the soil that is the predominant grain size constituent. Use unabbreviated and capitalized nouns (that is, CLAY, SILT, SAND, or GRAVEL). TOPSOIL is an adequate single term for the naturally occurring organic soil found at ground surface.

2. Secondary and tertiary (if needed) components - Those components greater than 20 percent of total composition, if present. The adjective used (that is, clayey, silty, sandy, or gravelly) may be abbreviated.

If needed, use the term "slightly" to modify a component that comprises less than 20 percent of the total soil mass being described, and the term "trace" to modify a component that comprises less than 10 percent of the total soil mass being described. Visual descriptions should include the major soil constituent first, followed by any modifiers in the order of importance (for example, SAND, clayey, trace silt).

Color

The color for soil should conform to numerical Munsell notation. List the major color first, followed by any accessory colors (for example, clay, yellow brown with light-green mottles). When secondary or tertiary descriptors are used, the color designation should follow each descriptor.

Consistence/ and Relative Density

Include the relative density of cohesionless soils and the consistency of cohesive soils in visual classifications. Use Attachment B7 in describing the consistency of cohesive soils and Attachment B7 in describing the relative density of cohesionless soils.

Structure

Describe the structural features of the soils, such as fissures, slickensides, lenses, and cross-bedding.

Moisture Content

Use the criteria for describing the moisture content of soils found in Attachment B7.

Accessories

Include elements such as rock fragments, fine roots, or nodules in the description following all other modifiers for the major components of the soil matrix. Describe any mineralogical or other significant components here.

Contamination

If monitoring indicates the presence of chemical contamination, note that fact in detail.

Descriptors

To provide consistency in logging soils, use standard soil descriptors provided in Attachment B7.

Measurement

Record lengths and measurements in feet and tenths of feet.

B.7 Borehole Abandonment

B.7.1 Purpose and Applicability

This procedure conforms to the EPA QA requirements and the QAPP, and describes the guidelines for borehole abandonment. These procedures apply to all field investigations.

B.7.2 Definitions

None.

B.7.3 Procedure

Boreholes that are not converted to monitoring wells shall be abandoned in accordance with applicable federal, state, or local requirements. If a slurry is used to abandon the borehole, a mud scale, Marsh funnel, or equivalent method shall be used to ensure that the density (pounds per gallon) of the abandonment mud mixture conforms with the manufacturer's specifications. The slurry shall be emplaced from the bottom to the top of the hole using a tremie pipe. Boreholes in rock shall be abandoned by use of cement-grout to a point at least 5 feet above the top of first rock.

Each abandoned boring will be checked approximately 2 to 3 hours after grouting to ensure that the boring has been properly abandoned and the grout has not settled. If the grout has settled, then additional grout will be added until the boring is properly abandoned and does not create a hazard. Following these procedures, abandoned boreholes shall be checked 24 to 48 hours after mud/solid bentonite/grout emplacement to determine whether curing is occurring properly. Curing specifications recommended by the manufacturer shall be followed. If settling has occurred at this point, a sufficient amount of mud/solid bentonite shall be added to fill the hole to the ground surface. These curing checks and any addition of mud/solid bentonite shall be recorded in the field logbook (AFCEE QAPP, March 1998).

B.8 Monitoring Well Installation

B.8.1 Purpose and Applicability

This procedure conforms to the EPA QA requirements and the QAPP, and describes the method for installing temporary and permanent monitoring wells. Well construction forms are provided in Attachment B3.

B.8.2 Definitions

None.

B.8.3 Procedure

The methods for installing temporary and permanent monitoring wells are described below.

B.8.3.2 Permanent Monitoring Wells

After adequate soil and groundwater samples have been collected to characterize the soil boring lithologically, hydrologically, and chemically, the well screen and casing will be installed to depth. A minimum 2-inch annular space is required between the casing and the borehole wall. The well casing, screen, sediment trap, and end cap will be assembled and installed so as to prevent damage to the sections and joints. No glue, solvents, or pipe dope should be used on casing threads to secure casing joints.

Well Casing and Screen Assembly

The casing for the monitoring wells is new, unused, threaded Schedule 40 polyvinyl chloride (PVC) pipe (such as pipe manufactured by Brainard-Kilman). Joints will be flush-threaded and assembled with Teflon® tape. O-rings will be removed prior to assembly; however, if the O-rings are made of Teflon®, they can be used in the well assembly to ensure a tight fit of casing joints.

The well screens will be new, unused, factory-made, machine-slotted Schedule 40 PVC pipe. Screens will be 10 feet in length and will be placed at the bottom of the well. Each well screen will be sealed by a threaded end cap. The screen has flush-threaded joints compatible with the well casing. Threaded joints will be secured with Teflon® tape to ensure a tight fit of the casing joints.

Before the well casing and screen are placed on the bottom of the borehole, at least 6 inches of filter material should be placed at the bottom of the borehole to serve as a firm footing. The top of the casing will have a temporary cap during installation of the annulus materials.

Filter Pack Installation

After the casing and screen assemblies are set at the appropriate depth, the sand filter pack will be inserted. The sand filter pack consists of a thoroughly washed, sound, durable, siliceous material containing less than 5 percent silt or clay (commercially available 20/30-grain size or equivalent). No organic material, anhydrite, gypsum, mica, or calcareous material is allowed. The minimum specific gravity of the sand pack material is 2.5. No water will be used unless approved. The filter pack will be installed around the well screen (preferably using a tremie) in approximate 2-foot lifts to prevent bridging. The depth to the top of the sand filter pack will be measured periodically using a weighted measuring tape.

Transition Seal

At least 3 feet of bentonite transition seal will be placed above the sand filter pack. The bentonite seal will be in pellet form. **(Note:** If wells are deeper than 15 feet, then seal and grout must be tremmied down the borehole). Depths to the bottom and top of the bentonite seal will be measured and documented to ensure the transition seal meets design requirements. The bentonite will be allowed to hydrate for at least 1 hour before beginning emplacement of the cement-bentonite grout. Potable water may be added to the borehole to hydrate well seals placed above the water table surface.

Annular Grout Seal

The grout seal will be Portland cement conforming to ASTM C-150, Type 1. The maximum allowable water content of the grout mix is 7 gallons per 94-pound sack of cement. The maximum amount of bentonite allowable in the grout mix is 2.7 pounds per 94-pound sack of cement. Bentonite will be either mixed into the water before adding the cement, or it will be mixed into the cement powder before adding water. The grout will be mixed thoroughly before being placed in the borehole.

Surface Completion of Well

For wells located in paved areas, concrete and asphalt at each boring location will be removed to create a 2-foot-square opening in the pavement (opening needs to be large enough to accommodate drilling activities and monitoring well activities subsequent to drilling). A concrete saw will be used to cut the opening in the concrete or asphalt. Jagged-edged openings will not be permitted. A jackhammer or similar tool may be required to remove the concrete pavement after cutting through the pavement with the concrete saw. The well head will be completed either by constructing a flush-mount cover consisting of a concrete slab at least 4 inches thick in the 2-foot-square opening or by a lockable steel encasement on stick-up wells. To allow the grout to cure, construction of the pads and guard posts shall not begin for a minimum of 24 hours after well completion.

The well cap will be a watertight cap or cover made specifically for the PVC well casings. The cap will be lockable and include a brass padlock. Wells will be keyed alike to match the facility’s standard monitoring well lock.

Flush Mount

On flush-mounted completions, an 8-inch-diameter vault will be placed 0.25 inch above the existing pavement surface, with the concrete surface sloping smoothly from the vault surface to the existing pavement surface. The vault will be centered in the 2-foot-square pavement opening, with each vault having bolt-on traffic-bearing iron covers. The slab will be reinforced with four 20-inch-long steel reinforcing rods (minimum #3 size) placed uniformly around the vault within the concrete slab. The concrete surface will be finished smoothly, and a metal survey marker will be embedded in the fresh concrete.

Above-Ground Finish

On stick-up wells, a protective outer casing with a hinged lid will be installed and centered on each monitoring well casing. At least one weep hole shall be drilled near the base of the protective cover to allow rainwater to drain out. Concrete filled guard posts (two to four per well location), consisting of 3-inch-diameter Schedule 40 steel, shall surround each well to protect it. The posts shall be a minimum of 5 feet long and shall be installed to a minimum depth of 2 feet bgs in a concrete footing and extend a minimum of 3 feet above ground surface. The protective casing and guard posts shall be painted with a rust-inhibiting paint and an acceptable color.

B.8.3.4 Well Development Procedures

Well development procedures should be completed no sooner than 48-hours and no later than 7-days after a well is installed. The wells should be developed by alternately pumping and surging until the water is visibly free of sediment. Development water will be contained as IDW. Development equipment is to be decontaminated as specified in Section B.9. Newly installed wells should not be developed for at least 24 hours after installation to allow sufficient time for the well materials to cure. Wells should be developed by surging, bailing, and pumping as follows:

1. Remove the well cap or cover and monitor for vapors using the instruments listed in the health and safety plan (HSP).
2. Obtain depth to water measurements and determine the well volume.
3. Pump/bail the well as necessary to lower the water level and draw sediment from the sand pack into the well. Bail or pump until the water is relatively clear. Containerize this development water as IDW. For unproductive wells and to aid in the development process, a surge block can be used to slowly swab the screened interval in between pumping and bailing.
4. As each well volume of water is removed, measure and record pH, temperature, specific conductance, and turbidity.
5. Bail or pump at least five well volumes of water from the well while taking field measurements (pH, temperature, specific conductance, and turbidity).

Development is considered complete if a minimum of five well volumes of water have been removed (including any water added during construction) and three successive measurements of pH, temperature, specific conductance, and turbidity have remained stable (Section B.10).

B.9 Cleaning and Decontamination of Sampling Equipment

B.9.1 Purpose and Applicability

This procedure conforms to the applicable EPA QA requirements and the QAPP, and it establishes standard methodologies for cleaning and decontaminating sample containers and sampling devices. The procedure applies to all field investigations.

B.9.2 Definitions

DOM: delivery order manager

B.9.3 Procedure

Sampling devices will be cleaned and decontaminated before and after field use, as well as between each sample collection location. Sample containers will be cleaned by the supplier before issuance to field personnel. Decontamination fluids will be regarded as IDW and will be containerized and disposed of as such. Specific cleaning and decontamination materials and methods are discussed below.

B.9.3.1 Cleaning and Decontamination Materials

The following materials may be used for decontamination:

1. Trisodium phosphate or a laboratory detergent, such as Alquinox, Liquinox, or the equivalent.
2. Pesticide-grade isopropanol. The delivery order manager (DOM) must justify the use of any solvent other than pesticide-grade isopropanol for cleaning and decontamination.
3. Tap water from an acceptable municipal water treatment system.
4. Organic/Metal-free water rinse.

During cleaning and decontamination operations, the substitution of higher-grade water for tap water is permitted and does not have to be noted as a variation.

B.9.3.2 Marking and Storage

Cleaned and decontaminated equipment will be bagged and wrapped in aluminum foil or plastic, depending on the size of the equipment, and the decontamination process and occurrences will be recorded in the field logbook. Cleaned and decontaminated items will be stored in a contaminant-free environment.

Unused field equipment, reusable or disposable sample containers, and sample tubing that have been transported to a facility or site where contamination is known or suspected to be present or which may have become contaminated during the course of the field investigation should not be replaced in storage without being cleaned and decontaminated.

B.9.3.3 Decontamination Quality Control

Source Water Blank

Collecting samples in containers provided by the laboratory and submitting them for analysis monitors the quality of tap and organic-free rinse water. At least one sample per lot of organic-free water will be collected and submitted for analysis, and each tap water source used for decontamination will be sampled. When field deionizing or organic-free water units are used, QC samples will be collected and analyzed more frequently. An initial sample plus subsequent weekly sampling is the minimum acceptable frequency of QC sampling. The rinse water will be collected and submitted for analyses of constituents for which normal samples collected with that piece of equipment are being analyzed.

Equipment Rinsate

The effectiveness of the cleaning and decontamination procedures used in the field may be monitored by rinsing cleaned and decontaminated equipment with the organic-free water and submitting the rinse water to the laboratory for analysis. At least one rinse blank will be collected during each week (or 10 day event) of sampling operations. An attempt should be made to include as many of the same type of sampling for each rinse performed. This will help ensure that a representative sampling is obtained. A rinsate should be collected from each type of sampling equipment being used. Any time a cleaning material different from those specified in Section B.9.3.1 is used, an equipment rinsate sample must be submitted to the laboratory for analysis. The rinse water will be collected and submitted for analyses of constituents for which normal samples collected with that piece of equipment are being analyzed.

B.9.3.4 Specified Field Equipment Cleaning and Decontamination Steps

Equipment used to collect samples that contain oil, grease, or other material difficult to remove may need to be rinsed several times with methanol or hexane before regular cleaning and decontamination steps are taken. In extreme cases, it may be necessary to steam clean the equipment. If the equipment cannot be adequately cleaned and decontaminated using these methods, it should be discarded.

Teflon® and Glass Field Sampling Equipment

1. Wash the equipment thoroughly with laboratory detergent and water using a brush to remove particulate matter or surface film.
2. Rinse the equipment thoroughly with tap water.
3. If necessary (metals analyses), rinse the equipment with a 10 percent or stronger nitric acid solution. Small and awkward equipment, such as vacuum bottle inserts and well bailers, may be soaked in the nitric acid solution instead of being rinsed with it. Prepare fresh nitric acid solution for each cleaning.
4. Rinse the equipment thoroughly with tap water.
5. Rinse the equipment twice with pesticide-grade isopropyl alcohol and allow to air dry.
6. Rinse the equipment thoroughly with organic-free water.

7. Wrap the equipment completely with aluminum foil (dull side in) to prevent contamination during storage and/or transport to the field.

Stainless Steel or Metal Field Sampling Equipment

1. Wash the equipment thoroughly with laboratory detergent and water using a brush to remove particulate matter or surface film.
2. Rinse the equipment thoroughly with tap water.
3. Rinse the equipment twice with pesticide-grade isopropyl alcohol and allow to air dry.
4. Rinse the equipment thoroughly with organic-free water and allow to air dry.
5. Wrap the equipment completely with aluminum foil (dull side in) to prevent contamination during storage or transport to the field. Larger pieces of equipment (for example, auger flights with 5-foot split spoon samplers attached) may be wrapped in new Visqueen or equivalent.

B.9.3.5 Specific Cleaning and Decontamination Steps for Sample Tubing

Silastic Rubber Pump Tubing (Automatic Samplers and Peristaltic Pumps)

New cleaned tubing will be used for each automatic sampler setup. The silastic rubber pump tubing need not be replaced in peristaltic pumps where the sample does not contact the tubing or where the pump is being used for purging purposes (that is, not being used to collect samples).

The silastic tubing will be cleaned as follows:

1. Flush the tubing with tap water and phosphate-free laboratory detergent.
2. Rinse the tubing thoroughly with tap water.
3. Rinse the tubing with organic-free water.
4. Cap both ends of the tubing with aluminum foil (dull side in) until ready for use.

Teflon® Tubing (Bladder Pumps and Small-Diameter Electric Pumps)

New Teflon® tubing, used for collection of samples for organic compound analyses, will be cleaned as follows:

1. Cut the Teflon® tubing into convenient lengths before cleaning.
2. Rinse the outside of the tubing with pesticide-grade isopropyl alcohol.
3. Flush the interior of the tubing with pesticide-grade isopropyl alcohol.
4. Rinse the equipment thoroughly with organic-free water.
5. Wrap the equipment completely with aluminum foil (dull side in) to prevent contamination during storage or transport to the field.

Polyvinyl Chloride Tubing (bladder Pumps and Small-Diameter Electric Pumps)

PVC tubing is used selectively and only where organic compounds are of no concern. Only new tubing will be used. The tubing will be flushed with sample immediately before use to remove residues from the manufacturing or extruding process. The tubing will be stored in the original container and not removed until needed.

Stainless Steel Tubing

Stainless steel tubing will be washed with laboratory detergent and water using a long, narrow bottle brush. Steps 2 through 6, as outlined in Section B.9.3.4, will then be followed.

Glass Tubing

Only new glass tubing will be used. The tubing will be cleaned as follows:

1. Rinse the tubing thoroughly with pesticide-grade isopropyl alcohol.
2. Air dry the tubing.
3. Wrap the tubing completely with aluminum foil (dull side in) to prevent contamination during storage.

B.9.3.6 Specific Cleaning and Decontamination Steps for Miscellaneous Equipment

Submersible Pumps and Hoses Used to Purge Groundwater Wells

1. Wash the equipment with laboratory detergent and tap water, running solutions through the pumps and pump hoses.
2. Rinse the equipment with tap water.
3. Rinse the equipment thoroughly with pesticide-grade isopropyl alcohol.
4. Rinse the equipment with organic-free water and allow to air dry.
5. Place the equipment in a polyethylene bag or wrap with polyethylene film to prevent contamination during storage or transit.

Well Sounders or Tapes Used to Measure Groundwater Levels

1. Rinse the equipment with pesticide-grade isopropyl alcohol.
2. Rinse the equipment with organic-free water.
3. Air dry the equipment.
4. Wrap the equipment completely with aluminum foil (dull side in) to prevent contamination during storage.

Drilling Rigs and Equipment

1. Before being mobilized and brought onsite, clean the engine and power head with a power washer or steam cleaner, or hand washed with a brush using detergent (does not have to be laboratory detergent but should not be a degreaser) to remove oil, grease, and hydraulic fluid from the exterior of the unit. Rinse these units thoroughly with tap water.
2. Steam clean and rinse auger flights, auger bits, drilling rods, drill bits, HSAs, split-spoon samplers, Shelby tubes, or other parts of the drilling equipment that will contact soil or groundwater prior to it arriving onsite and between each boring.

Miscellaneous Sampling, Flow Measuring, and Field Instrumentation and Equipment

Miscellaneous flow measuring and sampling instrumentation will be washed with laboratory detergent, rinsed with tap water, followed by a thorough deionized or organic-free water rinse, and dried before being stored. This procedure does not apply to equipment used for collecting samples for trace organic compounds or metals analyses.

The exterior of sealed, watertight equipment, such as flow meters, should be washed with a mild detergent (for exmaple, liquid dishwashing detergent) and rinsed with tap water before storage. The interior of such equipment may be wiped with a damp cloth if necessary.

Other field instruments should be wiped with a clean, damp cloth; pH meter electrodes, conductivity electrodes, dissolved oxygen meter electrodes, etc., should be rinsed with deionized water before storage.

Ice chests and reusable shipping containers will be washed with laboratory detergent (interior and exterior), rinsed with tap water, and air dried before storage. In the event that an ice chest or shipping container becomes severely contaminated, it will be cleaned as thoroughly as possible, rendered unusable, and disposed of properly.

Pressure Field Filtration Apparatus

The steps for cleaning Teflon® and glass equipment will be used (Section B.9.3.4), except that the apparatus will be assembled and pressure will be applied after each rinse step to drive the rinse liquid through the porous glass filter holder in the bottom of the apparatus. After cleaning and decontamination, the apparatus will be assembled and the pressure inlet and sample discharge lines will be capped with aluminum foil (dull side in) to prevent contamination during storage.

B.9.3.7 Decontamination Procedures for Modified Low-Flow Sampling

Refer to Section B.10.3.4 for modified low-flow sampling procedures. The following procedures will be followed to reduce contamination between sampling points during modified low-flow sampling.

1. All wells sampled via modified low-flow techniques will be equipped with dedicated, Teflon®-lined, high-density polyethylene (HDPE) tubing.

2. Before using new tubing, pump a deionized water rinse through the tubing and wash the tubing surface thoroughly with laboratory detergent and water, using a brush to remove particulate matter or surface film. Rinse the tubing surface with isopropyl alcohol, followed by deionized water, and allow to air dry.

3. Before each use, decontaminate the submersible pump in accordance with Section B.9.3.6.

4. Decontaminate the field parameter instrumentation before each use according to the procedures outlined above.

5. After each well has been sampled, pump a deionized water rinse through the tubing, and if necessary, wash the surface with laboratory detergent and water to remove

particulate matter or surface film. Rinse the tubing surface with isopropyl alcohol, followed by deionized water, and allow to air dry.

6. After the tubing has been allowed to air dry, place it in a polyethylene bag and label with the monitoring well ID.

7. Take periodic equipment rinses from the tubing to determine decontamination effectiveness and tubing integrity. At visible signs of tubing wear (staining, odor, excessive nicks and scrapes) or positive equipment rinse results, replace dedicated tubing.

B.10 Groundwater Sampling

B.10.1 Purpose and Applicability

This procedure conforms to the EPA QA requirements and the QAPP. It describes methods for purging and sampling a groundwater monitoring well to ensure that the sample collected is representative of the formation groundwater.

B.10.2 Definitions

Bailer: A hollow tube constructed of stainless steel or Teflon® that is used to collect groundwater samples. A dedicated bailer remains in the well casing.

B.10.3 Procedures

B.10.3.1 Purging

The following equipment is required for well purging:

1. Bailer or pump. The device used depends upon aquifer properties, individual well construction, well yield, and DQOs.
2. Water level measuring device.
3. Tape measuring device.
4. pH, specific conductance, turbidity, and temperature measuring device.

Well purging will be performed as follows:

1. For the well to be purged/sampled, obtain and record the following information on the groundwater purging/sampling data sheet (Attachment B2) or in the field log book: date, field conditions, well location, well ID, well diameter, groundwater elevation, total well depth, screened interval, water quality field measurements (pH, specific conductance, turbidity, and temperature), and the method for disposal of purged water.
2. Calibrate field instruments before use and according to manufacturer's instructions.
3. Before opening the well, place plastic sheeting on the ground surrounding the well head to prevent contamination by sample spillage.
4. Unlock and open the well and take an FID/PID reading immediately.
5. Measure the water level and the total depth of the well.

6. Calculate the volume in gallons of water in the well casing or sections of telescoping well casing as follows:

$$(\prod r^2 h)\ 7.48 = \text{gallons}$$

where: $\prod$ = 3.142
r = radius of the well pipe in feet
h = linear feet of water in well
7.48 = gallons per cubic foot of water

The volume of water in typical well casings may be calculated as follows:

gallons/feet x _ (linear feet of water) = total gallons

where:

2-inch well =	0.163 gallon per foot
3-inch well =	0.367 gallon per foot
4-inch well =	0.653 gallon per foot
5-inch well =	1.02 gallons per foot
6-inch well =	1.469 gallons per foot
7-inch well =	1.999 gallons per foot
8-inch well =	2.611 gallons per foot
10-inch well =	4.28 gallons per foot
12-inch well =	5.87 gallons per foot

7. To purge the well, lower the decontaminated purging apparatus (pump or bailer) to the standing water column so the water will be pulled through the casing and the entire static volume will be removed. Use a bailer when the well does not yield sufficient water for pumping; otherwise, a pump is preferred. For low-flow sampling techniques, see Section B.10.3.4.

8. Measure the initial pH, specific conductance, turbidity, and temperature of water and record in the field logbook, along with the odor, color, clarity, silt concentrations, and general water condition. During purging, measure field parameters at least once during each well volume (more often is preferable). Record changes in the physical condition of the monitoring wells that could affect the well integrity.

9. For purging to be complete, remove at least 3 volumes of groundwater from the well, and allow the field parameters to stabilize. Measure the amount of purged fluid by filling a graduated bucket or using a stopwatch and noting the flow rate of the pump versus elapsed time. Stabilization for each field parameter is defined as follows: pH measurements ± 0.1 units, temperature measurements ±1 degree Celsius, specific conductance measurements ± 10 percent, and ± 10 percent for turbidity).

10. Purge wells with little or no recharge to near dryness, and allow the well to recover before sampling.

11. When using a pump before completing purging activities, bring the pump to the water surface to ensure complete removal of stagnant water.

12. Place purged water in a storage tank and disposed as IDW (as specified in the IDW plan).

Wells will be sampled immediately after purging, if possible, but generally no later than 6 hours after purging. Wells that recharge slowly will be purged dry and allowed to recharge before sampling. If excessive time (greater than 10 hours) is required for the slow recharging wells to recharge, it will be documented in the field logbook.

B.10.3.2 Sample Collection

The following are the general procedures for groundwater sampling along with methods for using specific sampling devices and techniques.

General

1. With the exception of low-flow sampling (Section B.10.3.4) and open borehole sampling (Section B.4), before samples are taken, purge the well as described in Section B.10.3.1.
2. Clean and decontaminate sampling equipment before commencing sampling activities. A new pair of disposable gloves will be worn at each location by sampling personnel.
3. Use pre-labeled, pre-cleaned sample bottles with preservative added to contain the groundwater samples. Volatile organic analysis (VOA) samples will be collected first, followed by other organic analyses. Inorganic analyses will be collected last, except where the influences of turbidity on metals concentrations are a concern. In that case, collect metals samples immediately following the volatile organics.
4. As the sample is taken, tilt the sample container slightly to allow the water to run down the inside of the sample bottle with a minimum of splashing.
5. Leave adequate space in the bottle to allow for expansion, except for VOA vials, which will be filled to overflowing and capped. Check VOA vials for air bubbles; if air bubbles are detected, carefully add more sample to the vial, taking care to minimize the loss of preservative.
6. Place samples in appropriate containers and pack with ice in coolers immediately after the sample is collected.
7. Measure pH, conductivity, temperature, and turbidity after sample bottles have been filled and record the measurements in the field logbook.

Bailer

A decontaminated Teflon® bailer can be used to remove groundwater samples from a well as follows:

1. Lower a decontaminated and properly secured bailer to the sampling interval from which the sample will be collected.
2. Allow the bailer to fill with a minimum of surface disturbance to prevent sample water aeration. When the bailer is raised, the bailer cord must not touch the ground.
3. Slowly pour the sample from the bailer, tilting the bottle slightly to allow the water to run down the inside of the sample bottle with a minimum of splashing.

4. If the bailer is dedicated, return it to the well and cap and lock the well. Clean and decontaminate nondedicated samplers after use.

B.10.3.3 Purging/Sampling Using a Small-Diameter, Electric Submersible Pump

Small-diameter electric submersible pumps include a range of small diameter, variable speed pumps capable of pumping rates ranging from 0.5 milliliter per minute (mL/min) to in excess of 9 gallons per minute (gal/min). The power source for these pumps can be provided directly from an automobile battery or a generator. Although small-diameter pumps are usually light-weight and easily lowered by one person into a well, two people generally are needed to remove the pump: one person to pull and the other to reel the hose and power lead. Groundwater monitoring wells can be purged using a decontaminated pump and clean flexible tubing as follows:

1. Slowly lower the pump to the middle of the screened interval. This method will minimize the mixing of stagnant water in the casing above the screen with the screened interval zone water and minimize the re-suspension of solids which have collected at the bottom of the well (EPA, 1996c).
2. Following the manufacturer's procedures, begin pump-purging the monitoring well.
3. If the recovery rate of the well is faster than the pump rate, the pump may be left hanging at the initial level. If the pump rate exceeds the recovery rate, the pump must be lowered to accommodate the drawdown, or the pump rate can be decreased.
4. Once 3 to 5 well volumes have been removed from the well and the field parameters have stabilized, remove the pump from the well and sample utilizing a Teflon® bailer.

B.10.3.4 Purging/Sampling Using Modified Low-Flow Techniques

Low-flow techniques are used to obtain a more representative sample from the aquifer formation. In general, the advantages of low-flow purging include (EPA, 1996):

- Samples which are representative of the mobile load of contaminants present (dissolved and colloid-associated)
- Minimal disturbance of the sampling point, thereby minimizing sampling artifacts (that is, less turbidity)
- Less operator variability, greater operator control
- Reduced stress on the formation (minimal drawdown)
- Less mixing of stagnant casing water with formation water
- Reduces the need for filtration and thus the time needed for sampling
- Smaller purging volume which decreases IDW disposal costs
- Better sample consistency; reduced artificial sample variability

The pumps selected to perform low-flow sampling should be capable of producing purge rates sufficient to allow for the modified low-flow sampling technique. Pumps which meet these requirements include, but are not limited to, bladder-type pumps (provided that reagent grade nitrogen is used for bladder inflation) and the Grundfos Redi-Flow2 pump.

The following are the procedures for modified low-flow groundwater sampling. These procedures include adaptations from EPA's paper entitled "Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures" (EPA 1996c):

1. Slowly lower the decontaminated pump to the middle of the screened interval. This method will minimize the mixing of stagnant water in the casing above the screen with the screened interval zone water, and minimize resuspension of solids that have collected at the bottom of the well.

2. Once the pump is positioned in the well, an airtight flow-through cell (equipped with a YSI or Horiba-type water quality meter) will be plumbed to the water discharge line.

3. Lower a decontaminated water level gauge into the well to monitor the water table.

4. Once purging is initiated, water level measurements should be monitored continuously, and pumping rates adjusted as necessary (for example, 0.1 to 0.3L/min) to maintain minimal drawdown. Modified low-flow techniques should cause less than 3 feet of drawdown during purging.

5. While purging, the groundwater field parameters (including water level) should be continuously monitored every 3 to 5 minutes until parameters have stabilized for three consecutive readings.

6. Stabilization for each parameter is defined as follows: ±0.1 for pH, ±3 percent for conductivity, ±10 millivolts for redox potential, ±10 percent for turbidity, ±10 percent for dissolved oxygen, and ±3 feet for drawdown.

Once field parameters have stabilized for three consecutive readings, samples may be taken. The same device used for purging should be used for sampling (remove flow-through cell).

B.11 Land Surveying

B.11.1 Purpose and Applicability

This procedure provides directions for surveying locations of wells and other sampling locations. Accurate surveys of sampling locations, wellheads, boundaries, etc., are necessary to determine precise spatial reference points for characterization of site conditions.

B.11.2 Definitions

None.

B.11.3 Procedure

Each designated survey location will be surveyed by a licensed surveyor. The locations will be referenced both horizontally and vertically to permanent land monuments or a grid system. Horizontal control will be the State of Alabama Plane Coordinate System and vertical control will be mean sea level (National Geodetic and Vertical Datum [NGVD]). The survey controls will be tied to a recognized reference point. Ground surface and top of casing vertical control will be to the nearest 0.01 foot; horizontal control will be to the nearest 0.1 foot. The top of casing will be notched or otherwise marked to identify a constant measuring point for determining groundwater elevations. All surveys will be performed by an Alabama-licensed surveyor.

B.12 Sample Management

B.12.1 Purpose and Applicability

Where applicable, this procedure conforms to the EPA QA requirements and it describes sample management. This procedure applies to liquid and solid environmental and hazardous samples collected for analysis of physical or chemical properties. The procedure is applicable to all field investigations.

B.12.2 Definitions

SAP: sampling analysis plan

B.12.3 Procedure

B.12.3.1 Sample Holding Times, Containers, and Preservatives

Based on expected sampling efforts, a supply of sample containers and field preservatives, if needed, will be delivered to the field sampling teams by the contracted laboratory. The containers must be certified clean by the laboratory. Required containers and preservatives for various sample types are listed in the QAPP.

Sample containers and preservatives are obtained and used as follows:

1. The DOM requests sample containers from the laboratory no fewer than 14 working days in advance of each scheduled sampling event.

2. The laboratory supplies the sampling team with the appropriate clean containers, which contain the required preservatives and are labeled as to what preservatives are in each container. Containers should be delivered at least 2 working days before the scheduled sampling event. The DOM or designee checks the completeness of the shipment and the integrity of the containers.

3. Preservatives are added to sample containers by the laboratory before shipment or by field personnel as required during sampling. The type and quantity of preservatives added to the container are marked on the container label.

B.12.3.2 Sample Packaging and Management

Chain-of-Custody Forms

Samples shipped to the laboratory for analysis will be accompanied by a chain-of-custody form. These forms track the custody of the samples after they have been collected and verify the information contained on the bottle labels. Every sample bottle shipped to the laboratory for analysis will be listed on the chain-of-custody form. Other information contained on the form includes:

- Project number
- Project name and location
- Sample manager
- Date and time of sample collection
- Sample location ID (field ID)

- Number of containers
- Analysis required
- Sample type and matrix
- Laboratory name
- Remarks
- Airbill number
- Relinquishing signatures, dates and times

Sample Bottle Labels

Each bottle shipped to the laboratory for analysis will be identified with a sample label. This label will contain the following information:

- Project name
- Project number
- Sample location ID (including site)
- Date and time of sample collection
- Analysis required (method)
- Preservation
- Sampler
- Matrix
- Number of containers/analysis

When the sample label information has been completed, the label will be placed on the appropriate bottle and covered with clear tape to ensure the integrity of the sample label.

Sample Packaging

Once the samples have been collected, the sample bottles will be prepared for shipment to the laboratory in the following manner:

1. Ensure the caps the containers are tightly sealed.
2. Place containers in bubble pack.
3. Place all containers in a zipper-lock-type bag and seal.
4. Place samples into an insulated cooler and cool to 4 ± 2 degrees Celsius using wet ice.
5. Line insulated shipping cooler with a large trash bag and place samples in insulated shipping cooler with ice.
6. Seal the completed chain-of-custody form in a zipper-lock-type plastic bag and tape to the inside of the cooler lid.
7. Close trash bag and seal with tape.
8. Securely seal the shipping container with packing tape and two custody seals.
9. Place the shipping cooler in a cardboard shipping box and ship to laboratory via overnight express.

B.13 Data Quality Assurance/Quality Control

B.13.1 Purpose and Applicability

Where applicable, this procedure conforms to the EPA QA requirements and the QAPP. The procedure describes the data management, data reduction, data quality assessment, and data validation/reporting functions associated with QA and QC. The procedure applies to liquid and solid environmental and hazardous samples collected for analysis of physical or chemical properties. The procedure applies to all field investigations.

B.13.2 Definitions

USACE: U.S. Army Corps of Engineers
SAP: sampling analysis plan

B.13.3 Procedure

B.13.3.1 Field Data Reduction

Field measurements will be taken by the field team lead (FTL) and field team members during sample collection activities. The results of pH, conductivity, and temperature measurements taken in the field will be reported. Field data will be recorded to provide a permanent record of field activities.

During processing of field data, the FTL will perform validation checks. Data will be compared against data obtained in previous investigations, where available, and against applicable standards and guidelines. The purpose of these checks is to identify ”outliers,” which are data that do not conform to the patterns established by other or previous observations.

Although outliers may be the result of transcription errors or instrumental breakdowns, they also may be manifestations of a greater degree of spatial or temporal variability than expected. Therefore, after an outlier has been identified, a decision must be made concerning its further use. Obvious mistakes in data will be corrected when possible and the correct value inserted. If the correct value cannot be obtained, the data may be excluded. An attempt should be made to explain the existence of the outlier. If no plausible explanation can be found, a note to that effect should be included in the report and the outlier may be excluded. In addition, an attempt should be made to determine the effect of included and excluded outliers in the data set.

B.13.3.2 Laboratory Data Reduction

The first step in laboratory data reduction is data processing. In general, data will be processed by an analyst in one or more of the following ways:

- Manual calculations of instrument calibration and sample results (typically performed on method-specific bench sheets)
- Manual input of raw data for subsequent computer processing
- Manual integration of instrument output for subsequent computer processing

- Direct acquisition and processing of raw data by a computer

No matter how data processing is done, sufficient documentation should be presented to allow another analyst to review and verify the work.

If manual integration is deemed necessary by the analyst, a “before” and “after” hard copy of the area manually integrated, including the reason, date, and signature of the analyst, should be forwarded with the data to the section supervisor for review. After review, the section supervisor shall sign the manual integration as proof of approval. The data, with both manual integration hard copies, then will be forwarded to the QA/QC officer for review and approval. The documentation of the manual integration should be included in the project file.

Raw data will be entered into bound laboratory notebooks. The data entered should be sufficient to document all factors used to arrive at the reported value for each sample. Calculations may include factors like sample dilution ratios or conversion to dry-weight basis for solid samples.

B.13.3.3 Data Quality Assessment

Upon completing all field and analytical work, the quality of the data generated as a result of these activities (field and laboratory data) will be assessed.

Review of Field Records

The FTLs, project QA/QC officer, and project manager will ensure that all field records are evaluated for the following:

- Completeness of field records
- Identification of valid samples
- Correlation of data
- Identification of anomalous field-test data
- Accuracy and precision of field data and measurements

Field record review is an ongoing process. FTLs are responsible for ensuring that proper documentation is recorded during each site’s sampling activities.

Review of Laboratory Data

Both the laboratory and contractor personnel will review all laboratory data, and at a minimum, the review should focus on the following subjects:

- Chain-of-custody forms
- Holding times
- Method calibration limits
- Method blanks
- Laboratory-established detection limits
- Analytical batch control records, including spike recoveries and spike duplicate results
- Corrective actions
- Formulas used for analyte quantitation
- Calculations supporting analyte quantitation
- Completeness of data

The establishment of detection and control limits will be verified before any sample analysis to ensure they meet the QAPP and laboratory subcontract requirements. Any control limits reported outside of the acceptable range specified in the analytical methods will be identified. Any trends or problems with the data will be evaluated. Any sample detection limits that exceed the established limits in the SAP or laboratory subcontract will be identified, with the reason for the elevated detection limit (for example, dilution, matrix interference). The absence of records supporting the establishment of control criteria and detection limits also will be noted. Analytical batch QC, calibration check samples, method calibrations, continuing calibration verifications, corrective action reports, the results of reanalysis, sample holding times, sample preservations, and any resampling and analysis will be evaluated. See the QAPP for the soil and water compliance monitoring analytical requirements (analytical method, reporting limits, method detection limit, accuracy control limit, precision control limit) for Fort Ruckers.

Samples associated with QC data that are outside the established control limits will be identified in the technical report, and an assessment of the quality of such analytical results will be made. The check of laboratory data completeness will be documented and ensures the following:

- All samples and analyses required by the statement of work (SOW) have been processed.
- Complete records exist for each analysis and the associated QC samples.
- Procedures specified in the SAP have been implemented.

A laboratory review analyst, other than the original data processor, will be responsible for reviewing all steps of the data processing. All of the input parameters, calibrations, and transcriptions should be checked, and at least 20 percent of the calculations should be checked. If errors are found during the 20 percent check, 100 percent of any related calculations will be checked. All computer-processed data should have the manually input data checked. Each page of checked data will be signed and dated by the verifier.

QC sample results (laboratory control samples, matrix spike [MS], matrix spike duplicates [MSDs], surrogates, initial calibration standards, and continuing calibration standards) will be compared against stated criteria for accuracy and precision. All samples will be analyzed in accordance with EPA Test Methods for Evaluating Solid Waste, SW846 Update III (or the most recent version), and the method specified QC criteria. Laboratory control limit criteria will be used. In the absence of laboratory control limits, the method specified control limits may be used. QC data must meet acceptance levels before processing the analytical data. If QC standards are not met, the cause will be determined. If the cause can be corrected without affecting the integrity of the analytical data, processing of the data will proceed. If the resolution jeopardizes the integrity of the data, reanalysis will occur. If the reanalysis does not resolve the conformance problem, the results of the reanalysis run will be flagged as “not within control limits” when reported in the data package. Note that the reanalyses may occur outside of holding times because of time elapse between sample extraction and analysis.

B.13.3.4 Data Validation and Reporting

This section describes field, laboratory, data validation, and reporting activities.

Field Reporting

The following standard reporting units should be used:

- pH will be reported to 0.1 standard unit
- Specific conductance values below 100 µmhos per square centimeter (cm^2) will be reported to two significant figures; specific conductance values above 100 µmhos/cm^2 will be reported to three significant figures.
- Temperature will be reported to the nearest 0.1 degree Celsius.
- Water level data will be reported to the nearest 0.01 foot.

Laboratory Data Verification and Reporting

All analytical data must be verified before being released by the laboratory. Laboratory data verification consists of reviewing the data for editorial and technical validity. The editorial review checks for typographical, transpositional, and omission errors, and includes proofreading any text that may accompany the data. The technical review verifies that all precision, accuracy, and detection limit requirements have been met.

Environmental and QC sample analysis data should be reported as a hard copy and on a computer disk using the USACE format. Analytical hard copy reports should contain the following items:

- Laboratory name
- Client name
- Date of issue
- Project ID
- Field sample number
- Laboratory sample number
- Sample matrix description
- Analytical method description and reference citation
- Individual parameter results
- Date of analysis and extraction (where appropriate)
- Detection limits achieved
- Concentration units
- Any special conditions
- Dilution or concentration factors
- Corresponding QC report

QC data will be recorded on the QC report forms for the appropriate tests and correlated to the analysis results by the laboratory lot control numbers. The QC results will be used to prepare control charts for each test and matrix type. QC reports should contain the following items:

- Method blank

- Surrogate results
- Laboratory control sample results
- MS/MSD results

The QC report should be submitted with the analytical results report. The units of measure used for reporting analytical results for water samples should be micrograms per liter (µg/L) for organic compounds, including metals, and micrograms per liter (µg/L) for inorganic compounds. The units of measure used for reporting analytical results for soil samples should be milligrams per kilogram (mg/Kg) for inorganic compounds, including metals.

All samples should be analyzed in accordance with EPA Test Methods for Evaluating Solid Waste, SW846 Update III (or most recent version), and the method specified QC criteria that specifies calibration requirements.

The project QA/QC officer will review all laboratory data packages. Any reports that are rejected as incomplete or in error will be returned to the laboratory for correction. The laboratory should submit a revised, corrected report within 2 weeks of notification of a rejected report.

Laboratory QC Checks and Corrective Action Procedures

The laboratory will employ control samples to assess the validity of the analytical results. The validity of sample results will be based on the control samples meeting the acceptance criteria. The acceptance criteria for each type of control sample are defined in the appropriate SOP. These acceptance criteria are in accordance with method requirements or calculated annually from historical data. The control samples will be analyzed in the same manner as the field samples.

An analytical batch is defined as a group of field samples which are processed as a unit. If the number of field samples in the group is greater than 20, each group of 20 samples or less will be handled as a separate batch. The minimum QC items for the analytical batch will be a method or reagent blank and a laboratory control sample. MSs will be processed at a frequency of 5 percent of samples (1 MS and 1 MSD per 20 samples).

For organic compounds QC procedures include the following:

- A method blank will be analyzed for each batch of samples.

- A blank spike or laboratory control standard (LCS) will be processed and analyzed (in accordance with method requirement) with each batch of samples. A laboratory control standard duplicate (LCSD) will be prepared and analyzed if sufficient sample is not supplied for the MS/MSD or duplicate.

- Appropriate surrogate(s) will be added to all samples, standards, and blanks.

- MSs will be analyzed at a frequency of 5 percent of the samples. If a method does not specify matrix-spiking compounds, the SW-846 matrix spiking compounds will be used. Appropriate MSs will be used for other chromatographic methods in which MSs are not defined.

- Duplicate samples or MSDs will be analyzed at a frequency of 5 percent of the samples. In cases where MSDs are used, precision data will be obtained only on the matrix spiking compounds.

For inorganic compounds and general chemistry, QC procedures include the following:

- Calibration blanks are nondigested blanks that are analyzed at a frequency of 10 percent of the samples.
- Method blanks or reagent blanks will be processed and analyzed with each batch of samples of the same matrix.
- A blank spike or LCS will be processed and analyzed with each batch of samples. An LCSD will be prepared and analyzed if sufficient sample is not supplied for the MS/MSD or duplicate.
- MSs will be analyzed at a frequency of 5 percent of the samples.
- Duplicate samples or MSDs will be analyzed at a frequency of 5 percent of the samples.

Data Validation and Reporting

The following steps should be implemented to interpret the data:

- **Evaluate field duplicate results**. Precise field duplicate or replicate results indicate reproducible sampling technique and precise laboratory analysis. Field duplicate or replicate results not within control limits could indicate a heterogeneous sample medium, poor sampling technique, or a lack of analytical precision. If homogenized samples show poor precision, the imprecision is probably in the laboratory analytical process.
- **Evaluate field and laboratory blank results**. Analyses of blanks shall be assessed to determine sources of contamination and the impact of any contamination on the analytical results for environmental samples. Examples of sources capable of contaminating field blanks (such as trip blanks) include combustion engine exhaust, container cleaning solvents, pollution from offsite sources, the water used, or the container used. Method blank results are useful to detect laboratory contamination from reagents, instruments, ambient sources, or sample handling. The blanks must have no analyte concentrations greater than the reporting limits. The presence of a contaminant greater than the reporting limit in a blank requires a corrective action to eliminate the source of contamination and re-establish analytical control.
- **Evaluate sample matrix effects**. Assessment of the sample matrix can help to define the sources of anomalous data. The matrix can cause a high or low bias to the results of normal environmental samples. High analytical results can be caused by natural background material in the sample. Potential matrix effects should be identified through the evaluation of MS and MSD samples.
- **Evaluate LCS**. The LCS is used to evaluate every analytical batch and to determine if the method is in control. A QC failure of an analyte in any of the LCSs shall require appropriate corrective action to re-establish analytical control.

Attachment B1
Soil Boring Log

CH2MHILL

PROJECT NUMBER	BORING NUMBER SHEET OF
	SOIL BORING LOG

PROJECT : LOCATION : ELEVATION (TBM or MSL) :

DRILLING CONTRACTOR : NAME OF DRILLER :

DRILLING METHOD/EQUIPMENT: SIZE/TYPE OF BIT :

DIRECTION OF HOLE : vertical inclined ______ deg from vertical

OVERBURDEN THICKNESS : DEPTH DRILLED INTO ROCK : TOTAL DEPTH OF BORING :

WATER LEVELS : START : END : LOGGER :

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	RECOVERY (IN)	#/TYPE	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS DEBRIS ENCOUNTERED, XRF RESULTS, SAMPLE COLLECTION (date, time, sample ID)

Attachment B2
Monitoring Well Development/Purge/Low-Flow Sampling Log

CH2MHILL

Project Number:

GROUNDWATER PURGING & SAMPLING DATA SHEET

Client: ______________________ **Well ID:** ______________________
Location: ______________________ **Sample ID:** ______________________
Event: ______________________
Date: ______________________ Sample Team: ______________________
Weather: ______________________

Total Depth: __________ FT.(BTOC) Measuring Device: ______________________
Depth to water: (-) __________ FT.(BTOC) Date and Time: ______________________
Water Column: __________ FT.
(x) __________ GAL/FT. **WELL DIAMETER**
Well Volume: __________ GAL. [(**2**" DIA.= 0.163 GAL/FT.) (**4**" DIA. = 0.653 GAL/FT.)]
Total Purge Volume: __________ GAL. (**1**" DIA.= 0.041 GAL/FT.) (**1 1/4** " DIA.= 0.064 GAL/FT.)
Purge Device: ______________________

FIELD PARAMETERS

Time	Cummulative Purge Vol. (gals)	Temp., °C	Cond. (uS/cm)	DO (mg/L)	Redox (mV)	pH	Turbidity (NTU)	Color / Odor / Comments

Sample information: method, container number, size, and type, preservative used.

Sample Time ______________________
Sample Appearance ______________________

Notes:

Signed by: ______________________
DATE

Attachment B3
Monitor Well Construction Form

PROJECT NUMBER	WELL NUMBER
	SHEET 1 OF 1

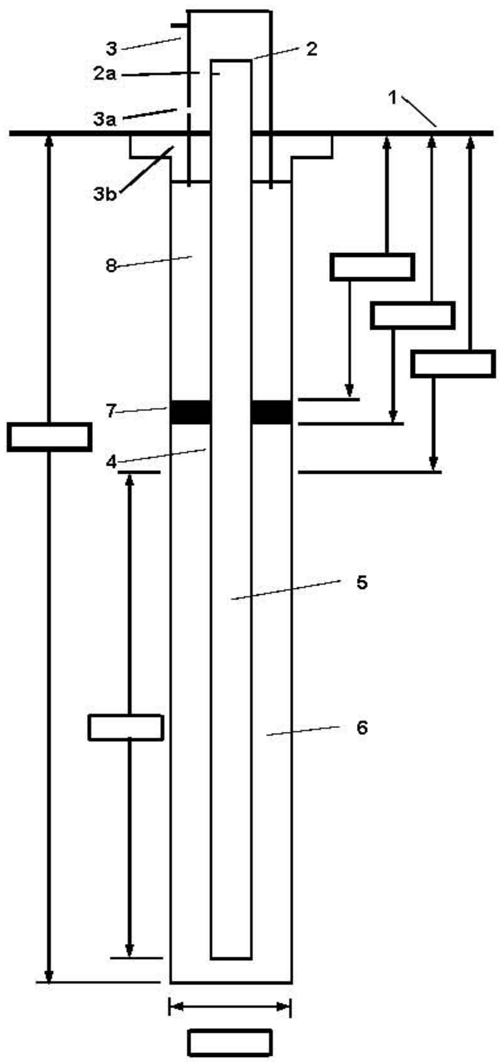
WELL COMPLETION LOG

PROJECT : LOCATION :

DRILLING CONTRACTOR :

DRILLING METHOD AND EQUIPMENT USED :

WATER LEVELS : START : END : LOGGER :



1- Ground elevation at well ______

2- Top of casing elevation ______
a) vent hole? ______

3- Wellhead protection cover type ______
a) weep hole? ______
b) concrete pad dimensions ______

4- Dia./type of well casing ______

5- Type/slot size of screen ______

6- Type screen filter ______
a) Quantity used ______

7- Type of seal ______
a) Quantity used ______

8- Grout
a) Grout mix used ______
b) Method of placement ______
c) Vol. of well casing grout ______

Development method ______

Development time ______

Estimated purge volume ______

Comments ______

Attachment B4

Field Equipment Standard Operating Procedures

Air Monitoring with the MultiRae Instrument

Purpose

This technical practice provides general guidelines for calibration and use of a MultiRae air monitoring device.

Scope and Applicability

This technical practice provides a broad guideline for the field use of a MultiRae. The MultiRae is configured to measure volatile organic carbon (VOC), hydrogen disulfide (H_2S), lower explosive limit (LEL), oxygen (O_2), and carbon dioxide (CO_2). For specific instructions, refer to manufacturer's operations and maintenance manual.

Equipment / Materials

- Operations manual
- A MultiRae with fully charged battery pack
- A cylinder of calibration gas
- A regulator for the calibration gas cylinder
- A short length (as short as possible) of tubing to transfer calibration gas from cylinder to MultiRae

Procedures / Guidelines

Only properly trained personnel shall use this instrument. For specific instructions, see operation manual.

Calibrating the MultiRae

Charge each MultiRae every evening and calibrate it every morning following the manufacturer's instructions.

Air Monitoring with the MultiRae

When air monitoring for Health and Safety purposes or sample screening with a PID is performed, the MultiRae air monitoring device may be used. MultiRae air monitoring data are to be recorded on a field form (e.g., a boring log) or in the field logbook. The MultiRae can perform four types of air monitoring. The applicability of the air monitoring technique depends on the task.

- **Breathing Zone Monitoring:** The MultiRae can monitor the air in the breathing zone. Monitoring shall be done periodically to ensure that workers are not exposed to potentially hazardous atmospheres or circumstances.

- **Borehole Monitoring:** The MultiRae is to be used monitor the top of a boring to check for potentially hazardous atmospheres. This technique is applicable during monitor well installation, direct push soil sampling, and some hand augering.
- **Sample Headspace Monitoring:** Headspace monitoring is performed by placing a soil sample in an enclosed space for a set period and then monitoring the space above the sample. Headspace air monitoring can be performed if there is enough soil volume remaining after analytical soil sampling. For details on headspace sampling, see SOP 8.4 *Split-Spoon Soil Sampling*.
- **Sample Screening:** Sample screening is performed by placing the probe tip of the monitoring instrument near the location to be screened (e.g., a soil sample, water sample, unknown surface). The quality of the screening depends on the wind direction and distance of the monitoring instrument tip from the screened material or surface.

Key Checks / Items

- Check battery.
- Zero and calibrate.
- Verify that sensor probe is working.
- Recharge unit after use.

Preventive Maintenance

If a MultiRae instrument is not working, refer to the Operations Manual provided with the instrument or return to instrument to it's point of origin for replacement.

STANDARD OPERATING PROCEDURE
HORIBA U-10/U-22 MULTI-PARAMETER WATER QUALITY MONITORING SYSTEM

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to describe the protocol for the field operation of a Horiba U-10 or U-22 Multi-Parameter Water Quality Monitoring System. The Horiba U-10 and U-22 model instruments incorporate the same monitoring probes, user interface systems, and calibration procedures, but are configured for batch sampling (U-10) or use with an in-line flow-through cell (U-11). The instruments are equipped with several probes used to measure specific field chemistry parameters including pH, oxidation reduction potential (ORP), temperature, dissolved oxygen (DO), specific conductivity, and turbidity. These probes are contained within one unit and allow for simultaneous measurements to be collected.

The Horiba will be used to monitor the stabilization of key indicator parameters (refer to the USEPA Region 2 “Low Flow Purging and Sampling” guidance document) which will determine when adequate purging of groundwater has occurred and sampling of the well is acceptable. The model U-22 will be fitted with a flow through cell which eliminates the contact of the purge water with air and allows for continuous, undisturbed monitoring of the well water. The model U-10 will be utilized for surface water sampling (including QA/QC sampling of fire hydrant, DI water, and potable tank water supplies) and well development activities.

This SOP will provide guidance for using this instrument during the water investigation activities.

2.0 Materials

a. Horiba U-10 with sample container cup or U-22 with flow through cell (flow through cell connection barbs should match the inner diameter of sample tubing being used).

b. Teflon lined polyethylene tubing (3/8” or ½” ID) for well sampling

c. Horiba Auto Cal solution

d. Calibration cup

3.0 Procedure

3.1 Calibration (Auto Calibration procedure)

3.1.1 The Auto Calibration mode allows for the calibration of the pH, COND, and TURB sensors in the Auto Calibration solution. DO is calibrated in the atmosphere simultaneously. Temperature and ORP are not field calibrated.

3.1.2 Before performing the auto calibration procedure, turn the unit on and allow it to warm up for about a half hour to one hour. This will allow the temperature to stabilize which will minimize unstable values during calibration.

3.1.3 Wash the sensors with distilled water a few times and fill the calibration cup to the marked line with the Auto Calibration solution. Immerse the probe sensors into the calibration solution until the cup snaps securely onto the probe.

3.1.4 Be sure that one of the measurement modes (pH, COND, or TURB) are selected. Press the **CAL** key. **AUTO** and **CAL** appear in the upper portion of the screen and the instrument is now in Auto Calibration mode.

3.1.5 Press the **ENT** key to start the Auto Calibration. During calibration **DATA IN** and the current measurement being calibrated blink. When a measurement is calibrated it stops blinking and remains illuminated.

3.1.6 **END** will be displayed upon the completion of the calibration procedure for all measurements. Press the **MEAS** key to return to the measurement mode.

3.1.7 Press the **MEAS** key to view each of the measurements and record the readings while in the Auto calibration solution.

3.1.8 If an **ERROR** message occurs after calibration refer to the Horiba "Operation Manual" for error explanations and troubleshooting guidance (p. 89)

3.2 Operation

U-22

3.2.1 Connect the flow through cell to the U-22 probe. Be sure that the probe is attached securely to the flow through cell to ensure an air tight seal. Check that barbed fittings are tightly in place. If necessary, re-apply Teflon plumbers tape to the barbed fittings and secure into place.

3.2.2 Connect the end of the tubing from the submersible pump (already installed in the well) to the intake barb of the flow through cell (located on the bottom of the flow through cell). For correct operation the flow through cell must be filled from the bottom up.

3.2.3 Cut a small piece of tubing (approximately 2' to 3') to connect to the discharge barb of the flow through cell (located on the top of the flow through cell). The end of this tubing should be placed into a 5 gallon bucket for containment of the purge water.

3.2.4 Once all tubing connections have been made, secure the probe so that it does not tip over during purging. While purging, movement of the probe should be minimized so as to prevent disturbance of the measurements.

U-10

3.2.5 A sampling container is not provided with the U-10. The calibration cup can not be used for sampling due to the cut-out in the cup that exposes the dissolved oxygen sensor to ambient air for calibration (this sensor would not be exposed to the water sample if the calibration cup were utilized for sampling). Fill a sampling container (e.g., a tupperware container) with enough water to cover all of the sensors – including the dissolved oxygen sensor – when the instrument is placed in the sampling container.

3.2.6 Turn the Horiba U-10 / U-22 on. Proceed with purging as per Field Sampling Protocols. Toggle through the measurements by pressing the **MEAS** key.

4.0 Maintenance

During periods of meter operation, silt and other foreign materials can accumulate on the probes. The turbidity probe is especially susceptible to this due to its small size. The accumulation of these materials may result in erroneous readings. While in use it is not recommended to stop purging and clean the probe. At a minimum, the probe and sensors should be cleaned between each well and at the end of the day before packing the instrument away.

The following items cover basic field maintenance procedures for the Horiba U-22. Maintenance instructions for specific Error Codes can be obtained from the Horiba "Operation Manual." Complicated repairs and sensor replacement should be left to a trained service technician.

4.1 After use in each well**,** remove the protective cage from around the probe and the protective cover over the turbidity sensor**.** Using a non-abrasive Alconox wash, rinse the probe and the individual sensors.

4.2 Apply a final rinse using deionized water**.** Be sure to remove all soapy material.

4.3 The turbidity probe can be further cleaned by gently wiping the two lenses with a clean, damp paper towel.

4.4 Replace the turbidity and probe protective covers.

5.0 Precautions

5.1 The Horiba is designed to monitor groundwater. The instrument (hand held display) is constructed to be water resistant. However, it is good practice to keep the instrument as dry as possible. When working in the rain the instrument should be placed inside a Ziplock baggie.

5.2 The probe is not designed to monitor groundwater containing free product. Free product will likely damage the sensors rendering the unit inoperable. Care should be taken to confirm that no free product will be encountered in the wells to be sampled

5.3 Exposure to direct sunlight can cause the LCD display to deteriorate. Do not expose the instrument to direct sunlight for long periods of time. It is preferable to provide some type of shade when working in direct sunlight conditions.

5.4 Freezing temperatures can cause damage to the instrument sensors. When working in freezing or near freezing conditions, store the instruments in a warm location overnight to avoid damage.

5.5 When storing the instrument the sensors should be kept moist to avoid drying out. Place a small amount of Auto Calibration solution in the calibration cup and place the probe inside the cup.

5.6 Do not drop the instrument or probe. Glass electrodes in some sensors and delicate electronics can easily break if the instrument is grossly mishandled.

6.0 References

Horiba, 1999, U-20 Series Operation Manual

7.0 Attachments

Calibration Form

METHOD 6200

FIELD PORTABLE X-RAY FLUORESCENCE SPECTROMETRY FOR THE DETERMINATION OF ELEMENTAL CONCENTRATIONS IN SOIL AND SEDIMENT

SW-846 is not intended to be an analytical training manual. Therefore, method procedures are written based on the assumption that they will be performed by analysts who are formally trained in at least the basic principles of chemical analysis and in the use of the subject technology.

In addition, SW-846 methods, with the exception of required method use for the analysis of method-defined parameters, are intended to be guidance methods which contain general information on how to perform an analytical procedure or technique which a laboratory can use as a basic starting point for generating its own detailed Standard Operating Procedure (SOP), either for its own general use or for a specific project application. The performance data included in this method are for guidance purposes only, and are not intended to be and must not be used as absolute QC acceptance criteria for purposes of laboratory accreditation.

1.0 SCOPE AND APPLICATION

1.1 This method is applicable to the in situ and intrusive analysis of the 26 analytes listed below for soil and sediment samples. Some common elements are not listed in this method because they are considered "light" elements that cannot be detected by field portable x-ray fluorescence (FPXRF). These light elements are: lithium, beryllium, sodium, magnesium, aluminum, silicon, and phosphorus. Most of the analytes listed below are of environmental concern, while a few others have interference effects or change the elemental composition of the matrix, affecting quantitation of the analytes of interest. Generally elements of atomic number 16 or greater can be detected and quantitated by FPXRF. The following RCRA analytes have been determined by this method:

Analytes	CAS Registry No.
Antimony (Sb)	7440-36-0
Arsenic (As)	7440-38-0
Barium (Ba)	7440-39-3
Cadmium (Cd)	7440-43-9
Chromium (Cr)	7440-47-3
Cobalt (Co)	7440-48-4
Copper (Cu)	7440-50-8
Lead (Pb)	7439-92-1
Mercury (Hg)	7439-97-6
Nickel (Ni)	7440-02-0
Selenium (Se)	7782-49-2
Silver (Ag)	7440-22-4
Thallium (Tl)	7440-28-0
Tin (Sn)	7440-31-5

Analytes	CAS Registry No.
Vanadium (V)	7440-62-2
Zinc (Zn)	7440-66-6

In addition, the following non-RCRA analytes have been determined by this method:

Analytes	CAS Registry No.
Calcium (Ca)	7440-70-2
Iron (Fe)	7439-89-6
Manganese (Mn)	7439-96-5
Molybdenum (Mo)	7439-93-7
Potassium (K)	7440-09-7
Rubidium (Rb)	7440-17-7
Strontium (Sr)	7440-24-6
Thorium (Th)	7440-29-1
Titanium (Ti)	7440-32-6
Zirconium (Zr)	7440-67-7

1.2 This method is a screening method to be used with confirmatory analysis using other techniques (e.g., flame atomic absorption spectrometry (FLAA), graphite furnance atomic absorption spectrometry (GFAA), inductively coupled plasma-atomic emission spectrometry, (ICP-AES), or inductively coupled plasma-mass spectrometry, (ICP-MS)). This method's main strength is that it is a rapid field screening procedure. The method's lower limits of detection are typically above the toxicity characteristic regulatory level for most RCRA analytes. However, when the obtainable values for precision, accuracy, and laboratory-established sensitivity of this method meet project-specific data quality objectives (DQOs), FPXRF is a fast, powerful, cost effective technology for site characterization.

1.3 The method sensitivity or lower limit of detection depends on several factors, including the analyte of interest, the type of detector used, the type of excitation source, the strength of the excitation source, count times used to irradiate the sample, physical matrix effects, chemical matrix effects, and interelement spectral interferences. Example lower limits of detection for analytes of interest in environmental applications are shown in Table 1. These limits apply to a clean spiked matrix of quartz sand (silicon dioxide) free of interelement spectral interferences using long (100 -600 second) count times. These sensitivity values are given for guidance only and may not always be achievable, since they will vary depending on the sample matrix, which instrument is used, and operating conditions. A discussion of performance-based sensitivity is presented in Sec. 9.6.

1.4 Analysts should consult the disclaimer statement at the front of the manual and the information in Chapter Two for guidance on the intended flexibility in the choice of methods, apparatus, materials, reagents, and supplies, and on the responsibilities of the analyst for demonstrating that the techniques employed are appropriate for the analytes of interest, in the matrix of interest, and at the levels of concern.

In addition, analysts and data users are advised that, except where explicitly specified in a regulation, the use of SW-846 methods is *not* mandatory in response to Federal testing requirements. The information contained in this method is provided by EPA as guidance to be used by the analyst and the regulated community in making judgments necessary to generate results that meet the data quality objectives for the intended application.

1.5 Use of this method is restricted to use by, or under supervision of, personnel appropriately experienced and trained in the use and operation of an XRF instrument. Each analyst must demonstrate the ability to generate acceptable results with this method.

2.0 SUMMARY OF METHOD

2.1 The FPXRF technologies described in this method use either sealed radioisotope sources or x-ray tubes to irradiate samples with x-rays. When a sample is irradiated with x-rays, the source x-rays may undergo either scattering or absorption by sample atoms. This latter process is known as the photoelectric effect. When an atom absorbs the source x-rays, the incident radiation dislodges electrons from the innermost shells of the atom, creating vacancies. The electron vacancies are filled by electrons cascading in from outer electron shells. Electrons in outer shells have higher energy states than inner shell electrons, and the outer shell electrons give off energy as they cascade down into the inner shell vacancies. This rearrangement of electrons results in emission of x-rays characteristic of the given atom. The emission of x-rays, in this manner, is termed x-ray fluorescence.

Three electron shells are generally involved in emission of x-rays during FPXRF analysis of environmental samples. The three electron shells include the K, L, and M shells. A typical emission pattern, also called an emission spectrum, for a given metal has multiple intensity peaks generated from the emission of K, L, or M shell electrons. The most commonly measured x-ray emissions are from the K and L shells; only metals with an atomic number greater than 57 have measurable M shell emissions.

Each characteristic x-ray line is defined with the letter K, L, or M, which signifies which shell had the original vacancy and by a subscript alpha (α), beta (β), or gamma (γ) etc., which indicates the higher shell from which electrons fell to fill the vacancy and produce the x-ray. For example, a K_α line is produced by a vacancy in the K shell filled by an L shell electron, whereas a K_β line is produced by a vacancy in the K shell filled by an M shell electron. The K_α transition is on average 6 to 7 times more probable than the K_β transition; therefore, the K_α line is approximately 7 times more intense than the K_β line for a given element, making the K_α line the choice for quantitation purposes.

The K lines for a given element are the most energetic lines and are the preferred lines for analysis. For a given atom, the x-rays emitted from L transitions are always less energetic than those emitted from K transitions. Unlike the K lines, the main L emission lines (L_α and L_β) for an element are of nearly equal intensity. The choice of one or the other depends on what interfering element lines might be present. The L emission lines are useful for analyses involving elements of atomic number (Z) 58 (cerium) through 92 (uranium).

An x-ray source can excite characteristic x-rays from an element only if the source energy is greater than the absorption edge energy for the particular line group of the element, that is, the K absorption edge, L absorption edge, or M absorption edge energy. The absorption edge energy is somewhat greater than the corresponding line energy. Actually, the K absorption edge energy is approximately the sum of the K, L, and M line energies of the particular element, and the L absorption edge energy is approximately the sum of the L and M line energies. FPXRF is more sensitive to an element with an absorption edge energy close to but less than the excitation energy of the source. For example, when using a cadmium-109 source, which has an excitation energy of 22.1 kiloelectron volts (keV), FPXRF would exhibit better sensitivity for zirconium which has a K line energy of 15.77 keV than to chromium, which has a K line energy of 5.41 keV.

2.2 Under this method, inorganic analytes of interest are identified and quantitated using a field portable energy-dispersive x-ray fluorescence spectrometer. Radiation from one or more radioisotope sources or an electrically excited x-ray tube is used to generate characteristic x-ray emissions from elements in a sample. Up to three sources may be used to irradiate a sample. Each source emits a specific set of primary x-rays that excite a corresponding range of elements in a sample. When more than one source can excite the element of interest, the source is selected according to its excitation efficiency for the element of interest.

For measurement, the sample is positioned in front of the probe window. This can be done in two manners using FPXRF instruments, specifically, in situ or intrusive. If operated in the in situ mode, the probe window is placed in direct contact with the soil surface to be analyzed. When an FPXRF instrument is operated in the intrusive mode, a soil or sediment sample must be collected, prepared, and placed in a sample cup. The sample cup is then placed on top of the window inside a protective cover for analysis.

Sample analysis is then initiated by exposing the sample to primary radiation from the source. Fluorescent and backscattered x-rays from the sample enter through the detector window and are converted into electric pulses in the detector. The detector in FPXRF instruments is usually either a solid-state detector or a gas-filled proportional counter. Within the detector, energies of the characteristic x-rays are converted into a train of electric pulses, the amplitudes of which are linearly proportional to the energy of the x-rays. An electronic multichannel analyzer (MCA) measures the pulse amplitudes, which is the basis of qualitative x-ray analysis. The number of counts at a given energy per unit of time is representative of the element concentration in a sample and is the basis for quantitative analysis. Most FPXRF instruments are menu-driven from software built into the units or from personal computers (PC).

The measurement time of each source is user-selectable. Shorter source measurement times (30 seconds) are generally used for initial screening and hot spot delineation, and longer measurement times (up to 300 seconds) are typically used to meet higher precision and accuracy requirements.

FPXRF instruments can be calibrated using the following methods: internally using fundamental parameters determined by the manufacturer, empirically based on site-specific calibration standards (SSCS), or based on Compton peak ratios. The Compton peak is produced by backscattering of the source radiation. Some FPXRF instruments can be calibrated using multiple methods.

3.0 DEFINITIONS

3.1 FPXRF -- Field portable x-ray fluorescence.

3.2 MCA -- Multichannel analyzer for measuring pulse amplitude.

3.3 SSCS -- Site-specific calibration standards.

3.4 FP -- Fundamental parameter.

3.5 ROI -- Region of interest.

3.6 SRM -- Standard reference material; a standard containing certified amounts of metals in soil or sediment.

3.7 eV -- Electron volt; a unit of energy equivalent to the amount of energy gained by an electron passing through a potential difference of one volt.

3.8 Refer to Chapter One, Chapter Three, and the manufacturer's instructions for other definitions that may be relevant to this procedure.

4.0 INTERFERENCES

4.1 The total method error for FPXRF analysis is defined as the square root of the sum of squares of both instrument precision and user- or application-related error. Generally, instrument precision is the least significant source of error in FPXRF analysis. User- or application-related error is generally more significant and varies with each site and method used. Some sources of interference can be minimized or controlled by the instrument operator, but others cannot. Common sources of user- or application-related error are discussed below.

4.2 Physical matrix effects result from variations in the physical character of the sample. These variations may include such parameters as particle size, uniformity, homogeneity, and surface condition. For example, if any analyte exists in the form of very fine particles in a coarser-grained matrix, the analyte's concentration measured by the FPXRF will vary depending on how fine particles are distributed within the coarser-grained matrix. If the fine particles "settle" to the bottom of the sample cup (i.e., against the cup window), the analyte concentration measurement will be higher than if the fine particles are not mixed in well and stay on top of the coarser-grained particles in the sample cup. One way to reduce such error is to grind and sieve all soil samples to a uniform particle size thus reducing sample-to-sample particle size variability. Homogeneity is always a concern when dealing with soil samples. Every effort should be made to thoroughly mix and homogenize soil samples before analysis. Field studies have shown heterogeneity of the sample generally has the largest impact on comparability with confirmatory samples.

4.3 Moisture content may affect the accuracy of analysis of soil and sediment sample analyses. When the moisture content is between 5 and 20 percent, the overall error from moisture may be minimal. However, moisture content may be a major source of error when analyzing samples of surface soil or sediment that are saturated with water. This error can be minimized by drying the samples in a convection or toaster oven. Microwave drying is not recommended because field studies have shown that microwave drying can increase variability between FPXRF data and confirmatory analysis and because metal fragments in the sample can cause arcing to occur in a microwave.

4.4 Inconsistent positioning of samples in front of the probe window is a potential source of error because the x-ray signal decreases as the distance from the radioactive source increases. This error is minimized by maintaining the same distance between the window and each sample. For the best results, the window of the probe should be in direct contact with the sample, which means that the sample should be flat and smooth to provide a good contact surface.

4.5 Chemical matrix effects result from differences in the concentrations of interfering elements. These effects occur as either spectral interferences (peak overlaps) or as x-ray absorption and enhancement phenomena. Both effects are common in soils contaminated with heavy metals. As examples of absorption and enhancement effects; iron (Fe) tends to absorb copper (Cu) x-rays, reducing the intensity of the Cu measured by the detector, while chromium (Cr) will be enhanced at the expense of Fe because the absorption edge of Cr is slightly lower in energy than the fluorescent peak of iron. The effects can be corrected mathematically through the use of fundamental parameter (FP) coefficients. The effects also can be compensated for using SSCS, which contain all the elements present on site that can interfere with one another.

4.6 When present in a sample, certain x-ray lines from different elements can be very close in energy and, therefore, can cause interference by producing a severely overlapped spectrum. The degree to which a detector can resolve the two different peaks depends on the energy resolution of the detector. If the energy difference between the two peaks in electron volts is less than the resolution of the detector in electron volts, then the detector will not be able to fully resolve the peaks.

The most common spectrum overlaps involve the K_β line of element Z-1 with the K_α line of element Z. This is called the K_α/K_β interference. Because the K_α:K_β intensity ratio for a given element usually is about 7:1, the interfering element, Z-1, must be present at large concentrations to cause a problem. Two examples of this type of spectral interference involve the presence of large concentrations of vanadium (V) when attempting to measure Cr or the presence of large concentrations of Fe when attempting to measure cobalt (Co). The V K_α and K_β energies are 4.95 and 5.43 keV, respectively, and the Cr K_α energy is 5.41 keV. The Fe K_α and K_β energies are 6.40 and 7.06 keV, respectively, and the Co K_α energy is 6.92 keV. The difference between the V K_β and Cr K_α energies is 20 eV, and the difference between the Fe K_β and the Co K_α energies is 140 eV. The resolution of the highest-resolution detectors in FPXRF instruments is 170 eV. Therefore, large amounts of V and Fe will interfere with quantitation of Cr or Co, respectively. The presence of Fe is a frequent problem because it is often found in soils at tens of thousands of parts per million (ppm).

4.7 Other interferences can arise from K/L, K/M, and L/M line overlaps, although these overlaps are less common. Examples of such overlap involve arsenic (As) K_α/lead (Pb) L_α and sulfur (S) K_α/Pb M_α. In the As/Pb case, Pb can be measured from the Pb L_β line, and As can be measured from either the As K_α or the As K_β line; in this way the interference can be corrected. If the As K_β line is used, sensitivity will be decreased by a factor of two to five times because it is a less intense line than the As K_α line. If the As K_α line is used in the presence of Pb, mathematical corrections within the instrument software can be used to subtract out the Pb interference. However, because of the limits of mathematical corrections, As concentrations cannot be efficiently calculated for samples with Pb:As ratios of 10:1 or more. This high ratio of Pb to As may result in reporting of a "nondetect" or a "less than" value (e.g., <300 ppm) for As, regardless of the actual concentration present.

No instrument can fully compensate for this interference. It is important for an operator to understand this limitation of FPXRF instruments and consult with the manufacturer of the FPXRF instrument to evaluate options to minimize this limitation. The operator's decision will be based on action levels for metals in soil established for the site, matrix effects, capabilities of the instrument, data quality objectives, and the ratio of lead to arsenic known to be present at the site. If a site is encountered that contains lead at concentrations greater than ten times the concentration of arsenic it is advisable that all critical soil samples be sent off site for confirmatory analysis using other techniques (e.g., flame atomic absorption spectrometry (FLAA), graphite furnance atomic absorption spectrometry (GFAA), inductively coupled plasma-atomic emission spectrometry, (ICP-AES), or inductively coupled plasma-mass spectrometry, (ICP-MS)).

4.8 If SSCS are used to calibrate an FPXRF instrument, the samples collected must be representative of the site under investigation. Representative soil sampling ensures that a sample or group of samples accurately reflects the concentrations of the contaminants of concern at a given time and location. Analytical results for representative samples reflect variations in the presence and concentration ranges of contaminants throughout a site. Variables affecting sample representativeness include differences in soil type, contaminant concentration variability, sample collection and preparation variability, and analytical variability, all of which should be minimized as much as possible.

4.9 Soil physical and chemical effects may be corrected using SSCS that have been analyzed by inductively coupled plasma (ICP) or atomic absorption (AA) methods. However, a major source of error can be introduced if these samples are not representative of the site or if the analytical error is large. Another concern is the type of digestion procedure used to prepare the soil samples for the reference analysis. Analytical results for the confirmatory method will vary depending on whether a partial digestion procedure, such as Method 3050, or a total digestion procedure, such as Method 3052, is used. It is known that depending on the nature of the soil or sediment, Method 3050 will achieve differing extraction efficiencies for different analytes of interest. The confirmatory method should meet the project-specific data quality objectives (DQOs).

XRF measures the total concentration of an element; therefore, to achieve the greatest comparability of this method with the reference method (reduced bias), a total digestion procedure should be used for sample preparation. However, in the study used to generate the performance data for this method (see Table 8), the confirmatory method used was Method 3050, and the FPXRF data compared very well with regression correlation coefficients (r often exceeding 0.95, except for barium and chromium). The critical factor is that the digestion procedure and analytical reference method used should meet the DQOs of the project and match the method used for confirmation analysis.

4.10 Ambient temperature changes can affect the gain of the amplifiers producing instrument drift. Gain or drift is primarily a function of the electronics (amplifier or preamplifier) and not the detector as most instrument detectors are cooled to a constant temperature. Most FPXRF instruments have a built-in automatic gain control. If the automatic gain control is allowed to make periodic adjustments, the instrument will compensate for the influence of temperature changes on its energy scale. If the FPXRF instrument has an automatic gain control function, the operator will not have to adjust the instrument's gain unless an error message appears. If an error message appears, the operator should follow the manufacturer's procedures for troubleshooting the problem. Often, this involves performing a new energy calibration. The performance of an energy calibration check to assess drift is a quality control measure discussed in Sec. 9.2.

If the operator is instructed by the manufacturer to manually conduct a gain check because of increasing or decreasing ambient temperature, it is standard to perform a gain check after every 10 to 20 sample measurements or once an hour whichever is more frequent. It is also suggested that a gain check be performed if the temperature fluctuates more than 10° F. The operator should follow the manufacturer's recommendations for gain check frequency.

5.0 SAFETY

5.1 This method does not address all safety issues associated with its use. The user is responsible for maintaining a safe work environment and a current awareness file of OSHA regulations regarding the safe handling of the chemicals listed in this method. A reference file of material safety data sheets (MSDSs) should be available to all personnel involved in these analyses.

NOTE: No MSDS applies directly to the radiation-producing instrument because that is covered under the Nuclear Regulatory Commission (NRC) or applicable state regulations.

5.2 Proper training for the safe operation of the instrument and radiation training should be completed by the analyst prior to analysis. Radiation safety for each specific instrument can be found in the operator's manual. Protective shielding should never be removed by the analyst or any personnel other than the manufacturer. The analyst should be aware of the local state and national regulations that pertain to the use of radiation-producing equipment and radioactive materials with which compliance is required. There should be a person appointed within the organization that is solely responsible for properly instructing all personnel, maintaining inspection records, and monitoring x-ray equipment at regular intervals.

Licenses for radioactive materials are of two types, specifically: (1) a general license which is usually initiated by the manufacturer for receiving, acquiring, owning, possessing, using, and transferring radioactive material incorporated in a device or equipment, and (2) a specific license which is issued to named persons for the operation of radioactive instruments as required by local, state, or federal agencies. A copy of the radioactive material license (for specific licenses only) and leak tests should be present with the instrument at all times and available to local and national authorities upon request.

X-ray tubes do not require radioactive material licenses or leak tests, but do require approvals and licenses which vary from state to state. In addition, fail-safe x-ray warning lights should be illuminated whenever an x-ray tube is energized. Provisions listed above concerning radiation safety regulations, shielding, training, and responsible personnel apply to x-ray tubes just as to radioactive sources. In addition, a log of the times and operating conditions should be kept whenever an x-ray tube is energized. An additional hazard present with x-ray tubes is the danger of electric shock from the high voltage supply, however, if the tube is properly positioned within the instrument, this is only a negligible risk. Any instrument (x-ray tube or radioisotope based) is capable of delivering an electric shock from the basic circuitry when the system is inappropriately opened.

5.3 Radiation monitoring equipment should be used with the handling and operation of the instrument. The operator and the surrounding environment should be monitored continually for analyst exposure to radiation. Thermal luminescent detectors (TLD) in the form of badges and rings are used to monitor operator radiation exposure. The TLDs or badges should be worn in the area of maximum exposure. The maximum permissible whole-body dose from occupational exposure is 5 Roentgen Equivalent Man (REM) per year. Possible exposure pathways for radiation to enter the body are ingestion, inhaling, and absorption. The best precaution to prevent radiation exposure is distance and shielding.

6.0 EQUIPMENT AND SUPPLIES

The mention of trade names or commercial products in this manual is for illustrative purposes only, and does not constitute an EPA endorsement or exclusive recommendation for use. The products and instrument settings cited in SW-846 methods represent those products and settings used during method development or subsequently evaluated by the Agency. Glassware, reagents, supplies, equipment, and settings other than those listed in this manual may be employed provided that method performance appropriate for the intended application has been demonstrated and documented.

6.1 FPXRF spectrometer -- An FPXRF spectrometer consists of four major components: (1) a source that provides x-rays; (2) a sample presentation device; (3) a detector that converts x-ray-generated photons emitted from the sample into measurable electronic signals; and (4) a data processing unit that contains an emission or fluorescence energy analyzer, such as an MCA, that processes the signals into an x-ray energy spectrum from which elemental concentrations in the sample may be calculated, and a data display and storage system. These components and additional, optional items, are discussed below.

6.1.1 Excitation sources -- FPXRF instruments use either a sealed radioisotope source or an x-ray tube to provide the excitation source. Many FPXRF instruments use sealed radioisotope sources to produce x-rays in order to irradiate samples. The FPXRF instrument may contain between one and three radioisotope sources. Common radioisotope sources used for analysis for metals in soils are iron Fe-55 (^{55}Fe), cadmium Cd-109 (^{109}Cd), americium Am-241 (^{241}Am), and curium Cm-244 (^{244}Cm). These sources may be contained in a probe along with a window and the detector; the probe may be connected to a data reduction and handling system by means of a flexible cable. Alternatively, the sources, window, and detector may be included in the same unit as the data reduction and handling system.

The relative strength of the radioisotope sources is measured in units of millicuries (mCi). All other components of the FPXRF system being equal, the stronger the source, the greater the sensitivity and precision of a given instrument. Radioisotope sources undergo constant decay. In fact, it is this decay process that emits the primary x-rays used to excite samples for FPXRF analysis. The decay of radioisotopes is measured in "half-lives." The half-life of a radioisotope is defined as the length of time required to reduce the radioisotopes strength or activity by half. Developers of FPXRF technologies recommend source replacement at regular intervals based on the source's half-life. This is due to the ever increasing time required for the analysis rather than a decrease in instrument performance. The characteristic x-rays emitted from each of the different sources have energies capable of exciting a certain range of analytes in a sample. Table 2 summarizes the characteristics of four common radioisotope sources.

X-ray tubes have higher radiation output, no intrinsic lifetime limit, produce constant output over their lifetime, and do not have the disposal problems of radioactive sources but are just now appearing in FPXRF instruments. An electrically-excited x-ray tube operates by bombarding an anode with electrons accelerated by a high voltage. The electrons gain an energy in electron volts equal to the accelerating voltage and can excite atomic transitions in the anode, which then produces characteristic x-rays. These characteristic x-rays are emitted through a window which contains the vacuum necessary for the electron acceleration. An important difference between x-ray tubes and radioactive sources is that the electrons which bombard the anode also produce a continuum of x-rays across a broad range of energies in addition to the characteristic x-rays. This continuum is weak compared to the characteristic x-rays but can provide substantial excitation since it covers a broad energy range. It has the undesired property of producing background in the spectrum near the analyte x-ray lines when it is scattered by the sample. For this reason a filter is often used between the x-ray tube and the sample to suppress the continuum radiation while passing the characteristic x-rays from the anode. This filter is sometimes incorporated into the window of the x-ray tube. The choice of accelerating voltage is governed both by the anode material, since the electrons must have sufficient energy to excite the anode, which requires a voltage greater than the absorption edge of the anode material and by the instrument's ability to cool the x-ray tube. The anode is most efficiently excited by voltages 2 to 2.5 times the edge energy (most x-rays per unit power to the tube), although voltages as low as 1.5 times the absorption edge energy will work. The characteristic x-rays emitted by the anode are capable of exciting a range of elements in the sample just as with a radioactive source. Table 3 gives the recommended operating voltages and the sample elements excited for some common anodes.

6.1.2 Sample presentation device -- FPXRF instruments can be operated in two modes: in situ and intrusive. If operated in the in situ mode, the probe window is placed in direct contact with the soil surface to be analyzed. When an FPXRF instrument is operated in the intrusive mode, a soil or sediment sample must be collected, prepared, and placed in a sample cup. For FPXRF instruments operated in the intrusive mode, the probe may be rotated so that the window faces either upward or downward. A protective sample cover is placed over the window, and the sample cup is placed on top of the window inside the protective sample cover for analysis.

6.1.3 Detectors -- The detectors in the FPXRF instruments can be either solid-state detectors or gas-filled, proportional counter detectors. Common solid-state detectors include mercuric iodide (HgI_2), silicon pin diode and lithium-drifted silicon Si(Li). The HgI_2 detector is operated at a moderately subambient temperature controlled by a low power thermoelectric cooler. The silicon pin diode detector also is cooled via the thermoelectric Peltier effect. The Si(Li) detector must be cooled to at least -90 °C either with liquid nitrogen or by thermoelectric cooling via the Peltier effect. Instruments with a Si(Li) detector have an internal liquid nitrogen dewar with a capacity of 0.5 to 1.0 L. Proportional counter detectors are rugged and lightweight, which are important features of a field portable detector. However, the resolution of a proportional counter detector is not as good as that of a solid-state detector. The energy resolution of a detector for characteristic x-rays is usually expressed in terms of full width at half-maximum (FWHM) height of the manganese K_α peak at 5.89 keV. The typical resolutions of the above mentioned detectors are as follows: HgI_2-270 eV; silicon pin diode-250 eV; Si(Li)–170 eV; and gas-filled, proportional counter-750 eV.

During operation of a solid-state detector, an x-ray photon strikes a biased, solid-state crystal and loses energy in the crystal by producing electron-hole pairs. The electric charge produced is collected and provides a current pulse that is directly proportional to the energy of the x-ray photon absorbed by the crystal of the detector. A gas-filled, proportional counter detector is an ionization chamber filled with a mixture of noble and other gases. An x-ray photon entering the chamber ionizes the gas atoms. The electric charge produced is collected and provides an electric signal that is directly proportional to the energy of the x-ray photon absorbed by the gas in the detector.

6.1.4 Data processing units -- The key component in the data processing unit of an FPXRF instrument is the MCA. The MCA receives pulses from the detector and sorts them by their amplitudes (energy level). The MCA counts pulses per second to determine the height of the peak in a spectrum, which is indicative of the target analyte's concentration. The spectrum of element peaks are built on the MCA. The MCAs in FPXRF instruments have from 256 to 2,048 channels. The concentrations of target analytes are usually shown in ppm on a liquid crystal display (LCD) in the instrument. FPXRF instruments can store both spectra and from 3,000 to 5,000 sets of numerical analytical results. Most FPXRF instruments are menu-driven from software built into the units or from PCs. Once the data–storage memory of an FPXRF unit is full or at any other time, data can be downloaded by means of an RS-232 port and cable to a PC.

6.2 Spare battery and battery charger.

6.3 Polyethylene sample cups -- 31 to 40 mm in diameter with collar, or equivalent (appropriate for FPXRF instrument).

6.4 X-ray window film -- Mylar™, Kapton™, Spectrolene™, polypropylene, or equivalent; 2.5 to 6.0 µm thick.

6.5 Mortar and pestle -- Glass, agate, or aluminum oxide; for grinding soil and sediment samples.

6.6 Containers -- Glass or plastic to store samples.

6.7 Sieves -- 60-mesh (0.25 mm), stainless-steel, Nylon, or equivalent for preparing soil and sediment samples.

6.8 Trowels -- For smoothing soil surfaces and collecting soil samples.

6.9 Plastic bags -- Used for collection and homogenization of soil samples.

6.10 Drying oven -- Standard convection or toaster oven, for soil and sediment samples that require drying.

7.0 REAGENTS AND STANDARDS

7.1 Reagent grade chemicals must be used in all tests. Unless otherwise indicated, it is intended that all reagents conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

7.2 Pure element standards -- Each pure, single-element standard is intended to produce strong characteristic x-ray peaks of the element of interest only. Other elements present must not contribute to the fluorescence spectrum. A set of pure element standards for commonly sought analytes is supplied by the instrument manufacturer, if designated for the instrument; not all instruments require the pure element standards. The standards are used to set the region of interest (ROI) for each element. They also can be used as energy calibration and resolution check samples.

7.3 Site-specific calibration standards -- Instruments that employ fundamental parameters (FP) or similar mathematical models in minimizing matrix effects may not require SSCS. If the FP calibration model is to be optimized or if empirical calibration is necessary, then SSCSs must be collected, prepared, and analyzed.

7.3.1 The SSCS must be representative of the matrix to be analyzed by FPXRF. These samples must be well homogenized. A minimum of 10 samples spanning the concentration ranges of the analytes of interest and of the interfering elements must be obtained from the site. A sample size of 4 to 8 ounces is recommended, and standard glass sampling jars should be used.

7.3.2 Each sample should be oven-dried for 2 to 4 hr at a temperature of less than 150 °C. If mercury is to be analyzed, a separate sample portion should be dried at ambient temperature as heating may volatilize the mercury. When the sample is dry, all large, organic debris and nonrepresentative material, such as twigs, leaves, roots, insects, asphalt, and rock should be removed. The sample should be homogenized (see Sec. 7.3.3) and then a representative portion ground with a mortar and pestle or other mechanical means, prior to passing through a 60-mesh sieve. Only the coarse rock fraction should remain on the screen.

7.3.3 The sample should be homogenized by using a riffle splitter or by placing 150 to 200 g of the dried, sieved sample on a piece of kraft or butcher paper about 1.5 by 1.5 feet in size. Each corner of the paper should be lifted alternately, rolling the soil over on itself and toward the opposite corner. The soil should be rolled on itself 20 times. Approximately 5 g of the sample should then be removed and placed in a sample cup for FPXRF analysis. The rest of the prepared sample should be sent off site for ICP or AA analysis. The method use for confirmatory analysis should meet the data quality objectives of the project.

7.4 Blank samples -- The blank samples should be from a "clean" quartz or silicon dioxide matrix that is free of any analytes at concentrations above the established lower limit of detection. These samples are used to monitor for cross-contamination and laboratory-induced contaminants or interferences.

7.5 Standard reference materials -- Standard reference materials (SRMs) are standards containing certified amounts of metals in soil or sediment. These standards are used for accuracy and performance checks of FPXRF analyses. SRMs can be obtained from the National Institute of Standards and Technology (NIST), the U.S. Geological Survey (USGS), the Canadian National Research Council, and the national bureau of standards in foreign nations. Pertinent NIST SRMs for FPXRF analysis include 2704, Buffalo River Sediment; 2709, San Joaquin Soil; and 2710 and 2711, Montana Soil. These SRMs contain soil or sediment from actual sites that has been analyzed using independent inorganic analytical methods by many different laboratories. When these SRMs are unavailable, alternate standards may be used (e.g., NIST 2702).

8.0 SAMPLE COLLECTION, PRESERVATION, AND STORAGE

Sample handling and preservation procedures used in FPXRF analyses should follow the guidelines in Chapter Three, "Inorganic Analytes."

9.0 QUALITY CONTROL

9.1 Follow the manufacturer's instructions for the quality control procedures specific to use of the testing product. Refer to Chapter One for additional guidance on quality assurance (QA) and quality control (QC) protocols. Any effort involving the collection of analytical data should include development of a structured and systematic planning document, such as a Quality Assurance Project Plan (QAPP) or a Sampling and Analysis Plan (SAP), which translates project objectives and specifications into directions for those that will implement the project and assess the results.

9.2 Energy calibration check -- To determine whether an FPXRF instrument is operating within resolution and stability tolerances, an energy calibration check should be run. The energy calibration check determines whether the characteristic x-ray lines are shifting, which would indicate drift within the instrument. As discussed in Sec. 4.10, this check also serves as a gain check in the event that ambient temperatures are fluctuating greatly (more than 10 °F).

9.2.1 The energy calibration check should be run at a frequency consistent with manufacturer's recommendations. Generally, this would be at the beginning of each working day, after the batteries are changed or the instrument is shut off, at the end of each working day, and at any other time when the instrument operator believes that drift is occurring during analysis. A pure element such as iron, manganese, copper, or lead is often used for the energy calibration check. A manufacturer-recommended count time per source should be used for the check.

9.2.2 The instrument manufacturer's manual specifies the channel or kiloelectron volt level at which a pure element peak should appear and the expected intensity of the peak. The intensity and channel number of the pure element as measured using the source should be checked and compared to the manufacturer's recommendation. If the energy calibration check does not meet the manufacturer's criteria, then the pure element sample should be repositioned and reanalyzed. If the criteria are still not met, then an energy calibration should be performed as described in the manufacturer's manual. With some FPXRF instruments, once a spectrum is acquired from the energy calibration check, the peak can be optimized and realigned to the manufacturer's specifications using their software.

9.3 Blank samples -- Two types of blank samples should be analyzed for FPXRF analysis, specifically, instrument blanks and method blanks.

9.3.1 An instrument blank is used to verify that no contamination exists in the spectrometer or on the probe window. The instrument blank can be silicon dioxide, a polytetraflurorethylene (PTFE) block, a quartz block, "clean" sand, or lithium carbonate. This instrument blank should be analyzed on each working day before and after analyses are conducted and once per every twenty samples. An instrument blank should also be analyzed whenever contamination is suspected by the analyst. The frequency of analysis will vary with the data quality objectives of the project. A manufacturer-recommended count time per source should be used for the blank analysis. No element concentrations above the established lower limit of detection should be found in the instrument blank. If concentrations exceed these limits, then the probe window and the check sample should be checked for contamination. If contamination is not a problem, then the instrument must be "zeroed" by following the manufacturer's instructions.

9.3.2 A method blank is used to monitor for laboratory-induced contaminants or interferences. The method blank can be "clean" silica sand or lithium carbonate that undergoes the same preparation procedure as the samples. A method blank must be analyzed at least daily. The frequency of analysis will depend on the data quality objectives of the project. If the method blank does not contain the target analyte at a level that interferes with the project-specific data quality objectives then the method blank would be considered acceptable. In the absence of project-specific data quality objectives, if the blank is less than the lowest level of detection or less than 10% of the lowest sample concentration for the analyte, whichever is greater, then the method blank would be considered acceptable. If the method blank cannot be considered acceptable, the cause of the problem must be identified, and all samples analyzed with the method blank must be reanalyzed.

9.4 Calibration verification checks -- A calibration verification check sample is used to check the accuracy of the instrument and to assess the stability and consistency of the analysis for the analytes of interest. A check sample should be analyzed at the beginning of each working day, during active sample analyses, and at the end of each working day. The frequency of calibration checks during active analysis will depend on the data quality objectives of the project. The check sample should be a well characterized soil sample from the site that is representative of site samples in terms of particle size and degree of homogeneity and that contains contaminants at concentrations near the action levels. If a site-specific sample is not available, then an NIST or other SRM that contains the analytes of interest can be used to verify the accuracy of the instrument. The measured value for each target analyte should be within ±20 percent (%D) of the true value for the calibration verification check to be acceptable. If a measured value falls outside this range, then the check sample should be reanalyzed. If the value continues to fall outside the acceptance range, the instrument should be recalibrated, and the batch of samples analyzed before the unacceptable calibration verification check must be reanalyzed.

9.5 Precision measurements -- The precision of the method is monitored by analyzing a sample with low, moderate, or high concentrations of target analytes. The frequency of precision measurements will depend on the data quality objectives for the data. A minimum of one precision sample should be run per day. Each precision sample should be analyzed 7 times in replicate. It is recommended that precision measurements be obtained for samples with varying concentration ranges to assess the effect of concentration on method precision. Determining method precision for analytes at concentrations near the site action levels can be extremely important if the FPXRF results are to be used in an enforcement action; therefore, selection of at least one sample with target analyte concentrations at or near the site action levels or levels of concern is recommended. A precision sample is analyzed by the instrument for the same field analysis time as used for other project samples. The relative standard deviation (RSD) of the sample mean is used to assess method precision. For FPXRF data to be considered adequately precise, the RSD should not be greater than 20 percent with the exception of chromium. RSD values for chromium should not be greater than 30 percent. If both in situ and intrusive analytical techniques are used during the course of one day, it is recommended that separate precision calculations be performed for each analysis type.

The equation for calculating RSD is as follows:

$$RSD = (SD/\text{Mean Concentration}) \times 100$$

where:

RSD = Relative standard deviation for the precision measurement for the analyte
SD = Standard deviation of the concentration for the analyte
Mean concentration = Mean concentration for the analyte

The precision or reproducibility of a measurement will improve with increasing count time, however, increasing the count time by a factor of 4 will provide only 2 times better precision, so there is a point of diminishing return. Increasing the count time also improves the sensitivity, but decreases sample throughput.

9.6 The lower limits of detection should be established from actual measured performance based on spike recoveries in the matrix of concern or from acceptable method performance on a certified reference material of the appropriate matrix and within the appropriate calibration range for the application. This is considered the best estimate of the true method sensitivity as opposed to a statistical determination based on the standard deviation of replicate analyses of a low-concentration sample. While the statistical approach demonstrates the potential data variability for a given sample matrix at one point in time, it does not represent what can be detected or most importantly the lowest concentration that can be calibrated. For this reason the sensitivity should be established as the lowest point of detection based on acceptable target analyte recovery in the desired sample matrix.

9.7 Confirmatory samples -- The comparability of the FPXRF analysis is determined by submitting FPXRF-analyzed samples for analysis at a laboratory. The method of confirmatory analysis must meet the project and XRF measurement data quality objectives. The confirmatory samples must be splits of the well homogenized sample material. In some cases the prepared sample cups can be submitted. A minimum of 1 sample for each 20 FPXRF-analyzed samples should be submitted for confirmatory analysis. This frequency will depend on project-specific data quality objectives. The confirmatory analyses can also be used to verify the quality of the FPXRF data. The confirmatory samples should be selected from the lower, middle, and upper range of concentrations measured by the FPXRF. They should also include samples with analyte concentrations at or near the site action levels. The results of the confirmatory analysis and FPXRF analyses should be evaluated with a least squares linear regression analysis. If the measured concentrations span more than one order of magnitude, the data should be log-transformed to standardize variance which is proportional to the magnitude of measurement. The correlation coefficient (r) for the results should be 0.7 or greater for the FPXRF data to be considered screening level data. If the r is 0.9 or greater and inferential statistics indicate the FPXRF data and the confirmatory data are statistically equivalent at a 99 percent confidence level, the data could potentially meet definitive level data criteria.

10.0 CALIBRATION AND STANDARDIZATION

10.1 Instrument calibration -- Instrument calibration procedures vary among FPXRF instruments. Users of this method should follow the calibration procedures outlined in the operator's manual for each specific FPXRF instrument. Generally, however, three types of calibration procedures exist for FPXRF instruments, namely: FP calibration, empirical calibration, and the Compton peak ratio or normalization method. These three types of calibration are discussed below.

10.2 Fundamental parameters calibration -- FP calibration procedures are extremely variable. An FP calibration provides the analyst with a "standardless" calibration. The advantages of FP calibrations over empirical calibrations include the following:

- No previously collected site-specific samples are necessary, although site-specific samples with confirmed and validated analytical results for all elements present could be used.

- Cost is reduced because fewer confirmatory laboratory results or calibration standards are necessary.

However, the analyst should be aware of the limitations imposed on FP calibration by particle size and matrix effects. These limitations can be minimized by adhering to the preparation procedure described in Sec. 7.3. The two FP calibration processes discussed below are based on an effective energy FP routine and a back scatter with FP (BFP) routine. Each FPXRF FP calibration process is based on a different iterative algorithmic method. The calibration procedure for each routine is explained in detail in the manufacturer's user manual for each FPXRF instrument; in addition, training courses are offered for each instrument.

10.2.1 Effective energy FP calibration -- The effective energy FP calibration is performed by the manufacturer before an instrument is sent to the analyst. Although SSCS can be used, the calibration relies on pure element standards or SRMs such as those obtained from NIST for the FP calibration. The effective energy routine relies on the spectrometer response to pure elements and FP iterative algorithms to compensate for various matrix effects.

Alpha coefficients are calculated using a variation of the Sherman equation, which calculates theoretical intensities from the measurement of pure element samples. These coefficients indicate the quantitative effect of each matrix element on an analyte's measured x-ray intensity. Next, the Lachance Traill algorithm is solved as a set of simultaneous equations based on the theoretical intensities. The alpha coefficients are then downloaded into the specific instrument.

The working effective energy FP calibration curve must be verified before sample analysis begins on each working day, after every 20 samples are analyzed, and at the end of sampling. This verification is performed by analyzing either an NIST SRM or an SSCS that is representative of the site-specific samples. This SRM or SSCS serves as a calibration check. A manufacturer-recommended count time per source should be used for the calibration check. The analyst must then adjust the y-intercept and slope of the calibration curve to best fit the known concentrations of target analytes in the SRM or SSCS.

A percent difference (%D) is then calculated for each target analyte. The %D should be within ±20 percent of the certified value for each analyte. If the %D falls outside this acceptance range, then the calibration curve should be adjusted by varying the slope of the line or the y-intercept value for the analyte. The SRM or SSCS is reanalyzed until the %D falls within ±20 percent. The group of 20 samples analyzed before an out-of-control calibration check should be reanalyzed.

The equation to calibrate %D is as follows:

$$\%D = ((C_s - C_k) / C_k) \times 100$$

where:

%D = Percent difference
C_k = Certified concentration of standard sample
C_s = Measured concentration of standard sample

10.2.2 BFP calibration -- BFP calibration relies on the ability of the liquid nitrogen-cooled, Si(Li) solid-state detector to separate the coherent (Compton) and incoherent (Rayleigh) backscatter peaks of primary radiation. These peak intensities are known to be a function of sample composition, and the ratio of the Compton to Rayleigh peak is a function of the mass absorption of the sample. The calibration procedure is explained in detail in the instrument manufacturer's manual. Following is a general description of the BFP calibration procedure.

The concentrations of all detected and quantified elements are entered into the computer software system. Certified element results for an NIST SRM or confirmed and validated results for an SSCS can be used. In addition, the concentrations of oxygen and silicon must be entered; these two concentrations are not found in standard metals analyses. The manufacturer provides silicon and oxygen concentrations for typical soil types. Pure element standards are then analyzed using a manufacturer-recommended count time per source. The results are used to calculate correction factors in order to adjust for spectrum overlap of elements.

The working BFP calibration curve must be verified before sample analysis begins on each working day, after every 20 samples are analyzed, and at the end of the analysis. This verification is performed by analyzing either an NIST SRM or an SSCS that is representative of the site-specific samples. This SRM or SSCS serves as a calibration check. The standard sample is analyzed using a manufacturer-recommended count time per source to check the calibration curve. The analyst must then adjust the y-intercept and slope of the calibration curve to best fit the known concentrations of target analytes in the SRM or SSCS.

A %D is then calculated for each target analyte. The %D should fall within ±20 percent of the certified value for each analyte. If the %D falls outside this acceptance range, then the calibration curve should be adjusted by varying the slope of the line the y-intercept value for the analyte. The standard sample is reanalyzed until the %D falls within ±20 percent. The group of 20 samples analyzed before an out-of-control calibration check should be reanalyzed.

10.3 Empirical calibration -- An empirical calibration can be performed with SSCS, site-typical standards, or standards prepared from metal oxides. A discussion of SSCS is included in Sec. 7.3; if no previously characterized samples exist for a specific site, site-typical standards can be used. Site-typical standards may be selected from commercially available characterized soils or from SSCS prepared for another site. The site-typical standards should closely approximate the site's soil matrix with respect to particle size distribution, mineralogy, and contaminant analytes. If neither SSCS nor site-typical standards are available, it is possible to make gravimetric standards by adding metal oxides to a "clean" sand or silicon dioxide matrix that simulates soil. Metal oxides can be purchased from various chemical vendors. If standards are made on site, a balance capable of weighing items to at least two decimal places is necessary. Concentrated ICP or AA standard solutions can also be used to make standards. These solutions are available in concentrations of 10,000 parts per million, thus only small volumes have to be added to the soil.

An empirical calibration using SSCS involves analysis of SSCS by the FPXRF instrument and by a conventional analytical method such as ICP or AA. A total acid digestion procedure should be used by the laboratory for sample preparation. Generally, a minimum of 10 and a maximum of 30 well characterized SSCS, site-typical standards, or prepared metal oxide standards are necessary to perform an adequate empirical calibration. The exact number of standards depends on the number of analytes of interest and interfering elements. Theoretically, an empirical calibration with SSCS should provide the most accurate data for a site because the calibration compensates for site-specific matrix effects.

The first step in an empirical calibration is to analyze the pure element standards for the elements of interest. This enables the instrument to set channel limits for each element for spectral deconvolution. Next the SSCS, site-typical standards, or prepared metal oxide standards are analyzed using a count time of 200 seconds per source or a count time recommended by the manufacturer. This will produce a spectrum and net intensity of each analyte in each standard. The analyte concentrations for each standard are then entered into the instrument software; these concentrations are those obtained from the laboratory, the certified results, or the gravimetrically determined concentrations of the prepared standards. This gives the instrument analyte values to regress against corresponding intensities during the modeling stage. The regression equation correlates the concentrations of an analyte with its net intensity.

The calibration equation is developed using a least squares fit regression analysis. After the regression terms to be used in the equation are defined, a mathematical equation can be developed to calculate the analyte concentration in an unknown sample. In some FPXRF instruments, the software of the instrument calculates the regression equation. The software uses calculated intercept and slope values to form a multiterm equation. In conjunction with the software in the instrument, the operator can adjust the multiterm equation to minimize interelement interferences and optimize the intensity calibration curve.

It is possible to define up to six linear or nonlinear terms in the regression equation. Terms can be added and deleted to optimize the equation. The goal is to produce an equation with the smallest regression error and the highest correlation coefficient. These values are automatically computed by the software as the regression terms are added, deleted, or modified. It is also possible to delete data points from the regression line if these points are significant outliers or if they are heavily weighing the data. Once the regression equation has been selected for an analyte, the equation can be entered into the software for quantitation of analytes in subsequent samples. For an empirical calibration to be acceptable, the regression equation for a specific analyte should have a correlation coefficient of 0.98 or greater or meet the DQOs of the project.

In an empirical calibration, one must apply the DQOs of the project and ascertain critical or action levels for the analytes of interest. It is within these concentration ranges or around these action levels that the FPXRF instrument should be calibrated most accurately. It may not be possible to develop a good regression equation over several orders of analyte concentration.

10.4 Compton normalization method -- The Compton normalization method is based on analysis of a single, certified standard and normalization for the Compton peak. The Compton peak is produced from incoherent backscattering of x-ray radiation from the excitation source and is present in the spectrum of every sample. The Compton peak intensity changes with differing matrices. Generally, matrices dominated by lighter elements produce a larger Compton peak, and those dominated by heavier elements produce a smaller Compton peak. Normalizing to the Compton peak can reduce problems with varying matrix effects among samples. Compton normalization is similar to the use of internal standards in organics analysis. The Compton normalization method may not be effective when analyte concentrations exceed a few percent.

The certified standard used for this type of calibration could be an NIST SRM such as 2710 or 2711. The SRM must be a matrix similar to the samples and must contain the analytes of interests at concentrations near those expected in the samples. First, a response factor has to be determined for each analyte. This factor is calculated by dividing the net peak intensity by the analyte concentration. The net peak intensity is gross intensity corrected for baseline reading. Concentrations of analytes in samples are then determined by multiplying the baseline corrected analyte signal intensity by the normalization factor and by the response factor. The normalization factor is the quotient of the baseline corrected Compton K_α peak intensity of the SRM divided by that of the samples. Depending on the FPXRF instrument used, these calculations may be done manually or by the instrument software.

11.0 PROCEDURE

11.1 Operation of the various FPXRF instruments will vary according to the manufacturers' protocols. Before operating any FPXRF instrument, one should consult the manufacturer's manual. Most manufacturers recommend that their instruments be allowed to warm up for 15 to 30 minutes before analysis of samples. This will help alleviate drift or energy calibration problems later during analysis.

11.2 Each FPXRF instrument should be operated according to the manufacturer's recommendations. There are two modes in which FPXRF instruments can be operated: in situ and intrusive. The in situ mode involves analysis of an undisturbed soil sediment or sample. Intrusive analysis involves collection and preparation of a soil or sediment sample before analysis. Some FPXRF instruments can operate in both modes of analysis, while others are designed to operate in only one mode. The two modes of analysis are discussed below.

11.3 For in situ analysis, remove any large or nonrepresentative debris from the soil surface before analysis. This debris includes rocks, pebbles, leaves, vegetation, roots, and concrete. Also, the soil surface must be as smooth as possible so that the probe window will have good contact with the surface. This may require some leveling of the surface with a stainless-steel trowel. During the study conducted to provide example performance data for this method, this modest amount of sample preparation was found to take less than 5 min per sample location. The last requirement is that the soil or sediment not be saturated with water. Manufacturers state that their FPXRF instruments will perform adequately for soils with moisture contents of 5 to 20 percent but will not perform well for saturated soils, especially if ponded water exists on the surface. Another recommended technique for in situ analysis is to tamp the soil to increase soil density and compactness for better repeatability and representativeness. This condition is especially important for heavy element analysis, such as barium. Source count times for in situ analysis usually range from 30 to 120 seconds, but source count times will vary among instruments and depending on the desired method sensitivity. Due to the heterogeneous nature of the soil sample, in situ analysis can provide only "screening" type data.

11.4 For intrusive analysis of surface or sediment, it is recommended that a sample be collected from a 4- by 4-inch square that is 1 inch deep. This will produce a soil sample of approximately 375 g or 250 cm^3, which is enough soil to fill an 8-ounce jar. However, the exact dimensions and sample depth should take into consideration the heterogeneous deposition of contaminants and will ultimately depend on the desired project-specific data quality objectives. The sample should be homogenized, dried, and ground before analysis. The sample can be homogenized before or after drying. The homogenization technique to be used after drying is discussed in Sec. 4.2. If the sample is homogenized before drying, it should be thoroughly mixed in a beaker or similar container, or if the sample is moist and has a high clay content, it can be kneaded in a plastic bag. One way to monitor homogenization when the sample is kneaded in a plastic bag is to add sodium fluorescein dye to the sample. After the moist sample has been homogenized, it is examined under an ultraviolet light to assess the distribution of sodium fluorescein throughout the sample. If the fluorescent dye is evenly distributed in the sample, homogenization is considered complete; if the dye is not evenly distributed, mixing should continue until the sample has been thoroughly homogenized. During the study conducted to provide data for this method, the time necessary for homogenization procedure using the fluorescein dye ranged from 3 to 5 min per sample. As demonstrated in Secs. 13.5 and 13.7, homogenization has the greatest impact on the reduction of sampling variability. It produces little or no contamination. Often, the direct analysis through the plastic bag is possible without the more labor intensive steps of drying, grinding, and sieving given in Secs. 11.5 and 11.6. Of course, to achieve the best data quality possible all four steps should be followed.

11.5 Once the soil or sediment sample has been homogenized, it should be dried. This can be accomplished with a toaster oven or convection oven. A small aliquot of the sample (20 to 50 g) is placed in a suitable container for drying. The sample should be dried for 2 to 4 hr in the convection or toaster oven at a temperature not greater than 150 °C. Samples may also be air dried under ambient temperature conditions using a 10- to 20-g portion. Regardless of what drying mechanism is used, the drying process is considered complete when a constant sample weight can be obtained. Care should be taken to avoid sample cross-contamination and these measures can be evaluated by including an appropriate method blank sample along with any sample preparation process.

CAUTION: Microwave drying is not a recommended procedure. Field studies have shown that microwave drying can increase variability between the FPXRF data and confirmatory analysis. High levels of metals in a sample can cause arcing in the microwave oven, and sometimes slag forms in the sample. Microwave oven drying can also melt plastic containers used to hold the sample.

11.6 The homogenized dried sample material should be ground with a mortar and pestle and passed through a 60-mesh sieve to achieve a uniform particle size. Sample grinding should continue until at least 90 percent of the original sample passes through the sieve. The grinding step normally takes an average of 10 min per sample. An aliquot of the sieved sample should then be placed in a 31.0-mm polyethylene sample cup (or equivalent) for analysis. The sample cup should be one-half to three-quarters full at a minimum. The sample cup should be covered with a 2.5 μm Mylar (or equivalent) film for analysis. The rest of the soil sample should be placed in a jar, labeled, and archived for possible confirmation analysis. All equipment including the mortar, pestle, and sieves must be thoroughly cleaned so that any cross-contamination is below the established lower limit of detection of the procedure or DQOs of the analysis. If all recommended sample preparation steps are followed, there is a high probability the desired laboratory data quality may be obtained.

12.0 DATA ANALYSIS AND CALCULATIONS

Most FPXRF instruments have software capable of storing all analytical results and spectra. The results are displayed in ppm and can be downloaded to a personal computer, which can be used to provide a hard copy printout. Individual measurements that are smaller than three times their associated SD should not be used for quantitation. See the manufacturer's instructions regarding data analysis and calculations.

13.0 METHOD PERFORMANCE

13.1 Performance data and related information are provided in SW-846 methods only as examples and guidance. The data do not represent required performance criteria for users of the methods. Instead, performance criteria should be developed on a project-specific basis, and the laboratory should establish in-house QC performance criteria for the application of this method. These performance data are not intended to be and must not be used as absolute QC acceptance criteria for purposes of laboratory accreditation.

13.2 The sections to follow discuss three performance evaluation factors; namely, precision, accuracy, and comparability. The example data presented in Tables 4 through 8 were generated from results obtained from six FPXRF instruments (see Sec. 13.3). The soil samples analyzed by the six FPXRF instruments were collected from two sites in the United States. The soil samples contained several of the target analytes at concentrations ranging from "nondetect" to tens of thousands of mg/kg. These data are provided for guidance purposes only.

13.3 The six FPXRF instruments included the TN 9000 and TN Lead Analyzer manufactured by TN Spectrace; the X-MET 920 with a SiLi detector and X-MET 920 with a gas-filled proportional detector manufactured by Metorex, Inc.; the XL Spectrum Analyzer manufactured by Niton; and the MAP Spectrum Analyzer manufactured by Scitec. The TN 9000 and TN Lead Analyzer both have a HgI_2 detector. The TN 9000 utilized an Fe-55, Cd-109, and Am-241 source. The TN Lead Analyzer had only a Cd-109 source. The X-Met 920 with the SiLi detector had a Cd-109 and Am-241 source. The X-MET 920 with the gas-filled proportional detector had only a Cd-109 source. The XL Spectrum Analyzer utilized a silicon pin-diode detector and a Cd-109 source. The MAP Spectrum Analyzer utilized a solid-state silicon detector and a Cd-109 source.

13.4 All example data presented in Tables 4 through 8 were generated using the following calibrations and source count times. The TN 9000 and TN Lead Analyzer were calibrated using fundamental parameters using NIST SRM 2710 as a calibration check sample. The TN 9000 was operated using 100, 60, and 60 second count times for the Cd-109, Fe-55, and Am-241 sources, respectively. The TN Lead analyzer was operated using a 60 second count time for the Cd-109 source. The X-MET 920 with the Si(Li) detector was calibrated using fundamental parameters and one well characterized site-specific soil standard as a calibration check. It used 140 and 100 second count times for the Cd-109 and Am-241 sources, respectively. The X-MET 920 with the gas-filled proportional detector was calibrated empirically using between 10 and 20 well characterized site-specific soil standards. It used 120 second times for the Cd-109 source. The XL Spectrum Analyzer utilized NIST SRM 2710 for calibration and the Compton peak normalization procedure for quantitation based on 60 second count times for the Cd-109 source. The MAP Spectrum Analyzer was internally calibrated by the manufacturer. The calibration was checked using a well-characterized site-specific soil standard. It used 240 second times for the Cd-109 source.

13.5 Precision measurements -- The example precision data are presented in Table 4. These data are provided for guidance purposes only. Each of the six FPXRF instruments performed 10 replicate measurements on 12 soil samples that had analyte concentrations ranging from "nondetects" to thousands of mg/kg. Each of the 12 soil samples underwent 4 different preparation techniques from in situ (no preparation) to dried and ground in a sample cup. Therefore, there were 48 precision data points for five of the instruments and 24 precision points for the MAP Spectrum Analyzer. The replicate measurements were taken using the source count times discussed at the beginning of this section.

For each detectable analyte in each precision sample a mean concentration, standard deviation, and RSD was calculated for each analyte. The data presented in Table 4 is an average RSD for the precision samples that had analyte concentrations at 5 to 10 times the lower limit of detection for that analyte for each instrument. Some analytes such as mercury, selenium, silver, and thorium were not detected in any of the precision samples so these analytes are not listed in Table 4. Some analytes such as cadmium, nickel, and tin were only detected at concentrations near the lower limit of detection so that an RSD value calculated at 5 to 10 times this limit was not possible.

One FPXRF instrument collected replicate measurements on an additional nine soil samples to provide a better assessment of the effect of sample preparation on precision. Table 5 shows these results. These data are provided for guidance purposes only. The additional nine soil samples were comprised of three from each texture and had analyte concentrations ranging from near the lower limit of detection for the FPXRF analyzer to thousands of mg/kg. The FPXRF analyzer only collected replicate measurements from three of the preparation methods; no measurements were collected from the in situ homogenized samples. The FPXRF analyzer conducted five replicate measurements of the in situ field samples by taking measurements at five different points within the 4-inch by 4-inch sample square. Ten replicate measurements were collected for both the intrusive undried and unground and intrusive dried and ground samples contained in cups. The cups were shaken between each replicate measurement.

Table 5 shows that the precision dramatically improved from the in situ to the intrusive measurements. In general there was a slight improvement in precision when the sample was dried and ground. Two factors caused the precision for the in situ measurements to be poorer. The major factor is soil heterogeneity. By moving the probe within the 4-inch by 4-inch square, measurements of different soil samples were actually taking place within the square. Table 5 illustrates the dominant effect of soil heterogeneity. It overwhelmed instrument precision when the FPXRF analyzer was used in this mode. The second factor that caused the RSD values to be higher for the in situ measurements is the fact that only five instead of ten replicates were taken. A lesser number of measurements caused the standard deviation to be larger which in turn elevated the RSD values.

13.6 Accuracy measurements -- Five of the FPXRF instruments (not including the MAP Spectrum Analyzer) analyzed 18 SRMs using the source count times and calibration methods given at the beginning of this section. The 18 SRMs included 9 soil SRMs, 4 stream or river sediment SRMs, 2 sludge SRMs, and 3 ash SRMs. Each of the SRMs contained known concentrations of certain target analytes. A percent recovery was calculated for each analyte in each SRM for each FPXRF instrument. Table 6 presents a summary of this data. With the exception of cadmium, chromium, and nickel, the values presented in Table 6 were generated from the 13 soil and sediment SRMs only. The 2 sludge and 3 ash SRMs were included for cadmium, chromium, and nickel because of the low or nondetectable concentrations of these three analytes in the soil and sediment SRMs.

Only 12 analytes are presented in Table 6. These are the analytes that are of environmental concern and provided a significant number of detections in the SRMs for an accuracy assessment. No data is presented for the X-MET 920 with the gas-filled proportional detector. This FPXRF instrument was calibrated empirically using site-specific soil samples. The percent recovery values from this instrument were very sporadic and the data did not lend itself to presentation in Table 6.

Table 7 provides a more detailed summary of accuracy data for one particular FPXRF instrument (TN 9000) for the 9 soil SRMs and 4 sediment SRMs. These data are provided for guidance purposes only. Table 7 shows the certified value, measured value, and percent recovery for five analytes. These analytes were chosen because they are of environmental concern and were most prevalently certified for in the SRM and detected by the FPXRF instrument. The first nine SRMs are soil and the last 4 SRMs are sediment. Percent recoveries for the four NIST SRMs were often between 90 and 110 percent for all analytes.

13.7 Comparability -- Comparability refers to the confidence with which one data set can be compared to another. In this case, FPXRF data generated from a large study of six FPXRF instruments was compared to SW-846 Methods 3050 and 6010 which are the standard soil extraction for metals and analysis by inductively coupled plasma. An evaluation of comparability was conducted by using linear regression analysis. Three factors were determined using the linear regression. These factors were the y-intercept, the slope of the line, and the coefficient of determination (r^2).

As part of the comparability assessment, the effects of soil type and preparation methods were studied. Three soil types (textures) and four preparation methods were examined during the study. The preparation methods evaluated the cumulative effect of particle size, moisture, and homogenization on comparability. Due to the large volume of data produced during this study, linear regression data for six analytes from only one FPXRF instrument is presented in Table 8. Similar trends in the data were seen for all instruments. These data are provided for guidance purposes only.

Table 8 shows the regression parameters for the whole data set, broken out by soil type, and by preparation method. These data are provided for guidance purposes only. The soil types are as follows: soil 1--sand; soil 2--loam; and soil 3--silty clay. The preparation methods are as follows: preparation 1--in situ in the field; preparation 2--intrusive, sample collected and homogenized; preparation 3--intrusive, with sample in a sample cup but sample still wet and not ground; and preparation 4–intrusive, with sample dried, ground, passed through a 40-mesh sieve, and placed in sample cup.

For arsenic, copper, lead, and zinc, the comparability to the confirmatory laboratory was excellent with r^2 values ranging from 0.80 to 0.99 for all six FPXRF instruments. The slopes of the regression lines for arsenic, copper, lead, and zinc, were generally between 0.90 and 1.00 indicating the data would need to be corrected very little or not at all to match the confirmatory laboratory data. The r^2 values and slopes of the regression lines for barium and chromium were not as good as for the other for analytes, indicating the data would have to be corrected to match the confirmatory laboratory.

Table 8 demonstrates that there was little effect of soil type on the regression parameters for any of the six analytes. The only exceptions were for barium in soil 1 and copper in soil 3. In both of these cases, however, it is actually a concentration effect and not a soil effect causing the poorer comparability. All barium and copper concentrations in soil 1 and 3, respectively, were less than 350 mg/kg.

Table 8 shows there was a preparation effect on the regression parameters for all six analytes. With the exception of chromium, the regression parameters were primarily improved going from preparation 1 to preparation 2. In this step, the sample was removed from the soil surface, all large debris was removed, and the sample was thoroughly homogenized. The additional two preparation methods did little to improve the regression parameters. This data indicates that homogenization is the most critical factor when comparing the results. It is essential that the sample sent to the confirmatory laboratory match the FPXRF sample as closely as possible.

Sec. 11.0 of this method discusses the time necessary for each of the sample preparation techniques. Based on the data quality objectives for the project, an analyst must decide if it is worth the extra time necessary to dry and grind the sample for small improvements in comparability. Homogenization requires 3 to 5 min. Drying the sample requires one to two hours. Grinding and sieving requires another 10 to 15 min per sample. Lastly, when grinding and sieving is conducted, time has to be allotted to decontaminate the mortars, pestles, and sieves. Drying and grinding the samples and decontamination procedures will often dictate that an extra person be on site so that the analyst can keep up with the sample collection crew. The cost of requiring an extra person on site to prepare samples must be balanced with the gain in data quality and sample throughput.

13.8 The following documents may provide additional guidance and insight on this method and technique:

13.8.1 A. D. Hewitt, "Screening for Metals by X-ray Fluorescence Spectrometry/Response Factor/Compton K_α Peak Normalization Analysis," American Environmental Laboratory, pp 24-32, 1994.

13.8.2 S. Piorek and J. R. Pasmore, "Standardless, In Situ Analysis of Metallic Contaminants in the Natural Environment With a PC-Based, High Resolution Portable X-Ray Analyzer," Third International Symposium on Field Screening Methods for Hazardous Waste and Toxic Chemicals, Las Vegas, Nevada, February 24-26, 1993, Vol 2, pp 1135-1151, 1993.

13.8.3 S. Shefsky, "Sample Handling Strategies for Accurate Lead-in-soil Measurements in the Field and Laboratory," *International Symposium of Field Screening Methods for Hazardous Waste and Toxic Chemicals*, Las Vegas, NV, January 29-31, 1997.

14.0 POLLUTION PREVENTION

14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity and/or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best option.

14.2 For information about pollution prevention that may be applicable to laboratories and research institutions consult *Less is Better: Laboratory Chemical Management for Waste Reduction* available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th St., N.W. Washington, D.C. 20036, http://www.acs.org.

15.0 WASTE MANAGEMENT

The Environmental Protection Agency requires that laboratory waste management practices be conducted consistent with all applicable rules and regulations. The Agency urges laboratories to protect the air, water, and land by minimizing and controlling all releases from hoods and bench operations, complying with the letter and spirit of any sewer discharge permits and regulations, and by complying with all solid and hazardous waste regulations, particularly the hazardous waste identification rules and land disposal restrictions. For further information on waste management, consult *The Waste Management Manual for Laboratory Personnel* available from the American Chemical Society at the address listed in Sec. 14.2.

16.0 REFERENCES

1. Metorex, X-MET 920 User's Manual.

2. Spectrace Instruments, "Energy Dispersive X-ray Fluorescence Spectrometry: An Introduction," 1994.

3. TN Spectrace, Spectrace 9000 Field Portable/Benchtop XRF Training and Applications Manual.

4. Unpublished SITE data, received from PRC Environment Management, Inc.

17.0 TABLES, DIAGRAMS, FLOWCHARTS, AND VALIDATION DATA

The following pages contain the tables referenced by this method. A flow diagram of the procedure follows the tables.

TABLE 1

EXAMPLE INTERFERENCE FREE LOWER LIMITS OF DETECTION

Analyte	Chemical Abstract Series Number	Lower Limit of Detection in Quartz Sand (milligrams per kilogram)
Antimony (Sb)	7440-36-0	40
Arsenic (As)	7440-38-0	40
Barium (Ba)	7440-39-3	20
Cadmium (Cd)	7440-43-9	100
Calcium (Ca)	7440-70-2	70
Chromium (Cr)	7440-47-3	150
Cobalt (Co)	7440-48-4	60
Copper (Cu)	7440-50-8	50
Iron (Fe)	7439-89-6	60
Lead (Pb)	7439-92-1	20
Manganese (Mn)	7439-96-5	70
Mercury (Hg)	7439-97-6	30
Molybdenum (Mo)	7439-93-7	10
Nickel (Ni)	7440-02-0	50
Potassium (K)	7440-09-7	200
Rubidium (Rb)	7440-17-7	10
Selenium (Se)	7782-49-2	40
Silver (Ag)	7440-22-4	70
Strontium (Sr)	7440-24-6	10
Thallium (Tl)	7440-28-0	20
Thorium (Th)	7440-29-1	10
Tin (Sn)	7440-31-5	60
Titanium (Ti)	7440-32-6	50
Vanadium (V)	7440-62-2	50
Zinc (Zn)	7440-66-6	50
Zirconium (Zr)	7440-67-7	10

Source: Refs. 1, 2, and 3
These data are provided for guidance purposes only.

TABLE 2

SUMMARY OF RADIOISOTOPE SOURCE CHARACTERISTICS

Source	Activity (mCi)	Half-Life (Years)	Excitation Energy (keV)	Elemental Analysis Range	
Fe-55	20-50	2.7	5.9	Sulfur to Chromium	K Lines
				Molybdenum to Barium	L Lines
Cd-109	5-30	1.3	22.1 and 87.9	Calcium to Rhodium	K Lines
				Tantalum to Lead	K Lines
				Barium to Uranium	L Lines
Am-241	5-30	432	26.4 and 59.6	Copper to Thulium	K Lines
				Tungsten to Uranium	L Lines
Cm-244	60-100	17.8	14.2	Titanium to Selenium	K Lines
				Lanthanum to Lead	L Lines

Source: Refs. 1, 2, and 3

TABLE 3

SUMMARY OF X-RAY TUBE SOURCE CHARACTERISTICS

Anode Material	Recommended Voltage Range (kV)	K-alpha Emission (keV)	Elemental Analysis Range	
Cu	18-22	8.04	Potassium to Cobalt	K Lines
			Silver to Gadolinium	L Lines
Mo	40-50	17.4	Cobalt to Yttrium	K Lines
			Europium to Radon	L Lines
Ag	50-65	22.1	Zinc to Technicium	K Lines
			Ytterbium to Neptunium	L Lines

Source: Ref. 4

Notes: The sample elements excited are chosen by taking as the lower limit the same ratio of excitation line energy to element absorption edge as in Table 2 (approximately 0.45) and the requirement that the excitation line energy be above the element absorption edge as the upper limit (L2 edges used for L lines). K-beta excitation lines were ignored.

TABLE 4

EXAMPLE PRECISION VALUES

Analyte	Average Relative Standard Deviation for Each Instrument at 5 to 10 Times the Lower Limit of Detection					
	TN 9000	TN Lead Analyzer	X-MET 920 (SiLi Detector)	X-MET 920 (Gas-Filled Detector)	XL Spectrum Analyzer	MAP Spectrum Analyzer
Antimony	6.54	NR	NR	NR	NR	NR
Arsenic	5.33	4.11	3.23	1.91	12.47	6.68
Barium	4.02	NR	3.31	5.91	NR	NR
Cadmium	29.84[a]	NR	24.80[a]	NR	NR	NR
Calcium	2.16	NR	NR	NR	NR	NR
Chromium	22.25	25.78	22.72	3.91	30.25	NR
Cobalt	33.90	NR	NR	NR	NR	NR
Copper	7.03	9.11	8.49	9.12	12.77	14.86
Iron	1.78	1.67	1.55	NR	2.30	NR
Lead	6.45	5.93	5.05	7.56	6.97	12.16
Manganese	27.04	24.75	NR	NR	NR	NR
Molybdenum	6.95	NR	NR	NR	12.60	NR
Nickel	30.85[a]	NR	24.92[a]	20.92[a]	NA	NR
Potassium	3.90	NR	NR	NR	NR	NR
Rubidium	13.06	NR	NR	NR	32.69[a]	NR
Strontium	4.28	NR	NR	NR	8.86	NR
Tin	24.32[a]	NR	NR	NR	NR	NR
Titanium	4.87	NR	NR	NR	NR	NR
Zinc	7.27	7.48	4.26	2.28	10.95	0.83
Zirconium	3.58	NR	NR	NR	6.49	NR

These data are provided for guidance purposes only.
Source: Ref. 4

[a] These values are biased high because the concentration of these analytes in the soil samples was near the lower limit of detection for that particular FPXRF instrument.

NR Not reported.

NA Not applicable; analyte was reported but was below the established lower limit detection.

TABLE 5

EXAMPLES OF PRECISION AS AFFECTED BY SAMPLE PREPARATION

Analyte	Average Relative Standard Deviation for Each Preparation Method		
	In Situ-Field	Intrusive-Undried and Unground	Intrusive-Dried and Ground
Antimony	30.1	15.0	14.4
Arsenic	22.5	5.36	3.76
Barium	17.3	3.38	2.90
Cadmium[a]	41.2	30.8	28.3
Calcium	17.5	1.68	1.24
Chromium	17.6	28.5	21.9
Cobalt	28.4	31.1	28.4
Copper	26.4	10.2	7.90
Iron	10.3	1.67	1.57
Lead	25.1	8.55	6.03
Manganese	40.5	12.3	13.0
Mercury	ND	ND	ND
Molybdenum	21.6	20.1	19.2
Nickel[a]	29.8	20.4	18.2
Potassium	18.6	3.04	2.57
Rubidium	29.8	16.2	18.9
Selenium	ND	20.2	19.5
Silver[a]	31.9	31.0	29.2
Strontium	15.2	3.38	3.98
Thallium	39.0	16.0	19.5
Thorium	NR	NR	NR
Tin	ND	14.1	15.3
Titanium	13.3	4.15	3.74
Vanadium	NR	NR	NR
Zinc	26.6	13.3	11.1
Zirconium	20.2	5.63	5.18

These data are provided for guidance purposes only.
Source: Ref. 4

[a] These values may be biased high because the concentration of these analytes in the soil samples was near the lower limit of detection.

ND Not detected.
NR Not reported.

TABLE 6

EXAMPLE ACCURACY VALUES

Analyte	Instrument															
	TN 9000				TN Lead Analyzer				X-MET 920 (SiLi Detector)				XL Spectrum Analyzer			
	n	Range of % Rec.	Mean % Rec.	SD	n	Range of % Rec.	Mean % Rec.	SD	n	Range of % Rec.	Mean % Rec	SD	n	Range of % Rec.	Mean % Rec.	SD
Sb	2	100-149	124.3	NA	--	--	--	--	--	--	--	--	--	--	--	--
As	5	68-115	92.8	17.3	5	44-105	83.4	23.2	4	9.7-91	47.7	39.7	5	38-535	189.8	206
Ba	9	98-198	135.3	36.9	--	--	--	--	9	18-848	168.2	262	--	--	--	--
Cd	2	99-129	114.3	NA	--	--	--	--	6	81-202	110.5	45.7	--	--	--	--
Cr	2	99-178	138.4	NA	--	--	--	--	7	22-273	143.1	93.8	3	98-625	279.2	300
Cu	8	61-140	95.0	28.8	6	38-107	79.1	27.0	11	10-210	111.8	72.1	8	95-480	203.0	147
Fe	6	78-155	103.7	26.1	6	89-159	102.3	28.6	6	48-94	80.4	16.2	6	26-187	108.6	52.9
Pb	11	66-138	98.9	19.2	11	68-131	97.4	18.4	12	23-94	72.7	20.9	13	80-234	107.3	39.9
Mn	4	81-104	93.1	9.70	3	92-152	113.1	33.8	--	--	--	--	--	--	--	--
Ni	3	99-122	109.8	12.0	--	--	--	--	--	--	--	--	3	57-123	87.5	33.5
Sr	8	110-178	132.6	23.8	--	--	--	--	--	--	--	--	7	86-209	125.1	39.5
Zn	11	41-130	94.3	24.0	10	81-133	100.0	19.7	12	46-181	106.6	34.7	11	31-199	94.6	42.5

Source: Ref. 4. These data are provided for guidance purposes only.
n: Number of samples that contained a certified value for the analyte and produced a detectable concentration from the FPXRF instrument.
SD: Standard deviation; NA: Not applicable; only two data points, therefore, a SD was not calculated.
%Rec.: Percent recovery.
-- No data.

TABLE 7

EXAMPLE ACCURACY FOR TN 9000[a]

Standard Reference Material	Arsenic			Barium			Copper			Lead			Zinc		
	Cert. Conc.	Meas. Conc.	%Rec.	Cert. Conc.	Meas. Conc.	%Rec.	Cert. Conc.	Meas. Conc.	%Rec.	Cert. Conc.	Meas. Conc.	%Rec.	Cert. Conc.	Meas. Conc.	%Rec.
RTC CRM-021	24.8	ND	NA	586	1135	193.5	4792	2908	60.7	144742	149947	103.6	546	224	40.9
RTC CRM-020	397	429	92.5	22.3	ND	NA	753	583	77.4	5195	3444	66.3	3022	3916	129.6
BCR CRM 143R	--	--	--	--	--	--	131	105	80.5	180	206	114.8	1055	1043	99.0
BCR CRM 141	--	--	--	--	--	--	32.6	ND	NA	29.4	ND	NA	81.3	ND	NA
USGS GXR-2	25.0	ND	NA	2240	2946	131.5	76.0	106	140.2	690	742	107.6	530	596	112.4
USGS GXR-6	330	294	88.9	1300	2581	198.5	66.0	ND	NA	101	80.9	80.1	118	ND	NA
NIST 2711	105	104	99.3	726	801	110.3	114	ND	NA	1162	1172	100.9	350	333	94.9
NIST 2710	626	722	115.4	707	782	110.6	2950	2834	96.1	5532	5420	98.0	6952	6476	93.2
NIST 2709	17.7	ND	NA	968	950	98.1	34.6	ND	NA	18.9	ND	NA	106	98.5	93.0
NIST 2704	23.4	ND	NA	414	443	107.0	98.6	105	106.2	161	167	103.5	438	427	97.4
CNRC PACS-1	211	143	67.7	--	772	NA	452	302	66.9	404	332	82.3	824	611	74.2
SARM-51	--	--	--	335	466	139.1	268	373	139.2	5200	7199	138.4	2200	2676	121.6
SARM-52	--	--	--	410	527	128.5	219	193	88.1	1200	1107	92.2	264	215	81.4

Source: Ref. 4. These data are provided for guidance purposes only.
[a] All concentrations in milligrams per kilogram.
%Rec.: Percent recovery; ND: Not detected; NA: Not applicable.
-- No data.

TABLE 8

EXAMPLE REGRESSION PARAMETERS FOR COMPARABILITY[1]

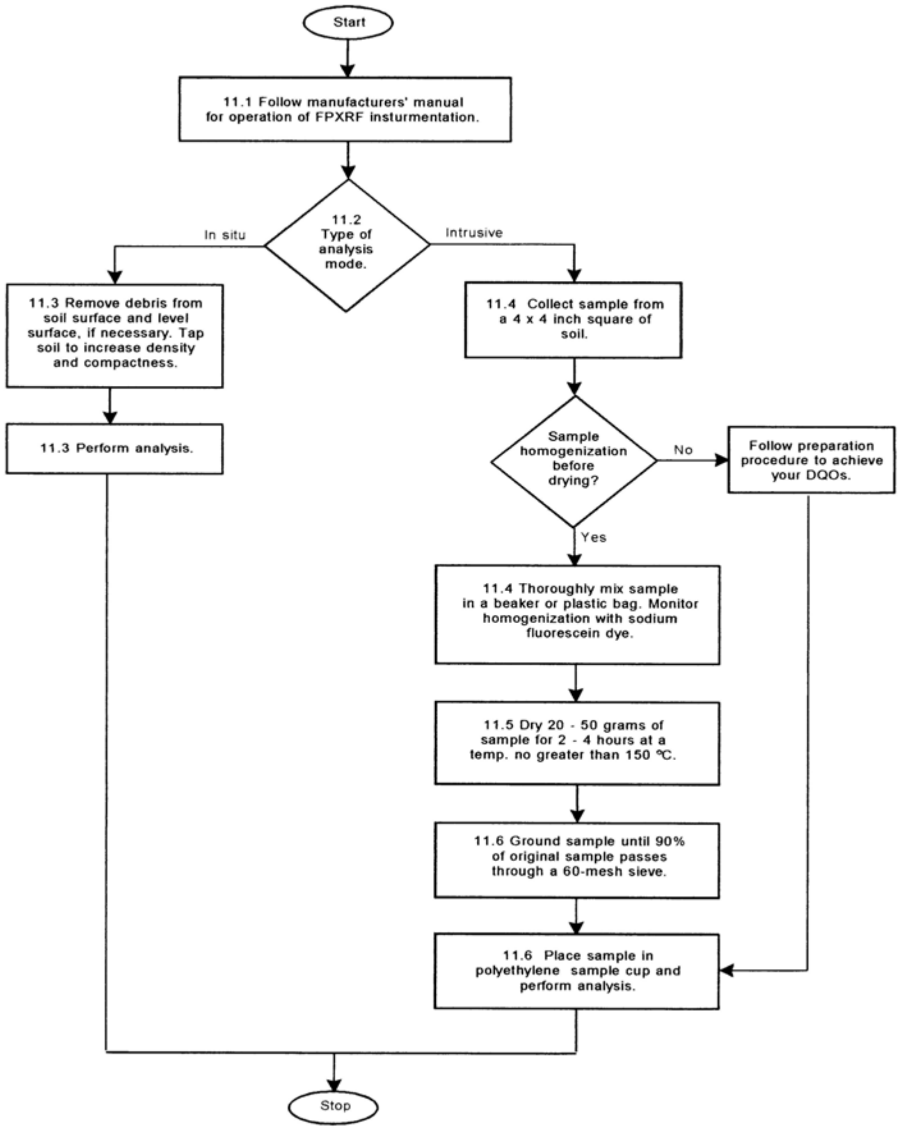
	Arsenic				Barium				Copper			
	n	r^2	Int.	Slope	n	r^2	Int.	Slope	n	r^2	Int.	Slope
All Data	824	0.94	1.62	0.94	1255	0.71	60.3	0.54	984	0.93	2.19	0.93
Soil 1	368	0.96	1.41	0.95	393	0.05	42.6	0.11	385	0.94	1.26	0.99
Soil 2	453	0.94	1.51	0.96	462	0.56	30.2	0.66	463	0.92	2.09	0.95
Soil 3	—	—	—	—	400	0.85	44.7	0.59	136	0.46	16.60	0.57
Prep 1	207	0.87	2.69	0.85	312	0.64	53.7	0.55	256	0.87	3.89	0.87
Prep 2	208	0.97	1.38	0.95	315	0.67	64.6	0.52	246	0.96	2.04	0.93
Prep 3	204	0.96	1.20	0.99	315	0.78	64.6	0.53	236	0.97	1.45	0.99
Prep 4	205	0.96	1.45	0.98	313	0.81	58.9	0.55	246	0.96	1.99	0.96

	Lead				Zinc				Chromium			
	n	r^2	Int.	Slope	n	r^2	Int.	Slope	n	r^2	Int.	Slope
All Data	1205	0.92	1.66	0.95	1103	0.89	1.86	0.95	280	0.70	64.6	0.42
Soil 1	357	0.94	1.41	0.96	329	0.93	1.78	0.93	—	—	—	—
Soil 2	451	0.93	1.62	0.97	423	0.85	2.57	0.90	—	—	—	—
Soil 3	397	0.90	2.40	0.90	351	0.90	1.70	0.98	186	0.66	38.9	0.50
Prep 1	305	0.80	2.88	0.86	286	0.79	3.16	0.87	105	0.80	66.1	0.43
Prep 2	298	0.97	1.41	0.96	272	0.95	1.86	0.93	77	0.51	81.3	0.36
Prep 3	302	0.98	1.26	0.99	274	0.93	1.32	1.00	49	0.73	53.7	0.45
Prep 4	300	0.96	1.38	1.00	271	0.94	1.41	1.01	49	0.75	31.6	0.56

Source: Ref. 4. These data are provided for guidance purposes only.
[1] Log-transformed data
n: Number of data points; r^2: Coefficient of determination; Int.: Y-intercept
— No applicable data

METHOD 6200

FIELD PORTABLE X-RAY FLUORESCENCE SPECTROMETRY FOR THE DETERMINATION OF ELEMENTAL CONCENTRATIONS IN SOIL AND SEDIMENT



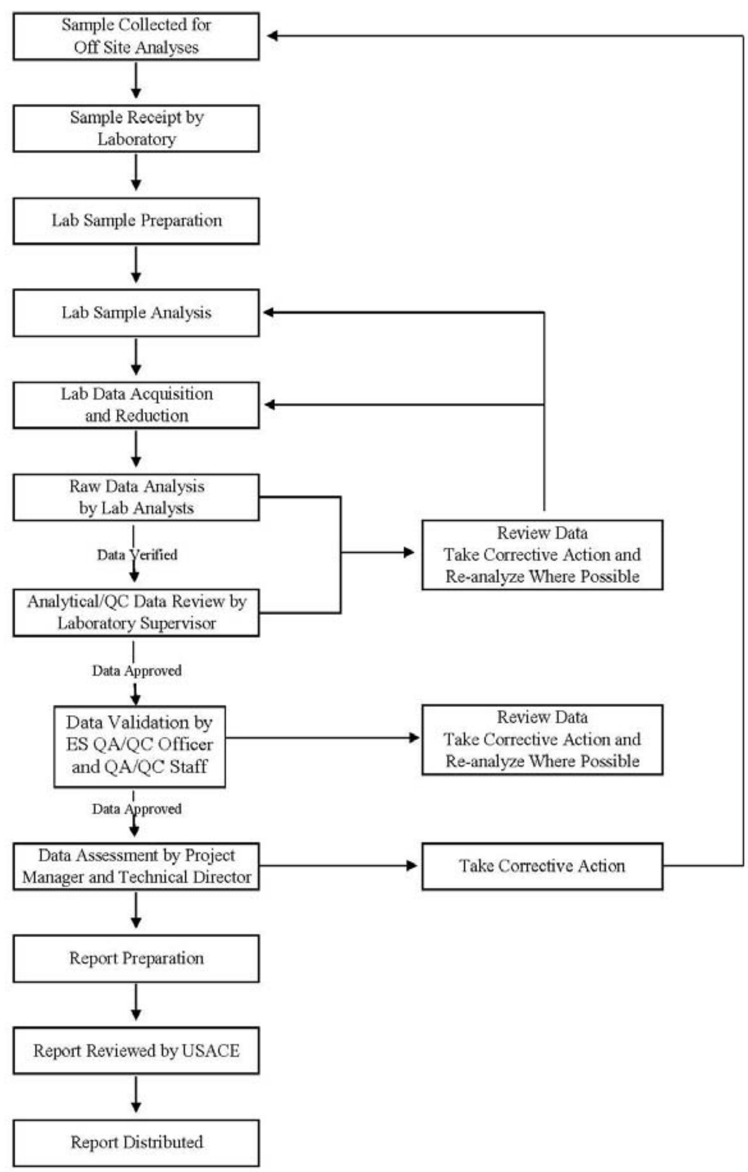
Attachment B5
Data Quality Control Report

DAILY QUALITY CONTROL REPORT

DATE:	Report Number:
USACE Technical Project Manager:	
CH2M HILL Field Team Leader:	
Project Name:	
Contract Number:	
Personnel On Site:	
Work Performed:	
PPE Required	
Samples Collected (type, location, ID numbers, etc.)	
Field Analysis (type, results, calibration, problems, etc.)	
Problems and Corrective Actions:	
QC Activities:	
Verbal or Written Instructions from Government Personnel:	
Anticipated Activities for the Following Day:	
General Remarks.	
Signature and Date:	

Attachment B6
Data Management Flow Chart

Data Management Flow Chart



Attachment B7
Soil Parameters/Definitions/Descriptors

SOIL AND ROCK CLASSIFICATION GUIDE

January 2010

SECTION 1: SOIL CLASSIFICATION

TABLE 1.1

CONSISTENCY OF FINE-GRAINED SOILS

CONSISTENCY OF FINE-GRAINED SOILS(a)

Description	Criteria
Very Soft	Thumb will penetrate soil more than one inch (25 mm)
Soft	Thumb will penetrate soil about one inch (25 mm)
Firm	Thumb will indent soil about one-quarter inch (6 mm)
Hard	Thumb will not indent soil, but readily indented with thumbnail
Very Hard	Thumbnail will not indent soil

TABLE 1.2

DENSITY OF COARSE-GRAINED SOILS

DENSITY OF COARSE-GRAINED SOILS

DENSITY	BLOWS PER ONE FOOT (30 CM)(a) OF PENETRATION FROM SPT(b)
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	Over 50

(a)Summation of blows required for second and third six-inch (15 cm) intervals.
(b)SPT - Standard Penetration Test (ASTM D1586).

TABLE 1.3

STRUCTURE DESCRIPTION FOR SOIL

STRUCTURE DESCRIPTIONS FOR SOIL(a)

DESCRIPTION	CRITERIA
Stratified	Alternating layers of varying material or color with layers at least six millimeters thick. Thickness should be recorded.
Laminated	Alternating layers of varying materials or color with layers less than six millimeters thick. Thickness should be recorded.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided	Fracture planes appear polished or glossy, sometimes striated
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed	Inclusion of small pockets of different soils, e.g., small lenses of sand scattered through a mass of clay. Thickness should be recorded
Homogeneous	Uniform Color and/or appearance throughout

(a)See also ASTM D2488, Table 7.

TABLE 1.4

USCS SYMBOLS

UNIFIED SOIL CLASSIFICATION SYSTEM SYMBOLS

SYMBOL	CHARACTERIZATION	DESCRIPTION
	Coarse-Grained	
	Clean gravels	
GW		Well-graded(a) gravels, gravel-sand mixtures, little or no fines (less than 5%)
GP		Poorly graded(b) gravels, gravel-sand mixtures, little or no fines (less than 5%)
	Gravels with appreciable amount of fines (greater than 15%)	
GM		Silty gravels, gravel and silt mixtures
GC		Clayey gravels, gravel and clay mixtures
	Clean sands	
SW		Well-graded sands, gravelly sands, little or no fines (less than -5%)
SP		Poorly graded sands, gravelly sands, little or no fines (less than 5%)
	Sands with appreciable amount, of fines (greater than 15%)	
SM		Silty sands, sand-silt mixtures
SC		Clayey sands, and clay mixtures
	Coarse-Grained With approximately 10% fines	
	Gravel	
GWGM		Well-graded gravel with silt or well-graded gravel with silt and sand
GWGC		Well-graded gravel with clay or well-graded gravel with clay and sand
GPGM		Poorly graded gravel with silt or poorly graded gravel with silt and sand
GPGC		Poorly graded gravel with clay or poorly graded gravel with clay and sand

UNIFIED SOIL CLASSIFICATION SYSTEM SYMBOLS

SYMBOL	CHARACTERIZATION	DESCRIPTION
	Sand	
SWSM		Well-graded sand with silt or well-graded sand with silt and gravel
SWSC		Well-graded sand with clay or well-graded sand with clay and gravel
SPSM		Poorly graded sand with silt or poorly graded sand with silt and gravel
SPSC		Poorly graded sand with clay or poorly graded sand with clay and gravel
	Fine-Grained/Highly Organic	
ML		Silt, inorganic silts, and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
CL		Lean clay, inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays
OL		Organic silts and organic silty clays of low plasticity
MH		Elastic silt, inorganic silts, micaeous or diatomaceous fine sandy or silty soils
CH		Fat clay, inorganic clays of high plasticity
OH		Organic clays of medium to high plasticity, organic silts
	Highly organic	
PT		Peat, humus, swamp soils with high organic contents

(a)A Well-graded material `has a wide range of particle sizes with substantial amounts of intermediate particle size.
(b)A poorly graded material consists predominantly of one particle size or has a wide range, of size with obvious gaps in particle size.

TABLE 1.5

RANGE OF PARTICAL SIZE FOR COARSE GRAINED SOIL

RANGE OF PARTICLE SIZE FOR COARSE GRAINED SOIL(a)

SOIL	DESCRIPTION	CRITERIA
Gravel	Coarse	Soil passes three-inch sieve and is retained on a ¾-inch sieve.
	Fine	Soil passes three-inch sieve and is retained on a No. 4 sieve.
Sand	Coarse	Soil passes a No. 4 sieve and is retained on a No. 10 sieve.
	Medium	Soil passes a No. 10 sieve and is retained on a No. 40 sieve.
	Fine	Soil passes a No. 40 sieve and is retained on a No. 200 sieve.

(a)See also ASTM D2488.

TABLE 1.6

GRAIN SHAPE DESCRIPTION FOR COARSE-GRAINED PARTICLES

GRAIN SHAPE DESCRIPTION FOR COARSE-GRAINED PARTICLES

DESCRIPTION	CRITERIA
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular	Particles are similar to angular, but have rounded edges
Subrounded	Particles have nearly plane sides, but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges

(a)See also ASTM D2488, Table 1.

TABLE 1.7

CLASSIFICATION OF FINED GRAINED SOILS

CLASSIFICATION OF FINE-GRAINED SOILS(a)

SOIL	SOIL SYMBOL	DRY STRENGTH	DILATANCY	TOUGHNESS
Silt	ML	None to low	Slow to rapid	Low or thread cannot be formed
Lean clay	CL	Medium to high	None to slow	Medium
Elastic silt	MH	Low to medium	None to slow	Low to medium
Fat clay	CH	High to very high	None	High

(a)See also ASTM D2488, Table 12.

TABLE 1.8

DRY-STRENGTH DESCRIPTIONS FOR FINE-GRAINED SOILS

DRY-STENGTH DESCRIPTIONDS FOR FINE-GRAINED SOILS(a)

DESCRIPTION	CRITERIA
None	The dry specimen crumbles into powder with mere pressure of handling(b)
Low	The dry specimen crumbles into powder with some finger pressure
Medium	The dry specimen breaks into pieces or crumbles with considerable finger pressure
High	The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface
Very High	The dry specimen cannot be broken between the thumb and a hard surface

(a)See also ASTM D2488, Table 8.

TABLE 1.9

DILANTANCY DESCRIPTIONS FOR FINE-GRAINED SOILS

TABLE 1-9
DILANTANCY DESCRIPTIONS FOR FINE-GRAINED SOILS(a)

DESCRIPTION	CRITERIA
None	No visible change in the specimen
Slow	Water appears slowly on the surface specimen during shaking and does not disappear or disappears slowly upon squeezing
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly on squeezing

(a)See also ASTM D2488, Table 9.

TABLE 1.10

TOUGHNESS DESCRIPTIONS FOR FINE-GRAINED SOILS

TOUGHNESS DESCRIPTIONS FOR FINE-GRAINED SOILS(a)

DESCRIPTION	CRITERIA
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft
Medium	Medium pressure is required to roll the thread to near the plastic limit. The thread and the lump have medium stiffness
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness

(a)See also ASTM D2488, Table 10.

TABLE 1.11

PLASTICITY DESCRIPTIONS FOR FINE-GRAINED SOILS

PLASTICITY DESCRIPTIONS FOR FINE-GRAINED SOILS(a)

DESCRIPTION	CRITERIA
Nonplastic	A one-eighth-inch thread cannot be rolled at any water content
Low	Thread can barely be rolled and the lump cannot be formed when drier than the plastic limit
Medium	Thread is easy to roll and little time is required to reach the plastic limit. Thread cannot be rerolled after reaching the plastic limit. Lump crumbles when drier than plastic limit
High	Considerable rolling and kneading time is required to reach the plastic limit. Thread can be rerolled several times after reaching the plastic limit. Lump can be formed without crumbling when drier than the plastic limit

(&)See ales A$TM D2488, Table 11.

TABLE 1.12

SOIL LOG ABBREVIATIONS

TABLE 2-12
SOIL LOG ABBREVIATIONS

Cgr	- Coarse Grained	Blk	- Black
Mgr	- Medium Grained	Yel	- Yellow
Fgr	- Fine Grained	Grn	- Green
Frg	- Fragments	Tr	- Trace
V	- Very	Td	- Total Depth of Boring or Drill Hole
Lt	- Light	Snd	- Sand
Dk	- Dark	Intbd	- Interbedded
Brn	- Brown	Lam	Laminated
Gfy	- Gray	w/	- With
Wh	- White	w/o	- Without
Abdt	- Abundant	@	- At
Ang	- Angular	/	- And
Calc	- Calcareous	V.S.	- Very Soft
Cly	-Clay	S.	- Soft
Slt	-Silt	H.	- Hard
V.H.	- Very Hard		

SECTION 2: ROCK CLASSIFICATION

2.0 VISUAL CLASSIFICATION OF ROCK USING FIELD LOG FORMS

This chapter describes the field documentation of rock classification. Several rock visual classification logs exist within CH2M HILL; however, the "Rock Core Log" shown in Figure 2-1 is the preferred rock classification form. The preferred form (Figure 2-1) is to be used unless a project demand dictates the use of another log form. Other log forms not presented herein may be used if approved prior to use by the CH2M HILL project team.

Typical information required to complete the rock classification log is described in the following sections.

2.1 HEADING INFORMATION

Heading information shall include the project number, project name, drill hole number, approximate ground surface elevation, boring coordinates, drilling methods) used, bit size, and identification of the CH2M HILL field representative. In addition, the dates the drill hole started and ended (if not recorded in the heading, this should be included in the COMMENTS column), and the page number shall be recorded. The page numbers shall begin with Page 1 for each boring and shall be consecutively numbered for the entire boring. If rock coring is conducted subsequent to soil boring, the page numbers shall be continued through the entire log (The rock core page number starting subsequent to the soil boring page number). In the event the boring requires more than one day for the completion of drilling, the dates of the 2nd., 3rd., etc., days shall be noted in the heading, and/or in the COMMENTS column at the depth each day's activities commence. If any of the previously mentioned data is not known at the time of drilling, its block shall be lined out or marked "NA"

2.1.1 Ground Water Level Information

Space is provided on the log forms so that ground water level data can be recorded. Along with the depth to the ground water level, the date and time each reading was taken is required. All times shall be recorded in terms of 24 hours; i.e., use 1457 hours and not 2:57 p.m. If the log form being used does not have a specific space for this information or if frequent tests are conducted such that the space provided on the log form is insufficient, ground water level data should be recorded in the COMMENTS column. In addition, if the ground water level is not encountered during the drilling period, this information shall be recorded in the ground water space or in the COMMENTS column.

Measurements of ground water level shall be made at the start of each workday for borings in progress, at the completion of each boring, and when the water level in each completed boring has stabilized (approximately 24 hours after completion).

2.1.2 Casing Information

Note in the space provided or the COMMENTS column if any casing was used, the different casing sizes, and to what depths the various sizes have been installed.

2.2 ROCK CLASSIFICATION

The purpose of rock classification logs is to define subsurface conditions. It is important that classification provide a concise, consistent, and complete representation of subsurface conditions. The following sections discuss the outline for classifying rock encountered during a field investigation program. It is necessary that rock classification be performed by experienced, professional CH2M HILL personnel.

2.2.1 Run Number

Horizontal lines shall be drawn through the RUN NUMBER column at the depths corresponding to the top and bottom of each core run. A run is usually used with reference to coring. However, if the drill hole is advanced alternately "%, with core and rotary bits, number only core runs. The run number shall then be marked within that defined space as "Run 1," "Run 2," etc.; with the numbers consecutively increasing with depth. Numbering shall always start with 1 for each boring.

Horizontal lines shall also be used to define each core run in the DEPTH, RECOVERY, PERCENT RECOVERED, PERCENT RQD, PROFILE, and JOINT SPACING columns.

2.2.2 Depth

Depths at the top and bottom of all core runs shall be recorded in feet or meters in the DEPTH BELOW SURFACE column. The units used shall be indicated. Project personnel will determine the scale to be used, but it should be the same as that used for any preceding soil classification logs. Depths must indicate the continuous advancement of the drill hole.

The top and bottom of each geologic unit shall be indicated by horizontal lines extending across the DESCRIPTION column. This line should also extend across the LITHOLOGY columns if they are included on the log. The depth of each change shall be numerically indicated immediately above this line.

2.2.3 Recovery

The actual length of core recovered in each run is the recovery. Units shall be defined consistent with those used for depth (feet or meters) and the length recorded in the RECOVERY column (if provided) within the defined core run interval.

2.2.4 Percent Recovered

The actual length of the core recovered in each run divided by the total core run length, multiplied by 100, is the percent recovered. This value shall be recorded in the PERCENT RECOVERED column within the defined run interval.

2.2.5 Rock Quality Designation (RQD)

The RQD is the total length of core pieces (unweathered rock) greater than or equal to four inches (10 centimeters) in length divided by the total length of the core run (Deere, 1989). RQD shall be expressed as a percentage and recorded in the PERCENT RQD column for each core run.

Care must be taken to correctly identify natural rock breaks from mechanical . breaks (breaks caused by drilling). Mechanical breaks are often, but not always, accompanied by fresh rock appearance.

Generally, natural breaks should first be considered as caused by a joint. Other natural breaks of the core may be due to:

- Irregular and rounded surfaces that reflect considerable grinding of the core due to rotation during drilling along a plane of weakness
- Rather -smooth surfaces that cannot be rejoined but which show no signs of weathering
- Weathered surfaces.

Include all pieces of core which are greater than or equal to four inches (10 centimeters) in length and bounded by natural surfaces. As s general guideline, if a core segment can be rejoined with only a hair-line separation, it should be included in computing the percent RQD.

2.2.6 Hardness

Hardness, or induration, shall be described in the HARDNESS column as per Table 2-1. If there if no specific column for hardness, it shall be included in the DESCRIPTION column.

2.2.7 Description

Rock core descriptions shall be recorded in the DESCRIPTION column for every core run. Consistency is important in describing the core. Describe the major petrologic aspects of the rock first. Add minor constituents as needed. Finally, describe. structural features of the rock.

An acceptable order of description is described below. Terms such as "AS ABOVE" and "AS BELOW" or drawing a continuous arrow down the drill log to indicate similarity in rock descriptions are NOT acceptable-on classification log sheets.

2.2.7.1 Rock Type

The first item in the description should be the rock type. Be specific and use the major rock classification (e.g., sandstone, basalt, etc.)

When necessary, edify the primary rock type with a secondary characteristic description (e.g., silty limestone or lime siltstone). All rock should be modified by grain or crystal size. Table 2-2 lists grain size

2.2.7.2 Color

Describe the color of the core when it is wet. The color shall be modified by using adjectives such as light, dark, mottled, or shades and tones of each other (e.g., grayish blue). As an alternate, the Geological Society of America or the Munsell color charts may be used. If color charts are used, the name of the chart should be noted on the log form.

2.2.7.3 Bedding Thickness

Bedding thickness modifiers shall be classified in accordance with Table 2-3. As an alternate, the actual bedding thickness may be listed on the log.

2.2.7.4 Hardness

If there is no specific column for hardness (Section 2.2.6) on the classification, it shall be included as part of the LITHOLOGY.

2.2.7.5 Fracturing

The concentration and fracture spacing of rock shall be described in accordance with Table 2-4. As an alternate, the observed fracture spacing may be listed on the log.

2.2.7.6 Weathering

If there is no specific column for weathering on the classification log form, it shall be included as part of the LITHOLOGY.

2.2.7.7 Other Terms

Other observations are usually necessary to accurately describe the core. These shall be included immediately following the terms discussed in Sections 2.2.7.1 through 2.2.7.6. These observations should include zones where the core is very broken, where grinding of the core is apparent, cementation and/or friability, zones of mineralization indicating the minerals present, intervals where core samples have been taken for laboratory testing, etc.

2.2.8 Weathering

The degree of weathering shall be described in the LITHOLOGY column using the following terms:

- Fresh - Crystals bright, joints rarely show staining. Rock rings with hammer if crystalline.
- Very Slight - Some joints stained, some joints may show clay if open, crystals in broken face show bright. Rock rings with hammer if crystalline.
- Slight - Joints stained and discoloration extends into rock up to one inch. Open joints contain clay. Some feldspar crystals are dull and discolored. Crystalline rocks ring with hammer.
- Moderate - Significant portions of rock show discoloration decomposition and disintegration. Most feldspars are dull and discolored; some show kaolinization. Rock has dull sound with hammer and shows significant loss of strength as compared with fresh rock.`
- Moderately Severe - All minerals except quartz are discolored or stained. All feldspars are dull and discolored and majority show kaolinization. Rock shows severe loss of strength and can be easily picked with a hammer. Dull sound with hammer. Decomposition and/or disintegration at least 5O percent.
- Severe – All minerals except quartz are discolored or stained. Rock fabric clear and evident, but reduced in strength to very dense soil. All feldspars kaolinized to some extent. Some fragments of strong rock scattered throughout.
- Very Severe - All minerals except quartz are discolored or stained. Rock fabric discernible, but mass effectively reduced to soil with only fragments of strong rock remaining. Decomposition and/or disintegration 100 percent with structure/fabric intact.
- Complete - Rock reduced to "soil." Rock "fabric" not discernible or discernible only in small scattered locations: Quartz may be present as dikes or stringers. All minerals in relic form. Decomposition and/or disintegration 100 percent with structure/fabric destroyed.

If there is no specific column for weathering, it shall be included in the LITHOLOGY column.

2.2.9 Joint Spacing

Joint spacing shall be written in the LITHOLOGY column. Depending upon the classification log form used, the following information shall be provided:

- Maximums, minimum, and average joint spacing for each run. (The maximum joint spacing is the length of the longest piece of core bounded at both ends by joint surfaces. The minimum joint spacing is the length of the shortest piece of core bounded at both ends by joint surfaces. Average joint spacing for each core run is determined by dividing the total length of all pieces bounded at both ends by joint surfaces by the total number of these pieces)

- Graphic illustration of joint pattern including orientation and a description of the joint surface (rough, smooth, shiny, dull, etc.).

2.2.10 Comments

The COMMENTS column should include pertinent information such as gain or loss of water, the performance of in situ tests, the time each day's activities begin, tool drops, soft zones, cavities, core losses, secondary minerals, fossils, casing sizes and depths (if no specific space provided), ground water levels (if no specific space provided), artesian conditions, etc.

COMMENTS should include items which pertain to the entire drill hole such as the type of drilling equipment used, drilling contractor and personnel, approximate distance drill hole was offset from original location, project-specific rock profile symbols (final log only), bit changes, drilling rate, etc. Other information may warrant being recorded at the discretion of field personnel.

2.2.11 Abbreviations

Abbreviations should be kept to a minimum. However, when expedient, the abbreviations suggested in Table 2-5 may be used individually or in combination.

2.2.12 **References**

Deere, D.U. 1989. *Rock quality designation (RQD) after 20 years*. U.S. Army Corps Engrs Contract Report GL-89-1. Vicksburg, MS: Waterways Experimental Station.

TABLE 2-1

ROCK HARDNESS TERMS

TABLE 2-1
ROCK HARDNESS TERMS

DESCRIPTIVE TERMS FOR HARDNESS		DEFINING CHARACTERISTICS
Extremely Soft	R0	Indented by thumbnail
Very Soft	R1	Crumbles ,under firm blows with point of geologist's pick, can be peeled with pocket knife
Soft	R2	Can be peeled with pocket knife with difficulty, shallow indentations made by firm blows of geologist's pick
Average	R3	Cannot be scraped or peeled with a pocket knife, can be fractured with a single blow from a geologist's hammer
Hard	R4	Requires more than one blow with geologist's hammer to break into pieces with sharp edges
Very Hard	R5	Requires many blows of geologist's hammer to fracture
Extremely Hard	R6	Can only be chipped with geologist's hammer

(a)All personnel must refer to the CH2M HILL Safety Policies and follow Safety Procedures before and during handling potentially hazardous and contaminated soil. oar rock.

TABLE 2-2

GRAIN SIZE CLASSIFICATION

TABLE 2-2
GRAIN-SIZE CLASSIFICATION

PARTICLE DIAMETER (MM)	SEDIMENTS (SOILS AND UN-CONSOLIDATED ROCK)	CONSOLIDATED ROCK
256 or more (10 inches or more)	Boulder	Boulder conglomerate
64 – 256(2.5 to 10 inches)	Cobble	Cobble conglomerate
4 – 64	Pebble	Pebble conglomerate
2 – 4	Granule	Granule conglomerate
1 – 2	Very coarse sand	Very coarse sandstone
0.5 – 1	Coarse sand	Coarse sandstone
0.25 – 0.5	Medium sand	Medium sandstone
0.125 - 0.25	Fine sand	Fine sandstone
0.0625 - 0.125	Very fine sand	Very fine sandstone
0.004 - 0.0625	Silt	Siltstone
0.004 or less	Clay	Claystone or shale

TABLE 2-3
BEDDING THICKNESS ROCK DESCRIPTION

TABLE 2-3
BEDDING THICKNESS ROCK DESCRIPTION

Thickness (English)	Thickness (Metric)	Bedding Classification
Over 3.3 feet	Over 1 m	Very thickly bedded
3.3 feet - 1 foot	1 m - 30 cm	Thickly bedded
1 foot - 4 inches	30 cm - 10 cm	Medium bedded
4 inches - 1 inch	10 cm - 3 cm	Thinly bedded
1 inch - 2/5 inch	3 cm - 1 cm	Very thinly bedded
2/5 inch - 1/8 inch	1 cm - 3 mm	Laminated
1/8 inch - 1/32 inch	3 mm - 1 mm	Thinly laminated
Less than 1/32 inch	Less than 1 mm	Microlaminated

TABLE 2-4

FRACTURE SPACING DESCRIPTION OF ROCK

TABLE 2-4
FRACTURE SPACING DESCRIPTION OF ROCK

ROCK DESCRIPTIVE TERMS	FRACTURE SPACING
Very broken	Less than 1 in.
Broken	1 in. to 3 in.
Slightly broken	3 in. to 6 in.
Massive (unbroken)	6 in. and greater

TABLE 2-5

ROCK LOG ABBREVATIONS

TABLE 2-5
ROCK LOG ABBREVIATIONS

Cgr	- Coarse Grained	Blk	- Black
Mgr	- Medium Grained	Yel	- Yellow
Fgr	- Fine Grained	Grn	- Green
Frg	- Fragments	Tr	- Trace
V	- Very	Td	- Total Depth of Boring or Drill Hole
Lt	- Light	Snd	- Sand
Dk	- Dark	Intbd	- Interbedded
Brn	- Brown	Lam	- Laminated
Gfy	- Gray	w/	- With
Wh	- White	w/o	- Without
Abdt	- Abundant	@	- At
Ang	- Angular	/	- And
Calc	- Calcareous		
Cly	- Clay		
Slt	- Silt		

3.0 IDEINTIFICATI0N, PACKAGING, STORING, AND SHIPPING OF SOIL SAMPLES AND ROCK CORE

Soil samples and rock core shall be properly identified, packaged, stored on site, and shipped. Prior to shipment, sample disturbance shall be minimized and any in situ characteristics to be investigated retained, to the extent possible.

Samples collected from a hazardous waste site or suspected hazardous waste site shall be treated as hazardous samples and handled in accordance with the provisions of the CH2M HILL SOP.

3.1 DISTURBED SOIL SAMPLES

Disturbed split-barrel soil samples shall be placed in sealable airtight glass jars as appropriate for applicable laboratory testing, except for specific hazardous materials, and labeled to indicate: project name and number, boring number, depths at top *and* bottom of sampling interval, recovery, sample number, number of blows for each six inches (15 centimeters) of penetration, date of sampling, and any other information pertinent to the project. This information should be placed on a gummed printed label which is then affixed to the jar. As an alternate, an indelible marker can be used to write on the glass or jar lid. If a label is used, the jar lid may also be marked with the project number, boring number, sample number, and depths at top and bottom of the sampling interval.

Place the jar samples in containers, such as cardboard boxes, with dividers for each jar to prevent movement and breakage. Samples from only one boring shall be placed in a box. The boxes should be taped shut in the field and labeled on the top and two adjacent sides to show the project number and name, identification of jar samples contained in the box, total depth interval of the samples, and other pertinent information.

Protect the jar samples from the weather including excessive heat and freezing during temporary on-site storage. Indoor storage shall be used whenever possible

3.2 UNDISTURBED SOIL SAMPLES

Upon recovery of an undisturbed thin-walled tube sample, at least one-half inch of soil shall be cleaned from each end of the tube. The ends of the soil sample should be squared off. The soil cleaned from the tube ends can be used for classification. When the tube contains drill cuttings, they must be removed prior to sealing. Use the cuttings to give a visual classification for the sample. Under certain circumstances, water in a tube may be allowed to drain prior to the sealing process.

Seal tubes with melted sealing material, such as paraffin or bees wax, or with approved expandable packers that are compatible with the expected analysis. When tubes contain only partial samples, seal the ends of the sample with approximately one inch of melted sealing material, then pack the remaining space with a dry filler, cuttings, sand, etc., and reseal the tube ends. The filler material prevents the sample from moving and breaking the initial end seals during handling and shipment. The ends of the tube shall then be closed with tight-fitting metal or plastic caps and the seam between the cap and tube wrapped with tape. Finally, the capped and taped ends shall be dipped in hot wax, as a final seal. Hazardous materials must be handled in accordance with appropriate safety procedures.

The sample tube shall be labeled by writing directly on the tube with an indelible marker or by affixing a label. If possible, all labeling should be located in the top one foot of the tube to facilitate ease of identification of tubes in vertical holders. Information to be included on the tube shall be the project name and number, date of sampling, boring number, sample number, depths at the top and bottom of the sampling interval, recovery, limit of sample in tube, and any other pertinent information. In addition, the tube must be marked "TOP" and "BOTTOM" so that the in situ orientation of the soil sample is know.

Because thin-walled tubes contain undisturbed soil samples, their shipment is critical. Whenever possible, the tubes shall be delivered to the laboratory in a vertical position to maintain in situ orientation. If the tubes are to be transported by truck or automobile, they shall be carefully padded and wedged in place to prevent movement (e.g., through use of a tube rack). If tubes must be shipped as freight, they shall be packed in secure wooden boxes or fiber drums which have dividers built in to prevent movement of the tubes, or the boxes shall be tightly filled with packing material such as wood chips or styrofoam to prevent movement. The boxes should be marked "fragile" and "keep from heat and freezing." Any tubes that are imported into the United States must have affixed to them a United States Department of Agriculture Importation Certificate. This certificate states that CH2M HILL is importing the soil samples for geotechnical work and after testing will dispose of the samples in accordance with federal law. In general, this certificate will prevent Customs authorities from requiring the tubes to be opened. All tubes shipped or band carried to a CH2M HILL laboratory shall be accompanied by a Chain-of-Custody Record.

3.3 ROCK CORE

Carefully remove the core from the barrel. If a split tube inner core barrel is not being used, use a core tray to log the core. The core tray length should exceed the length of the expected maximum core run. The ends of the core tray should be marked "TOP" and "BOTTOM" to provide a continuous orientation of the core. When the core is soft or broken, it is to be pushed into, the core tray carefully. The use of core trays and the handling of hazardous materials must follow safety procedures.

Upon completion of logging the core, transfer the rock core to a core box. If moisture content is critical, the core must be wrapped in heavy plastic and sealed in wax before shipment. Cores should not sit outdoors for long periods of time, and never over night.

Core boxes shall be will constructed wooden boxes, or equivalent as approved by CH2M HILL. The boxes shall be constructed so that the inside dimension of the box between the bottom and the lid is only slightly larger than the core diameter. Within the core boxes, wooden spacers, equal to the height of the box are to be provided to separate the rows of the core. The spacers shall be fastened within the box. Provisions for the box lid to be securely fastened to the box shall be made. It is preferable that the lid be screwed to the box after the box is filled, but latches may be used with the approval of the CH2M HILL Field Supervisor. The boxes shall be constructed so that they may be stacked when filled with core.

At the end of each core run, wooden spacer blocks shall be placed to separate runs. These blocks shall be permanently attached to the core boxes with nails if appropriate. The spacer block at the end of a core run shall have indelibly marked on it the depth from the surface to the bottom of the core run. In addition, if portions of the core have not been recovered or if core has been removed for laboratory testing, a two-space partition shall be placed in the interval where core has been assumed to have been lost or has been removed. These partitions shall be permanently attached to the core boxes and marked with the depth interval represented. It is preferred that core boxes and longitudinal spacers be dimensioned and constructed to accommodate 16 feet of core (four rows of four feet each). Other size boxes may be used with the permission of the CH2M HILL Field Supervisor.

Core boxes shall be indelibly labeled on each end, the front side, and the inside and outside of the lid. Labeling shall include the project name and number, boring number, depth interval from which the contents were recovered, and box number. The amount of core recovered, as a percentage, may also be marked on the box. The core boxes for each boring shall be consecutively numbered from the top of the boring to the bottom with the total number of boxes for the boring also indicated, such as Box _ of _. It is suggested that on the inside of the lid the following additional information be shown in tabular form: run number, depths covered in the run, recovery, percent recovered, and RQD. Boxes are to be labeled as the core is placed in them.

Do not put core from more than one drill hole in a core box. Under no circumstances are the core samples to be transferred to other boxes without the approval of the CH2M HILL Field Supervisor and the presence of CH2M HILL personnel. Core boxes and their contents should be photographed by CH2M HILL personnel in s timely manner prior to the care being removed from the site. The photographs should clearly show the core and the information printed on the inside of the box lid.

Core boxes shall be handled and shipped carefully to minimize disturbance of the core. The boxes shall be protected from excessive moisture, heat, and freezing. If core boxes must be stored temporarily on site, they shall be protected from weather. Site storage facilities must be approved by the CH2M HILL Field Supervisor and shall be indoors, where possible. It is permissible to stack the core boxes, but it shall be done so that the markings on the box front or end can be easily read and so that all of the boxes are accessible.

4.0 ERPIMS CODE VALUES

Table 4.1

Lithologic Description	ERPIMS Code Value
Asphalt	[ASPT]
Bentonite	[BNTN]
Clay	[CLAY]
CLAY AND GRAVEL	[CLGV]
CLAY AND SAND	[CLSD]
CLAY AND SILT	[CLSL]
Concrete	[CN]
Coal	[COAL]
Cobble or Boulder	[COBL]
Conglomerate	[CONG]
Drill Bit Refusal	[DREF]
Fill or other Man-Made Deposits	[FILL]
Gneiss	[GNSS]
Greenstone	[GRNS]
Granite	[GRNT]
Gravel and Clay	[GVCL]
Gravel	[GVL]
Gravel, predominantly cobble or boulder-sized	[GVLB]
Gravel, predominantly granule-sized	[GVLG]
Gravel, predominantly pebble-sized	[GVLP]
GRAVEL AND SAND	[GVSD]
Gravel and Silt	[GVSL]
Hardpan	[HRDP]
Igneous (Undifferentiated)	[IGNS]
Metamorphic (Undifferentiated)	[META]
Marble	[MRBL]
Not Applicable; consolidated material	[NACM]
No Description Provided, Problems in Sampling	[NDPS]
No Sample or No Recovery Obtained	[NSNR]
Peat, Humus, and other Organic Material	[PTHM]
Quartzite	[QRTZ]
Salt	[SALT]
Schist	[SCHS]
Sand	[SD]
Sand & Clay	[SDCL]
Sand, coarse	[SDCR]
Sand, fine	[SDFN]
Sand & Gravel	[SDGR]
Sand, medium	[SDMD]
Sand & Silt	[SDSL]
Sand, very coarse	[SDVC]
Sand, very fine	[SDVF]
Silt	[SILT]

Silt & Clay	[SLCL]
SILT AND GRAVEL	[SLGV]
Silt & Sand	[SLSD]
Crystalline Igneous or Metamorphic, (Undifferentiated)	[XLN]

Table 4.2 (Same as Table 1.4 on page 6)

UNIFIED SOIL CLASSIFICATION SYSTEM SYMBOLS

SYMBOL	CHARACTERIZATION	DESCRIPTION
	Coarse-Grained	
	Clean gravels	
GW		Well-graded(a) gravels, gravel-sand mixtures, little or no fines (less than 5%)
GP		Poorly graded(b) gravels, gravel-sand mixtures, little or no fines (less than 5%)
	Gravels with appreciable amount of fines (greater than 15%)	
GM		Silty gravels, gravel and silt mixtures
GC		Clayey gravels, gravel and clay mixtures
	Clean sands	
SW		Well-graded sands, gravelly sands, little or no fines (less than -5%)
SP		Poorly graded sands, gravelly sands, little or no fines (less than 5%)
	Sands with appreciable amount, of fines (greater than 15%)	
SM		Silty sands, sand-silt mixtures
SC		Clayey sands, and clay mixtures
	Coarse-Grained With approximately 10% fines	
	Gravel	
GWGM		Well-graded gravel with silt or well-graded gravel with silt and sand
GWGC		Well-graded gravel with clay or well-graded gravel with clay and sand
GPGM		Poorly graded gravel with silt or poorly graded gravel with silt and sand
GPGC		Poorly graded gravel with clay or poorly graded gravel with clay and sand
	Sand	
SWSM		Well-graded sand with silt or well-graded sand with silt and gravel
SWSC		Well-graded sand with clay or well-graded sand with clay and gravel
SPSM		Poorly graded sand with silt or poorly graded sand with silt and gravel

UNIFIED SOIL CLASSIFICATION SYSTEM SYMBOLS

SYMBOL	CHARACTERIZATION	DESCRIPTION
SPSC		Poorly graded sand with clay or poorly graded sand with clay and gravel
	Fine-Grained/Highly Organic	
ML		Silt, inorganic silts, and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
CL		Lean clay, inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays
OL		Organic silts and organic silty clays of low plasticity
MH		Elastic silt, inorganic silts, micaeous or diatomaceous fine sandy or silty soils
CH		Fat clay, inorganic clays of high plasticity
OH		Organic clays of medium to high plasticity, organic silts
	Highly organic	
PT		Peat, humus, swamp soils with high organic contents

(a)A Well-graded material `has a wide range of particle sizes with substantial amounts of intermediate particle size.
(b)A poorly graded material consists predominantly of one particle size or has a wide range, of size with obvious gaps in particle size.

Appendix C
Project Schedule
for
Site-Wide Sampling and Analysis Plan
Environmental Remediation Services
Fort Rucker, Alabama

Contract No. W91ZLK-05-D-0014
Task Order No. 0001

Prepared for

U.S. ARMY ENVIRONMENTAL COMMAND

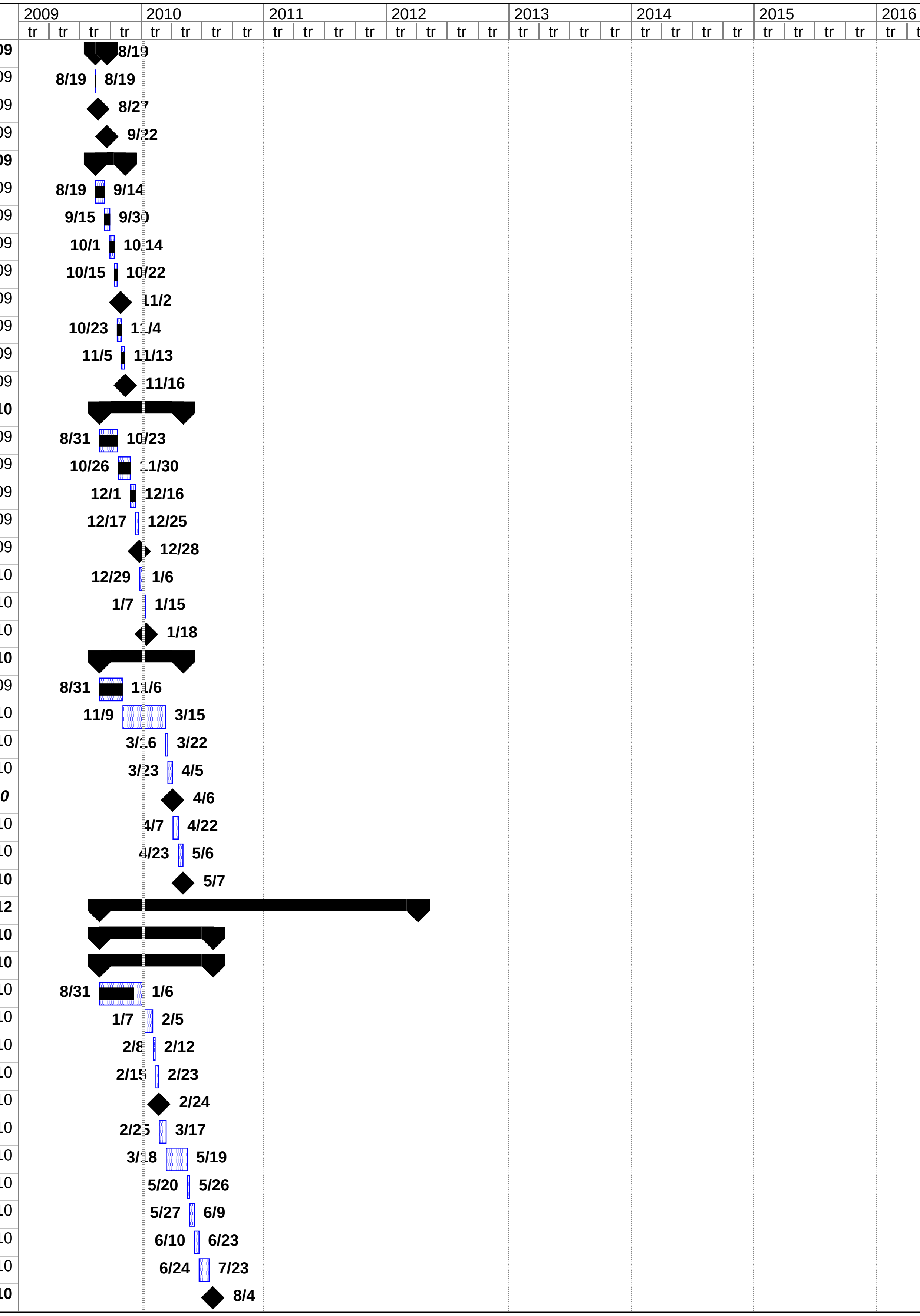
January 2010

Prepared by

CH2MHILL

Northpark 400
1000 Abernathy Road
Suite 1600
Atlanta, GA 30328

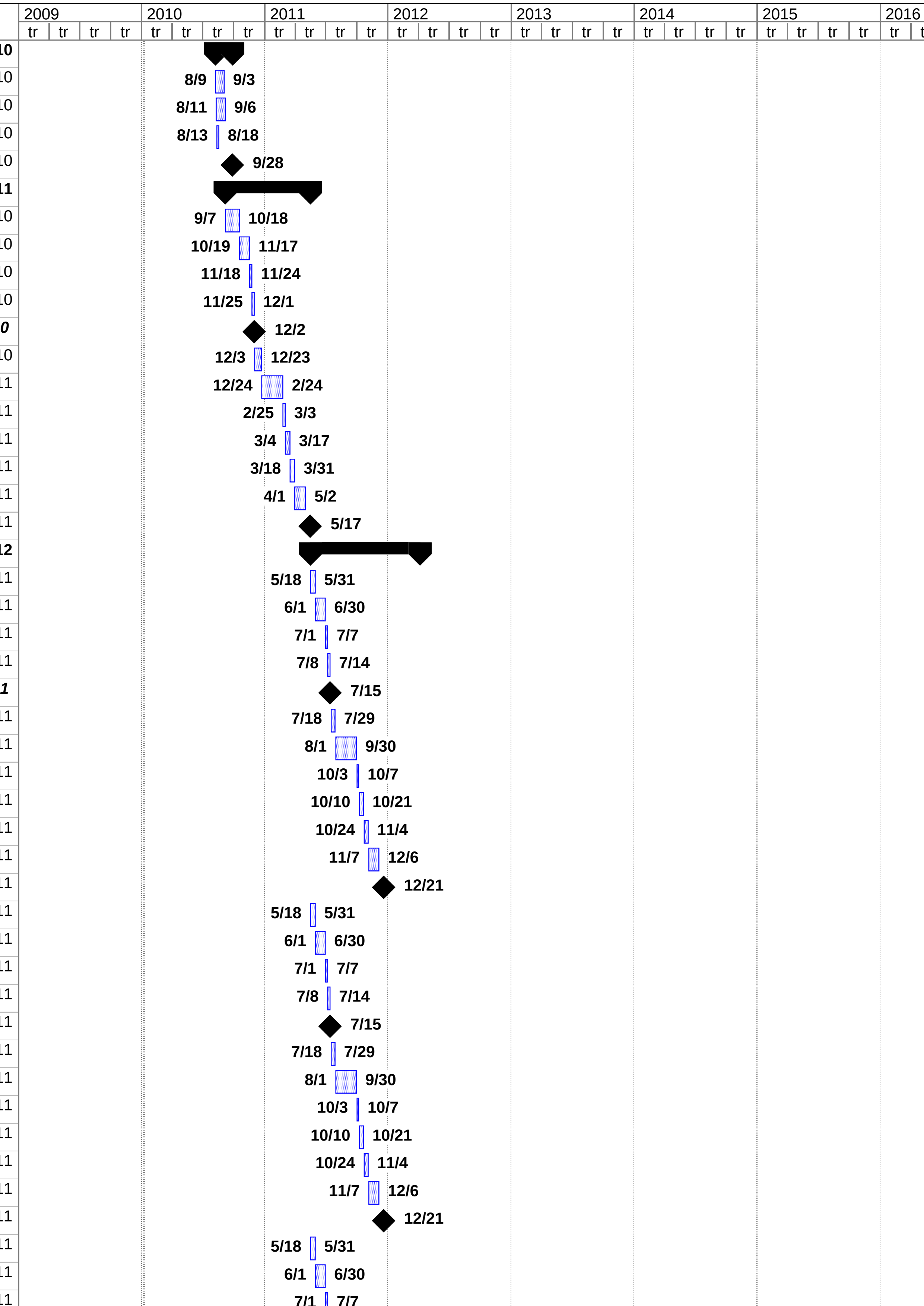
ID	Indicators	WBS	Task Name	Duration	Start	Finish
1	✓	**2004**	**ENVIRONMENTAL REMEDIATION SERVICES AT FT. RUCKER**	**25 days**	**Wed 8/19/09**	**Tue 9/22/09**
2	✓	2004A	Award Date	1 day	Wed 8/19/09	Wed 8/19/09
3	✓	2004B	Site Recon Visit	1 day	Thu 8/27/09	Thu 8/27/09
4	✓	2004C	Project Kick-Off Meeting	1 day	Tue 9/22/09	Tue 9/22/09
5	✓	**2004AA**	**PMP/QASP**	**63 days**	**Wed 8/19/09**	**Mon 11/16/09**
6	✓	2004AA1	Draft PMP/QASP Preparation and Submittal	19 days	Wed 8/19/09	Mon 9/14/09
7	✓	2004AA2	Army Review/Comments	12 days	Tue 9/15/09	Wed 9/30/09
8	✓	2004AA3	Prepare Response to Army Comments and Response Submittal	10 days	Thu 10/1/09	Wed 10/14/09
9	✓	2004AA4	Army Review/Acceptance of Response to Comments	6 days	Thu 10/15/09	Thu 10/22/09
10	✓	2004AA5	***Army Approval of Draft PMP/QASP***	0 days	Mon 11/2/09	Mon 11/2/09
11	✓	2004AA6	Final PMP Preparation and Submittal	9 days	Fri 10/23/09	Wed 11/4/09
12	✓	2004AA7	Army Review of Final PMP	7 days	Thu 11/5/09	Fri 11/13/09
13	✓	2004AA8	***Army Approval of Final PMP/QASP***	0 days	Mon 11/16/09	Mon 11/16/09
14		**2004BA**	**ADDITIONAL SITE-WIDE PLANS**	**180 days**	**Mon 8/31/09**	**Fri 5/7/10**
15	✓	2004BA1	Draft SSHP/SAP/WMP Preparation and Submittal	40 days	Mon 8/31/09	Fri 10/23/09
16	✓	2004BA2	Army Review/Comments	26 days	Mon 10/26/09	Mon 11/30/09
17	✓	2004BA3	Prepare Response to Army Comments and Response Submittal	12 days	Tue 12/1/09	Wed 12/16/09
18		2004BA4	Army Review/Acceptance of Response to Comments	7 days	Thu 12/17/09	Fri 12/25/09
19		2004BA5	***Army Approval of Draft SSHP/SAP//WMP***	1 day	Mon 12/28/09	Mon 12/28/09
20		2004BA6	Final SSHP/SAP/WMP Preparation and Submittal	7 days	Tue 12/29/09	Wed 1/6/10
21		2004BA7	Army Review of Final SSHP/SAP/WMP	7 days	Thu 1/7/10	Fri 1/15/10
22		2004BA8	***Army Approval of Final SSHP/SAP/WMP***	1 day	Mon 1/18/10	Mon 1/18/10
23		**2004BA9**	**Explosives Site Plan (includes all MMRP Sites)**	**180 days**	**Mon 8/31/09**	**Fri 5/7/10**
24	✓	2004BA10	Draft Explosives Siting Plan Preparation and Submittal	50 days	Mon 8/31/09	Fri 11/6/09
25		2004BA11	Army Review/Comments	91 days	Mon 11/9/09	Mon 3/15/10
26		2004BA12	Prepare Response to Army Comments and Response Submittal	5 days	Tue 3/16/10	Mon 3/22/10
27		2004BA13	Army Review/Acceptance of Response to Comments	10 days	Tue 3/23/10	Mon 4/5/10
28		***2004BA14***	***Army Approval of Draft Explosives Siting Plan***	***1 day***	***Tue 4/6/10***	***Tue 4/6/10***
29		2004BA15	Final Explosives Siting Plan Preparation and Submittal	12 days	Wed 4/7/10	Thu 4/22/10
30		2004BA16	Army Review of Final Explosives Siting Plan	10 days	Fri 4/23/10	Thu 5/6/10
31		**2004BA17**	***Army Approval of Final Explosives Siting Plan***	**1 day**	**Fri 5/7/10**	**Fri 5/7/10**
32		**2004CA**	**MMRP SITES**	**680 days**	**Mon 8/31/09**	**Fri 4/6/12**
33		**2004CA1**	**RFI/CMS WORK PLAN**	**243 days**	**Mon 8/31/09**	**Wed 8/4/10**
34		**2004CA2**	**RFI/CMS Work Plan (includes all MMRP Sites)**	**243 days**	**Mon 8/31/09**	**Wed 8/4/10**
35		2004CA3	Draft RFI/CMS Work Plan Preparation and Submittal	93 days	Mon 8/31/09	Wed 1/6/10
36		2004CA4	Army Review/Comments	22 days	Thu 1/7/10	Fri 2/5/10
37		2004CA5	Prepare Response to Army Comments and Response Submittal	5 days	Mon 2/8/10	Fri 2/12/10
38		2004CA6	Army Review/Acceptance of Response to Comments	7 days	Mon 2/15/10	Tue 2/23/10
39		**2004CA7**	***Army Approval of Draft Final RFI/CMS Work Plan***	1 day	Wed 2/24/10	Wed 2/24/10
40		2004CA8	Draft Final RFI/CMS Work Plan Preparation and Submittal	15 days	Thu 2/25/10	Wed 3/17/10
41		2004CA9	ADEM/Army Review/Comments	45 days	Thu 3/18/10	Wed 5/19/10
42		2004CA10	Prepare Response to ADEM/Army Comments and Response Submittal	5 days	Thu 5/20/10	Wed 5/26/10
43		2004CA11	ADEM/Army Review/Acceptance of Response to Comments	10 days	Thu 5/27/10	Wed 6/9/10
44		2004CA12	Final RFI/CMS Work Plan Preparation and Submittal	10 days	Thu 6/10/10	Wed 6/23/10
45		2004CA13	ADEM/Army Review of Final RFI/CMS Work Plan	22 days	Thu 6/24/10	Fri 7/23/10
46		**2004CA14**	***Army/ADEM Approval of Final RFI/CMS Work Plan***	**1 day**	**Wed 8/4/10**	**Wed 8/4/10**



Project: FORT RUCKER PROJECT S
Date: 12/17/09

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

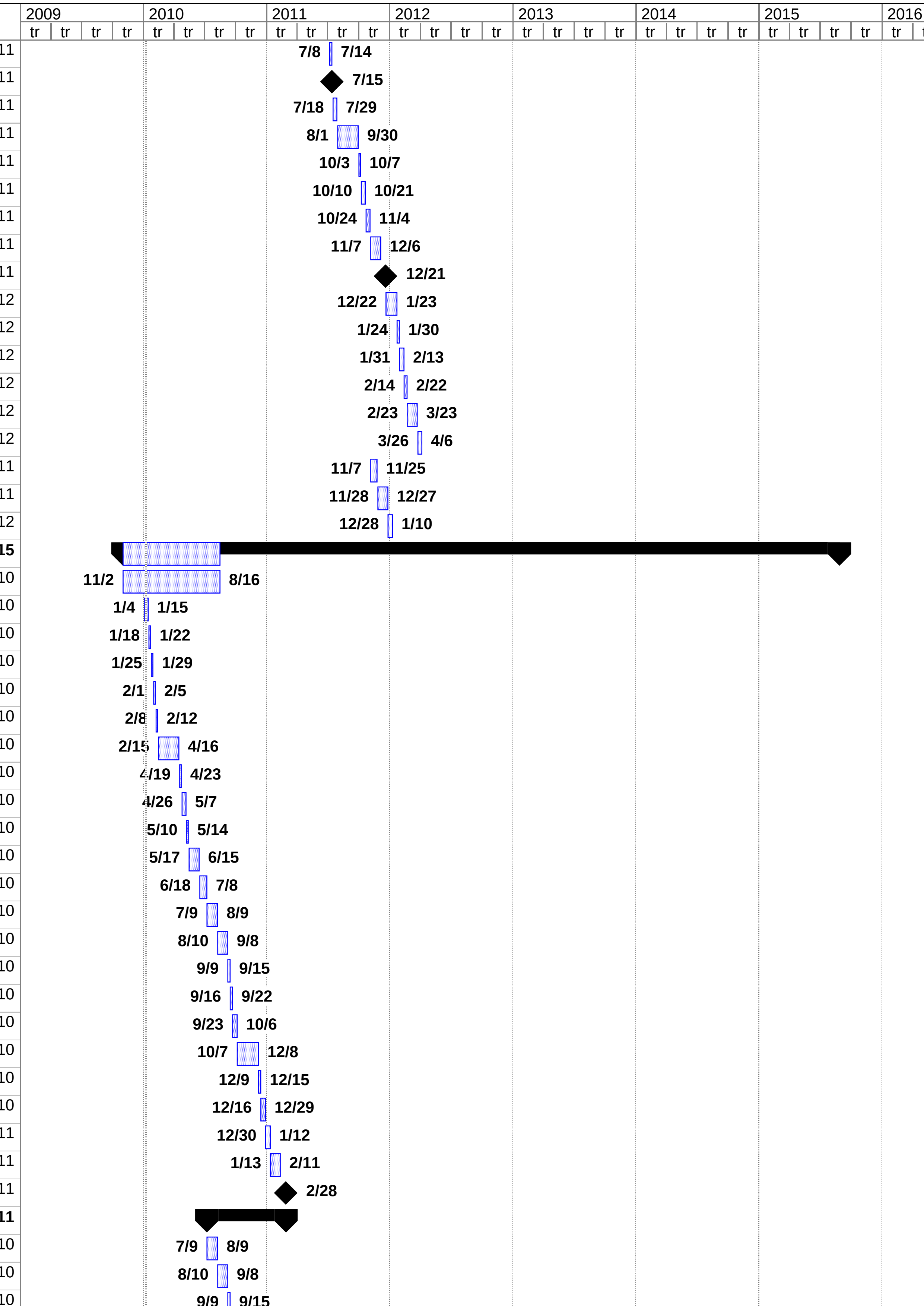
ID		WBS	Task Name	Duration	Start	Finish
47		**2004CA15**	**RCRA FACILITY INVESTIGATION**	**37 days**	**Mon 8/9/10**	**Tue 9/28/10**
48		2004CA16	DGM/Intrusive Investigation - Anti-Tank/Rocket Grenade Range	20 days	Mon 8/9/10	Fri 9/3/10
49		2004CA17	DGM/Intrusive Investigation - Infiltration/Grenade Range	19 days	Wed 8/11/10	Mon 9/6/10
50		2004CA18	DGM/Intrusive Investigation - .22-Caliber Target Butt	4 days	Fri 8/13/10	Wed 8/18/10
51		***2004CA19***	***Army Acceptance of Total LF of Geophysical Transects/Instrusive Inv. TM***	1 day	Tue 9/28/10	Tue 9/28/10
52		**2004CA20**	**RCRA FACILITY INVESTIGATION REPORT / CMS**	**181 days**	**Tue 9/7/10**	**Tue 5/17/11**
53		2004CA21	Draft RFI/CMS Report (includes all MMRP Sites) Preparation and Submittal	30 days	Tue 9/7/10	Mon 10/18/10
54		2004CA22	Army Review/Comments	22 days	Tue 10/19/10	Wed 11/17/10
55		2004CA23	Prepare Response to Army Comments and Response Submittal	5 days	Thu 11/18/10	Wed 11/24/10
56		2004CA24	Army Review/Acceptance of Response to Comments	5 days	Thu 11/25/10	Wed 12/1/10
57		***2004CA25***	***Army Approval of Draft Final RFI/CMS Report***	***1 day***	***Thu 12/2/10***	***Thu 12/2/10***
58		2004CA26	Draft Final RFI/CMS Report Preparation and Submittal	15 days	Fri 12/3/10	Thu 12/23/10
59		2004CA27	ADEM/Army Review/Comment	45 days	Fri 12/24/10	Thu 2/24/11
60		2004CA28	Response to ADEM/Army Comments and Response Submittal	5 days	Fri 2/25/11	Thu 3/3/11
61		2004CA29	ADEM/Army Review/Acceptance of Response to Comments	10 days	Fri 3/4/11	Thu 3/17/11
62		2004CA30	Final RFI/CMS Report Preparation and Submittal	10 days	Fri 3/18/11	Thu 3/31/11
63		2004CA31	ADEM/Army Review of Final RFI/CMS Report	22 days	Fri 4/1/11	Mon 5/2/11
64		**2004CA32**	***Army/ADEM Approval of Final RFI/CMS Report***	1 day	Tue 5/17/11	Tue 5/17/11
65		**2004CA33**	**STATEMENT OF BASIS**	**233 days**	**Wed 5/18/11**	**Fri 4/6/12**
66		2004CA34	Draft Statement of Basis - Anti-Tank/Rocket Grenade Range Prep and Submittal	10 days	Wed 5/18/11	Tue 5/31/11
67		2004CA35	Army Review/Comments	22 days	Wed 6/1/11	Thu 6/30/11
68		2004CA36	Prepare Response to Army Comments and Response Submitttal	5 days	Fri 7/1/11	Thu 7/7/11
69		2004CA37	Army Review/Acceptance of Response to Comments	5 days	Fri 7/8/11	Thu 7/14/11
70		*2004CA38*	Army Approval of Draft SB-Anti-Tank/Rocket Grenade Range	***1 day***	***Fri 7/15/11***	***Fri 7/15/11***
71		2004CA39	Draft Final Statement of Basis - Anti-Tank/Rocket Grenade Range Prep and Submittal	10 days	Mon 7/18/11	Fri 7/29/11
72		2004CA40	ADEM/Army Review/Comment	45 days	Mon 8/1/11	Fri 9/30/11
73		2004CA41	Response to ADEM/Army Comments and Response Submittal	5 days	Mon 10/3/11	Fri 10/7/11
74		2004CA42	ADEM/Army Review/Acceptance of Response to Comments	10 days	Mon 10/10/11	Fri 10/21/11
75		2004CA43	Final Statement of Basis - Anti-Tank/Rocket Grenade Range Prep and Submittal	10 days	Mon 10/24/11	Fri 11/4/11
76		2004CA44	ADEM/Army Review of Final Statement of Basis - Anti-Tank/Rocket Grenade Rg	22 days	Mon 11/7/11	Tue 12/6/11
77		**2004CA45**	***Army/ADEM Approval of Final SB-Anti-Tank/Rocket Grenade***	1 day	Wed 12/21/11	Wed 12/21/11
78		2004CA46	Draft Statement of Basis - Infiltration/Grenade Range Preparation and Submittal	10 days	Wed 5/18/11	Tue 5/31/11
79		2004CA47	Army Review/Comments	22 days	Wed 6/1/11	Thu 6/30/11
80		2004CA48	Prepare Response to Army Comments and Response Submittal	5 days	Fri 7/1/11	Thu 7/7/11
81		2004CA49	Army Review/Acceptance of Response to Comments	5 days	Fri 7/8/11	Thu 7/14/11
82		2004CA50	Army Approval of Draft SB-Infiltration/Grenade Range	1 day	Fri 7/15/11	Fri 7/15/11
83		2004CA51	Draft Final Statement of Basis - Infiltration/Grenade Range Prep and Submittal	10 days	Mon 7/18/11	Fri 7/29/11
84		2004CA52	ADEM/Army Review/Comments	45 days	Mon 8/1/11	Fri 9/30/11
85		2004CA53	Prepare Response to ADEM/Army Comments and Response Submittal	5 days	Mon 10/3/11	Fri 10/7/11
86		2004CA54	ADEM/Army Review/Acceptance of Response to Comments	10 days	Mon 10/10/11	Fri 10/21/11
87		2004CA55	Final Statement of Basis - Infiltration/ Grenade Range Prep and Submittal	10 days	Mon 10/24/11	Fri 11/4/11
88		2004CA56	ADEM/Army Review of Final Statement of Basis - Infiltration/Grenade Range	22 days	Mon 11/7/11	Tue 12/6/11
89		**2004CA57**	***Army/ADEM Approval of Final SB-Infiltration/Grenade Range***	1 day	Wed 12/21/11	Wed 12/21/11
90		2004CA658	Draft Statement of Basis - .22-Caliber Target Butt Preparation and Submittal	10 days	Wed 5/18/11	Tue 5/31/11
91		2004CA59	Army Review/Comments	22 days	Wed 6/1/11	Thu 6/30/11
92		2004CA60	Prepare Response to Army Comments and Response Submittal	5 days	Fri 7/1/11	Thu 7/7/11



Project: FORT RUCKER PROJECT S
Date: 12/17/09

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

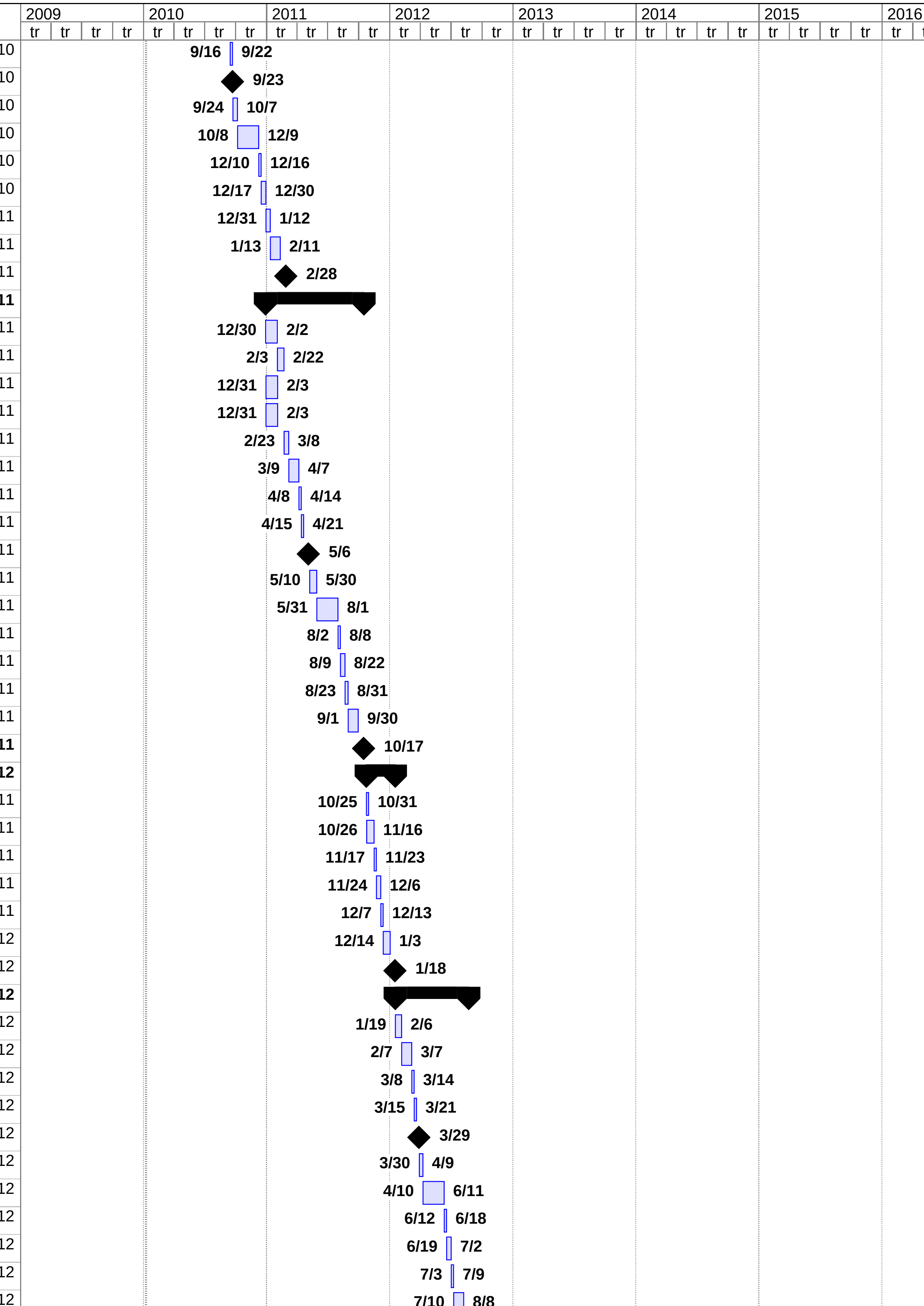
ID		WBS	Task Name	Duration	Start	Finish
93		2004CA61	Army Review/Acceptance of Response to Comments	5 days	Fri 7/8/11	Thu 7/14/11
94		2004CA62	Army Approval of Draft SB-.22-Caliber Target Butt	1 day	Fri 7/15/11	Fri 7/15/11
95		2004CA63	Draft Final Statement of Basis - .22-Caliber Target Butt Prep and Submittal	10 days	Mon 7/18/11	Fri 7/29/11
96		2004CA64	ADEM/Army Review/Comment	45 days	Mon 8/1/11	Fri 9/30/11
97		2004CA65	Prepare Response to ADEM/Army Comments and Response Submittal	5 days	Mon 10/3/11	Fri 10/7/11
98		2004CA66	ADEM/Army Review/Acceptance of Response to Comments	10 days	Mon 10/10/11	Fri 10/21/11
99		2004CA67	Final Statement of Basis - .22-Caliber Target Butt Prep and Submittal	10 days	Mon 10/24/11	Fri 11/4/11
100		2004CA68	ADEM/Army Review of Final Statement of Basis - .22-Caliber Target Butt	22 days	Mon 11/7/11	Tue 12/6/11
101		**2004CA69**	***Army/ADEM Approval of Final SB-.22-Caliber Target Butt***	1 day	Wed 12/21/11	Wed 12/21/11
102		2004CA70	Public Comment Period (All MMRP Sites)	23 days	Thu 12/22/11	Mon 1/23/12
103		2004CA71	Prepare Response to Public Comments	5 days	Tue 1/24/12	Mon 1/30/12
104		2004CA72	Army/ADEM Review/Acceptance of Response to Public Comments	10 days	Tue 1/31/12	Mon 2/13/12
105		2004CA73	Revise Statement of Basis (If Needed Based on Public Comment)	7 days	Tue 2/14/12	Wed 2/22/12
106		2004CA74	ADEM/Army Review of Final Statement fo Basis	22 days	Thu 2/23/12	Fri 3/23/12
107		2004CA75	Final Statement of Basis - Acceptance of Ranges	10 days	Mon 3/26/12	Fri 4/6/12
108		2004CA76	Draft MMRP Scores Update and Submittal	15 days	Mon 11/7/11	Fri 11/25/11
109		2004CA77	Army Review/Comments	22 days	Mon 11/28/11	Tue 12/27/11
110		2004CA78	Final MMRP Scores Update and Submittal	10 days	Wed 12/28/11	Tue 1/10/12
111		**2004DA**	**IRP SITE AOC-S**	**1520 days**	**Mon 11/2/09**	**Fri 8/28/15**
112		**2004DA1**	**FINAL RFI**	206 days	Mon 11/2/09	Mon 8/16/10
113		2004DA2	Draft RFI Technical Memorandum Work Plan Preparation and Submittal	10 days	Mon 1/4/10	Fri 1/15/10
114		2004DA3	Army Review/Comment	5 days	Mon 1/18/10	Fri 1/22/10
115		2004DA4	Prepare Response to Army Comments and Submittal	5 days	Mon 1/25/10	Fri 1/29/10
116		2004DA5	Army Review/Acceptance of Response to Comments	5 days	Mon 2/1/10	Fri 2/5/10
117		2004DA6	Draft Final RFI Technical Memorandum Work Plan Preparation and Submittal	5 days	Mon 2/8/10	Fri 2/12/10
118		2004DA7	ADEM/Army Review/Comment	45 days	Mon 2/15/10	Fri 4/16/10
119		2004DA8	Prepare Response to ADEM/Army Comments and Response Submittal	5 days	Mon 4/19/10	Fri 4/23/10
120		2004DA9	ADEM/Army Review/Acceptance of Response to Comments	10 days	Mon 4/26/10	Fri 5/7/10
121		2004DA10	Final RFI Technical Memorandum Work Plan Preparation and Submittal	5 days	Mon 5/10/10	Fri 5/14/10
122		2004DA11	Army/ADEM Approval of Final RFI Technical Memorandum Work Plan	22 days	Mon 5/17/10	Tue 6/15/10
123		2004DA12	RFI Field Work-Well Installation/Sampling	15 days	Fri 6/18/10	Thu 7/8/10
124		2004DA13	Final (Draft) RFI Report Preparation and Submittal	22 days	Fri 7/9/10	Mon 8/9/10
125		2004DA14	Army Review/Comment	22 days	Tue 8/10/10	Wed 9/8/10
126		2004DA15	Prepare Response to Army Comments and Submittal	5 days	Thu 9/9/10	Wed 9/15/10
127		2004DA16	Army Review/Acceptance of Response to Comments	5 days	Thu 9/16/10	Wed 9/22/10
128		2004DA17	Final (Draft Final) RFI Report Preparation and Submittal	10 days	Thu 9/23/10	Wed 10/6/10
129		2004DA18	Army/ADEM Review/Comment	45 days	Thu 10/7/10	Wed 12/8/10
130		2004DA19	Prepare Response to ADEM/Army Comments and Response Submittal	5 days	Thu 12/9/10	Wed 12/15/10
131		2004DA20	ADEM/Army Review/Acceptance of Response to Comments	10 days	Thu 12/16/10	Wed 12/29/10
132		2004DA21	Final RFI Report Preparation and Submittal	10 days	Thu 12/30/10	Wed 1/12/11
133		2004DA22	ADEM/Army Review of Final RFI Report	22 days	Thu 1/13/11	Fri 2/11/11
134		**2004DA23**	***Army/ADEM Approval of Final RFI Report***	1 day	Mon 2/28/11	Mon 2/28/11
135		**2004DA24**	**ARBCA EVALUATION**	**167 days**	**Fri 7/9/10**	**Mon 2/28/11**
136		2004DA25	Draft AOC-S ARBCA Technical Memorandum Preparation and Submittal	22 days	Fri 7/9/10	Mon 8/9/10
137		2004DA26	Army Review/Comment	22 days	Tue 8/10/10	Wed 9/8/10
138		2004DA27	Prepare Response to Army Comments and Submittal	5 days	Thu 9/9/10	Wed 9/15/10



Project: FORT RUCKER PROJECT S
Date: 12/17/09

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

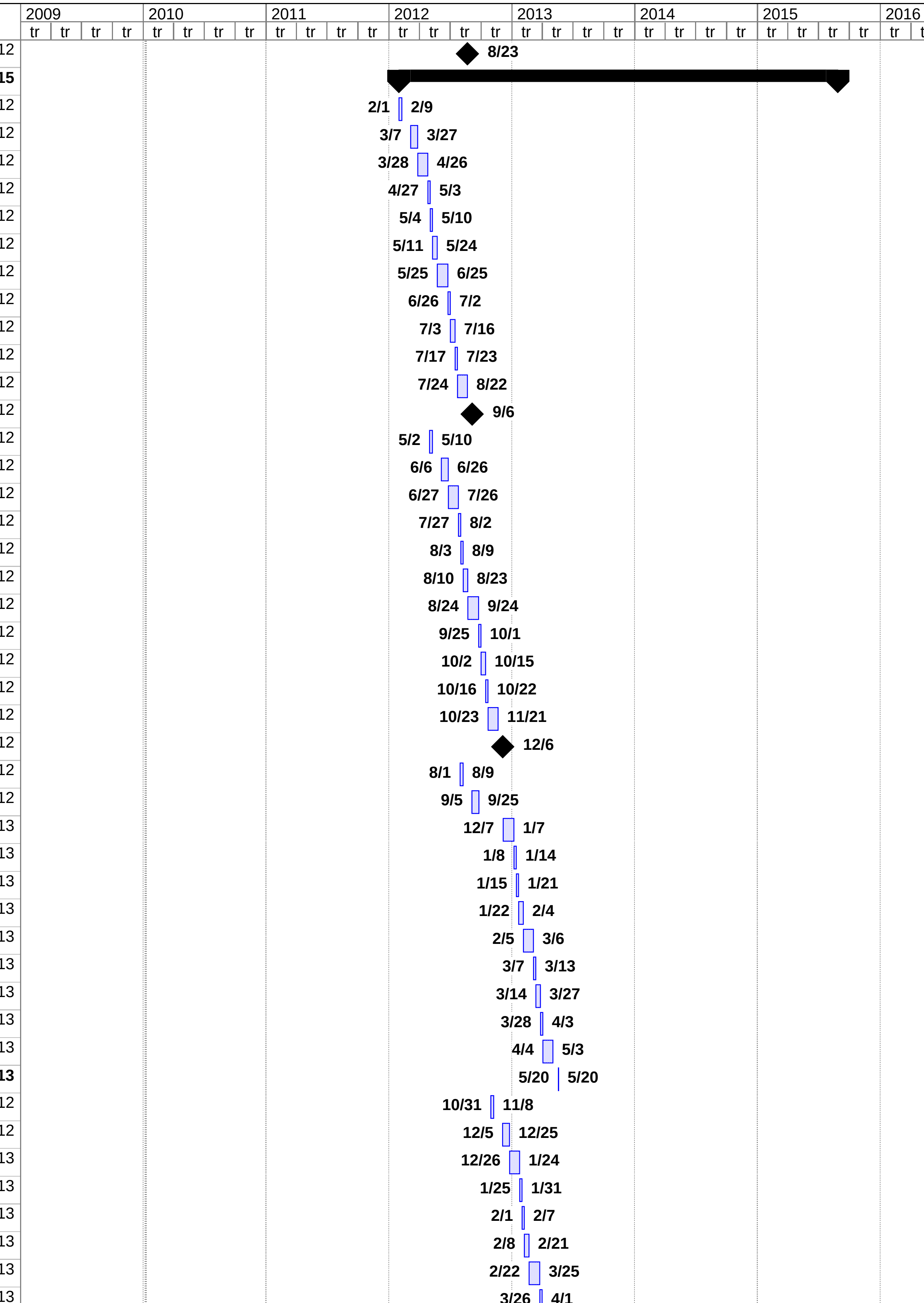
ID		WBS	Task Name	Duration	Start	Finish
139		2004DA28	Army Review/Acceptance of Response to Comments	5 days	Thu 9/16/10	Wed 9/22/10
140		**2004DA29**	***Army Approval of Draft Final AOC-S ARBCA Technical Memorandum***	1 day	Thu 9/23/10	Thu 9/23/10
141		2004DA30	Draft Final AOC-S ARBCA Technical Memorandum Preparation and Submittal	10 days	Fri 9/24/10	Thu 10/7/10
142		2004DA31	ADEM/Army Review/Comment	45 days	Fri 10/8/10	Thu 12/9/10
143		2004DA32	Prepare Response to ADEM/Army Comments and Submittal	5 days	Fri 12/10/10	Thu 12/16/10
144		2004DA33	ADEM/Army Review/Acceptance of Response to Comments	10 days	Fri 12/17/10	Thu 12/30/10
145		2004DA34	Final AOC-S ARBCA Technical Memorandum Preparation and Submittal	9 days	Fri 12/31/10	Wed 1/12/11
146		2004DA35	ADEM/Army Review of Final AOC-S ARBCA Technical Memorandum	22 days	Thu 1/13/11	Fri 2/11/11
147		**2004DA36**	***Army/ADEM Approval of Final AOC-S ARBCA Technical Memorandum***	1 day	Mon 2/28/11	Mon 2/28/11
148		**2004DA37**	**CMS/CMIP**	**208 days**	**Thu 12/30/10**	**Mon 10/17/11**
149		2004DA38	Pre-Construction Survey	25 days	Thu 12/30/10	Wed 2/2/11
150		2004DA39	PRB Remedial Design	14 days	Thu 2/3/11	Tue 2/22/11
151		2004DA40	CMS	25 days	Fri 12/31/10	Thu 2/3/11
152		2004DA41	LTM Plan	25 days	Fri 12/31/10	Thu 2/3/11
153		2004DA42	Draft CMS/CMIP Preparation and Submittal	10 days	Wed 2/23/11	Tue 3/8/11
154		2004DA43	Army Review/Comment	22 days	Wed 3/9/11	Thu 4/7/11
155		2004DA44	Prepare Response to Army Comments and Submittal	5 days	Fri 4/8/11	Thu 4/14/11
156		2004DA45	Army Review/Acceptance of Response to Comments	5 days	Fri 4/15/11	Thu 4/21/11
157		**2004DA46**	***Army Approval of Draft Final CMS/CMIP***	1 day	Fri 5/6/11	Fri 5/6/11
158		2004DA47	Draft Final CMS/CMIP Preparation and Submittal	15 days	Tue 5/10/11	Mon 5/30/11
159		2004DA48	ADEM/Army Review/Comment	45 days	Tue 5/31/11	Mon 8/1/11
160		2004DA49	Prepare Response to ADEM/Army Comments and Submittal	5 days	Tue 8/2/11	Mon 8/8/11
161		2004DA50	ADEM/Army Review/Acceptance of Response to Comments	10 days	Tue 8/9/11	Mon 8/22/11
162		2004DA51	Final CMS/CMIP Preparation and Submittal	7 days	Tue 8/23/11	Wed 8/31/11
163		2004DA52	ADEM/Army Review of Final CMS/CMIP	22 days	Thu 9/1/11	Fri 9/30/11
164		**2004DA53**	***Army/ADEM Approval of Final CMS/CMIP***	**1 day**	**Mon 10/17/11**	**Mon 10/17/11**
165		**2004DA54**	**CMI**	**62 days**	**Tue 10/25/11**	**Wed 1/18/12**
166		2004DA55	Site Preparation Mobilization	5 days	Tue 10/25/11	Mon 10/31/11
167		2004DA56	Site Preparation (clearing, work platform)	16 days	Wed 10/26/11	Wed 11/16/11
168		2004DA57	PRB Mobilization	5 days	Thu 11/17/11	Wed 11/23/11
169		2004DA58	PRB Installation	9 days	Thu 11/24/11	Tue 12/6/11
170		2004DA59	PRB Monitoring Well Network Installation	5 days	Wed 12/7/11	Tue 12/13/11
171		2004DA60	Post-Construction Survey	15 days	Wed 12/14/11	Tue 1/3/12
172		***2004DA61***	***Army Acceptance of Installation of ZVI/Sand TM***	1 day	Wed 1/18/12	Wed 1/18/12
173		**2004DA62**	**CMI Report**	**156 days**	**Thu 1/19/12**	**Thu 8/23/12**
174		2004DA63	Draft AOC-S CMI Report Preparation and Submittal	13 days	Thu 1/19/12	Mon 2/6/12
175		2004DA64	Army Review/Comment	22 days	Tue 2/7/12	Wed 3/7/12
176		2004DA65	Prepare Response to Army Comments and Submittal	5 days	Thu 3/8/12	Wed 3/14/12
177		2004DA66	Army Review/Acceptance of Response to Comments	5 days	Thu 3/15/12	Wed 3/21/12
178		**2004DA67**	***Army Approval of Draft Final AOC-S CMI Report***	1 day	Thu 3/29/12	Thu 3/29/12
179		2004DA68	Draft Final AOC-S CMI Report Preparation and Submittal	7 days	Fri 3/30/12	Mon 4/9/12
180		2004DA69	ADEM/Army Review/Comment	45 days	Tue 4/10/12	Mon 6/11/12
181		2004DA70	Prepare Response to ADEM/Army Comments and Submittal	5 days	Tue 6/12/12	Mon 6/18/12
182		2004DA71	ADEM/Army Review/Acceptance of Response to Comments	10 days	Tue 6/19/12	Mon 7/2/12
183		2004DA72	Final AOC-S CMI Report Preparation and Submittal	5 days	Tue 7/3/12	Mon 7/9/12
184		2004DA73	ADEM/Army Review of Final AOC-S CMI Report	22 days	Tue 7/10/12	Wed 8/8/12



Project: FORT RUCKER PROJECT S
Date: 12/17/09

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

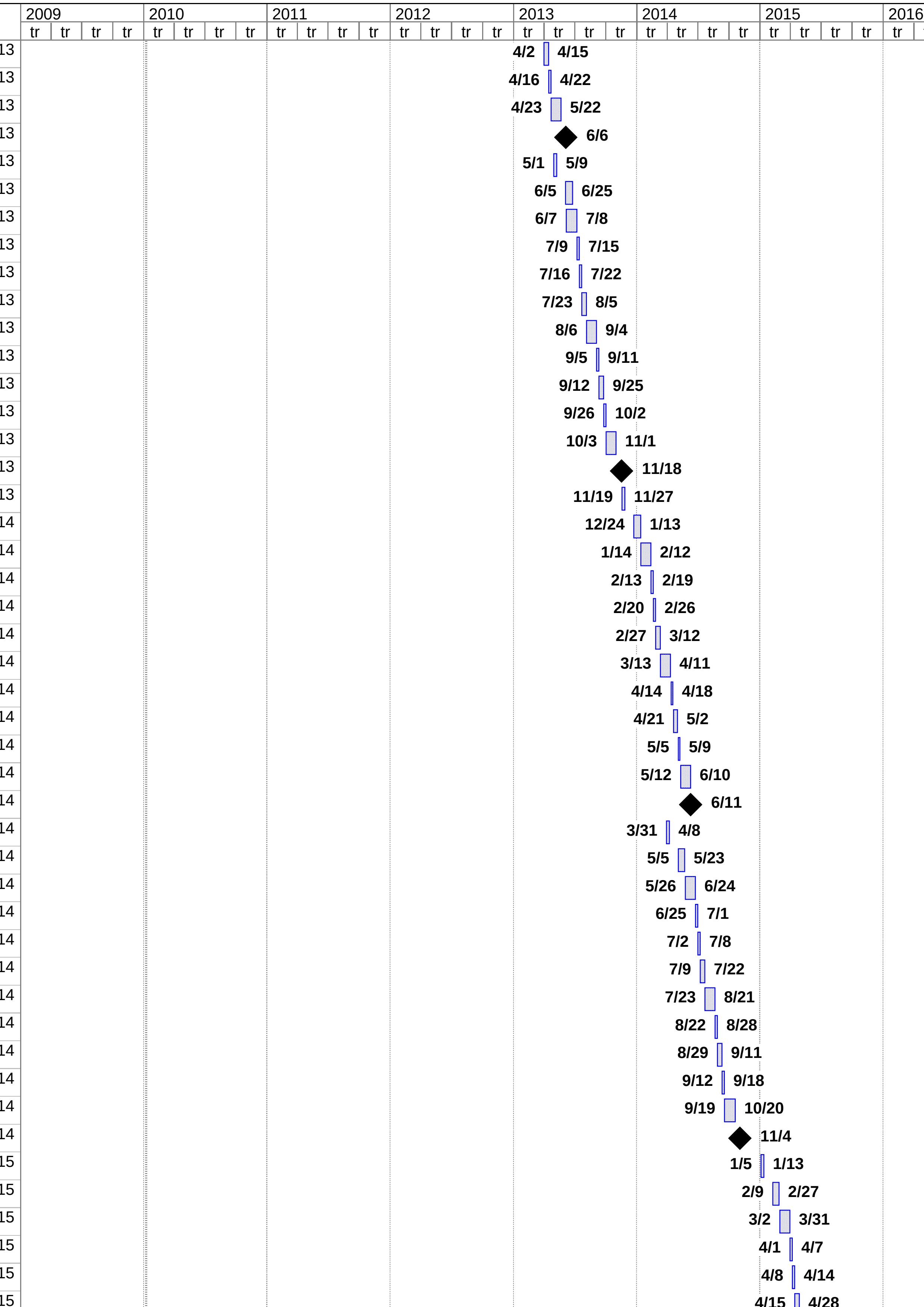
ID		WBS	Task Name	Duration	Start	Finish
185		**2004DA74**	***Army/ADEM Approval of Final AOC-S CMI Report***	1 day	Thu 8/23/12	Thu 8/23/12
186		**2004DB**	**LTM**	**933 days**	**Wed 2/1/12**	**Fri 8/28/15**
187		2004DB1	AOC-S LTM Q1 (2012) Monitoring Event	7 days	Wed 2/1/12	Thu 2/9/12
188		2004DB2	AOC-S LTM Q1 (2012) LTM Draft Report Preparation and Submittal	15 days	Wed 3/7/12	Tue 3/27/12
189		2044DB3	Army Review/Comment	22 days	Wed 3/28/12	Thu 4/26/12
190		2044DB4	Prepare Response to Army Comments and Submittal	5 days	Fri 4/27/12	Thu 5/3/12
191		2004DB5	Army Review/Acceptance of Response to Comments	5 days	Fri 5/4/12	Thu 5/10/12
192		2004DB6	AOC-S LTM Q1 (2012) LTM Draft Final Report Preparation and Submittal	10 days	Fri 5/11/12	Thu 5/24/12
193		2004DB7	ADEM/Army Review/Comment	22 days	Fri 5/25/12	Mon 6/25/12
194		2004DB8	Prepare Response to ADEM/Army Comments and Submittal	5 days	Tue 6/26/12	Mon 7/2/12
195		2004DB9	ADEM/Army Review/Acceptance of Response to Comments	10 days	Tue 7/3/12	Mon 7/16/12
196		2004DB10	AOC-S LTM Q1 (2012) LTM Final Report Preparation and Submittal	5 days	Tue 7/17/12	Mon 7/23/12
197		2004DB11	ADEM/Army Review of AOC-S LTM Q1 (2012) Final Report	22 days	Tue 7/24/12	Wed 8/22/12
198		**2004DB12**	***Army/ADEM Approval of AOC-S LTM Q1 (2012) LTM Final Report***	1 day	Thu 9/6/12	Thu 9/6/12
199		2004DB13	AOC-S LTM Q2 (2012) Monitoring Event	7 days	Wed 5/2/12	Thu 5/10/12
200		2004DB14	AOC-S LTM Q2 (2012) LTM Draft Report Preparation and Submittal	15 days	Wed 6/6/12	Tue 6/26/12
201		2004DB15	Army Review/Comment	22 days	Wed 6/27/12	Thu 7/26/12
202		2004DB16	Prepare Response to Army Comments and Submittal	5 days	Fri 7/27/12	Thu 8/2/12
203		2004DB17	Army Review/Acceptance of Response to Comments	5 days	Fri 8/3/12	Thu 8/9/12
204		2004DB18	AOC-S LTM Q2 (2012) LTM Draft Final Report Preparation and Submittal	10 days	Fri 8/10/12	Thu 8/23/12
205		2004DB19	ADEM/Army Review/Comment	22 days	Fri 8/24/12	Mon 9/24/12
206		2004DB20	Prepare Response to ADEM/Army Comments and Submittal	5 days	Tue 9/25/12	Mon 10/1/12
207		2004DB21	ADEM/Army Review/Acceptance of Response to Comments	10 days	Tue 10/2/12	Mon 10/15/12
208		2004DB22	AOC-S LTM Q2 (2012) LTM Final Report Preparation and Submittal	5 days	Tue 10/16/12	Mon 10/22/12
209		2004DB23	ADEM/Army Review of AOC-S LTM Q2 (2011) LTM Final Report	22 days	Tue 10/23/12	Wed 11/21/12
210		**2004DB24**	***Army/ADEM Approval of AOC-S LTM Q2 (2011) LTM Final Report***	1 day	Thu 12/6/12	Thu 12/6/12
211		2004DB25	AOC-S LTM Q3 (2012) Monitoring Event	7 days	Wed 8/1/12	Thu 8/9/12
212		2004DB26	AOC-S LTM Q3 (2012) LTM Draft Report Preparation and Submittal	15 days	Wed 9/5/12	Tue 9/25/12
213		2004DB27	Army Review/Comment	22 days	Fri 12/7/12	Mon 1/7/13
214		2004DB28	Prepare Response to Army Comments and Submittal	5 days	Tue 1/8/13	Mon 1/14/13
215		2004DB29	Army Review/Acceptance of Response to Comments	5 days	Tue 1/15/13	Mon 1/21/13
216		2004DB30	AOC-S LTM Q3 (2012) LTM Draft Final Report Preparation and Submittal	10 days	Tue 1/22/13	Mon 2/4/13
217		2004DB31	ADEM/Army Review/Comment	22 days	Tue 2/5/13	Wed 3/6/13
218		2004DB32	Prepare Response to ADEM/Army Comments and Submittal	5 days	Thu 3/7/13	Wed 3/13/13
219		2004DB33	ADEM/Army Review/Acceptance of Response to Comments	10 days	Thu 3/14/13	Wed 3/27/13
220		2004DB34	AOC-S LTM Q3 (2012) LTM Final Report Preparation and Submittal	5 days	Thu 3/28/13	Wed 4/3/13
221		2004DB35	ADEM/Army Review of AOC-S LTM Q3 (2012) LTM Final Report	22 days	Thu 4/4/13	Fri 5/3/13
222		**2004DB36**	***Army/ADEM Approval of AOC-S LTM Q3 (2012) LTM Final Report***	**1 day**	**Mon 5/20/13**	**Mon 5/20/13**
223		2004DB37	AOC-S LTM Q4 (2012) Monitoring Event	7 days	Wed 10/31/12	Thu 11/8/12
224		2004DB38	AOC-S LTM Q4 (2012) LTM Draft Report Preparation and Submittal	15 days	Wed 12/5/12	Tue 12/25/12
225		2004DB39	Army Review/Comment	22 days	Wed 12/26/12	Thu 1/24/13
226		2004DB40	Prepare Response to Army Comments and Submittal	5 days	Fri 1/25/13	Thu 1/31/13
227		2004DB41	Army Review/Acceptance of Response to Comments	5 days	Fri 2/1/13	Thu 2/7/13
228		2004DB42	AOC-S LTM Q4 (2012) LTM Draft Final Report Preparation and Submittal	10 days	Fri 2/8/13	Thu 2/21/13
229		2004DB43	ADEM/Army Review/Comment	22 days	Fri 2/22/13	Mon 3/25/13
230		2004DB44	Prepare Response to ADEM/Army Comments and Submittal	5 days	Tue 3/26/13	Mon 4/1/13



Project: FORT RUCKER PROJECT S
Date: 12/17/09

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

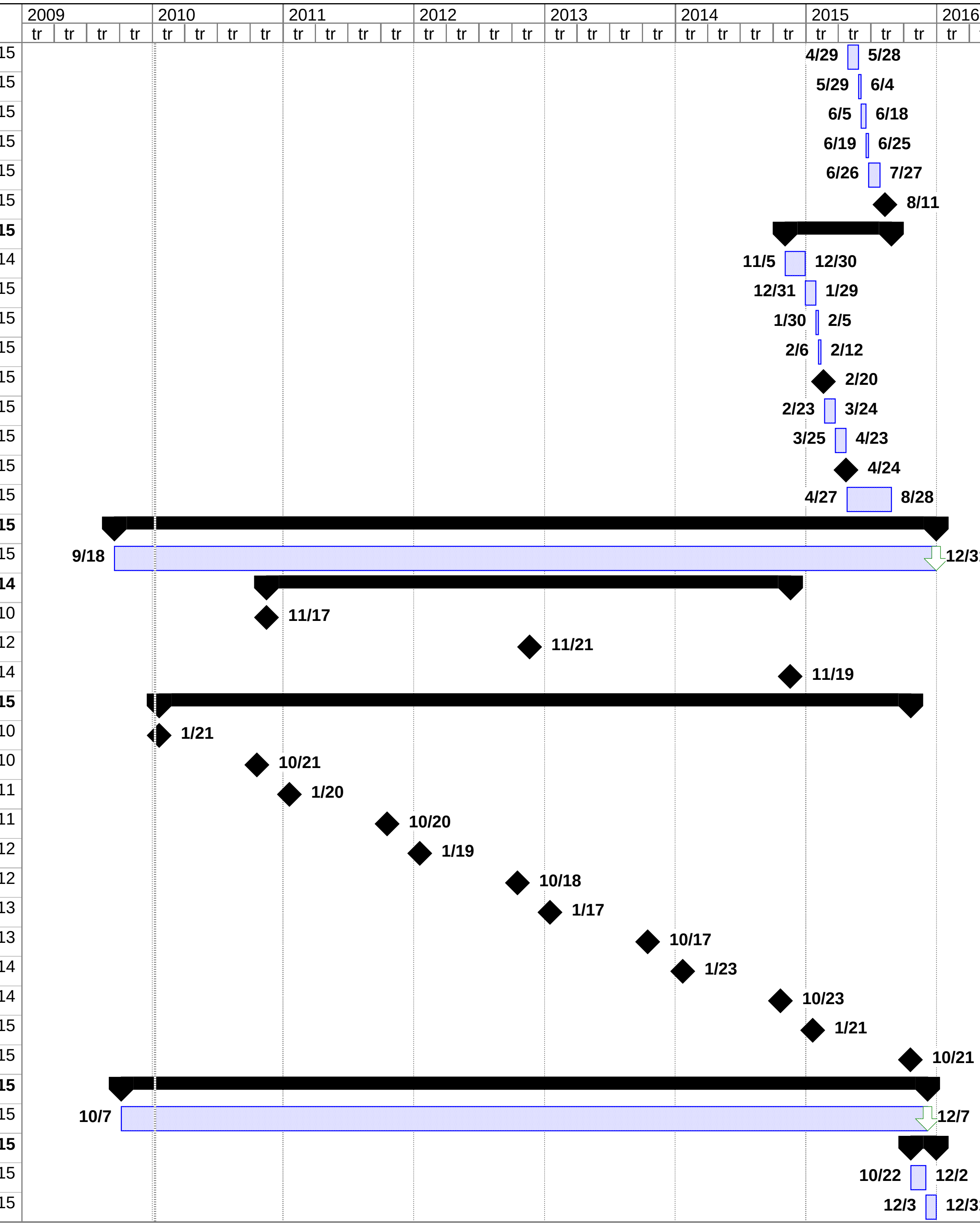
ID		WBS	Task Name	Duration	Start	Finish
231		2004DB45	ADEM/Army Review/Acceptance of Response to Comments	10 days	Tue 4/2/13	Mon 4/15/13
232		2004DB446	AOC-S LTM Q4 (2012) LTM Final Report Preparation and Submittal	5 days	Tue 4/16/13	Mon 4/22/13
233		2004DB47	ADEM/Army Review of AOC-S LTM Q4 (2012) LTM Final Report	22 days	Tue 4/23/13	Wed 5/22/13
234		**2004DB48**	***Army/ADEM Approval of AOC-S LTM Q4 (2011) LTM Final Report***	1 day	Thu 6/6/13	Thu 6/6/13
235		2004DC1	AOC-S LTM SA1 (2013) Monitoring Event	7 days	Wed 5/1/13	Thu 5/9/13
236		2004DC2	AOC-S LTM SA1 (2013) LTM Draft Report Preparation and Submittal	15 days	Wed 6/5/13	Tue 6/25/13
237		2004DC3	Army Review/Comment	22 days	Fri 6/7/13	Mon 7/8/13
238		2004DC4	Prepare Response to Army Comments and Submittal	5 days	Tue 7/9/13	Mon 7/15/13
239		2004DC5	Army Review/Acceptance of Response to Comments	5 days	Tue 7/16/13	Mon 7/22/13
240		2004DC6	AOC-S LTM SA1 (2013) LTM Draft Final Report Preparation and Submittal	10 days	Tue 7/23/13	Mon 8/5/13
241		2004DC7	ADEM/Army Review/Comment	22 days	Tue 8/6/13	Wed 9/4/13
242		2004DC8	Prepare Response to ADEM/Army Comments and Submittal	5 days	Thu 9/5/13	Wed 9/11/13
243		2004DC9	ADEM/Army Review/Acceptance of Response to Comments	10 days	Thu 9/12/13	Wed 9/25/13
244		2004DC10	AOC-S LTM SA1 (2013) LTM Final Report Preparation and Submittal	5 days	Thu 9/26/13	Wed 10/2/13
245		2004DC11	ADEM/Army Review of AOC-S LTM SA1 (2013) LTM Final Report	22 days	Thu 10/3/13	Fri 11/1/13
246		**2004DC12**	***Army/ADEM Approval of AOC-S LTM SA1 (2013) LTM Final Report***	1 day	Mon 11/18/13	Mon 11/18/13
247		2004DC13	AOC-S LTM SA2 (2013) Monitoring Event	7 days	Tue 11/19/13	Wed 11/27/13
248		2004DC14	AOC-S LTM SA2 (2013) LTM Draft Report Preparation and Submittal	15 days	Tue 12/24/13	Mon 1/13/14
249		2004DC15	Army Review/Comment	22 days	Tue 1/14/14	Wed 2/12/14
250		2004DC16	Prepare Response to Army Comments and Submittal	5 days	Thu 2/13/14	Wed 2/19/14
251		2004DC17	Army Review/Acceptance of Response to Comments	5 days	Thu 2/20/14	Wed 2/26/14
252		2004DC18	AOC-S LTM SA2 (2013) LTM Draft Final Report Preparation and Submittal	10 days	Thu 2/27/14	Wed 3/12/14
253		2004DC19	ADEM/Army Review/Comment	22 days	Thu 3/13/14	Fri 4/11/14
254		2004DC20	Prepare Response to ADEM/Army Comments and Submittal	5 days	Mon 4/14/14	Fri 4/18/14
255		2004DC21	ADEM/Army Review/Acceptance of Response to Comments	10 days	Mon 4/21/14	Fri 5/2/14
256		2004DC22	AOC-S LTM SA2 (2013) LTM Final Report Preparation and Submittal	5 days	Mon 5/5/14	Fri 5/9/14
257		2004DC23	ADEM/Army Review of AOC-S LTM SA2 (2013) LTM Final Report	22 days	Mon 5/12/14	Tue 6/10/14
258		**2004DC24**	***Army/ADEM Approval of AOC-S LTM SA2 (2013) LTM Final Report***	10 days	Wed 6/11/14	Tue 6/24/14
259		2004DD1	AOC-S LTM A1 (2014) Monitoring Event	7 days	Mon 3/31/14	Tue 4/8/14
260		2004DD2	AOC-S LTM A1 (2014) LTM Draft Report Preparation and Submittal	15 days	Mon 5/5/14	Fri 5/23/14
261		2004DD3	Army Review/Comment	22 days	Mon 5/26/14	Tue 6/24/14
262		2004DD4	Prepare Response to Army Comments and Submittal	5 days	Wed 6/25/14	Tue 7/1/14
263		2004DD5	Army Review/Acceptance of Response to Comments	5 days	Wed 7/2/14	Tue 7/8/14
264		2004DD6	AOC-S LTM A1 (2014) LTM Draft Final Report Preparation and Submittal	10 days	Wed 7/9/14	Tue 7/22/14
265		2004DD7	ADEM/Army Review/Comment	22 days	Wed 7/23/14	Thu 8/21/14
266		2004DD8	Prepare Response to ADEM/Army Comments and Submittal	5 days	Fri 8/22/14	Thu 8/28/14
267		2004DD9	ADEM/Army Review/Acceptance of Response to Comments	10 days	Fri 8/29/14	Thu 9/11/14
268		2004DD10	AOC-S LTM A1 (2014) LTM Final Report Preparation and Submittal	5 days	Fri 9/12/14	Thu 9/18/14
269		2004DD11	ADEM/Army Review of AOC-S LTM A1 (2014) LTM Final Report	22 days	Fri 9/19/14	Mon 10/20/14
270		**2004DD12**	***Army/ADEM Approval of AOC-S LTM A1 (2014) LTM Final Report***	1 day	Tue 11/4/14	Tue 11/4/14
271		2004DE1	AOC-S LTM A2 (2015) Monitoring Event	7 days	Mon 1/5/15	Tue 1/13/15
272		2004DE2	AOC-S LTM A2 (2015) LTM Draft Report Preparation and Submittal	15 days	Mon 2/9/15	Fri 2/27/15
273		2004DE3	Army Review/Comment	22 days	Mon 3/2/15	Tue 3/31/15
274		2004DE4	Prepare Response to Army Comments and Submittal	5 days	Wed 4/1/15	Tue 4/7/15
275		2004DE5	Army Review/Acceptance of Response to Comments	5 days	Wed 4/8/15	Tue 4/14/15
276		2004DE6	AOC-S LTM A2 (2015) LTM Draft Final Report Preparation and Submittal	10 days	Wed 4/15/15	Tue 4/28/15



Project: FORT RUCKER PROJECT S
Date: 12/17/09

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

ID		WBS	Task Name	Duration	Start	Finish
277		2004DE7	ADEM/Army Review/Comment	22 days	Wed 4/29/15	Thu 5/28/15
278		2004DE8	Prepare Response to ADEM/Army Comments and Submittal	5 days	Fri 5/29/15	Thu 6/4/15
279		2004DE9	ADEM/Army Review/Acceptance of Response to Comments	10 days	Fri 6/5/15	Thu 6/18/15
280		2004DE10	AOC-S LTM A2 (2015) LTM Final Report Preparation and Submittal	5 days	Fri 6/19/15	Thu 6/25/15
281		2004DE11	ADEM/Army Review of AOC-S LTM A2 (2015) LTM Final Report	22 days	Fri 6/26/15	Mon 7/27/15
282		**2004DE12**	***Army/ADEM Approval of AOC-S LTM A2 (2015) LTM Final Report***	1 day	Tue 8/11/15	Tue 8/11/15
283		**2004DH**	**REMEDY REVIEW**	**213 days**	**Wed 11/5/14**	**Fri 8/28/15**
284		2004DH1	Preparation of Remedy Review Draft Document and Submittal	40 days	Wed 11/5/14	Tue 12/30/14
285		2004DH2	Army Review/Comment	22 days	Wed 12/31/14	Thu 1/29/15
286		2004DH3	Prepare Response to Army Comments and Submittal	5 days	Fri 1/30/15	Thu 2/5/15
287		2004DH4	Army Review/Acceptance of Response to Comments	5 days	Fri 2/6/15	Thu 2/12/15
288		**2004DH5**	***Remedy Review Draft Final Report Acceptance***	1 day	Fri 2/20/15	Fri 2/20/15
289		2004DH6	Remedy Review Final Report Preparation and Submittal	22 days	Mon 2/23/15	Tue 3/24/15
290		2004DH7	Army/ADEM Review of Remedy Review Final Report	22 days	Wed 3/25/15	Thu 4/23/15
291		**2004DH8**	***Remedy Review Final Report Acceptance***	1 day	Fri 4/24/15	Fri 4/24/15
292		2004DH8	Successful Correction of Deficiencies Noted in Remedy Review	90 days	Mon 4/27/15	Fri 8/28/15
293		**2004DI**	**PROJECT REPOSITORY/ADMINISTRATIVE RECORD**	**1640 days**	**Fri 9/18/09**	**Thu 12/31/15**
294		2004DI1	PROJECT REPOSITORY/ADMINISTRATIVE RECORD	1640 days	Fri 9/18/09	Thu 12/31/15
295		**2004DJ**	**BIANNUAL PUBLIC INTEREST ASSESSMENT**	**1046 days**	**Wed 11/17/10**	**Wed 11/19/14**
296		2004DJ1	August 2010	1 day	Wed 11/17/10	Wed 11/17/10
297		2004DJ2	August 2012	1 day	Wed 11/21/12	Wed 11/21/12
298		2004DJ3	August 2014	1 day	Wed 11/19/14	Wed 11/19/14
299		**2004DK**	**STAKEHOLDER PRESENTATIONS**	**1500 days**	**Thu 1/21/10**	**Wed 10/21/15**
300		2004DK1	January 2010	1 day	Thu 1/21/10	Thu 1/21/10
301		2004DK2	October 2010	1 day	Thu 10/21/10	Thu 10/21/10
302		2004DK3	January 2011	1 day	Thu 1/20/11	Thu 1/20/11
303		2004DK4	October 2011	1 day	Thu 10/20/11	Thu 10/20/11
304		2004DK5	January 2012	1 day	Thu 1/19/12	Thu 1/19/12
305		2004DK6	October 2012	1 day	Thu 10/18/12	Thu 10/18/12
306		2004DK7	January 2013	1 day	Thu 1/17/13	Thu 1/17/13
307		2004DK8	October 2013	1 day	Thu 10/17/13	Thu 10/17/13
308		2004DK9	January 2014	1 day	Thu 1/23/14	Thu 1/23/14
309		2004DK10	October 2014	1 day	Thu 10/23/14	Thu 10/23/14
310		2004DK11	January 2015	1 day	Wed 1/21/15	Wed 1/21/15
311		2004DK12	October 2015	1 day	Wed 10/21/15	Wed 10/21/15
312		**2004DL**	**STATUS REPORTS (MONTHLY)**	**1609 days**	**Wed 10/7/09**	**Mon 12/7/15**
313		2004DL1	STATUS REPORTS (MONTHLY)	1609 days	Wed 10/7/09	Mon 12/7/15
314		**2004DM**	**PROJECT CLOSEOUT**	**51 days**	**Thu 10/22/15**	**Thu 12/31/15**
315		2004DM1	Close Out Prep	30 days	Thu 10/22/15	Wed 12/2/15
316		2004DM2	Final Close Out	21 days	Thu 12/3/15	Thu 12/31/15



Project: FORT RUCKER PROJECT S
Date: 12/17/09

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

Quality Assurance Project Plan

Volume II:
Quality Assurance Project Plan (QAPP)

Environmental Remediation Services
Fort Rucker, Alabama

FINAL

Contract No. W91ZLK-05-D-0014
Contract Task Order No. 0001

Prepared for:

U.S. Army Environmental Command

Prepared by:

CH2MHILL

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January 2010

Contents

Attachments-Tables

Acronyms and Abbreviations

ASTM	American Society for Testing and Materials
CCV	All Continuing Calibration Verification
CD	compact disk
CL	control limits
CMI	corrective measures implementation
COC	chain-of-custody
DI	de-ionized
DO	dissolved oxygen
DQE	data quality evaluation
DQO	data quality objective
ECD	electron capture detector
EDD	electronic data deliverable
ELAB	Empirical Laboratories
EM	Engineering Manual
EPA	U.S. Environmental Protection Plan
ERB	equipment rinsate blank
FB	field blank
FSP	Field Sampling Plan
FTL	Field Team Leader
GC	gas chromatography
GFAA	Graphite Furnace Atomic Absorption
ICP	Inductively Coupled Plasma
ICPES	Inductively Coupled Plasma Emission Spectrometry
ICS	interference check sample
ICV	initial calibration verification
IDL	instrument detection limit
IS	internal standard
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LPM	laboratory project manager
LQMP	Laboratory Quality Management Plan
MB	method blanks
MD	matrix duplicate
MDL	method detection limit
mL	milliliter
mm	millimeter
MQL	method quantification limit
MQO	method quality objective
MRL	method reporting limit
MS	mass spectrometry
MS/MSD	matrix spike/matrix spike duplicate
M&TE	measuring and test equipment

NIST	National Institute of Standards and Technology
ORP	oxidation-reduction potential
P	percent recovery
PARCCS	precision, accuracy, representativeness, completeness, comparability, and sensitivity
PC	project chemist
PDM	project data manager
PDS	post-digestion spike
PLM	Polarized Light Microscopy
PM	project manager
QA	quality assurance
QAM	Quality Assurance Manual
QAPP	Quality Assurance Project Plan
QC	quality control
QL	Quantitation Limit
RCRA	Resource Conservation and Recovery Act
RF	response factors
RL	reporting limit
RPD	relative percent difference
SA	sample concentration added
SD	spike duplicate
SDG	sample delivery group
SOP	standard operating procedures
SQL	sample quantitation limit
SR	sample result
SSR	spike sample result
TB	trip blank
TCLP	toxicity characteristic leaching procedure
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound

1. Project Laboratory Organization and Responsibilities

This section identifies key project team members associated with the planned sampling work and lists the responsibilities associated with each position. The organizational structure and responsibilities are designed to provide project control and quality assurance (QA) for the proposed investigation.

1.1 Laboratory Work Group

The selected laboratories are responsible for analyzing samples collected during field activities in accordance with this Quality Assurance Project Plan (QAPP) and the laboratory's Quality Assurance Manual (QAM). Empirical Laboratories, LLC (ELAB) in Nashville, Tennessee, will be performing all of the analyses. Janice Shilling has been identified as the laboratory project manager (LPM), and her back-up is Marcia McGinnity. The LPM or client service manager acts as a liaison between the project chemist, the field, and laboratory operations, and is responsible for the following:

- Receipt of sample custody from the field team members, verification of sample integrity, and transfer of sample fractions to the appropriate analytical departments
- Coordination of sample analyses to meet project objectives
- Ensuring that laboratory personnel understand technical requirements, including chain-of-custody (COC) procedures
- Preparation of analytical reports
- Review of laboratory data for compliance with method requirements
- Review of any quality control (QC) deficiencies reported by the analytical department manager
- Coordination of necessary changes
- Completion of data package deliverables
- Communication with the project chemist (PC) pertaining to analytical and QC issues
- Response to questions from the project team during the data quality evaluation (DQE) process

1.2 Subcontracted Laboratory

No subcontracted laboratories will be performing analytical work associated with this project. If this becomes necessary due to an unforeseen issue, the lab must have the permission of the project manager (PM). Elab will be responsible for the performance of the subcontract laboratory.

1.3 Quality Assurance Laboratory

No samples will be collected as QA samples and submitted to a U. S. Army Corps of Engineers (USACE) contracted laboratory during this project.

1.4 Project Communication

Effective communication among all project personnel will be established and maintained. Project and task instructions will be distributed to all applicable project team members as needed throughout the project.

During field investigation phases of this project, the field team will meet daily to review the status of the project and to discuss technical and safety issues. When necessary, other meetings will be scheduled or the field team leader (FTL) will meet individually with field personnel to resolve problems.

During the field effort, the FTL will be in regular telephone or personal contact with the project team. When significant problems or decisions requiring additional authority occur, the FTL will immediately contact the PM for assistance. The PC will coordinate communication with the laboratory through sample collection, sample analysis, and the DQE process, and will consult with the PM.

2. Data Assessment Organization and Responsibilities

Whenever chemical data are generated, their quality must be assessed prior to use. The type and degree of assessment required depends upon the project data quality objectives (DQOs). Several different levels of data assessment exist, including data verification, data review, data evaluation, and data validation.

The data will undergo several steps of review at the laboratory. Upon receipt of the hard copy data packages and electronic data deliverables, all data will be validated by CH2M HILL chemists.

After the data have been validated and a DQE report written, the data will be evaluated against risk criteria and the results presented in the Long-term Monitoring (LTM) and Corrective Measures Implementation (CMI) reports.

3. Data Quality Objectives

3.1 Data Quality Objective and Development

DQOs are both qualitative and quantitative statements that define the type, quality, and quantity of data necessary to support the decision making process during project activities. The intended final use of the data determines the DQOs, which are developed before sampling and analysis plans.

The credibility of the data is strengthened by the level of the supporting QA/QC documentation. The greater the importance of the data or the resulting decision, the more QA/QC information is needed to validate the data. This reasoning must be applied to the data collected for any project. The DQO process used for this project follows the Engineering Manual (EM) 200-1-2 (1998) and U. S. Environmental Protection Agency (EPA) QA/G-4 guidance (EPA, 2000) and uses the following seven-step DQO development process:

1. **State the problem.** Describe concisely the problem to be studied.
2. **Identify the decisions.** State the decisions to be made to solve the problem.
3. **Identify inputs to the decisions.** Identify information and supporting measurements needed to make the decisions and describe the source(s) of the information.
4. **Define the boundaries of the study.** Specify conditions (that is, time periods and spatial locations).
5. **Develop a decision rule.** Define the conditions by which a decision maker will select alternatives, usually specified as "if/then" statements. (For example, if average concentration in soil is less than cleanup level, then the site achieves remedial action goals.)
6. **Specify tolerable limits on decision errors.** Define in statistical terms.
7. **Optimize the design for obtaining data.** Evaluate the results of the previous steps and develop the most resource-efficient design for data collection.

3.2 Quality Objectives for Chemical Data Measurement

The sampling approach and rationale are based on the DQOs and are presented in the Work Plan. One activity associated with developing the sampling approach and rationale is developing a list of samples to be collected, sample types, sampling intervals, analytical parameters, and required detection/quantitation limits for each required parameter.

Once the number and type of samples and analytical parameters are determined, the quality objectives are developed. The quality objectives focus on determining the level of QA/QC and the data package deliverables for all analyses needed to meet specified DQOs. To meet a minimum level of certainty about the quality of the field data, the following elements will be addressed to meet the objectives specified by the client and regulatory agencies:

- Field operations will be conducted in accordance with written procedures.
- To maintain accuracy within necessary limits, measuring and test equipment (M&TE) used in field investigations will be calibrated against traceable standards at specific intervals, using approved standard operating procedures (SOPs) or manufacturer's instructions.
- When M&TE is found to be out of specification, the previous inspection or test results will be evaluated for validity and acceptability. This evaluation will be documented.
- Before project fieldwork begins, all project staff conducting fieldwork will be trained to be familiar with the project Work Plan and associated documents.
- Internal audits may be performed to assess the quality of project activities and to evaluate compliance with established QA requirements.
- QC samples will be used to monitor the quality of field and laboratory techniques and data.

3.3 Levels of Data Quality and Data Reporting

The level of data quality is dependent on the objective use of the results supported by the data.

The data use determines the required levels of data quality. The two categories of data quality established by the EPA are "screening" and "definitive." These categories are defined as follows:

Screening data are generated by rapid methods of analysis with less rigorous sample preparation, calibration and/or QC requirements compared with the requirements for producing definitive data. Sample preparation steps are commonly restricted to simple procedures such as dilution with a solvent, instead of elaborate extraction/digestion and cleanup. Screening data may provide analyte identification and quantitation, although the quantitation may be relatively imprecise, unless EPA reference methods are used. Physical test methods such as dissolved oxygen (DO) measurements, temperature and pH measurements, moisture content, turbidity, and conductance have been designated by definition as screening techniques.

Depending on the DQOs, screening methods may require confirmation samples that generate definitive data. Confirmation samples will be selected to include both detected and nondetected results from the screening technique.

Definitive data are generated using rigorous analytical methods such as approved EPA reference methods as discussed in Section 5 of this QAPP. Data are analyte-specific, and both identification and quantitation are confirmed. These methods have standardized QC and documentation requirements as discussed in Section 5 and in the analytical method. Definitive data are not restricted in their use unless quality problems require data qualification.

Four levels of data reporting may be performed as part of this field effort, with each level having different supporting QA/QC documentation. The four levels correspond to QC Levels I, II, III, and IV. Screening or Levels I and II data reporting includes field monitoring activities, such as measurements of pH, temperature, conductivity, DO, oxidation-reduction potential (ORP), turbidity, and limited analytical results from the laboratory. Definitive or Level III data reporting provides definitive and/or confirmation data. Comprehensive or Level IV data reporting includes the highest level of QC with significant additional documentation. For this project Level III data reporting will be required of the laboratory.

These levels are described in greater detail in Section 7.

3.4 Quality of Data

To ensure that quality data are continually produced during analysis, systematic QC checks are incorporated into the sampling and analyses to show that procedures and test results remain reproducible and that the analytical method is actually measuring the quantity of target analytes without unacceptable bias. Systematic QC checks include the scheduled analyses of field and laboratory replicates, standards, surrogates, spiked samples, and blanks.

Analytical performance requirements are expressed in terms of precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS). Summarized below are brief definitions for each PARCCS parameter and the equations used for calculations. The precision and accuracy QC limits for each method and matrix are identified in **Attachments A-1 through A-8** of this QAPP.

3.4.1 Precision

Precision is a measure of the agreement or repeatability of a set of replicate results obtained from duplicate analyses made under identical conditions. Precision can be estimated by comparing duplicate matrix spike (MS) concentrations with field duplicate sample results. Long-term analytical precision for an analyte in a method can be calculated from multiple determinations of the analyte from a homogeneous sample or a laboratory control sample (LCS) over a period of time. LCS values obtained over a period of time should be used to construct a control chart and to evaluate long-term analytical precision. The laboratory-established long-term analytical precision is not a reporting requirement for the data packages. The laboratory established control limits (CLs) (a measure of precision) for each analyte should not be wider than the limits specified in **Attachments A-1 through A-8**. Single analytical batch precision can be measured from laboratory duplicates (for example, LCS and laboratory control sample duplicate [LCSD]). The precision of a duplicate determination can be expressed as the relative percent difference (RPD), calculated as:

$$\text{RPD} = \left\{ \frac{|X_1 - X_2|}{\frac{(X_1 + X_2)}{2}} \right\} x\,100$$

where X_1 is the result from the native sample, and X_2 is the result from the duplicate sample.

3.4.2 Accuracy

Accuracy is a measure of the agreement between an experimental determination and the true value of the parameter being measured. Accuracy is estimated through the use of known reference materials and MSs. Both field and analytical accuracy will be monitored through initial and continuing calibration of instruments. In addition, internal standards, MSs, blank samples, LCSs, and surrogate standards will be used to assess the accuracy of the analytical data. It is calculated from analytical data and is not measured directly. Spiking of reference materials into a sample matrix provides a measure of the matrix effects on analytical accuracy. Spiking of reference materials into a "non-matrix," such as de-ionized (DI) water or Ottawa sand, provides a measure of the accuracy of the analytical method itself. Accuracy, defined as percent recovery (P), is calculated as:

$$P = \left[\frac{(SSR - SR)}{SA} \right] x\ 100$$

where SSR is the spiked sample result, SR is the sample result (native), and SA is the spike concentration added to the spiked sample.

3.4.3 Representativeness

Representativeness is a measure of the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is most concerned with the proper design of the sampling program. Representativeness is demonstrated by providing full descriptions in the project planning documents of the sampling techniques and by making certain that the sampling locations are selected and the number of samples collected such that the accuracy and precision criteria are met.

3.4.4 Comparability

Comparability is another qualitative measure designed to express the confidence with which one data set may be compared with another. Sample collection and handling techniques, sample matrix type, and analytical method all affect comparability. Comparability is limited by the other PARCCS parameters because data sets can be compared with confidence only when precision and accuracy are known. Data from one phase of an investigation can be compared with others when similar methods are used and similar data packages are obtained.

3.4.5 Completeness

The data completeness of laboratory analyses results will be assessed for compliance with the amount of data required for decision making. Complete data are data that are not rejected. Data qualified with qualifiers such as a "J" or a "UJ" are still deemed acceptable and can still be used to make project decisions. Completeness is defined as the percentage of measurements judged to be valid compared with the total number of measurements made for a specific sample matrix and analysis. Completeness is calculated using the formula:

$$Completeness = \frac{Valid\ Measurements}{Total\ Measurements}\, x100$$

Experience on similar projects has shown that laboratories typically achieve approximately 90 percent completeness. All validated data will be used. During the data validation process, an assessment will be made of whether the valid data are sufficient to meet project objectives. If sufficient valid data are not obtained, the PM will initiate corrective action.

3.4.6 Sensitivity

Sensitivity is the measure of the concentration at which an analytical method can positively identify and report analytical results. The sensitivity of a given method is commonly referred to as the detection limit. The terms and definitions of detection limits that will be used for this program are discussed in greater detail in Section 6.3 of this QAPP.

4. Sample Receipt, Handling, Custody, and Holding Time Requirements

4.1 Sample Custody

The sample custody and documentation procedures described in this subsection will be followed throughout all sample collection activities. Proper sample handling, preservation, shipment, and maintenance of COC are key components to building the documentation and support for data within the evidentiary process in order that the data can be used for decision making. It is essential that all sample handling and sample COC requirements be met in a complete, accurate, and consistent manner. Components of sample custody procedures include the use of field logbooks, sample labels, custody seals, and COC forms. Sample handling and custody requirements must be followed for all samples collected as part of the investigation. Each person involved with sample handling must be trained in COC procedures before the start of the field project. The COC form must accompany the samples during shipment from the field to the laboratory.

A sample is under custody under the following conditions:

- It is in one's actual possession.
- It is in one's view, after being in one's physical possession.
- It was in one's physical possession and that person locks it up to prevent tampering.
- It is in a designated and identified secure area.

4.2 Field Custody

The procedures used to document, establish, and maintain custody of field samples are addressed in the Field SOPs. The following procedures, at a minimum, must be used to document, establish, and maintain custody of field samples:

- Sample labels must be completed for each sample with waterproof ink, ensuring that the labels are legible and affixed firmly on the sample container.
- All sample-related information must be recorded in the project logbook.
- The field sampler must retain custody of samples until they are transferred or properly dispatched.
- One individual from the field sampling team should be designated as the individual responsible for all sample transfer activities. This field investigator will be responsible for the care and custody of samples until they are properly transferred to another person or facility.
- All samples will be accompanied by a COC record. This record documents the transfer of custody of samples from the field investigator to another person, to the laboratory, or

to other organizational entities. Each change of possession must be accompanied by an authorized signature for relinquishment and receipt of the samples. The original record must accompany the shipment, and the FTL must retain a copy.

- Completed COC forms will be enclosed in a sealed plastic Zip-Lock®-type baggie and placed inside the shipping container used for sample transport from the field to the laboratory.
- When samples are relinquished to a shipping company for transport, the tracking number from the shipping bill or receipt will be recorded on the COC form.
- Custody seals must be affixed on shipping containers when samples are shipped to the laboratory to prevent sample tampering during transportation. If seals are numbered, record the numbers on the COC and in the field logbook.

4.3 Sample Packing and Shipping

Samples will be delivered to the designated laboratories by a common carrier such as Federal Express. Hard plastic ice chests or coolers with similar durability will be used for shipping samples. The coolers must be able to withstand a 4-foot drop onto solid concrete in the position most likely to cause damage. The samples must be cushioned to cause the least amount of damage if such a fall occurs.

All aqueous volatile organic compound (VOC) sample vials will be shipped in the same cooler on a given day. A trip blank will be included in each cooler with VOC samples (aqueous). After the collection of soil samples, the EZ-Draw sample syringes are placed in a re-sealable packet supplied by the vendor and included in the sample coolers. (In those cases where soil samples may contain high levels of target compounds, it is advisable to ship the aqueous and soil samples in separate coolers.) After packing is complete, the cooler will be taped with COC seals affixed across the top and bottom joints. Each container will be clearly marked with a sticker containing the originator's address.

The procedures used to pack and ship samples are addressed in the Field Sampling Plan (FSP). The following procedures, at a minimum, must be used when transferring samples for shipment:

- All sample coolers and packages must be accompanied by a COC form identifying the contents. When transferring possession of samples, the individuals relinquishing and receiving the sample must sign, date, and note the time on the record. This record documents the transfer of custody of samples from the field sampler to another person or to the laboratory. The original COC record must accompany the shipment, and the FTL must retain a copy.
- Samples must be properly packaged for shipment and dispatched to the appropriate laboratory for analysis with a separate signed COC form enclosed in each sample box or cooler.

4.4 Laboratory Sample Receipt

Each laboratory receiving samples must comply with the laboratory sample custody requirements outlined in the subcontract document and its own QAM. The FTL or PC will notify the laboratory of upcoming field sampling activities and the subsequent transfer of samples to the laboratory. This notification will include information concerning the number and type of samples to be shipped, and the expected date of arrival.

The following procedures will be used by the laboratory sample custodian, once the samples have arrived at the laboratory:

- The laboratory will designate a sample custodian who will be responsible for maintaining custody of the samples and for maintaining all associated records documenting that custody.
- Upon receipt of the samples, the custodian will check the original COC and request-for-analysis documents and compare them with the labeled contents of each sample container for corrections and traceability. The sample custodian will sign the COC and record the date and time received. The sample custodian also will assign a unique laboratory sample number to each sample.
- Each individual cooler will have the temperature (via the temperature blank) checked and recorded for analytical method compliance.
- Care will be exercised to annotate any labeling or descriptive errors. If discrepancies occur in the documentation, the laboratory will immediately contact the FTL as part of the corrective action process. A qualitative assessment of each sample container will be performed to note anomalies, such as broken or leaking bottles. This assessment will be recorded as part of the incoming COC procedure.
- If all data and samples are correct and there has been no tampering with the custody seals, the "Received by Laboratory" box will be signed and dated.
- All samples will be accompanied by a COC form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the field sampler to another person or to the laboratory. Overnight carriers will be treated as a single entity, and a single signature will be required when samples are delivered to the laboratory.
- Copies of the COC and request-for-analysis forms will accompany the laboratory report and will become a permanent part of the project records.
- The laboratory will send a sample acknowledgment letter to the PC as a record that the shipment arrived and noting the conditions of the containers upon arrival.

4.5 Laboratory Sample Storage

After the samples have been received and labeled by the laboratory, they will be moved to the locked refrigerators/freezers where they will be maintained at at the proper temperature. Sample extracts will be stored in designated secure, refrigerated storage areas. Samples and sample extracts will be maintained in secure storage until disposal. No samples or extracts will be disposed of without prior written approval from an appropriate member of the project team. The sample custodian will note sample disposal date in the sample ledger. The laboratory, in accordance with applicable regulations, will dispose of samples. The laboratory will be required to retain the sample for a minimum of 90 days and sample extracts for a minimum of 60 days after submission, pending the need for re-analysis.

4.6 Corrective Actions for Incoming Samples

Any discrepancy will be identified and corrective actions performed. These remarks will be documented on a "sample receipt checklist" or its equivalent. The PC may need to be contacted to provide guidance concerning additional corrective actions.

4.6.1 Analytical Holding Times

The laboratory contractor will adhere to all analytical holding times as described in the analytical methods. The holding times for the requested analyses are listed in Attachment A-18.

5. Analytical Procedures

This subsection summarizes analytical methods that will be performed for this project, including the laboratory facilities and calibration requirements. The analytical methods, specific target parameter lists, reporting limits (RLs), and QC criteria are listed in **Attachments A-1 through A-25.**

Samples will be analyzed using EPA-approved methods or other recognized standard methods. The two principal sources for analytical methods are as follows:

- *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA SW-846, Third Edition, and its updates, 1998)
- *Methods for Chemical Analysis of Water and Wastes* (EPA, 1993/1994)

5.1 Laboratory Facility and Equipment

5.1.1 Laboratory Facility Requirements

The laboratory will provide a secure testing facility that can accommodate the proper performance for the type, range, and volume of analytical services it provides. Facility entries must be controlled and monitored as necessary to assure restricted access, especially for areas affecting the quality of activities or data. The design of the facility must provide effective separation of incompatible testing activities and adequate energy sources, lighting, heating/cooling, and ventilation to ensure stability of voltage, temperature, humidity, and other pertinent environmental conditions. This may involve inclusion of an area under positive pressure for analysis of VOCs. Adequate monitoring of environmental conditions and general housekeeping should be maintained to avoid any influence on the testing activities performed.

5.1.2 Laboratory Equipment Requirements

The laboratory will provide sufficient equipment, instruments, and related supplies for proper performance of work. All equipment used will be reflective of the measurement accuracy necessary. The laboratory will ensure that all equipment and supplies purchased are inspected, a unique identifier assigned to them, and the equipment verified as compliant with all relevant requirements prior to their initial use. Records of all suppliers used to obtain support services and materials will be maintained.

Equipment Preventative Maintenance

To minimize downtime and interruption of analytical work, preventive maintenance will be routinely performed on each analytical instrument. Designated laboratory personnel should be trained in routine maintenance procedures for all major instrumentation. When repairs are necessary, the equipment will be taken out of service, repairs performed by either trained staff or trained service engineers, and an evaluation of the impact on previous calibrations or tests performed. It is generally recommended that maintenance contracts be maintained on all major analytical instruments. Detailed SOPs will be on file or the information incorporated into method SOPs/Laboratory Quality Management Plan (LQMP) that describes preventive maintenance procedures and schedules. The laboratory will maintain detailed logs for each instrument documenting the preventive maintenance and repairs performed.

Equipment Backup Capabilities

Backup instruments will be designated in case of an extended breakdown for an analytical instrument. It is the laboratory's responsibility to have a backup plan in force to ensure that all sample holding times can be met. This plan can include the rental of backup instruments for specific analytical procedures. All equipment outside of the laboratory's permanent control will be evaluated to ensure that all relevant requirements are met prior to its initial use. Before any subcontracting is performed, USACE must be informed and approval given, in writing. The laboratory will ensure and be able to document that all subcontractors employed are competent to perform the duties requested and comply with all of the requirements established within this guidance and EM 200-1-1, as appropriate.

Laboratory Equipment Records

The laboratory will maintain appropriate records or documentation for all instruments and support equipment. Documentation includes:

- Type of equipment
- Manufacturer's name or equipment make, model, and any serial numbers or unique identifiers
- Dates received and placed into service
- Condition when purchased (new, used, etc.)
- Current location
- Manufacturer's instructions/manuals
- History of any damage, modification, or repair
- Instrument maintenance logs
- Calibration/calibration verification run logs

5.2 Calibration Procedures and Frequency

Calibration procedures for field instruments and laboratory equipment are discussed below.

5.2.1 Field Instruments

Because instruments used during field investigation activities may be of several models and manufacturers, it is not feasible to present instrument-specific details in this subsection. Instead, instrument-specific calibration will be performed in accordance with the manufacturer's instructions, as provided in the instrument's SOP.

Field instruments will be calibrated daily in accordance with manufacturers' specifications before the beginning of sampling activities. The calibration of all field equipment will be documented in the field notebook. Standards used to calibrate the field survey instruments will be traceable to National Institute of Standards and Technology (NIST) standards whenever possible. The method and frequency of calibration for the instruments used for each field activity are described in the manufacturer's instructions.

The pH, DO, ORP, conductivity, and turbidimeters will be decontaminated before each sample is measured. The probes will be rinsed three times with American Society for Testing and Materials (ASTM) Type II water before storage each day. The meters will be checked for battery charge and physical damage each day. The meters, pH standard solutions, and conductivity buffer solutions will be stored in a cool, dry environment. Standard solutions will be discarded on their expiration dates and will not be used for any purpose.

5.2.2 Laboratory Equipment

Laboratory instruments will be calibrated in accordance with the manufacturer's directions and applicable method specifications. Laboratory instrument calibration procedures will be summarized in the laboratory QAM, which will be reviewed and approved by the PM or designee before samples are submitted for analysis. The calibration of all laboratory equipment will be documented in the specific maintenance logbook, or analytical logbook, as described in the laboratory's QAM.

Analytical instruments will be calibrated in accordance with the analytical methods. All target analytes reported will be present in the initial and continuing calibrations. All results reported will be within the calibration range. Records of standard preparation and instrument calibration will be maintained. Records will unambiguously trace the preparation of standards and their use in calibration and quantitation of sample results. Calibration standards will be traceable to standard materials.

Instrument calibration will be checked using all of the target analytes. This applies equally to multi-response analytes. All calibration criteria will satisfy SW-846, Update III requirements at a minimum. The initial calibration will be checked at the frequency specified in the method using materials prepared independently of the calibration standards. Multipoint calibrations will contain the minimum number of calibration points specified in the applicable method including a standard at or below the corresponding RL. Analyte concentrations are determined with either calibration curves or response factors (RF). For gas chromatograph (GC) and gas chromatograph/mass spectrometry (GC/MS) methods, when using RFs to determine analyte concentrations, the average RF from the initial five-point calibration will be used. The continuing calibration will not be used to update the RFs from the initial five-point calibration. The continuing calibration verification cannot be used as the LCS.

If more than the required minimum number of standard concentrations is used in the initial calibration, all standard concentrations must be included in calculating the acceptance of the initial curve. All results for field samples will be reported only within the calibration linearity range.

5.3 Field and Laboratory QC Procedures

Type and frequencies of specific QC samples performed by the laboratory are dependent upon the specified analytical method. Internal QC methods require performance on a sample batch basis and include analyses of method blanks, LCSs, and actual environmental samples as duplicates, matrix spikes (MSs), and matrix spike duplicates (MSDs). Additional QC is incorporated into the analytical sequence. The following text gives a brief description of QC sample requirements. A detailed discussion of internal QC procedures can be found in Appendix I of EM 200-1-3.

5.3.1 Field QC Blank Samples and Duplicate Field Samples

Trip Blank

Trip blank (TB) samples are used to monitor potential VOC contamination introduced during sample shipping and handling. Trip blanks are 40-milliliter (mL) VOC vials of ASTM Type II water, which are filled in the laboratory, transported to the sampling site, and returned to the laboratory with the VOC samples. TB samples are prepared and analyzed for VOCs only; they should not be opened in the field. One TB will be included with each cooler containing samples for VOC analysis (aqueous phase).

Equipment Rinsate Blank Samples

Equipment rinsate blank (ERB) samples are samples of ASTM Type II water passed through and over the surface of decontaminated sampling equipment. The rinse water is collected in sample bottles, preserved, and handled in the same manner that is used when collecting aqueous samples, even if the ERB samples are being collected for soil samples. ERB samples are used to monitor the effectiveness of the decontamination process. ERBs will be collected at a rate of 10 percent of the field samples per matrix, per type of sampling equipment, and analyzed for the same parameters as the corresponding samples.

Temperature Blanks

Temperature blanks are sent with each cooler shipped to the offsite laboratory containing samples requiring preservation at 4 degrees Celsius (°C). Temperature blanks consist of a non-preserved VOC vial, or similar laboratory container, filled with ASTM reagent grade water. Temperature blanks are measured at the laboratory upon receipt to verify the temperature of the samples contained in the cooler. One temperature blank will be shipped with each cooler to each offsite laboratory.

Duplicate Field Samples

Duplicate field samples are collected to monitor the precision of the field sampling process. The identity of the duplicate samples is not noted on the laboratory COC form. The FTL will choose at least 10 percent (per matrix) of the total number of sample locations known or suspected to contain moderate contamination, and duplicate field samples will then be collected at these locations. The identity of the duplicate samples will be recorded in the field sampling logbook, and this information will be forwarded to the DQE team to aid in reviewing and evaluating the data.

5.3.2 Laboratory QC Blank and Matrix Spike Samples

Laboratory Method/Preparation Blanks

Laboratory method blanks are blank matrices (such as ASTM Type II water or Ottawa sand) that are treated as environmental samples, being prepared and analyzed along with the field samples. Laboratory method blanks are used to monitor laboratory performance and to check for contamination introduced during the preparation and analytical procedures. A method blank is required for every 20 field samples or for each analytical batch, whichever is more frequent.

Blank samples should not contain any target parameter of interest. There are certain organic compounds known to be common laboratory contaminants, such as acetone, methylene chloride, and the common phthalates. However, the laboratory must make all efforts to eliminate these compounds as contaminants. The concentration of all target compounds must be less than the RL, except for the common laboratory contaminants; the concentration of the common laboratory contaminants must be less than five times the RL.

Matrix Spike/Matrix Spike Duplicate Samples. For MS/MSD samples, three aliquots of a single sample are analyzed: one native and two spiked with target compounds or metals. Spike recovery is used to evaluate potential matrix interferences, as well as accuracy. The duplicate spike results (MS and MSD) are compared to evaluate precision. MS/MSDs will be collected at a frequency of 5 percent (1 MS/MSD sample set for every 20 field samples) of the number of field samples.

Surrogate Spikes. Surrogate spike compounds are added to each sample for the organic analytical methods. Surrogate spike compounds are structurally similar (but not identical) to target compounds and should behave in a similar manner during analysis. Surrogate spike recoveries are used to monitor both laboratory performance and matrix interferences. Surrogate spike recoveries from field and laboratory blanks are used to evaluate laboratory performance because these blanks represent an ideal sample matrix. Surrogate spike recoveries for field samples are used to evaluate the potential for matrix interferences. When surrogate spike recoveries for field samples fall outside the method target acceptance windows, the samples are re-extracted if appropriate, then re-analyzed. If the surrogate spike recovery is still outside the acceptance window for the re-analyzed sample, then the sample results are qualified as affected by matrix interferences.

Laboratory Control Spike Samples. The LCSs are analyte-free water (for aqueous analyses) or Ottawa sand (for soil analyses) (except metals where glass beads of 1-millimeter (mm) diameter or smaller may be used) spiked with all target analytes. The appropriate spiking solution will be spiked at a concentration less than or equal to the midpoint of the calibration curve for each analyte.

The LCS will be carried through the complete sample preparation and analysis procedure. The LCS is used to evaluate each preparation and analytical batch, and to determine if the method is in control. The LCS cannot be used as the continuing calibration verification. One LCS will be included in every preparation and analytical batch. If more than one LCS is analyzed in an analytical batch, results from all LCSs analyzed will be reported.

Whenever an analyte in an LCS is outside the acceptance limit, corrective action will be performed. After the system problems have been resolved and system control has been reestablished, all samples in the analytical batch will be reanalyzed for the out-of-control analyte(s). When an analyte in an LCS exceeds the upper or lower control limit and no corrective action is performed or the corrective action was ineffective, the laboratory should discuss the issue with the PC or QA personnel.

Interference Check Samples. The interference check sample (ICS), used in inductively coupled plasma (ICP) analyses only, contains both interfering and analyte elements of known concentrations. The ICS is used to verify background and inter-element correction factors and is run at the beginning and end of each run sequence.

When the ICS results are outside of the acceptance limits as prescribed in the method, corrective action will be performed. After the system problems have been resolved and system control has been re-established, re-analyze the ICS. If the ICS result is acceptable, re-analyze all affected samples.

Internal Standards

Internal standards (ISs) are known amounts of certain compounds added after preparation or extraction of a sample. These compounds are used in an IS calibration method to correct sample results affected by column injection losses, purging losses, or viscosity effects. ISs will be added to environmental samples, control samples, and blanks in accordance with the method requirements.

When the IS results are outside of the acceptance limits, corrective actions will be performed. After the system problems have been resolved and system control has been reestablished, all samples analyzed while the system was malfunctioning will be reanalyzed.

5.4 Performance and System Audits

Performance and system audits will be performed both in the field and at the laboratory. Laboratory audits should be conducted internally by the laboratory QC staff, as well as by external agencies. USACE may perform laboratory audits in conjunction with the laboratory validation process.

5.4.1 System Audits and Surveillances

During the course of the field activities, USACE personnel may perform QA system audits or QA surveillances, at USACE discretion. The primary purpose of the system audits and surveillances is to verify and document that field activities are being performed efficiently and in conformance with approved standards and procedures, federal and state regulatory requirements, sound engineering and environmental practices, and contract requirements.

The audits will include an objective examination of work areas, activities, and processes; review of documents and records; interviews with project personnel; and review of procedures associated with the project. Surveillances are generally less formal, and generally will focus on one specific area of review, rather than entire program effectiveness.

Audit/surveillance results will be documented and the audit report submitted to the Task Order Manager for action. The Task Order Manager will investigate any adverse audit findings, determine the root cause (if necessary), schedule corrective action, and respond in writing to the report as requested. The Task Order Manager will report periodically on the status of corrective actions taken, until all required actions are completed.

5.4.2 Laboratory Evaluation

The laboratory chosen to perform chemical analysis of the project samples will be approved by USACE. The laboratory will have the current regulatory certifications for all analytes and matrices specific to this project. A copy of the laboratory's QAM will be reviewed and the laboratory's experience, capability, and adequacy will be evaluated prior to the submission of samples for analysis.

5.5 Nonconformance/Corrective Actions

Specific corrective actions must be implemented if method quality objectives (MQOs) are not met.

When errors, deficiencies, or out-of-control situations exist, the laboratory's QA program will include a system of QC activities that measure the system performance to verify that it meets stated requirements and objectives. When the analytical system performance does not meet defined standards, the laboratory will employ systematic procedures, called corrective actions, to resolve problems and restore proper functioning to the analytical system(s). Laboratory personnel are alerted that corrective actions are necessary under the following conditions:

- QC data are outside the warning or acceptable windows for precision and accuracy established for laboratory samples.
- Blanks contain contaminants at concentrations above the levels specified in the laboratory quality assurance plan for any target compound.
- Undesirable trends are detected in spike recoveries or RPD between duplicates.
- There are unusual changes in method detection limits.
- Deficiencies are detected by the laboratory QA director during internal or external audits, or from the results of performance evaluation samples.

Corrective actions are implemented immediately when nonconformances in QC sample results are identified by the bench analyst. Corrective action procedures are handled initially at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors and checks such parameters as instrument calibration, spike and calibration mixes, and instrument sensitivity.

The analyst immediately notifies his or her supervisor of the problem and the investigation being conducted. If the problem persists or cannot be identified, the matter must be referred to the laboratory supervisor and the QA/QC officer for further investigation. At this point, the PC and the PM must be notified about the nonconformance. All laboratory QC problems that will affect the final data must be discussed with the PC as part of the corrective action process. Once resolved, full documentation of the corrective action procedure must be filed with the laboratory supervisor, and the QA/QC officer must be provided with a corrective action memorandum for inclusion in the project file if data are affected. A copy of the corrective action memorandum must be included in the laboratory data package deliverable. In addition, all variances must be discussed a detail in the case narrative delivered with the laboratory report.

Corrective actions may include:

- Reanalyzing suspect samples
- Recalibration with new standards
- Eliminating blank contamination
- Resampling and analyzing new samples
- Evaluating and amending sampling and analytical procedures
- Accepting data with an acknowledged level of uncertainty
- Recalibrating analytical instruments
- Qualifying or rejecting the data

After implementation of the required corrective action measures, data that are deemed unacceptable may not be accepted by the PM, and follow-up corrective actions may be explored. Details of laboratory corrective actions are provided in the laboratory QAM.

In the absence of project specific requirements, the following identifies measurement quality objectives and the corrective actions necessary:

5.5.1 Incoming Samples

Problems noted during sample receipt will be documented on an appropriate form ("Cooler Receipt Form"). The project manager or appropriate technical personnel will be contacted immediately for problem resolution.

5.5.2 Sample holding times

If samples cannot be prepared or analyzed within the method required holding times, the project manager or appropriate technical personnel will be immediately notified so that an appropriate corrective action plan can be generated. If holding times are exceeded and results reported, the resulting data will be flagged, and a discussion of the impact included within the case narrative.

5.5.3 Instrument Calibration

Sample analysis will not be allowed until all initial calibrations, initial calibration verifications, and instrument blanks meet the appropriate requirements. All Continuing Calibration Verification (CCV) standards that do not meet method requirements will result in a review of the calibration, rerun of the appropriate calibration standard for the failed analytes, and, if necessary, reanalysis of all samples affected, back to the previous acceptable CCV check, for the target analytes that failed. Continued failure of the CCV will result in the construction of a new initial calibration curve followed by the reanalysis of all samples affected. If results are reported when a calibration criterion has been exceeded, then all results reported will be qualified, and a discussion of the impact included within the case narrative. Instrument blanks should be implemented as outlined in the prescribed method.

5.5.4 Method QC Samples

Each preparatory batch and analysis sequence must include the appropriate batch and matrix-specific QC samples and standards: that is, method blanks (MBs), LCSs, MSs, matrix duplicates (MDs), MSDs, surrogate spikes, and other method-specified QC. All QC will meet the appropriate project-specific measurement quality objectives and associated corrective actions. In the absence of such criteria or actions, the corrective actions as described in the following sections will be required. Failure of method QC will result in the review of all affected data. If no errors can be noted, the affected sample(s) may need to be re-analyzed or re-prepared and re-analyzed within method holding times, if possible. All re-preparation and re-analysis necessary due to method failure will be performed at no cost to CH2M HILL. If the situation is not corrected and results reported, then the corresponding data will be flagged and a discussion of the impact included within the case narrative. The project manager or appropriate technical personnel will be notified as soon as possible to discuss possible corrective actions should unusually difficult sample matrices be encountered.

Method Blanks (MB)

These criteria will be used to evaluate the acceptability of the MB data if project DQOs do not specify otherwise. The concentration of all target analytes will be below one-half of the method reporting limit (MRL) for each target analyte, or less than 5 percent of the regulatory limit associated with that analyte, or less than 5 percent of the sample result for the same analyte, whichever is greater for the MB to be acceptable. When this criterion is exceeded, corrective action should be taken to find/reduce/eliminate the source of this contamination in the MB. However, sample corrective action may be limited to qualification for blank contamination (that is, B-flag). When the concentrations of any target analytes within the MB are above one-half the MRL for the majority of target analytes or above the MRL for target analytes known to be common laboratory contaminants, assess the effect this may have had on the samples. If an analyte is found only in the MB, but not in any batch samples, no further corrective action may be necessary. Steps will be taken to find/reduce/eliminate the source of this contamination in the MB. The case narrative should also discuss the situation. If an analyte is found in the MB and in some, or all, of the other batch samples, additional corrective action is required to reanalyze the MB, and any samples containing the same contaminant. If the contamination remains, the contaminated samples of the batch should be re-prepared and re-analyzed with a new MB and batch-specific QC samples. Sporadic cases of contamination may be difficult to control; however, daily contamination would not be acceptable.

Laboratory Control Samples (LCS)

The LCS is evaluated by comparing the percent recovery for all of the target analytes to the recovery measurement quality objectives as determined by project-specific DQOs, or the default ranges established in this guidance. If target analytes are outside the acceptance windows, corrective action is required. Project DQOs will dictate the corrective actions necessary. Initially, the effect the QC failure has on the samples should be evaluated.

Regardless of this assessment, steps will be taken to find the source of the problem and correct it. The case narrative will discuss the corrective action taken and any other information. Typically, the LCS would be reanalyzed for the failed analytes only. If the second analysis fails, then the LCS, MB, and all associated samples of the batch would be re-prepared and re-analyzed for the failed analytes only. If sufficient sample is not available for re-preparation and re-analysis or if the corrective action is ineffective, the sample results reported within that batch will be flagged accordingly, and a discussion of the impact included within the case narrative. When multiple (greater than 5) target analytes are reported, the acceptance criteria may allow for the sporadic marginal failure of a few target analytes included within the LCS without requiring reanalysis of the entire batch. For methods that report several (greater than 5) target analytes, a small percentage of sporadic marginal failures may be tolerated (that is, will not trigger re-extraction and analysis of the entire batch). The number of target analytes reported for the method will dictate the number of allowable marginal QC failures. Refer to the individual method Attachments for details of this concept as it pertains to each of the methods discussed. The marginal failure allowance entails the application of an expanded acceptance criterion.

Matrix Spike (MS) Samples

The MS is evaluated by comparing the recovery for target analytes to the recovery windows established within project documents, or those established in the Attachments. MS data evaluation is more complex than MB or LCS data evaluation since MSs measure matrix effects in addition to sample preparation and analysis errors. The heterogeneity of soil, grab samples, and sequentially collected water samples further complicates the evaluation since matrix-specific bias assumes that the native concentrations in the duplicate analyses are constant. In addition, concentrations of the target analytes in the sample can also far exceed the spike amounts added, making the resulting recoveries invalid. MSs that fail to meet the appropriate acceptance criteria would indicate that a potential matrix effect is present. If the native concentration of target analytes in the sample chosen for spiking is high relative to the spiking concentration, the differences between the native concentration of the unspiked sample and the spiked samples may not be significant, making the bias measures unrepresentative of the true method and matrix performance. For this reason, if the native concentration is two or more times the spiking level, corrective actions would be based on project DQOs. Regardless, steps should be taken to find the cause of failure and corrective actions be taken to remedy it. If possible, respike the sample as outlined in the following sections at a higher level (for example, at two to four times the sample concentration), then reanalyze the sample based on project-specific requirements. A review of the MSD result, if available, may confirm the matrix effect, if it is the same direction and same order of magnitude. If the native concentration is low, and the MS/MSD recoveries confirm matrix interference, reanalyze the MS/MSD sample/extract after employing cleanup procedures (organic analyses) or dilution techniques to minimize matrix interference. If the matrix effect cannot be resolved, discuss the impact on the data within the case narrative.

Inorganic analyses. Corrective action for unacceptable MS recoveries for ICP and Graphite Furnace Atomic Absorption (GFAA) analyses will include implementation of a post digestion spike (PDS) from the same sample used to prepare the MS. In that way, information is obtained to identify whether matrix interference is occurring during the digestion or analytical procedures.

Organic analyses. When multiple (greater than 5) target analytes are reported, the acceptance criteria may allow for the sporadic marginal failure of a few target analytes included within the MS without requiring reanalysis. When only a subset of target analytes is included in the MS, allow only one sporadic marginal failure.

Matrix Duplicate (MD) and Matrix Spike Duplicate (MSD) Samples

The MSD is evaluated using the same bias criteria as described for the MS. The MD or MSD is evaluated by comparing the precision for all target analytes to the windows as determined by project-specific DQOs, or as stated herein. These criteria should be applied only to concentrations of target analytes that are above the method quantification limit (MQL) of each analyte. MDs or MSDs that fail to meet the appropriate acceptance criteria would indicate that a potential matrix effect is present. Corrective actions will be performed as described for the MS.

Surrogates

A surrogate is evaluated by comparing its recovery in each sample to the windows as determined by project-specific DQOs, or as stated within the Attachments. Surrogate spikes in matrix-specific samples that fail to meet the appropriate acceptance criteria would indicate that a potential matrix effect is present. If significant non-target interference occurs, corrective action will include implementing additional cleanup procedures and re-analyses. If this does not reduce the interference, discuss the impact on the data within the case narrative. Recommendations to the client may include method modifications, such as re-preparation and reanalysis with smaller sample aliquots to reduce the effects of the matrix. The consequences to detection limits must also be considered in this instance. Surrogate failures in MBs or LCSs are indicative of a general method failure and should be thoroughly investigated.

Post-digestion Spike Samples (PDS)

Default recovery control limits for the PDS are noted in the Attachments. Similar to the MS, if historic data or information on native sample concentrations is available, the MS or PDS should be spiked at a concentration at least twice the native sample concentration for the following evaluation to be considered valid. Professional judgment should be used to determine the corrective action necessary when the MS recovery for an analyte fails but the PDS recovery passes. For instance, when the MS recovery fails because it falls below the lower control limit but the PDS recovery passes, confirmatory redigestion and reanalysis may not be required if allowed by project DQOs. When both the MS and PDS indicate matrix interference is present, the laboratory must attempt to correct for the interference by the use of method of standard additions, an internal standard technique for ICP (for example, with yttrium), a different matrix modifier for GFAA, or different digestion or analytical procedures to achieve a representative result, before qualifying the sample for matrix interference. This does not apply to sporadic failures but rather to target analytes exhibiting out-of-control recoveries on consecutive batches. Also, verify overall batch control for the analysis by evaluation of the LCS.

Calculation Errors

Reports will be reissued if calculation or reporting errors are noted with any given data package. The case narrative will clearly state the reason(s) for re-issuance of the report.

5.6 Field Screening and Analysis Method Descriptions

5.6.1 EPA Method 120.1/SW846 9050 (Water)–Conductance

Standard conductivity meters, which also measure water temperature, should be used for this measurement. The person taking the measurement should follow the manufacturer's recommended instructions for instrument calibration, operation, and maintenance.

5.6.2 EPA 150.1/SW846 9040 (Water)–pH

Water samples will be measured for pH. Measurements are determined electrometrically using either a glass electrode in combination with a reference potential, or a combination electrode. The person taking the measurement should follow the manufacturer's recommended instructions for instrument calibration, operation, and maintenance.

5.6.3 EPA Method 170.1 (Water)–Temperature

Temperature measurements are made with a mercury-filled or dial-type centigrade thermometer, or a thermistor.

5.6.4 EPA Method 360.1 (Water)–Dissolved Oxygen

An instrumental probe, typically dependent on an electrochemical reaction, is used for the determination of DO in water. Under steady-state conditions, the current or potential can be correlated with DO concentrations. The person taking the measurement should follow the manufacturer's recommended instructions for instrument calibration, operation, and maintenance.

5.6.5 ASTM D1498-93 (Water)–Oxidation-Reduction Potential

This method is designed to measure the ORP in water, which is defined as the electromotive force between a noble metal electrode and a reference electrode when immersed in a solution.

5.6.6 Hach Turbidimeter Model–Turbidity

This method uses a turbidimeter to measure the turbidity of the water. An aliquot of the water is placed into a cell and the light that is scattered is proportional to the amount of turbidity in the sample.

5.7 Analytical Methods for Organics and Inorganics

The reporting Limits and associated QC criteria are provided in the Attachments.

5.7.1 SW846 6010B– Metals

SW846 Methods 6010B will be used for the determination of the selected parameters listed above. The 7000 series methods will be used if SW846 Method 6010B detection limits are not below the regulatory criteria for the project. SW846 Method 6010B - Inductively coupled plasma emission spectrometry (ICPES) determines trace elements. All matrices–excluding filtered groundwater samples but including groundwater, aqueous samples, toxicity characteristic leaching procedure (TCLP) extracts, soils, sludges, sediments, and other solid wastes–require digestion before analysis. Groundwater samples that have been prefiltered and acidified will not need acid digestion.

5.7.2 SW846 7470A/7471A – Mercury

SW846 Methods 7470A/7471A will be used for the determination of mercury. These methods utilize a chemical reduction to reduce mercury selectively.

5.7.3 SW846 8081A-Organochlorine Pesticides

This method provides procedures for the detection and quantitative measurement of organochlorine pesticides. The analytical method calls for the use of GC equipped with an electron capture detector on sample extracts.

5.7.4 SW846 8082- Polychlorinated Biphenyl Compounds

This method provides procedures for the detection and quantitative measurement of PCBs. The analytical method calls for the use of GC equipped with an electron capture detector on sample extracts.

5.7.5 SW846 8151A–Organochlorine Herbicides

This method provides extraction, derivatization, and gas chromatographic conditions for the analysis of chlorinated acid herbicides in water, soil, and waste samples. An option for the hydrolysis of esters also is described. Water samples are extracted with diethyl ether and then esterified with either diazomethane or pentafluorobenzyl bromide. The derivatives are determined by GC/electron capture detector (ECD). The results are reported as acid equivalents. Soil and waste samples are extracted and esterified with either diazomethane or afluorobenzyl bromide. The derivatives are determined by GC/ECD. The results are reported as acid equivalents.

5.7.6 SW846 8260B–ADEM Appendix I Volatile Organic Compounds

This method provides procedures for the detection and quantitative measurement of selected semivolatile compounds. The target parameters are “extracted” from the sample matrix using purge-and-trap technology. The analytical method calls for the use of GC/MS for the detection of the target parameters.

5.7.7 SW846 8270C–Semivolatile Organic Compounds

This method provides procedures for the detection and quantitative measurement of selected semivolatile compounds. The analytical method calls for the use of GC/MS on sample extracts.

5.7.8 EPA Method 300.0 (water)–Determination of Inorganic Anions in Water by Ion Chromatography

A small volume of sample, typically 2 to 3 mL, is introduced into an ion chromatograph. The anions of interest are separated and measured, using a system comprised of a guard column, separator column, suppressor device, and conductivity detector. Anions that can be determined by this analysis include bromide, chloride, fluoride, nitrate, nitrite, ortho-phosphate, and sulfate.

5.7.9 SM2320-B–Alkalinity

For this method, an unaltered sample is titrated to an end point of pH 4.5 using hydrochloric or sulfuric acid.

5.7.10 SM 5310-C/Lloyd Khan (water/soil)–Total Organic Carbon

Organic carbon is measured using a carbonaceous analyzer. This instrument converts the organic carbon in a sample to carbon dioxide either by catalytic combustion or by wet chemical oxidation. The carbon dioxide formed is then either measured directly by an infrared detector or converted to methane and measured by a flame ionization detector (FID). The amount of carbon dioxide or methane in a sample is directly proportional to the concentration of carbonaceous material in the sample.

5.7.11 SW846 9056 (Soil)–Determination of Inorganic Anions in Water by Ion Chromatography

This method addresses the sequential determination of the anions chloride, fluoride, bromide, nitrate, nitrite, phosphate, and sulfate in aqueous samples, aqueous extracts of solids, and collection solutions from the bomb combustion of solid waste samples.

A small volume of aqueous sample is injected into an ion chromatograph to flush and fill a constant volume sample loop. The sample is then injected into a stream of effluent. For aqueous extracts of solid samples, use the procedure listed in Section 11.7 of EPA Method 300.0 (a 10-fold dilution of the solid sample with reagent grade water).

The sample is pumped through three different ion exchange columns and into a conductivity detector. The first two columns, a precolumn (guard) column and a separator column, are packed with a low-capacity, strongly basic anion exchanger. Ions are separated into discrete bands based on their affinity for the exchange sites of the resin. The last column is a suppressor column that reduces the anions in the sample to their corresponding acids. The separated anions in their acid form are measured using an electrical-conductivity cell. Anions are identified based on their retention times compared to known standards. Quantitation is accomplished by measuring the peak height or area and comparing it to a calibration curve generated from known standards.

5.7.12 SW846 1311/1312–TCLP/SPLP Metals

The investigation derived waste (IDW) sample "leachates" will be measured for inorganic content. Methods SW-846 1311 and 1312 describe the leaching procedures used to obtain a "leachate." The leachate will then be analyzed following the appropriate analytical method;

for example, methods SW846/6010B and the 7000 series (for the eight Resource Conservation and Recovery Act [RCRA] metals, including mercury).

5.7.13 SW846 1010/1020–Ignitability; SW846 7.3.3.2/7.3.4.2–Reactivity; and SW846 1110/9040–Corrosivity

These methods are used to evaluate these three hazardous characteristics before land disposal.

6. Data Reduction/Calculation or Data Quality Indicators

The laboratory will perform in-house analytical data reduction and review of chemical analyses under the direction of the laboratory's technical staff, QA officer, and laboratory delivery order manager for each project. These individuals are responsible for evaluating the quality of the data and indicating which, if any, data may be listed as "unacceptable" and/or which should be considered potentially unreliable.

6.1 Precision

The descriptions of the precision indicator and calculations are provided in Section 3.4 of this QAPP. **Attachments A-1 and A-8** list the acceptable criteria.

6.2 Accuracy/Bias

The descriptions of the accuracy indicator and calculations are provided in Section 3.4 of this QAPP. **Attachments A-1 and A-2** list the acceptable criteria.

6.3 Detection, Quantitation, and Reporting Limits

The RLs are provided in **Attachments A-11 through A-23**.

The laboratory will supply analyte-specific quantification limits, with laboratory-specific method detection limit (MDL) studies, as part of its laboratory QA plan.

6.3.1 Method Detection Limits

The MDL is the minimum amount of an analyte that can be routinely identified using a specific method and instrument measured and reported with 99 percent confidence that the analyte concentration is greater than zero. MDLs are operationally determined as three times the standard deviation of seven replicate spiked samples run according to the complete method. However, the evaluation is routinely completed on reagent grade water. As a result, potentially significant matrix interferences that decrease analyte recoveries are not addressed.

Determine the MDL for each analyte as follows:

MDL = 3.14(s)

Note: s - The standard deviation for each analyte from the seven replicate analyses.

3.14 - The one-sided t-statistic at the 99 percent confidence level appropriate for determining the MDL using seven replicates.

When the concentration of concern (or project-specific action level) is greater than the MDL, to the extent that the confidence limits of both the MDL and concentration of concern do not overlap, then both “non-detect” and “detect” results can be used with confidence. There will be a possibility of false positives and false negatives if the confidence limits of the MDL and the concentration of concern overlap. When the concentration of concern is sufficiently less than the MDL that the confidence limits do not overlap, then there is a strong possibility of false negatives and only “detect” results are useable.

The laboratory will establish MDLs for each method, matrix, and analyte for each instrument the laboratory plans to use for the project. The laboratory will revalidate these MDLs at least once per 12-month period. The laboratory will provide the MDL at the beginning of the project. Project/laboratory specific MDLs will be included in the project-specific addendum.

Where multiple instruments are used, the MDL used for reporting purposes will represent the least sensitive instrument.

6.3.2 Quantitation Limits

The Quantitation Limit (QL), as defined in SW-846 methods, is the lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. The Sample Quantitation Limit (SQL) is the QL adjusted to reflect sample-specific actions such as dilution or use of smaller aliquot sizes than prescribed in the method, or for percent moisture. These adjustments may be due to matrix effects or the high concentration of some analytes. The SQL is the more useful limit for data users such as risk assessors.

For the same chemical, the SQL in one sample may be higher than, lower than, or equal to the SQL values for other samples. In addition, preparation or analytical adjustments, such as dilution of the sample for quantitation high levels target and non-target analytes, could result in non-detects for other analytes included in the analysis, even though target analytes may have been present at trace quantities in the undiluted sample.

All results will be reported on a dry-weight basis.

6.3.3 Reporting Limits

The laboratories participating in this work effort will compare the results of the experimental MDLs to RLs for each analyte. The MDL may not be more than one-half the corresponding RL. The laboratories will also verify RLs by including a standard at the RL as the lowest point on the calibration curve. For methods that do not include the RL as the low point of the calibration curve, an RL verification standard will be analyzed immediately following calibration. The RL verification standard must include all target analytes. The recoveries for all target analytes should be 70 to 130 percent. All results will be reported at or above the MDL values. No numerical results will be reported below the MDL; however, for those results falling between the MDL and the RL, a “J” flag will be applied to the results indicating the variability associated with the result. The MDLs are provided in **Attachments A-16 and A-25.**

6.4 Completeness

The descriptions of the completeness indicator and calculations are provided in Section 3.4 of this QAPP. The completeness goal of this project is: greater than 90 percent of the data are usable.

7. Laboratory Operations Documentation

7.1 Sample Management Records

All associated instrument printouts, raw data and logbooks, and reported data packages must be retained by the laboratory for a minimum of 5 years, or as dictated by project requirements (if longer than 5 years). In the event of laboratory closure, all applicable documents must be transferred to USACE.

7.2 Data Reporting Procedures

The chemistry data package should contain enough information to demonstrate that the project data quality objectives have been fulfilled. In general, one should be able to determine the precision, accuracy, representativeness, comparability, and sensitivity of the data from information contained in the data package. The amount of information required to demonstrate attainment of DQOs depends upon the acceptable level of uncertainty for the intended data use. In general, the type of data package required will fall into one of three general categories: Screening, Definitive, and Comprehensive.

7.2.1 Screening / Level 1 – Field Surveys and Screening / Level II - Physical Parameters, and Investigation-derived Waste Analyses

Level I data reporting encompasses field monitoring or screening activities and does not require formal data package deliverables. These activities are focused on easily measured bulk characteristics of a sample such as pH, conductivity, ORP, and DO. Monitoring results, as well as pertinent data concerning the sampling event, will be documented in the bound field book. Screening/Level II data reporting may be performed for analyses submitted to the laboratories for physical parameter testing, and analyses associated with the characterization of the IDW samples.

Screening data are generated by methods of analysis that tend to be relatively rapid, are performed in the field or submitted to an offsite laboratory, and may have less rigorous sample preparation. Screening data provide analyte identification but may tend to report false positives. Their ability to quantitate analytes is in general less precise and less accurate than "definitive" type methods (see next section). The screening data package will depend on the screening method used. A typical screening data package will include the following:

- Sample identification number
- Preparation method
- Determinative method
- Detection limits
- Identity and quantity of analyte(s) present
- Date and time of sample collection
- Date of sample analysis

- Field equipment calibration

More sophisticated field screening methods will involve QC samples such as duplicate samples, calibration standards, spiked samples, or blank samples. Results for these associated QC samples should also be included in the screening data package.

7.2.2 Definitive/Level III Data Package

The definitive data package format allows for the review of the data by an independent organization. However, this data package does not allow for complete independent reconstruction of the analytical data. Definitive data are produced using rigorous analytical methods, such as EPA standard reference methods (for example, SW-846, CLP). Analyte presence and quantitation are confirmed through extensive quality control procedures at the laboratory, which may be onsite or offsite. As discussed in more detail in the following sections, the definitive data package should include a cover sheet, table of contents, case narrative, the analytical results, laboratory RLs, sample management records, and internal laboratory QA/QC information. The laboratory data package should be organized such that the analytical results are reported on a per-batch basis unless otherwise specified.

Cover Sheet

The cover sheet should specify the following information:

- Title of report (that is, Test Report, Test Certificate)
- Name and location of laboratory (to include a point of contact, phone and facsimile numbers)
- Name and location of any subcontractor laboratories, and appropriate test method performed
- Contract number
- Client name and address
- Project name and site location
- Statement of data authenticity and official signature and title of person authorizing report release

  Amendments to previously released reports will clearly identify the serial number for the previous report and state the reason(s) for reissuance of the report

Table of Contents

Laboratory data packages should be organized in a format that allows for easy identification and retrieval of information. An index or table of contents should be included for this purpose.

Case Narrative

A case narrative should be included in each report. The case narrative should contain a table(s) summarizing samples received, providing a correlation between field sample numbers and laboratory sample numbers, and identifying which analytical test methods were performed and by which laboratories. Samples that were received but not analyzed should also be identified. Extractions or analyses that are performed out of holding times should be appropriately noted. The case narrative should define all data qualifiers or flags used. Deviations of any calibration standards or QC sample results from appropriate acceptance limits should be noted and associated corrective actions taken by the laboratory should be discussed. Any other factors that could affect the sample results (for example, air bubbles in VOC sample vials, excess headspace in soil VOC containers, the presence of multiple phases, sample temperature and sample pH excursions, container type or volume, etc.) should be noted.

Analytical Results

The results for each sample should contain the following information at a minimum:

- Laboratory name and location (city and state)
- Project name and unique ID number
- Field sample ID number as written on custody form
- Laboratory sample ID number
- Matrix (soil, water, oil, etc.)
- Sample description
- Sample preservation or condition at receipt
- Date sample collected
- Date sample received
- Date sample extracted or prepared
- Date sample analyzed
- Analysis time when holding time limit <48 hours
- Method (and SOP) numbers for all preparation, cleanup, and analysis procedures employed
- Preparation, analysis, and other batch numbers
- Analyte or parameter
- Method RLs adjusted for sample-specific factors (for example, aliquot size, dilution/concentration factors, moisture content)
- Method quantitation limits (low-level standard concentration)
- Method detection limits
- Analytical results with correct number of significant figures

- All confirmation data
- Any data qualifiers assigned
- Concentration units
- Dilution factors (All reported data will reflect any dilutions or concentrations. The dilution factor, if applicable, should be noted on the analytical report. If undiluted and/or diluted results are available, data from all runs should be recorded and reported.)
- Percent moisture or percent solids (all soils, sediments, sludges, etc. are to be reported on a dry weight basis)
- Chromatograms, as needed
- Sample aliquot analyzed
- Final extract volume

Laboratory Reporting Limits

The laboratory may use a RL expressed in terms of detection limit, quantitation limit, regulatory action level, or project-specific threshold limits. However, the laboratory's use of these terms must be well defined.

Sample Management Records

These types of records include the documentation accompanying the samples (that is, original COC record, shipping documents, laboratory notification sheets), records generated by the laboratory that detail the condition of the samples upon receipt at the laboratory (that is, sample cooler receipt forms, any telephone conversation records, etc.), and any records generated to document sample custody, transfer, analysis, and disposal.

QA/QC Information

The minimum data package must include the calibration, calibration verification, and internal laboratory QA/QC data with their respective acceptance criteria. The data package should also include the laboratory's method quantitation and RLs for project-specific parameters. The calibration data will include a summary of the initial calibration verification (ICV), all calibration verification standards, and any performance standards analyzed in conjunction with the test method. All calibration deviations will be discussed within the case narrative. The data package should correlate the method QC data with the corresponding environmental samples on a per-preparation batch basis with batch numbers clearly shown. Method QC data must include all spike target concentration levels; the measured spike concentration and calculated recoveries; all measures of precision, including relative percent difference; and all control limits for bias and precision. This would include laboratory performance information such as results for MBs, recoveries for LCSs, and recoveries for QC sample surrogates; and matrix-specific information such as matrix duplicate (MD) RPDs, MS and MSD recoveries, MS/MSD RPDs, field sample surrogate recoveries, spike duplicates (SD), and PDSs, etc. At a minimum, internal QC samples should be analyzed and reported at rates specified in the specific methods, within USACE guidance, or as specified in the contract, whichever is greater. Any deviations from the measurement quality objectives should be noted. Also include any data review, nonconformance, or corrective action forms within the data package.

7.2.3 Comprehensive Data Package

A comprehensive/Level IV data package contains sufficient information to completely reconstruct the chemical analyses that were performed. Hence, comprehensive data packages include all batch QC results, instrument QC results (for example, initial calibration verification, continuing calibration verification, and instrument performance checks), MDL studies, and raw data (for example, run logs, sample preparation logs, standard preparation logs, and printed instrumental output such as chromatograms). Typically, comprehensive data packages are required if third-party data validation is to be performed. The data validation guidelines for performance-based methods established in other USACE guidance on data review and data validation, EPA national functional guidelines, EPA regional functional guidelines, and project-specific guidelines for validation may all have distinct reporting formats. <u>Additionally, the laboratory's QC limits must be equal to or within established criteria of DoD QSM 4.1.</u>

7.2.4 Data Package Deliverables

The various Data QC Packages are described in the previous section. The data submitted for this project will be Definitive / Level III.

In addition, the laboratory must have the capability of providing the data package on compact disc (CD) in a scanned PDF format. At this time, it is anticipated that the laboratory will provide one hardcopy data package and one CD to the project chemist, and one CD to the project manager.

7.2.5 Electronic Deliverables

The project data manager (PDM) will be responsible for uploading sample collection data into the database. Data received from analytical labs in Electronic Data Deliverable (EDD) format will be checked for completeness by comparing them to the sample collection form before appending them directly into the database, and will be considered preliminary until validated.

One EDD will be generated by the laboratory(s) per each sample delivery group (SDG). The EDD specifications are provided in **Attachment A-38**.

7.2.6 Laboratory Turnaround Time

The requested turn-around time for the majority of the definitive data will be 21 days from the time of sample receipt at the laboratory. However, groundwater samples and analyses from the temporary wells will require a faster turn-around time, as quick as 72 hours. The laboratory will be notified of fast turn-around requirements.

7.2.7 Data Archival/Retention Requirements

All reported data packages must be retained by the laboratory for a minimum of 5 years, or as dictated by project requirements (if longer than 5 years).

8. Data Assessment Procedures

8.1 Data QC Review

All analytical data generated by the laboratory will be extensively reviewed prior to report release to assure the validity of the reported data. This internal data evaluation process will cover the areas of data generation, reduction, and a minimum three levels of documented review. For each level the review process will be documented using an appropriate checklist that is signed and dated by the reviewer. The analyst who generates the analytical data has the prime responsibility for the correctness and completeness of the data. Each step of this review process involves evaluation of data quality based on both the results of the QC data and the professional judgment of those conducting the review. This application of technical knowledge and experience to the data evaluation is essential in ensuring that data of known quality are generated consistently. All data generated and reduced will follow well documented in-house protocols. The laboratory will apply the following review process.

8.1.1 Analyst Review

Each analyst reviews the quality of his/her work based on an established set of guidelines. The review criteria as established in each method or within the laboratory will be used. This review will, at a minimum, ensure the following:

- Sample preparation information is correct and complete.
- Analysis information is correct and complete.
- The appropriate SOPs have been followed.
- Analytical results are correct and complete.
- Raw data, including all manual integrations, have been correctly interpreted.
- QC samples are within established QC control limits.
- Special sample preparation and analytical requirements have been met.
- Data transfers were verified.
- Documentation is complete (for example, all anomalies in the preparation and analysis have been documented; anomaly forms are complete, holding times are documented, etc.) Level 1 analyst review will be documented by using a checklist and by the signature of the reviewer and date.

8.1.2 Peer Review

Peer reviews will be performed by a supervisor, another analyst, or data review specialist who has documentation that supports demonstration of performance for all areas for which he/she provides review. The function of this review is to provide an independent, complete peer review of the analytical batch data package. This review will also be conducted according to an established set of guidelines and is structured to ensure the following:

- All appropriate laboratory SOPs have been referenced.
- Calibration data are scientifically sound, appropriate to the method, and completely documented.
- QC samples are within established guidelines.
- Qualitative identification of sample components is correct.
- Quantitative results, including calculations and any associated flags, are correct.
- Raw data, including manual integrations, have been correctly interpreted.
- Documentation is complete and correct (for example, anomalies in the preparation and analysis have been documented; nonconformance forms are complete, holding times are documented, etc.).
- The data are ready for incorporation into the final report.

Peer reviews will be structured so that all calibration data and QC sample results are reviewed and all of the analytical results are checked back to the raw data or bench sheets. If no problems are found with the data package, the review is complete. If any problems are found with the data package, then all sample results will be returned to the analyst and rechecked. All errors and corrections noted will be documented. Peer reviews will also be documented on a checklist with the signature of the reviewer and date.

8.1.3 Administrative Review

Administrative reviews are performed by the project administrator or designee at the laboratory. This review will provide a total overview of the data package, including sample receipt, to ensure its consistency and compliance with project-specific requirements. All errors noted will be corrected and documented. Based on the errors noted, samples may need to be reprepared and reanalyzed. Administrative reviews will also be documented on a checklist with the signature of the reviewer and date.

8.1.4 QA Review

QA review is performed by the laboratory QA Officer. This review is not part of the normal production data review process. The QA Officer would typically review at least 10 percent of the data produced by the laboratory using the procedures as outlined in the QA data reviews. Additional technical details should be reviewed in this QA review, similar to analyst and peer reviews, along with a total package review, that is, correlation of results from differing but related chemical parameters. The data packages reviewed would be randomly selected by the QA Officer. Nonconformance reports would be required for any errors noted.

8.2 Data Verification, Validation and Usability

This subsection addresses the QA activities that occur after the data collection has been completed. Implementation of these elements, which include data verification, validation, and reconciliation to DQOs, will determine the extent to which the data conform to the specified criteria and satisfy the project objectives.

Data verification and validation are processes whereby data generated in support of this project are reviewed against the QA/QC requirements. The data are evaluated for precision, accuracy, and completeness against the analytical protocol requirements. Non-conformances or deficiencies that could affect the usability of data are identified as noted. The types of data that will be validated are described further in the following subsections.

All analytical data will be supported by a data package as defined in previous sections. The data package will contain the supporting QC data for the associated field. Before the laboratory will release each data package, the laboratory QAM (or the analytical section supervisor) must carefully review the sample and laboratory performance QC data to verify sample identity, the completeness and accuracy of the sample and QC data, and compliance with method specifications.

8.2.1 Data Verification

Before the analytical results are released by the laboratory, both the sample and QC data will be reviewed carefully to verify sample identity, instrument calibration, detection limits, dilution factors, numerical computations, accuracy of transcriptions, and chemical interpretations. Additionally, the QC data will be reduced and spike recoveries will be included in control charts, and the resulting data will be reviewed to ascertain whether they are within the laboratory-defined limits for accuracy and precision. Any non-conforming data will be discussed in the data package cover letter and case narrative. The laboratory will retain all of the analytical and QC documentation associated with each data package.

The data are also verified to assess whether the EDDs and the hard-copy data deliverables are consistent with one another to ensure an accurate database.

8.2.2 Data Validation

Data validation is at times based on professional judgment. To achieve consistent data validation, data worksheets will be completed for each data validation effort. A data validation worksheet is a summary form on which the data validator records data validation notes and conclusions specific to each analytical method. The worksheets will help the validator track and summarize the overall quality of the data. Sample resuts will then be assigned a degree of usability based upon the overall data quality.

One hundred percent of the laboratory data reporting packages will be validated.

The data package will be validated by the PC using QC criteria established in this QAPP or in the analytical method and using a process analogous to that outlined in the following guidance documents:

- Engineer Manual EM 200-1-3, Requirements for the Preparation of Sampling and Analysis Plans, February 1, 2001

- Engineer Manual EM 200-1-6, Chemical Quality Assurance for HTRW Projects, October 10, 1997
- Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (EPA, 2002)
- Contract Laboratory Program National Functional Guidelines for Organic Data Review (EPA, 1999)

The data review and validation process is independent of the laboratory's checks; it focuses on the usability of the data to support the project data interpretation and decision-making process.

Sample results that do not meet the acceptance limit criteria will be indicated with a qualifying flag, which is a one or two-letter abbreviation that indicates a possible problem with the data. Flags used in the text may include the following:

U Undetected. Samples were analyzed for this analyte, but it was not detected above the MDL or instrument detection limit (IDL).

UJ Detection limit estimated. Samples were analyzed for this analyte, but the results were qualified as not detected. The result is estimated.

J Estimated. The analyte was present, but the reported value may not be accurate or precise.

R Rejected. The data are unusable. (Note: Analyte/compound may or may not be present.)

X Result excluded for a more suitable result (such as a dilution).

It is important to note that laboratory qualifying flags are included on the data summary forms (Form I) that are submitted to the project by the laboratory. However, during the data review and validation process, the laboratory qualifying flags are evaluated and replaced with the project-specific validation flags.

8.2.3 Data Quality Evaluation

The PC or designee will perform the DQE. The DQE process is used to assess the effect of the overall analytical process on the usability of the data. The two major categories of data evaluation are laboratory performance and matrix interferences. Evaluation of laboratory performance is a check for compliance with the method requirements. It is a straight-forward examination–either the laboratory did, or did not, analyze the samples within the limits of the analytical method. Evaluation of the matrix interferences is more subtle and involves analysis of several results, including surrogate spike recoveries, MS recoveries, and duplicate sample results. The project team will evaluate the data validation results. This evaluation will assess how the data, as qualified by the data validation, can be used on the project.

Once each of the data packages has been validated, and the data validation worksheets completed, then the entire data set will be evaluated for overall trends in data quality and usability. Information summarized as part of the DQE may include chemical compound frequencies of detection, dilution factors that might affect data usability, and patterns of target compound distribution. The data set also will be evaluated to identify potential data limitations or uncertainties in the laboratory.

8.3 Reconciliation with DQOs

The final activity of the data evaluation process is to assess whether the data meet the planned DQOs for the project. The final results, as adjusted for the findings of any data validation and data evaluation, will be checked against the DQOs, and an assessment will be made as to whether the data are of sufficient quality to support the DQOs. The decision as to data sufficiency may be affected by the overall precision, accuracy, and completeness of the data as demonstrated by the data validation process.

8.4 Project Completeness Assessment

The main project objective should be met assuming the 90 percent completeness goal is obtained after all of the data have undergone sufficient data validation. If the data, after validation and evaluation, are sufficient to achieve project objectives, the data quality and project managers will release the data and work may proceed.

Attachments A-1 through A-38

ATTACHMENT A-1
Precision and Accuracy Limits for SW-846 Method 8260B –
ADEM Appendix I VOC for Groundwater Samples
Environmental Remediation Services, Fort Rucker, Alabama

Analyte	Lab Limits %Recovery
1,1,1,2-Tetrachloroethane	70-140
1,1,1-Trichloroethane	80-125
1,1,2,2-Tetrachloroethane	70-130
1,1,2-Trichloroethane	80-130
1,1-Dichloroethane	75-130
1,1-Dichloroethene	70-125
1,2,3-Trichloropropane	70-140
1,2-Dibromo-3-chloropropane	70-130
1,2-Dibromoethane	75-130
1,2-Dichlorobenzene	70-130
1,2-Dichloroethane	70-135
1,2-Dichloropropane	75-130
1,4-Dichlorobenzene	70-125
2-Butanone	65-145
2-Hexanone	70-140
4-Methyl-2-pentanone	75-135
Acetone	35-175
Acrylonitrile	35-180
Benzene	75-125
Bromochloromethane	80-125
Bromodichloromethane	85-135
Bromoform	70-140
Bromomethane	45-150
Carbon disulfide	65-130
Carbon Tetrachloride	75-135
Chlorobenzene	75-120
Chloroethane	65-145
Chloroform	75-125
Chloromethane	45-145
Dibromochloromethane	80-140
Dibromomethane	65-140
Ethylbenzene	75-130
Iodomethane	50-140
Methylene chloride	70-130
Styrene	75-125
Tetrachloroethene	70-125
Toluene	75-125
Trichloroethene	80-125
Trichlorofluoromethane	70-140
Vinyl acetate	60-150
Vinyl chloride	65-140

ATTACHMENT A-1
Precision and Accuracy Limits for SW-846 Method 8260B –
ADEM Appendix I VOC for Groundwater Samples
Environmental Remediation Services, Fort Rucker, Alabama

Analyte	Lab Limits %Recovery
Xylene(total)	75-125
cis-1,2-Dichloroethene	80-120
cis-1,3-Dichloropropene	75-130
trans-1,2-Dichloroethene	70-125
trans-1,3-Dichloropropene	70-130
trans-1,4-Dichloro-2-butene	50-140

ATTACHMENT A-2
Precision and Accuracy Limits for EPA SW-846 8260B –
ADEM Appendix I VOC for Soil Samples
Environmental Remediation Services, Fort Rucker, Alabama

Analyte	Lab Limits %Recovery
1,1,1,2-Tetrachloroethane	70-140
1,1,1-Trichloroethane	80-125
1,1,2,2-Tetrachloroethane	70-130
1,1,2-Trichloroethane	80-130
1,1-Dichloroethane	75-130
1,1-Dichloroethene	70-125
1,2,3-Trichloropropane	70-140
1,2-Dibromo-3-chloropropane	70-130
1,2-Dibromoethane	75-130
1,2-Dichlorobenzene	70-130
1,2-Dichloroethane	70-135
1,2-Dichloropropane	75-130
1,4-Dichlorobenzene	70-125
2-Butanone	65-145
2-Hexanone	70-140
4-Methyl-2-pentanone	75-135
Acetone	35-175
Acrylonitrile	35-180
Benzene	75-125
Bromochloromethane	80-125
Bromodichloromethane	85-135
Bromoform	70-140
Bromomethane	45-150
Carbon disulfide	65-130
Carbon Tetrachloride	75-135
Chlorobenzene	75-120
Chloroethane	65-145
Chloroform	75-125
Chloromethane	45-145
Dibromochloromethane	80-140
Dibromomethane	65-140
Ethylbenzene	75-130
Iodomethane	50-140
Methylene chloride	70-130

ATTACHMENT A-2
Precision and Accuracy Limits for EPA SW-846 8260B – ADEM Appendix I VOC for Soil Samples
Environmental Remediation Services, Fort Rucker, Alabama

Analyte	Lab Limits %Recovery
Styrene	75-125
Tetrachloroethene	70-125
Toluene	75-125
Trichloroethene	80-125
Trichlorofluoromethane	70-140
Vinyl acetate	60-150
Vinyl chloride	65-140
Xylene(total)	75-125
cis-1,2-Dichloroethene	80-120
cis-1,3-Dichloropropene	75-130
trans-1,2-Dichloroethene	70-125
trans-1,3-Dichloropropene	70-130
trans-1,4-Dichloro-2-butene	50-140

ATTACHMENT A-3
Precision and Accuracy Limits for EPA SW-846 8270C – TCL SVOC for Groundwater Samples
Environmental Remediation Services, Fort Rucker, Alabama

Analyte	Lab Limits %Recovery
1,2,4-Trichlorobenzene	35-105
1,2-Dichlorobenzene	35-100
1,2-Diphenylhydrazine	55-115
1,3-Dichlorobenzene	30-100
1,4-Dichlorobenzene	30-100
2,4,5-Trichlorophenol	50-110
2,4,6-Trichlorophenol	50-115
2,4-Dichlorophenol	50-105
2,4-Dimethylphenol	30-110
2,4-Dinitrophenol	15-140
2,4-Dinitrotoluene	50-120
2,6-Dinitrotoluene	50-115
2-Chloronaphthalene	50-105
2-Chlorophenol	35-105
2-Methylnaphthalene	45-105
2-Methylphenol	40-110
2-Nitroaniline	50-115
2-Nitrophenol	40-115
3,3'-Dichlorobenzidine	20-110
3-Nitroaniline	20-125
4,6-Dinitro-2-methylphenol	40-130
4-Bromophenyl phenyl ether	50-115
4-Chloro-3-methylphenol	45-110
4-Chloroaniline	15-110
4-Chlorophenyl phenyl ether	50-110
4-Methylphenol	30-110
4- Nitroaniline	35-120
4-Nitrophenol	0-125

ATTACHMENT A-3
Precision and Accuracy Limits for EPA SW-846 8270C – TCL SVOC for Groundwater Samples
Environmental Remediation Services, Fort Rucker, Alabama

Analyte	Lab Limits %Recovery
Acenaphthene	45-110
Acenaphthylene	50-105
Anthracene	55-110
Benzo(a)anthracene	55-110
Benzo(a)pyrene	55-110
Benzo(b)fluoranthene	45-120
Benzo(g,h,i)perylene	40-125
Benzo(k)fluoranthene	45-125
Benzoic Acid	0-125
Benzyl alcohol	30-110
Bis(2-ethylhexyl)phthalate	40-125
Butylbenzyl phthalate	45-115
Carbazole	50-115
Chrysene	55-110
Di-n-butyl phthalate	55-115
Di-n-octyl phthalate	35-135
Dibenz(a,h)anthracene	40-125
Dibenzofuran	55-105
Diethyl phthalate	40-120
Dimethyl phthalate	25-125
Fluoranthene	55-115
Fluorene	50-110
Hexachlorobenzene	50-110
Hexachlorobutadiene	25-105
Hexachlorocyclopentadiene	10-110
Hexachloroethane	30-100
Indeno(1,2,3-cd)pyrene	45-125
Isophorone	50-110
N-Nitroso-di-methylamine	25-110
N-Nitroso-di-n-propylamine	35-130
N-Nitrosodiphenylamine	50-110
Naphthalene	40-100
Nitrobenzene	45-110
Pentachlorophenol	40-115
Phenanthrene	50-115
Phenol	0-115
Pyrene	50-130
Bis(2-chloroethoxy)methane	45-105
Bis(2-chloroethyl)ether	35-110
Bis(2-chloroisopropyl)ether	25-130

ATTACHMENT A-4
Precision and Accuracy Limits for EPA SW-846 8270C – TCL SVOC for Soil Samples
Environmental Remediation Services, Fort Rucker, Alabama

Analyte	Lab Limits %Recovery
1,2,4-Trichlorobenzene	45-110
1,2-Dichlorobenzene	45-95

ATTACHMENT A-4
Precision and Accuracy Limits for EPA SW-846 8270C – TCL SVOC for Soil Samples
Environmental Remediation Services, Fort Rucker, Alabama

Analyte	Lab Limits %Recovery
1,2-Diphenylhydrazine	40-100
1,3-Dichlorobenzene	35-105
1,4-Dichlorobenzene	50-110
2,4,5-Trichlorophenol	45-110
2,4,6-Trichlorophenol	45-110
2,4-Dichlorophenol	30-105
2,4-Dimethylphenol	15-130
2,4-Dinitrophenol	50-115
2,4-Dinitrotoluene	50-110
2,6-Dinitrotoluene	45-105
2-Chloronaphthalene	45-105
2-Chlorophenol	45-105
2-Methylnaphthalene	40-105
2-Methylphenol	45-120
2-Nitroaniline	40-110
2-Nitrophenol	10-130
3,3'-Dichlorobenzidine	25-110
3-Nitroaniline	30-135
4,6-Dinitro-2-methylphenol	45-115
4-Bromophenyl phenyl ether	45-115
4-Chloro-3-methylphenol	10-95
4-Chloroaniline	45-110
4-Chlorophenyl phenyl ether	40-105
4-Methylphenol	35-115
4- Nitroaniline	15-140
4-Nitrophenol	45-110
Acenaphthene	45-105
Acenaphthylene	55-105
Anthracene	50-110
Benzo(a)anthracene	50-110
Benzo(a)pyrene	45-115
Benzo(b)fluoranthene	40-125
Benzo(g,h,i)perylene	45-125
Benzo(k)fluoranthene	0-110
Benzoic Acid	20-125
Benzyl alcohol	45-125
Bis(2-ethylhexyl)phthalate	50-125
Butylbenzyl phthalate	45-115
Carbazole	55-110
Chrysene	55-110
Di-n-butyl phthalate	40-130
Di-n-octyl phthalate	40-125
Dibenz(a,h)anthracene	50-105
Dibenzofuran	50-115
Diethyl phthalate	50-110
Dimethyl phthalate	55-115
Fluoranthene	50-110
Fluorene	45-120
Hexachlorobenzene	40-115
Hexachlorobutadiene	10-110
Hexachlorocyclopentadiene	35-110
Hexachloroethane	40-120
Indeno(1,2,3-cd)pyrene	45-110

ATTACHMENT A-4
Precision and Accuracy Limits for EPA SW-846 8270C – TCL SVOC for Soil Samples
Environmental Remediation Services, Fort Rucker, Alabama

Analyte	Lab Limits %Recovery
Isophorone	20-115
N-Nitroso-di-methylamine	40-115
N-Nitroso-di-n-propylamine	50-115
N-Nitrosodiphenylamine	40-105
Naphthalene	40-115
Nitrobenzene	25-120
Pentachlorophenol	50-110
Phenanthrene	40-100
Phenol	45-125
Pyrene	45-110
Bis(2-chloroethoxy)methane	40-105
Bis(2-chloroethyl)ether	20-115
Bis(2-chloroisopropyl)ether	45-110

ATTACHMENT A-5
Precision and Accuracy Limits for EPA SW-846 Method 8081A/8082 – TCL Pesticides/PCBs for Groundwater Samples
Environmental Remediation Services, Fort Rucker, Alabama

Analyte	Method	Lab Limits %Recovery
4,4'-DDD	8081A	25-150
4,4'-DDE	8081A	35-140
4,4'-DDT	8081A	45-140
Aldrin	8081A	25-140
Alpha-BHC	8081A	60-130
Alpha-Chlordane	8081A	65-125
Beta-BHC	8081A	65-125
Delta-BHC	8081A	45-135
Dieldrin	8081A	60-130
Endosulfan I	8081A	50-110
Endosulfan II	8081A	30-130
Endosulfan sulfate	8081A	55-135
Endrin	8081A	55-135
Endrin aldehyde	8081A	55-135
Endrin ketone	8081A	75-125
Gamma-BHC	8081A	25-135
Gamma-Chlordane	8081A	60-125
Heptachlor	8081A	40-130
Heptachlor epoxide	8081A	60-130
Methoxychlor	8081A	55-150
Arochlor 1016	8082	25-145
Arochlor 1260	8082	30-145

ATTACHMENT A-6
Precision and Accuracy Limits for EPA SW-846 Method 8081A/8082 –I TCL Pesticides/PCBs for Soil Samples
Environmental Remediation Services, Fort Rucker, Alabama

Analyte	Method	Lab Limits %Recovery
4,4'-DDD	8081A	25-150
4,4'-DDE	8081A	35-140
4,4'-DDT	8081A	45-140
Aldrin	8081A	25-140
Alpha-BHC	8081A	60-130
Alpha-Chlordane	8081A	65-125
Beta-BHC	8081A	65-125
Delta-BHC	8081A	45-135
Dieldrin	8081A	60-130
Endosulfan I	8081A	50-110
Endosulfan II	8081A	30-130
Endosulfan sulfate	8081A	55-135
Endrin	8081A	55-135
Endrin aldehyde	8081A	55-135
Endrin ketone	8081A	75-125
Gamma-BHC	8081A	25-135
Gamma-Chlordane	8081A	60-125
Heptachlor	8081A	40-130
Heptachlor epoxide	8081A	60-130
Methoxychlor	8081A	55-150
Arochlor 1016	8082	25-145
Arochlor 1260	8082	30-145

ATTACHMENT A-7
Precision and Accuracy Limits for EPA SW-846 8151A – Herbicides for Groundwater Samples
Environmental Remediation Services, Fort Rucker, Alabama

Analyte	Lab Limits %Recovery
2,4,5-T	35-110
Silvex	50-115
2,4-D	35-115
2,4-DB	45-130
Dalapon	40-110
Dicamba	60-110
Dichlorprop	70-120
Dinoseb	20-95
MCPA	60-145
MCPP	25-135

ATTACHMENT A-8
Precision and Accuracy Limits for EPA SW-846 8151A – Herbicides for Soil Samples
Environmental Remediation Services, Fort Rucker, Alabama

Analyte	Lab Limits %Recovery
2,4,5-T	45-135
Silvex	45-125
2,4-D	35-145
2,4-DB	50-155
Dalapon	10-110
Dicamba	55-110
Dichlorprop	75-140
Dinoseb	5-130
MCPA	30-115
MCPP	35-135

ATTACHMENT A-9
Precision and Accuracy Limits for SW-846 Method 6010B/7470A – ADEM Appendix I Metals for Groundwater Samples
Environmental Remediation Services, AOC–S, Fort Rucker, Alabama

Analyte	Method	Lab Limits %Recovery
Arsenic	6010B	80-120
Barium	6010B	80-120
Beryllium	6010B	80-120
Cadmium	6010B	80-120
Cobalt	6010B	80-120
Chromium	6010B	80-120
Copper	6010B	80-120
Silver	6010B	80-120
Nickel	6010B	80-120
Lead	6010B	80-120
Selenium	6010B	80-120
Antimony	6010B	80-120
Thallium	6010B	80-120
Vanadium	6010B	80-120
Zinc	6010B	80-120
Mercury	7470A	80-120

ATTACHMENT A-10
Precision and Accuracy Limits for SW-846 Method 6010B/7471A – ADEM Appendix I Metals for Soil Samples
Environmental Remediation Services, AOC–S, Fort Rucker, Alabama

Analyte	Method	Lab Limits %Recovery
Arsenic	6010B	80-120
Barium	6010B	80-120
Beryllium	6010B	80-120
Cadmium	6010B	80-120
Cobalt	6010B	80-120
Chromium	6010B	80-120
Copper	6010B	80-120
Silver	6010B	80-120
Nickel	6010B	80-120
Lead	6010B	80-120
Selenium	6010B	80-120
Antimony	6010B	80-120
Thallium	6010B	80-120
Vanadium	6010B	80-120
Zinc	6010B	80-120
Mercury	7471A	80-120

ATTACHMENT A-11
Precision and Accuracy Limits for SW-846 Method 6010B/7470A – TAL Metals for Groundwater Samples
Environmental Remediation Services, AOC–S, Fort Rucker, Alabama

Analyte	Method	Lab Limits %Recovery
Aluminum	6010B	80-120
Arsenic	6010B	80-120
Barium	6010B	80-120
Beryllium	6010B	80-120
Calcium	6010B	80-120
Cadmium	6010B	80-120
Cobalt	6010B	80-120
Chromium	6010B	80-120
Copper	6010B	80-120
Iron	6010B	80-120
Potassium	6010B	80-120
Magnesium	6010B	80-120
Manganese	6010B	80-120
Silver	6010B	75-120
Sodium	6010B	80-120
Nickel	6010B	80-120
Lead	6010B	80-120
Selenium	6010B	80-120
Antimony	6010B	80-120
Thallium	6010B	80-120

ATTACHMENT A-11
Precision and Accuracy Limits for SW-846 Method 6010B/7470A – TAL Metals for Groundwater Samples
Environmental Remediation Services, AOC–S, Fort Rucker, Alabama

Analyte	Method	Lab Limits %Recovery
Vanadium	6010B	80-120
Zinc	6010B	80-120
Mercury	7470A	80-120

ATTACHMENT A-12
Precision and Accuracy Limits for SW-846 Method 6010B/7471A –TAL Metals for Soil Samples
Environmental Remediation Services, AOC–S, Fort Rucker, Alabama

Analyte	Method	Lab Limits %Recovery
Aluminum	6010B	80-120
Arsenic	6010B	80-120
Barium	6010B	80-120
Beryllium	6010B	80-120
Calcium	6010B	80-120
Cadmium	6010B	80-120
Cobalt	6010B	80-120
Chromium	6010B	80-120
Copper	6010B	80-120
Iron	6010B	80-120
Potassium	6010B	80-120
Magnesium	6010B	80-120
Manganese	6010B	80-120
Silver	6010B	80-120
Sodium	6010B	80-120
Nickel	6010B	80-120
Lead	6010B	80-120
Selenium	6010B	80-120
Antimony	6010B	80-120
Thallium	6010B	80-120
Vanadium	6010B	80-120
Zinc	6010B	80-120
Mercury	7471A	80-120

ATTACHMENT A-13
Precision and Accuracy Limits for Geochemical Parameters– Groundwater Samples
Environmental Remediation Services, AOC–S, Fort Rucker, Alabama

Analyte	Method	Lab Limits %Recovery
Iron	SW-846 6010B	80-120
Total Organic Carbon	SM 5310C	75-125
Alkalinity	SM 2320B	75-125
Nitrate	EPA 300.0	80-120
Sulfate	EPA 300.0	80-120

ATTACHMENT A-14
Precision and Accuracy Limits for Geochemical Parameters– Soil Samples
Environmental Remediation Services, AOC–S, Fort Rucker, Alabama

Analyte	Method	Limits %Recovery
Iron	SW-846 6010B	80-120
Total Organic Carbon	Lloyd Kahn	75-125
Nitrate	SW-846 9056	80-120
Sulfate	SW-846 9056	80-120

ATTACHMENT A-15
Precision and Accuracy Limits for Military Munitions Response Program Groundwater Samples
Environmental Remediation Services, AOC–S, Fort Rucker, Alabama

Analyte	Method	Lab Limits %Recovery
Lead	SW-846 6010B	80-120
Antimony	SW-846 6010B	80-120
Copper	SW-846 6010B	80-120
Zinc	SW-846 6010B	80-120

ATTACHMENT A-16
Precision and Accuracy Limits for Military Munitions Response Program–Soil Samples
Environmental Remediation Services, AOC–S, Fort Rucker, Alabama

Analyte	Method	Lab Limits %Recovery
Lead	SW846 6010B	80-120
Antimony	SW846 6010B	80-120
Copper	SW846 6010B	80-120
Zinc	SW846 6010B	80-120

ATTACHMENT A-17
Precision and Accuracy Limits for TCLP Parameters
Environmental Remediation Services, AOC–S, Fort Rucker, Alabama

Analyte	Method	Lab Limits %Recovery
Volatiles	8260B	80-120
Benzene	8260B	65-140
Carbon Tetrachloride	8260B	80-120
Chlorobenzene	8260B	65-135
Chloroform	8260B	70-130
1,2-Dichlorethane	8260B	70-130
1,1-Dichloroethene	8260B	30-150
2-Butanone	8260B	45-150
Tetrachloroethene	8260B	70-125
Trichloroethene	8260B	50-145
Vinyl Chloride	8260B	80-120
Semivolatiles		
O-Cresol	8270C	40-110
M-Cresol	8270C	30-110
P-Cresol	8270C	30-110
1,4-Dichlorobenzene	8270C	30-100
2,4-Dinitrotoluene	8270C	50-120
Hexachlorobenzene	8270C	50-110
Hexachlorobutadiene	8270C	25-105
Hexachloroethane	8270C	30-100
Nitrobenzene	8270C	45-110
Pentachlorophenol	8270C	40-115
Pyridine	8270C	10-110
2,4,5-Trichlorophenol	8270C	50-110
2,4,6-Trichlorophenol	8270C	50-115
Pesticides		
Chlordane	8081A	45-119
Endrin	8081A	55-135
Heptachlor	8081A	40-130
Hetachlor Epoxide	8081A	60-130
Lindane	8081A	25-135
Methoxychlor	8081A	55-150
Toxaphene	8081A	41-126
Herbicides		
2,4-D	8151A	35-115
2,4,5-TP (Silvex)	8151A	50-115
Metals		
Aluminum	3005A/6010B/200.7	80-120
Arsenic	3005A/6010B/200.7	80-120
Barium	3005A/6010B/200.7	80-120
Beryllium	3005A/6010B/200.7	80-120
Calcium	3005A/6010B/200.7	80-120
Cadmium	3005A/6010B/200.7	80-120
Cobalt	3005A/6010B/200.7	80-120

ATTACHMENT A-17
Precision and Accuracy Limits for TCLP Parameters
Environmental Remediation Services, AOC–S, Fort Rucker, Alabama

Analyte	Method	Lab Limits %Recovery
Chromium	3005A/6010B/200.7	80-120
Copper	3005A/6010B/200.7	80-120
Iron	3005A/6010B/200.7	80-120
Potassium	3005A/6010B/200.7	80-120
Magnesium	3005A/6010B/200.7	80-120
Manganese	3005A/6010B/200.7	80-120
Silver	3005A/6010B/200.7	75-120
Sodium	3005A/6010B/200.7	80-120
Nickel	3005A/6010B/200.7	80-120
Lead	3005A/6010B/200.7	80-120
Selenium	3005A/6010B/200.7	80-120
Antimony	3005A/6010B/200.7	80-120
Thallium	3005A/6010B/200.7	80-120
Vanadium	3005A/6010B/200.7	80-120
Zinc	3005A/6010B/200.7	80-120
Mercury	7470A	80-120
RCI		
Reactive Sulfide	Ch. 7.3.4.2	80-120
Cyanide	9012A/335.4	80-120
Ignitability		± 1.1 ºF
pH		± 0.2 units

ATTACHMENT A-18
Container, Preservative, and Holding Time Requirements for Groundwater, Soil, and TCLP Samples
Environmental Remediation Services, Fort Rucker, Alabama

Matrix	Test	Method	Container	Preservative	Holding Time
Water	ADEM Appendix I VOCs	8260B	3 X 40 mL vial	HCl / 4^{o}C	14 days
Water	TCL SVOCs	8270C	2-1L WM Amber	None / 4^{o}C	7 days to extraction 40 days after extraction
Water	TCL Pesticides/ PCBs	8081A/8082	2-1L WM Amber	None / 4^{o}C	7 days to extraction 40 days after extraction
Water	Herbicides	8151A	2-1L WM Amber	None / 4^{o}C	7 days to extraction 40 days after extraction
Water	ADEM Appendix I Metals	6010B/7000	1 X 1L HDPE	HNO_3 / 4^{o}C	6 months Mercury (28 days)
Water	TAL Metals	6010B/7470	1 X 1L HDPE	HNO_3 / 4^{o}C	6 months Mercury (28 days)

ATTACHMENT A-18
Container, Preservative, and Holding Time Requirements for Groundwater, Soil, and TCLP Samples
Environmental Remediation Services, Fort Rucker, Alabama

Matrix	Test	Method	Container	Preservative	Holding Time
Water	Alkalinity	SM 2320-B	500-ml polyethylene	Cool 4°C	14 days
Water	Nitrate	EPA 300.0	500-ml polyethylene	Cool to 4 ºC	48 hours
Water	Total Organic Carbon	SM 5310-C	40-ml, glass	H2SO4, pH <2, cool to 4 ºC	28 days
Water	Sulfate	EPA 300.0	500-ml polyethylene	Cool 4°C	28 days
Water	Iron	SW 846 6010B	500 mL	HNO3 to pH <2, Cool to 4^{o}C	180 days from collection to analysis
Soil	ADEM Appendix I VOC	8260B	3 x 5-g EZ-Draw with 3 pre-tared 40 ml vials	1 x Methanol 2 x Sodium Bisulfite/4^{o}C	48 hours
Soil	TCL SVOCs	8270C	Glass, 100 grams	None / 4^{o}C	14 days to extraction 40 days after extraction
Soil	TCL Pesticides/ PCBs	8081A/8082	Glass, 100 grams	None / 4^{o}C	14 days to extraction 40 days after extraction
Soil	Herbicides	8151A	Glass, 100 grams	None / 4^{o}C	14 days to extraction 40 days after extraction
Soil	ADEM Appendix I Metals	6010B and 7000 series	Plastic, 100 grams	None Cool 4^{o}C	180 days from collection to analysis except mercury at 28 days
Soil	Metals, lead, antimony, copper, zinc	EPA 6010B	Plastic, 100 grams	None Cool 4^{o}C	180 days from collection to analysis
Soil	TAL Metals	6010B and 7471A	Plastic, 100 grams	None Cool 4^{o}C	180 days from collection to analysis except mercury at 28 days
Soil-IDW	VOC	1311/8260B	1 x 2 oz. Glass jar	None / 4^{o}C	14 days/14 days
Soil-IDW	SVOC	1311/8270C	1 x 1L Amber Glass jar	None / 4^{o}C	14 days/7 days/40 days
Soil-IDW	Metals	1311/6010B Mercury – 1311/7470	1 x 1L Amber Glass jar	None / 4^{o}C	180 days/180 days Mercury (28 days/28 days)
Soil-IDW	Pesticides	1311/8081	1 x 1L Amber Glass jar	None / 4^{o}C	14 days/7 days/40 days
Soil-IDW	Herbicides	1311/8151	1 x 1L Amber Glass jar	None / 4^{o}C	14 days/7 days/40 days
Soil-IDW	Ignitability, Corrosivity, Reactivity	SW-846 1311	8 oz. glass	None	As soon as possible

ATTACHMENT A-18
Container, Preservative, and Holding Time Requirements for Groundwater, Soil, and TCLP Samples
Environmental Remediation Services, Fort Rucker, Alabama

Matrix	Test	Method	Container	Preservative	Holding Time
Liquid-IDW	VOC	8260B	2 x 40 mL glass vials[1]	HCL to pH <2 / 4^oC	14 days from collection to analysis
Liquid-IDW	SVOC	8270C	4-1L WM Amber	None / 4^oC	7 days to extraction 40 days after extraction
Liquid-IDW	Metals	6010B/7470A	1 – 500 mL HDPE	HNO_3 to pH <2, Cool 4ºC	180 days from collection to analysis except mercury at 28 days
Liquid-IDW	Pesticides	8081A	4-1L WM Amber	None / 4^oC	7 days to extraction 40 days after extraction
Liquid-IDW	Herbicides	8151A	4-1L WM Amber	None / 4^oC	7 days to extraction 40 days after extraction
Liquid-IDW	Ignitability,	1010A	100 gram Glass	N/A	N/A
Liquid-IDW	Corrosivity	9040C	100 gram Glass	Cool, 4^oC	N/A

1. Use Teflon® lined caps/lidsHCl – Hydrochloric acid

HDPE – High Density Polyethylene
HNO_3 – Nitric acid
VOC – Volatile Organic Compounds
TCLP –Target Compound List Parameters
SVOC- Semivolatile Organic Compounds
L – Liter
mL - milliliter
WM – wide mouth
PRB – permeable reactive barrier

All Analytical Fractions	
Case Narrative – A detailed case narrative for each analytical fraction is required and will include explanation of any non-compliance and/or exceptions, corrective action taken, and outcome of corrective action. Exceptions will be noted for receipt, holding times, analytical methods, preparation, calibration, blanks, spikes, surrogates (where applicable), and sample exceptions.	•
Sample ID Cross Reference Sheet (Lab ID's and Client ID's)	•
Completed Chain of Custody and any sample receipt information	•
Copies of non-conformance memos and corrective actions	•

Form *	Organic Fractions	GC/MS	GC
1	Sample results w/ lab sample ID, client sample ID, and station ID	•	•
2	Surrogate Recovery Summary (w/ applicable control limits)	•	•
3	MS/MSD Accuracy & Precision Summary with RPD calculated according to method specifications (CLP using % recovery, SW-846 using concentration) – including spike added, percent recovery, and applicable control limits	•	•
3	LCS Accuracy Summary (including spike added, percent recovery, and applicable control limits)	•	•
4	Method Blank Summary	•	•
5	Instrument Tuning Summary (including tuning summary for applicable initial calibrations)	•	
6	Initial Calibration Summary (including concentration levels of standards)	•	
6	Initial Calibration Summary (Retention Times (RT), Response or Calibration Factors, and linearity demonstration)		•
7	Continuing Calibration Summary	•	
7	Continuing Calibration Summary (Unique Instrument/Column ID, RTs, RT windows, calibration or response factors, percent difference or drift – as appropriate to method)		•
7	Degradation Summary (Organochlorine Pesticides only)		•
8	Internal Standard Summary (including internal standard summary for applicable initial calibrations)	•	
9	Analytical Sequence - For every analysis associated with a particular analytical sequence starting with the initial calibration, enter the client sample identification, lab sample identifier, and date and time of analysis. Each sample analyzed as part of the sequence should be reported on Form 8 even if it is not associated with the batch/SDG. The laboratory should use ZZZZZ as the client sample identification to distinguish all samples that are not part of the batch/SDG being reported.		•
10	Compound Identification Summary (where confirmation required) – including RT, RT windows, concentrations for detected compounds on both columns, and percent difference between results		•

Form *	Inorganic Fractions	Metals	General Chemistry
1	Sample Results (with lab ID, sample ID, and station ID)	•	•
2A	Initial and Continuing Calibration Summary	•	•
3	Initial and Continuing Calibration Blanks and Method Blanks Summary	•	•
4	Interference Check Standard Summary	•	
5A	Pre-digestion Matrix Spike Recoveries Summary	•	•
6	Native Duplicate or MS/MSD Precision Summary	•	•
7	Laboratory Control Sample Recovery Summary	•	•
8	Method of Standard Addition (if necessary)	•	
8	Serial Dilution	•	
10	Instrument or Method Detection Limit Summary	•	•
12	Linear Range Summary	•	
13	Preparation Log Summary	•	
14	Analytical Run Sequence and GFAA Post-spike Recovery Summary	•	

*CLP Form or summary form with equivalent information

ATTACHMENT A-20
Analytical Method Detection Limits for EPA Method 8260B – ADEM Appendix I VOCs for Groundwater Samples
Environmental Remediation Services, Fort Rucker, Alabama

SW-846		ADEM Appendix I List			
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**	**MDL**
8260B	630-20-6	1,1,1,2-Tetrachloroethane	ug/l	1	0.5
8260B	71-55-6	1,1,1-Trichloroethane	ug/l	1	0.5
8260B	79-34-5	1,1,2,2-Tetrachloroethane	ug/l	1	0.5
8260B	79-00-5	1,1,2-Trichloroethane	ug/l	1	0.5
8260B	75-34-3	1,1-Dichloroethane	ug/l	1	0.5
8260B	75-35-4	1,1-Dichloroethylene	ug/l	1	0.5
8260B	96-18-4	1,2,3-Trichloropropane	ug/l	2	1
8260B	96-12-8	1,2-Dibromo-3-chloropropane	ug/l	2	1
8260B	106-93-4	1,2-Dibromoethane (EDB)	ug/l	2	1
8260B	107-06-2	1,2-Dichloroethane	ug/l	1	0.5
8260B	78-87-5	1,2-Dichloropropane	ug/l	1	0.5
8260B	591-78-6	2-Hexanone	ug/l	5	2
8260B	108-10-1	4-Methyl-2-pentanone (MIBK)	ug/l	5	2
8260B	67-64-1	Acetone	ug/l	10	5
8260B	107-13-1	Acrylonitrile	ug/l	20	10
8260B	71-43-2	Benzene	ug/l	2	1
8260B	74-97-5	Bromochloromethane	ug/l	2	1
8260B	75-27-4	Bromodichloromethane	ug/l	2	1
8260B	75-25-2	Bromoform	ug/l	2	1
8260B	74-83-9	Bromomethane (Methyl bromide)	ug/l	2	1
8260B	75-15-0	Carbon disulfide	ug/l	2	1
8260B	56-23-5	Carbon tetrachloride	ug/l	2	1
8260B	108-90-7	Chlorobenzene	ug/l	2	1
8260B	75-00-3	Chloroethane	ug/l	2	1
8260B	67-66-3	Chloroform	ug/l	2	1
8260B	74-87-3	Chloromethane (Methyl chloride)	ug/l	2	1
8260B	156-59-2	cis-1,2-Dichloroethene	ug/l	2	1
8260B	10061-01-5	cis-1,3-Dichloropropene	ug/l	2	1
8260B	124-48-1	Dibromochloromethane	ug/l	2	1
8260B	74-95-3	Dibromomethane (Methylene bromide)	ug/l	2	1
8260B	95-56-1	o-dichlorobenzene	ug/l	2	1
8260B	106-46-7	p-dichlorobenzene	ug/l	2	1
8260B	100-41-4	Ethylbenzene	ug/l	2	1
8260B	74-88-4	Iodomethane (Methyl iodide)	ug/l	10	5
8260B	78-93-3	Methyl ethyl ketone	ug/l	10	5

ATTACHMENT A-20
Analytical Method Detection Limits for EPA Method 8260B – ADEM Appendix I VOCs for Groundwater Samples
Environmental Remediation Services, Fort Rucker, Alabama

SW-846		ADEM Appendix I List			
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**	**MDL**
8260B	75-09-2	Methylene chloride (Dichloromethane)	ug/l	2	1
8260B	100-42-5	Styrene	ug/l	2	1
8260B	127-18-4	Tetrachloroethene	ug/l	2	1
8260B	108-88-3	Toluene	ug/l	2	1
8260B	156-60-5	trans-1,2-Dichloroethene	ug/l	2	1
8260B	10061-02-6	trans-1,3-Dichloropropene	ug/l	2	1
8260B	110-57-6	trans-1,4-Dichloro-2-butene	ug/l	20	10
8260B	79-01-6	Trichloroethene	ug/l	2	1
8260B	75-69-4	Trichlorofluoromethane	ug/l	2	1
8260B	108-05-4	Vinyl acetate	ug/l	20	10
8260B	75-01-4	Vinyl chloride	ug/l	2	1
8260B	1330-20-7	Xylenes, Total	ug/l	5	2

ATTACHMENT A-21
Analytical Method Detection Limits for EPA Method 8260B – ADEM Appendix I VOCs for Soil Samples
Environmental Remediation Services, Fort Rucker, Alabama

SW-846		ADEM Appendix I List			
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**	**MDL**
8260B	630-20-6	1,1,1,2-Tetrachloroethane	ug/KG	5	2
8260B	71-55-6	1,1,1-Trichloroethane	ug/KG	5	2
8260B	79-34-5	1,1,2,2-Tetrachloroethane	ug/KG	5	2
8260B	79-00-5	1,1,2-Trichloroethane	ug/KG	5	2
8260B	75-34-3	1,1-Dichloroethane	ug/KG	5	2
8260B	75-35-4	1,1-Dichloroethylene	ug/KG	5	2
8260B	96-18-4	1,2,3-Trichloropropane	ug/KG	5	2
8260B	96-12-8	1,2-Dibromo-3-chloropropane	ug/KG	5	2
8260B	106-93-4	1,2-Dibromoethane (EDB)	ug/KG	5	2
8260B	107-06-2	1,2-Dichloroethane	ug/KG	5	2
8260B	78-87-5	1,2-Dichloropropane	ug/KG	5	2
8260B	591-78-6	2-Hexanone	ug/KG	10	5
8260B	108-10-1	4-Methyl-2-pentanone (MIBK)	ug/KG	10	5
8260B	67-64-1	Acetone	ug/KG	50	25

ATTACHMENT A-21
Analytical Method Detection Limits for EPA Method 8260B – ADEM Appendix I VOCs for Soil Samples
Environmental Remediation Services, Fort Rucker, Alabama

SW-846		**ADEM Appendix I List**			
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**	**MDL**
8260B	107-13-1	Acrylonitrile	ug/KG	20	10
8260B	71-43-2	Benzene	ug/KG	5	2
8260B	74-97-5	Bromochloromethane	ug/KG	5	2
8260B	75-27-4	Bromodichloromethane	ug/KG	5	2
8260B	75-25-2	Bromoform	ug/KG	5	2
8260B	74-83-9	Bromomethane (Methyl bromide)	ug/KG	10	5
8260B	75-15-0	Carbon disulfide	ug/KG	5	2
8260B	56-23-5	Carbon tetrachloride	ug/KG	5	2
8260B	108-90-7	Chlorobenzene	ug/KG	5	2
8260B	75-00-3	Chloroethane	ug/KG	10	5
8260B	67-66-3	Chloroform	ug/KG	5	2
8260B	74-87-3	Chloromethane (Methyl chloride)	ug/KG	10	5
8260B	156-59-2	cis-1,2-Dichloroethene	ug/KG	5	2
8260B	10061-01-5	cis-1,3-Dichloropropene	ug/KG	5	2
8260B	124-48-1	Dibromochloromethane	ug/KG	5	2
8260B	74-95-3	Dibromomethane (Methylene bromide)	ug/KG	5	2
8260B	95-56-1	o-dichlorobenzene	ug/KG	5	2
8260B	106-46-7	p-dichlorobenzene	ug/KG	5	2
8260B	100-41-4	Ethylbenzene	ug/KG	5	2
8260B	74-88-4	Iodomethane (Methyl iodide)	ug/KG	10	5
8260B	78-93-3	Methyl ethyl ketone	ug/KG	50	25
8260B	75-09-2	Methylene chloride (Dichloromethane)	ug/KG	10	5
8260B	100-42-5	Styrene	ug/KG	5	2
8260B	127-18-4	Tetrachloroethene	ug/KG	5	2
8260B	108-88-3	Toluene	ug/KG	5	2
8260B	156-60-5	trans-1,2-Dichloroethene	ug/KG	5	2
8260B	10061-02-6	trans-1,3-Dichloropropene	ug/KG	5	2
8260B	110-57-6	trans-1,4-Dichloro-2-butene	ug/KG	10	5
8260B	79-01-6	Trichloroethene	ug/KG	5	2
8260B	75-69-4	Trichlorofluoromethane	ug/KG	10	5
8260B	108-05-4	Vinyl acetate	ug/KG	10	5
8260B	75-01-4	Vinyl chloride	ug/KG	10	5
8260B	1330-20-7	Xylenes, Total	ug/KG	5	2

ATTACHMENT A-22
Analytical Method Detection Limits for EPA Method 8270C – TCL SVOCs for Groundwater Samples
Environmental Remediation Services, *Fort Rucker, Alabama*

SW-846		TCL List			
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**	**MDL**
8270C	630-20-6	1,1'-Biphenyl	ug/l	5	1.5
8270C	71-55-6	Bis(2-chloroisopropyl)ether, or 2,2'-oxybis (1-Chloropropane)	ug/l	5	1.5
8270C	79-34-5	1,2-Dichlorobenzene	ug/l	5	1.5
8270C	79-00-5	1,3-Dichlorobenzene	ug/l	5	1.5
8270C	75-34-3	1,4-Dichlorobenzene	ug/l	5	1.5
8270C	75-35-4	2,4,5-Trichlorophenol	ug/l	5	1.5
8270C	96-18-4	2,4,6-Trichlorophenol (TCP)	ug/l	5	1.5
8270C	96-12-8	2,4-Dichlorophenol (DCP)	ug/l	5	1.5
8270C	106-93-4	2,4-Dimethylphenol	ug/l	5	1.5
8270C	107-06-2	2,4-Dinitrophenol	ug/l	20	6
8270C	78-87-5	2,4-Dinitrotoluene (DNT)	ug/l	5	1.5
8270C	591-78-6	2,6-Dichlorophenol	ug/l	5	1.5
8270C	108-10-1	2,6-Dinitrotoluene	ug/l	5	1.5
8270C	67-64-1	1,2-Diphenylhydrazine	ug/l	5	1.5
8270C	107-13-1	2-Chloronaphthalene	ug/l	5	1.5
8270C	71-43-2	2-Chlorophenol	ug/l	5	1.5
8270C	74-97-5	2-Methylnaphthalene	ug/l	5	1.5
8270C	75-27-4	1-Methylnaphthalene	ug/l	5	1.5
8270C	75-25-2	2-Methylphenol (o-Cresol)	ug/l	5	1.5
8270C	74-83-9	2-Nitroaniline	ug/l	20	6
8270C	75-15-0	2-Nitrophenol (ONP)	ug/l	5	1.5
8270C	56-23-5	3,3'-Dichlorobenzidine (DCB)	ug/l	5	1.5
8270C	108-90-7	3-Methylphenol	ug/l	5	1.5
8270C	75-00-3	3-Nitroaniline	ug/l	20	6
8270C	67-66-3	4,6-Dinitro-2-methylphenol (DNOC)	ug/l	20	6
8270C	74-87-3	4-Bromophenyl phenyl ether	ug/l	5	1.5
8270C	156-59-2	4-Chloro-3-methylphenol	ug/l	5	1.5
8270C	10061-01-5	4-Chloroaniline	ug/l	5	1.5
8270C	124-48-1	4-Chlorophenyl phenyl ether	ug/l	5	1.5
8270C	74-95-3	4-Methylphenol (p-Cresol)	ug/l	5	1.5
8270C	95-56-1	4-Nitroaniline (PNA)	ug/l	20	6

ATTACHMENT A-22
Analytical Method Detection Limits for EPA Method 8270C – TCL SVOCs for Groundwater Samples
Environmental Remediation Services, *Fort Rucker, Alabama*

SW-846		TCL List			
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**	**MDL**
8270C	106-46-7	4-Nitrophenol (PNP)	ug/l	20	6
8270C	100-41-4	Acenaphthene	ug/l	5	1.5
8270C	74-88-4	Acenaphthylene	ug/l	5	1.5
8270C	78-93-3	Acetaphenone	ug/l	5	1.5
8270C	75-09-2	Anthracene	ug/l	5	1.5
8270C	100-42-5	Atrazine	ug/l	5	1.5
8270C	127-18-4	Benzaldehyde	ug/l	5	1.5
8270C	108-88-3	Benzidine	ug/l	50	15
8270C	156-60-5	Benzo(a)anthracene	ug/l	5	1.5
8270C	10061-02-6	Benzo(a)pyrene	ug/l	5	1.5
8270C	110-57-6	Benzo(b)fluoranthene	ug/l	5	1.5
8270C	79-01-6	Benzo(g,h,i)perylene	ug/l	5	1.5
8270C	92-52-4	Benzo(k)fluoranthene	ug/l	5	1.5
8270C	108-60-1	Benzyl alcohol	ug/l	5	1.5
8270C	95-50-1	Benzoic Acid	ug/l	50	15
8270C	541-73-1	bis(2-Chloroethoxy)methane	ug/l	5	1.5
8270C	106-46-7	bis(2-Chloroethyl)ether (BCEE)	ug/l	5	1.5
8270C	95-95-4	bis(2-Ethylhexyl)phthalate (BEHP)	ug/l	10	3.3
8270C	88-06-2	Butyl benzyl phthalate (BBP)	ug/l	5	1.5
8270C	120-83-2	Caprolactam	ug/l	5	1.5
8270C	105-67-9	Carbazole	ug/l	5	1.5
8270C	51-28-5	Chrysene	ug/l	5	1.5
8270C	121-14-2	Di-n-butyl phthalate (DBP)	ug/l	5	1.5
8270C	87-65-0	Di-n-octyl phthalate (DNOP)	ug/l	5	1.5
8270C	606-20-2	Dibenz(a,h)anthracene	ug/l	5	1.5
8270C	122-66-7	Dibenzofuran (DBF)	ug/l	5	1.5
8270C	91-58-7	Diethyl phthalate (DEP)	ug/l	5	1.5
8270C	95-57-8	Dimethyl phthalate (DMP)	ug/l	5	1.5
8270C	91-57-6	Fluoranthene	ug/l	5	1.5
8270C	90-12-0	Fluorene	ug/l	5	1.5
8270C	95-48-7	Hexachlorobenzene (HCB)	ug/l	5	1.5
8270C	88-74-4	Hexachlorobutadiene (HCBD)	ug/l	5	1.5
8270C	88-75-5	Hexachlorocyclopentadiene (HCCPD)	ug/l	5	1.5
8270C	91-94-1	Hexachloroethane (HCE)	ug/l	5	1.5

ATTACHMENT A-22
Analytical Method Detection Limits for EPA Method 8270C – TCL SVOCs for Groundwater Samples
Environmental Remediation Services*, Fort Rucker, Alabama*

SW-846		TCL List			
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**	**MDL**
8270C	108-39-4	Indeno(1,2,3-cd)pyrene	ug/l	5	1.5
8270C	99-09-2	Isophorone	ug/l	5	1.5
8270C	534-52-1	N-Nitrosodimethylamine	ug/l	5	1.5
8270C	101-55-3	N-Nitroso-di-n-propylamine (NDPA)	ug/l	5	1.5
8270C	59-50-7	N-nitrosodiphenylamine (NDPHA)	ug/l	5	1.5
8270C	106-47-8	Naphthalene	ug/l	5	1.5
8270C	7005-72-3	Nitrobenzene	ug/l	5	1.5
8270C	106-44-5	Pentachlorophenol	ug/l	20	6
8270C	100-01-6	Phenanthrene	ug/l	5	1.5
8270C	100-02-7	Phenol	ug/l	5	1.5
8270C	83-32-9	Pyrene	ug/l	5	1.5
8270C	208-96-8	Pyridine	ug/l	5	1.5
8270C	98-86-2	1,2,4,5-Tetrachlorobenzene	ug/l	5	1.5
8270C	120-12-7	2,3,4,6-Tetrachlorophenol	ug/l	5	1.5
8270C	1912-24-9	1,2,4-Trichlorobenzene	ug/l	5	1.5

ATTACHMENT A-23
Analytical Method Detection Limits for EPA Method 8270C – TCL SVOCs for Soil Samples
Environmental Remediation Services*, Fort Rucker, Alabama*

SW-846		TCL List			
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**	**MDL**
8270C	630-20-6	1,1'-Biphenyl	ug/kg	110	330
8270C	71-55-6	Bis(2-chloroisopropyl)ether, or 2,2'-oxybis (1-Chloropropane)	ug/kg	200	670
8270C	79-34-5	1,2-Dichlorobenzene	ug/kg	110	330
8270C	79-00-5	1,3-Dichlorobenzene	ug/kg	110	330
8270C	75-34-3	1,4-Dichlorobenzene	ug/kg	110	330
8270C	75-35-4	2,4,5-Trichlorophenol	ug/kg	110	330

ATTACHMENT A-23
Analytical Method Detection Limits for EPA Method 8270C – TCL SVOCs for Soil Samples
Environmental Remediation Services*, Fort Rucker, Alabama*

SW-846		TCL List			
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**	**MDL**
8270C	96-18-4	2,4,6-Trichlorophenol (TCP)	ug/kg	110	330
8270C	96-12-8	2,4-Dichlorophenol (DCP)	ug/kg	110	330
8270C	106-93-4	2,4-Dimethylphenol	ug/kg	200	670
8270C	107-06-2	2,4-Dinitrophenol	ug/kg	400	1300
8270C	78-87-5	2,4-Dinitrotoluene (DNT)	ug/kg	110	330
8270C	591-78-6	2,6-Dichlorophenol	ug/kg	110	330
8270C	108-10-1	2,6-Dinitrotoluene	ug/kg	110	330
8270C	67-64-1	1,2-Diphenylhydrazine	ug/kg	110	330
8270C	107-13-1	2-Chloronaphthalene	ug/kg	110	330
8270C	71-43-2	2-Chlorophenol	ug/kg	110	330
8270C	74-97-5	2-Methylnaphthalene	ug/kg	110	330
8270C	75-27-4	1-Methylnaphthalene	ug/kg	110	330
8270C	75-25-2	2-Methylphenol (o-Cresol)	ug/kg	110	330
8270C	74-83-9	2-Nitroaniline	ug/kg	400	1300
8270C	75-15-0	2-Nitrophenol (ONP)	ug/kg	110	330
8270C	56-23-5	3,3'-Dichlorobenzidine (DCB)	ug/kg	110	330
8270C	108-90-7	3-Methylphenol	ug/kg	110	330
8270C	75-00-3	3-Nitroaniline	ug/kg	400	1300
8270C	67-66-3	4,6-Dinitro-2-methylphenol (DNOC)	ug/kg	400	1300
8270C	74-87-3	4-Bromophenyl phenyl ether	ug/kg	110	330
8270C	156-59-2	4-Chloro-3-methylphenol	ug/kg	110	330
8270C	10061-01-5	4-Chloroaniline	ug/kg	110	330
8270C	124-48-1	4-Chlorophenyl phenyl ether	ug/kg	110	330
8270C	74-95-3	4-Methylphenol (p-Cresol)	ug/kg	110	330
8270C	95-56-1	4-Nitroaniline (PNA)	ug/kg	400	1300
8270C	106-46-7	4-Nitrophenol (PNP)	ug/kg	400	1300
8270C	100-41-4	Acenaphthene	ug/kg	110	330
8270C	74-88-4	Acenaphthylene	ug/kg	110	330
8270C	78-93-3	Acetaphenone	ug/kg	110	330
8270C	75-09-2	Anthracene	ug/kg	110	330
8270C	100-42-5	Atrazine	ug/kg	110	330
8270C	127-18-4	Benzaldehyde	ug/kg	110	330
8270C	108-88-3	Benzidine	ug/kg	1000	3300
8270C	156-60-5	Benzo(a)anthracene	ug/kg	110	330

ATTACHMENT A-23
Analytical Method Detection Limits for EPA Method 8270C – TCL SVOCs for Soil Samples
Environmental Remediation Services*, Fort Rucker, Alabama*

SW-846		TCL List			
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**	**MDL**
8270C	10061-02-6	Benzo(a)pyrene	ug/kg	110	330
8270C	110-57-6	Benzo(b)fluoranthene	ug/kg	110	330
8270C	79-01-6	Benzo(g,h,i)perylene	ug/kg	110	330
8270C	92-52-4	Benzo(k)fluoranthene	ug/kg	110	330
8270C	108-60-1	Benzyl alcohol	ug/kg	110	330
8270C	95-50-1	Benzoic Acid	ug/kg	1000	3300
8270C	541-73-1	bis(2-Chloroethoxy)methane	ug/kg	110	330
8270C	106-46-7	bis(2-Chloroethyl)ether (BCEE)	ug/kg	110	330
8270C	95-95-4	bis(2-Ethylhexyl)phthalate (BEHP)	ug/kg	110	330
8270C	88-06-2	Butyl benzyl phthalate (BBP)	ug/kg	110	330
8270C	120-83-2	Caprolactam	ug/kg	110	330
8270C	105-67-9	Carbazole	ug/kg	110	330
8270C	51-28-5	Chrysene	ug/kg	110	330
8270C	121-14-2	Di-n-butyl phthalate (DBP)	ug/kg	110	330
8270C	87-65-0	Di-n-octyl phthalate (DNOP)	ug/kg	110	330
8270C	606-20-2	Dibenz(a,h)anthracene	ug/kg	110	330
8270C	122-66-7	Dibenzofuran (DBF)	ug/kg	110	330
8270C	91-58-7	Diethyl phthalate (DEP)	ug/kg	110	330
8270C	95-57-8	Dimethyl phthalate (DMP)	ug/kg	110	330
8270C	91-57-6	Fluoranthene	ug/kg	110	330
8270C	90-12-0	Fluorene	ug/kg	110	330
8270C	95-48-7	Hexachlorobenzene (HCB)	ug/kg	110	330
8270C	88-74-4	Hexachlorobutadiene (HCBD)	ug/kg	110	330
8270C	88-75-5	Hexachlorocyclopentadiene (HCCPD)	ug/kg	110	330
8270C	91-94-1	Hexachloroethane (HCE)	ug/kg	110	330
8270C	108-39-4	Indeno(1,2,3-cd)pyrene	ug/kg	110	330
8270C	99-09-2	Isophorone	ug/kg	110	330
8270C	534-52-1	N-Nitrosodimethylamine	ug/kg	200	670
8270C	101-55-3	N-Nitroso-di-n-propylamine (NDPA)	ug/kg	110	330
8270C	59-50-7	N-nitrosodiphenylamine (NDPHA)	ug/kg	110	330
8270C	106-47-8	Naphthalene	ug/kg	110	330
8270C	7005-72-3	Nitrobenzene	ug/kg	110	330
8270C	106-44-5	Pentachlorophenol	ug/kg	400	1300
8270C	100-01-6	Phenanthrene	ug/kg	110	330

ATTACHMENT A-23
Analytical Method Detection Limits for EPA Method 8270C – TCL SVOCs for Soil Samples
Environmental Remediation Services*, Fort Rucker, Alabama*

SW-846		TCL List			
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**	**MDL**
8270C	100-02-7	Phenol	ug/kg	110	330
8270C	83-32-9	Pyrene	ug/kg	110	330
8270C	208-96-8	Pyridine	ug/kg	110	330
8270C	98-86-2	1,2,4,5-Tetrachlorobenzene	ug/kg	110	330
8270C	120-12-7	2,3,4,6-Tetrachlorophenol	ug/kg	110	330
8270C	1912-24-9	1,2,4-Trichlorobenzene	ug/kg	110	330

ATTACHMENT A-24
Analytical Method Detection Limits for EPA Method 8081A/8082 – TCL Pesticides/PCBs for Groundwater Samples
Environmental Remediation Services*, Fort Rucker, Alabama*

SW-846		TCL List			
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**	**MDL**
8081A	72-54-8	4,4'-DDD	ug/l	0.02	0.002
8081A	72-55-9	4,4'-DDE	ug/l	0.02	0.002
8081A	50-29-3	4,4'-DDT	ug/l	0.02	0.003
8081A	309-00-2	Aldrin	ug/l	0.01	0.002
8081A	319-84-6	alpha-BHC (alpha-HCH)	ug/l	0.01	0.003
8081A	5103-71-9	alpha-Chlordane	ug/l	0.01	0.002
8081A	319-85-7	beta-BHC (beta-HCH)	ug/l	0.01	0.003
8081A	319-86-8	delta-BHC (delta-HCH)	ug/l	0.01	0.002
8081A	60-57-1	Dieldrin	ug/l	0.02	0.002
8081A	959-98-8	Endosulfan I	ug/l	0.01	0.002
8081A	33213-65-9	Endosulfan II	ug/l	0.02	0.003
8081A	1031-07-8	Endosulfan sulfate	ug/l	0.02	0.002
8081A	72-20-8	Endrin	ug/l	0.02	0.003
8081A	7421-93-4	Endrin aldehyde	ug/l	0.02	0.003
8081A	53494-70-5	Endrin ketone	ug/l	0.02	0.003
8081A	58-89-9	gamma-BHC (Lindane; gamma-HCH)	ug/l	0.01	0.002
8081A	5103-74-2	gamma-Chlordane	ug/l	0.01	0.002
8081A	76-44-8	Heptachlor	ug/l	0.01	0.003
8081A	1024-57-3	Heptachlor epoxide	ug/l	0.01	0.002
8081A	72-43-5	Methoxychlor	ug/l	0.01	0.004

ATTACHMENT A-24
Analytical Method Detection Limits for EPA Method 8081A/8082 – TCL Pesticides/PCBs for Groundwater Samples
Environmental Remediation Services*, Fort Rucker, Alabama*

SW-846		**TCL List**			
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**	**MDL**
8081A	57-74-9	Chlordane	ug/l	0.05	0.01
8081A	8001-35-2	Toxaphene	ug/l	1	0.3
8082	12674-11-2	Aroclor-1016	ug/l	0.5	0.05
8082	11104-28-2	Aroclor-1221	ug/l	0.5	0.05
8082	11141-16-5	Aroclor-1232	ug/l	0.5	0.05
8082	53469-21-9	Aroclor-1242	ug/l	0.5	0.05
8082	12672-29-6	Aroclor-1248	ug/l	0.5	0.05
8082	11097-69-1	Aroclor-1254	ug/l	0.5	0.05
8082	11096-82-5	Aroclor-1260	ug/l	0.5	0.05

ATTACHMENT A-25
Analytical Method Detection Limits for EPA Method 8081A/8082 – TCL Pesticides/PCBs for Soil Samples
Environmental Remediation Services*, Fort Rucker, Alabama*

SW-846		**TCL List**			
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**	**MDL**
8081A	72-54-8	4,4'-DDD	ug/kg	0.1	1.7
8081A	72-55-9	4,4'-DDE	ug/kg	0.1	1.7
8081A	50-29-3	4,4'-DDT	ug/kg	0.2	1.7
8081A	309-00-2	Aldrin	ug/kg	0.1	1.7
8081A	319-84-6	alpha-BHC (alpha-HCH)	ug/kg	0.1	1.7
8081A	5103-71-9	alpha-Chlordane	ug/kg	0.2	1.7
8081A	319-85-7	beta-BHC (beta-HCH)	ug/kg	0.2	1.7
8081A	319-86-8	delta-BHC (delta-HCH)	ug/kg	0.1	1.7
8081A	60-57-1	Dieldrin	ug/kg	0.1	1.7
8081A	959-98-8	Endosulfan I	ug/kg	0.2	1.7
8081A	33213-65-9	Endosulfan II	ug/kg	0.1	1.7
8081A	1031-07-8	Endosulfan sulfate	ug/kg	0.1	1.7
8081A	72-20-8	Endrin	ug/kg	0.1	1.7
8081A	7421-93-4	Endrin aldehyde	ug/kg	0.3	1.7
8081A	53494-70-5	Endrin ketone	ug/kg	0.1	1.7
8081A	58-89-9	gamma-BHC (Lindane; gamma-HCH)	ug/kg	0.1	1.7
8081A	5103-74-2	gamma-Chlordane	ug/kg	0.2	1.7

ATTACHMENT A-25
Analytical Method Detection Limits for EPA Method 8081A/8082 – TCL Pesticides/PCBs for Soil Samples
Environmental Remediation Services*, Fort Rucker, Alabama*

SW-846		**TCL List**			
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**	**MDL**
8081A	76-44-8	Heptachlor	ug/kg	0.1	1.7
8081A	1024-57-3	Heptachlor epoxide	ug/kg	0.1	1.7
8081A	72-43-5	Methoxychlor	ug/kg	0.2	1.7
8081A	57-74-9	Chlordane	ug/kg	1	5
8081A	8001-35-2	Toxaphene	ug/kg	10	33
8082	12674-11-2	Aroclor-1016	mg/kg	0.005	0.017
8082	11104-28-2	Aroclor-1221	mg/kg	0.005	0.017
8082	11141-16-5	Aroclor-1232	mg/kg	0.005	0.017
8082	53469-21-9	Aroclor-1242	mg/kg	0.005	0.017
8082	12672-29-6	Aroclor-1248	mg/kg	0.005	0.017
8082	11097-69-1	Aroclor-1254	mg/kg	0.005	0.017
8082	11096-82-5	Aroclor-1260	mg/kg	0.005	0.017

ATTACHMENT A-26
Analytical Method Detection Limits for EPA Method 8151A – Herbicides for Groundwater Samples
Environmental Remediation Services*, Fort Rucker, Alabama*

SW-846					
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**	**MDL**
8151A	93-76-5	2,4,5-T	ug/l	0.1	0.03
8151A	93-72-1	2,4,5-TP (Silvex)	ug/l	0.1	0.03
8151A	94-75-7	2,4-D	ug/l	1	0.3
8151A	94-82-6	2,4-DB	ug/l	1	0.3
8151A	75-99-0	Dalapon	ug/l	1.2	0.4
8151A	1918-00-9	Dicamba	ug/l	0.1	0.03
8151A	120-36-5	Dichlorprop	ug/l	1	0.3
8151A	88-85-7	Dinoseb	ug/l	0.6	0.2
8151A	94-74-6	MCPA	ug/l	200	60
8151A	93-65-2	MCPP (Mecoprop)	ug/l	200	60

ATTACHMENT A-27
Analytical Method Detection Limits for EPA Method 8151A – Herbicides for Soil Samples
Environmental Remediation Services*, Fort Rucker, Alabama*

SW-846					
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**	**MDL**
8151A	93-76-5	2,4,5-T	ug/kg	1	0.005
8151A	93-72-1	2,4,5-TP (Silvex)	ug/kg	1	0.005
8151A	94-75-7	2,4-D	ug/kg	12	0.02
8151A	94-82-6	2,4-DB	ug/kg	25	0.05
8151A	75-99-0	Dalapon	ug/kg	12	0.04
8151A	1918-00-9	Dicamba	ug/kg	1	0.005
8151A	120-36-5	Dichlorprop	ug/kg	20	0.05
8151A	88-85-7	Dinoseb	ug/kg	3	0.0083
8151A	94-74-6	MCPA	ug/kg	1000	3000
8151A	93-65-2	MCPP (Mecoprop)	ug/kg	1000	3000

ATTACHMENT A-28
Analytical Method Detection Limits for EPA Method 6010B/7470A – ADEM Appendix I Metals for Groundwater Samples
Environmental Remediation Services, Fort Rucker, Alabama

SW-846		ADEM Appendix I List			
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**	**MDL**
6010B	7440-36-0	Antimony	ug/l	5	2
6010B	7440-38-2	Arsenic	ug/l	10	5
6010B	7440-39-3	Barium	ug/l	200	100
6010B	7440-41-7	Beryllium	ug/l	5	2
6010B	7440-43-9	Cadmium	ug/l	5	2
6010B	7440-47-3	Chromium	ug/l	10	5
6010B	7440-48-4	Cobalt	ug/l	50	25
6010B	7440-50-8	Copper	ug/l	25	10
6010B	7440-02-0	Nickel	ug/l	40	20
6010B	7440-22-4	Silver	ug/l	10	5
6010B	7440-62-2	Vanadium	ug/l	50	20
6010B	7440-66-6	Zinc	ug/l	20	10
6010B	7439-92-1	Lead	ug/l	5	2.5
7470A	7439-97-6	Mercury	ug/l	1	0.5
6010B	7782-49-2	Selenium	ug/l	10	5
6010B	7440-28-0	Thallium	ug/l	2	1

ATTACHMENT A-29
Analytical Method Detection Limits for EPA Method 6010B/7471A – ADEM Appendix I Metals for Soil Samples
Environmental Remediation Services, Fort Rucker, Alabama

SW-846		**ADEM Appendix I List**			
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**	**MDL**
6010B	7440-36-0	Antimony	mg/KG	3	1
6010B	7440-38-2	Arsenic	mg/KG	2	1
6010B	7440-39-3	Barium	mg/KG	40	20
6010B	7440-41-7	Beryllium	mg/KG	1	0.5
6010B	7440-43-9	Cadmium	mg/KG	1	0.5
6010B	7440-47-3	Chromium	mg/KG	2	1
6010B	7440-48-4	Cobalt	mg/KG	3	1
6010B	7440-50-8	Copper	mg/KG	5	2
6010B	7440-02-0	Nickel	mg/KG	8	4
6010B	7440-22-4	Silver	mg/KG	2	1
6010B	7440-62-2	Vanadium	mg/KG	10	5
6010B	7440-66-6	Zinc	mg/KG	4	2
6010B	7439-92-1	Lead	mg/KG	1	0.5
7471A	7439-97-6	Mercury	mg/KG	0.03	0.01
6010B	7782-49-2	Selenium	mg/KG	2	1
6010B	7440-28-0	Thallium	mg/KG	2	1

ATTACHMENT A-30
Analytical Method Detection Limits for EPA Method 6010B/7470A – TAL Metals for Groundwater Samples
Environmental Remediation Services, Fort Rucker, Alabama

SW-846		**TAL List**			
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**	**MDL**
6010B	7429-90-5	Aluminum	ug/l	50	200
6010B	7440-36-0	Antimony	ug/l	5	15
6010B	7440-38-2	Arsenic	ug/l	3	10
6010B	7440-39-3	Barium	ug/l	5	200
6010B	7440-41-7	Beryllium	ug/l	1	5
6010B	7440-43-9	Cadmium	ug/l	1	5

ATTACHMENT A-30
Analytical Method Detection Limits for EPA Method 6010B/7470A – TAL Metals for Groundwater Samples
Environmental Remediation Services, Fort Rucker, Alabama

SW-846		TAL List			
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**	**MDL**
6010B	7440-70-2	Calcium	ug/l	1000	5000
6010B	7440-47-3	Chromium, total	ug/l	2	10
6010B	7440-48-4	Cobalt	ug/l	5	50
6010B	7440-50-8	Copper	ug/l	5	25
6010B	7439-89-6	Iron	ug/l	30	100
6010B	7439-92-1	Lead	ug/l	1	3
6010B	7439-95-4	Magnesium	ug/l	1000	5000
6010B	7439-96-5	Manganese	ug/l	5	15
7470A	7439-97-6	Mercury	ug/l	0.08	0.2
6010B	7440-02-0	Nickel	ug/l	5	40
6010B	7440-09-7	Potassium	ug/l	1000	5000
6010B	7782-49-2	Selenium	ug/l	3	10
6010B	7440-22-4	Silver	ug/l	2	10
6010B	7440-23-5	Sodium	ug/l	1000	5000
6010B	7440-28-0	Thallium	ug/l	4	12
6010B	7440-31-5	Tin	ug/l	10	30
6010B	7440-62-2	Vanadium	ug/l	5	50
6010B	7440-66-6	Zinc	ug/l	5	20

ATTACHMENT A-31
Analytical Method Detection Limits for EPA Method 6010B/7471A – TAL Metals for Soil Samples
Environmental Remediation Services, Fort Rucker, Alabama

SW-846		TAL List			
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**	**MDL**
6010B	7429-90-5	Aluminum	ug/kg	5	20
6010B	7440-36-0	Antimony	ug/kg	1	3
6010B	7440-38-2	Arsenic	ug/kg	0.6	2
6010B	7440-39-3	Barium	ug/kg	1	40
6010B	7440-41-7	Beryllium	ug/kg	0.2	1
6010B	7440-43-9	Cadmium	ug/kg	0.2	1
6010B	7440-70-2	Calcium	ug/kg	0.2	1

ATTACHMENT A-31
Analytical Method Detection Limits for EPA Method 6010B/7471A – TAL Metals for Soil Samples
Environmental Remediation Services, Fort Rucker, Alabama

SW-846		TAL List			
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**	**MDL**
6010B	7440-47-3	Chromium, total	ug/kg	0.4	2
6010B	7440-48-4	Cobalt	ug/kg	1	3
6010B	7440-50-8	Copper	ug/kg	1	5
6010B	7439-89-6	Iron	ug/kg	6	20
6010B	7439-92-1	Lead	ug/kg	0.3	1
6010B	7439-95-4	Magnesium	ug/kg	200	1000
6010B	7439-96-5	Manganese	ug/kg	0.6	3
7471A	7439-97-6	Mercury	ug/kg	0.01	0.03
6010B	7440-02-0	Nickel	ug/kg	1	8
6010B	7440-09-7	Potassium	ug/kg	200	1000
6010B	7782-49-2	Selenium	ug/kg	0.6	2
6010B	7440-22-4	Silver	ug/kg	0.2	2
6010B	7440-23-5	Sodium	ug/kg	200	1000
6010B	7440-28-0	Thallium	ug/kg	0.6	2
6010B	7440-31-5	Tin	ug/kg	0.5	2.5
6010B	7440-62-2	Vanadium	ug/kg	1	10
6010B	7440-66-6	Zinc	ug/kg	1	4

ATTACHMENT A-32
Analytical Method Detection Limits for Geochemical Analysis – Groundwater Samples
Environmental Remediation Services, Fort Rucker, Alabama

Analysis Method	CAS Number	Analyte	Units	RL	MDL
SM 2320-B	NA	Alkalinity	mg/L	1	1
EPA 300.0	14797-55-8	Nitrate	mg/L	0.1	0.05
SM 5310-C	NA	Total Organic Carbon	mg/L	1.5	0.5
EPA 300.0	14808-79-8	Sulfate	mg/L	0.5	0.2
SW 846 6010B	7439-89-6	Iron	mg/L	0.1	0.05

ATTACHMENT A-33
Analytical Method Detection Limits for Geochemical Analysis – Soil Samples
Environmental Remediation Services, Fort Rucker, Alabama

Analysis Method	CAS Number	Analyte	Units	RL	MDL
EPA 9056	14797-55-8	Nitrate	mg/KG	1	0.5
Lloyd Kahn	NA	Total Organic Carbon	mg/KG	1600	500
EPA 9056	14808-79-8	Sulfate	mg/KG	10	5
SW 846 6010B	7439-89-6	Iron	mg/KG	20	10

ATTACHMENT A-34
Analytical Method Detection Limits for Military Munitions Response Program – Groundwater Samples
Environmental Remediation Services, Fort Rucker, Alabama

SW-846					
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**	**MDL**
6010B	7439-92-1	Lead	ug/L	5	2
6010B	7440-36-0	Antimony	ug/L	5	2
6010B	7440-50-8	Copper	ug/L	25	10
6010B	7440-66-6	Zinc	ug/L	20	10

ATTACHMENT A-35
Analytical Method Detection Limits for Military Munitions Response Program – Soil Samples
Environmental Remediation Services, Fort Rucker, Alabama

SW-846					
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**	**MDL**
6010B	7439-92-1	Lead	mg/KG	1	0.5
6010B	7440-36-0	Antimony	mg/KG	3	1
6010B	7440-50-8	Copper	mg/KG	5	2
6010B	7440-66-6	Zinc	mg/KG	4	2

ATTACHMENT A-36
TCLP Reporting Limits for Soil Samples
Environmental Remediation Services, AOC–S, Fort Rucker, Alabama

Method/Analyte	MDL(mg/L)	RL(mg/L)	Reg. Limit(mg/L)
Volatiles			
Benzene	0.005	0.010	0.5
Carbon Tetrachloride	0.005	0.010	0.5
Chlorobenzene	0.005	0.010	100
Chloroform	0.005	0.010	6
1,2-Dichloroethane	0.005	0.010	0.5
1,1-Dichloroethene	0.005	0.010	0.7
2-Butanone	0.050	0.10	200
Tetrachloroethene	0.005	0.010	0.7
Trichloroethene	0.005	0.010	0.5
Vinyl Chloride	0.010	0.020	0.2
Semivolatiles			
2-Methylphenol	0.005	0.010	200
3-Methylphenol	0.005	0.010	200
4-Methylphenol	0.005	0.010	200
Pentachlorophenol	0.010	0.025	100
2,4,5-Trichlorophenol	0.010	0.025	400
2,4,6-Trichlorophenol	0.005	0.010	2
1,4-Dichlorobenzene	0.005	0.010	7.5
2,4-Dinitrotoluene	0.005	0.010	0.13
Hexachlorobenzene	0.005	0.010	0.13
Hexachlorobutadiene	0.005	0.010	0.5
Hexachloroethane	0.005	0.010	3
Nitrobenzene	0.005	0.010	2
Pyridine	0.005	0.010	5

ATTACHMENT A-36
TCLP Reporting Limits for Soil Samples
Environmental Remediation Services, AOC–S, Fort Rucker, Alabama

Method/Analyte	MDL(mg/L)	RL(mg/L)	Reg. Limit(mg/L)
Pesticides			
Lindane	0.000050	0.00010	0.4
Endrin	0.000050	0.00010	0.02
Methoxychlor	0.000050	0.00010	10
Heptachlor	0.000050	0.00010	0.008
Heptachlor Epoxide	0.000050	0.00010	0.008
Chlordane	0.000025	0.00050	0.03
Toxaphene	0.0050	0.010	0.5
Herbicides			
2,4-D	0.0025	0.0050	10
Silvex	0.00025	0.00050	1
Metals			
Arsenic	0.050	0.10	5
Barium	1.0	2.0	100
Cadmium	0.025	0.050	1
Chromium	0.050	0.10	5
Lead	0.015	0.030	5
Mercury	0.0010	0.0020	0.2
Selenium	0.030	0.050	1
Silver	0.050	0.10	5

ATTACHMENT A-37
TCLP Reporting Limits for Liquid Samples
Environmental Remediation Services, AOC–S, Fort Rucker, Alabama

Method/Analyte	**MDL(mg/L)**	**RL(mg/L)**	**Reg. Limit(mg/L)**
Volatiles			
Benzene	0.005	0.010	0.5
Carbon Tetrachloride	0.005	0.010	0.5
Chlorobenzene	0.005	0.010	100
Chloroform	0.005	0.010	6
1,2-Dichloroethane	0.005	0.010	0.5
1,1-Dichloroethene	0.005	0.010	0.7
2-Butanone	0.050	0.10	200
Tetrachloroethene	0.005	0.010	0.7
Trichloroethene	0.005	0.010	0.5
Vinyl Chloride	0.010	0.020	0.2

EDD Specification Table

Field Number	Field Name	Data Type	Data Length	Rqmt	Description and Comments
1	VersionCode	text	15	R	Code identifying the version of the EDD deliverable.
2	LabName	text	10	R	Identification code for the laboratory performing the work. This value is used to distinguish among different facilities.
3	SDG	text	8	R	Sample delivery group designation. Always populated for all samples, including QC.
4	FieldID	text	13	R	Client sample ID as appears on COC with optional lab-assigned suffixes and/or prefixes to make it unique. If the sample identifier on the COC and the prefix/suffix is greater than 13 characters, abbreviate the value but make it unique. For laboratory QC samples (that is, method blanks, lab control samples), use a unique lab sample identifier.
5	NativeID	text	13	R	Client sample ID, exactly as on the COC. No prefix or suffix allowed. Used to identify the native sample from which other samples are derived (for example, QAQCType = ”LR”, “MS”, or “SD”). For laboratory QC samples (that is, method blanks, lab control samples), use a unique lab sample identifier. For lab blank spike (and blank spike duplicate) samples, use the FieldID value that was assigned to the associated method blank.
6	QAQCType	text	2	R	This is the code for the sample type. Any field sample that is not used as lab QC and is not otherwise marked on the COC should have the designation of “N” (normal field sample). No suffix allowed (that is, do not add numbers as suffixes to the QAQCType values as is called for in the ERPIMS guidelines).
					Note that if all analyses for a given sample are diluted, then the first dilution should be designated as the normal sample. If more dilutions are required, then the next dilution should be designated as the first true dilution with a QAQCType value of “LR” and a LRType value of “DL” (see LRType, below).
7	LRType	text	3	C	This is the code for laboratory replicate sample type. Values are:
					blank (if QAQCType value is not “LR”),
					“DL” (dilution),

EDD Specification Table

Field Number	Field Name	Data Type	Data Length	Rqmt	Description and Comments
					"RE" (re-analysis),
					"D" (inorganic duplicate),
					"CF" (confirmation).
					For multiple dilutions or re-analyses of the same sample, append the replicate number after the LRType value (that is, "RE", "RE2", "RE3", etc.).
8	Matrix	text	5	R	Sample matrix code. Valid values are as follows: "AIR", "WATER", "SOIL", unless otherwise provided by the project data manager and marked on the COC. The use of "liquid", "solid", etc. for lab QC is not allowed.
9	LabSampleID	text	20	R	Laboratory sample ID. Prefix or suffix is allowed. This is where dilutions or re-extractions are noted. Ex: "D97-11111RE" is acceptable.
10	AnalysisMethod	text	20	R	Analysis method code. This is the identifier of the analytical method that was performed on the sample. Example: SW8260A. Generic names such as "EPA" should not be used.
11	ExtractionMethod	text	20	R	Preparation method code. A value in this field is required. If the preparation is described in the method, use "METHOD". If there is no separate preparation required, use "NONE". Note that Total and Dissolved metal analyses are differentiated by the value in this column. Note that Total, TCLP, and SPLP analyses are now differentiated by the value in the LeachMethod column (see below).
12	SampleDate	date		C	Date of sample collection. Value is required for all samples sent to the laboratory and samples derived from those samples. Format: mm/dd/yyyy
13	SampleTime	time		C	Time of sample collection. Value is required for all samples sent to the laboratory and samples derived from those samples. 24-hour format: hh:mm
14	ReceiveDate	date		C	Date of sample receipt in the lab. Value is required for all samples sent to the laboratory and samples derived from those samples. Format: mm/dd/yyyy

EDD Specification Table					
Field	**Field**	**Data**	**Data**		
Number	**Name**	**Type**	**Length**	**Rqmt**	**Description and Comments**
15	ExtractDate	date		C	Date of sample preparation (extraction or digestion). Value is required if the ExtractionMethod field value is other than “NONE”. Format: mm/dd/yyyy
16	ExtractTime	time		C	Time of sample preparation. Value is required if the ExtractionMethod field value is other than “NONE”. 24-hour format: hh:mm
17	AnalysisDate	date		R	Date of sample analysis. Value is required for all records. Format: mm/dd/yyyy
18	AnalysisTime	time		R	Time of sample analysis. Value is required for all records. 24-hour format: hh:mm
19	PercentSolids	number		R	Percent solids within the sample. Should be zero for water samples.
20	LabLotCtlNum	text	10	C	Identifier of an autonomous group of environmental samples and associated QC samples **prepared** together. For example, its value can be a digestion or extraction batch ID. If there is no separate extraction or preparation performed, leave this field blank.
21	CAS	text	20	C	CAS number of analyte, if available.
22	ParamID	text	12	R	Parameter identifier code for the parameter listed in the Analyte field.
23	Analyte	text	60	R	Name of analyte, chemical name.
24	Result	text	10	R	Result of the analysis. Surrogate analytes will be reported in units of percent. All others will be reported in sample concentration units. If undetected, report the adjusted MDL or adjusted RL, depending on the project. (Reported as a text field to preserve significant figures.)
25	ExpectedValue	number		C	“100” for surrogates; “0” (zero) for blanks; spike level plus parent result for LCS, and MS/MSD; parent value for lab duplicate; etc.
26	Units	text	10	R	Units of measure used in the analysis. Report “PERCENT” for surrogate analytes and concentration units for all others.
27	Dilution	number		R	Total dilution reported in the analysis. Default value should be 1 (one). This value should reflect changes to sample preparation amounts as defined by the method (for

EDD Specification Table					
Field Number	**Field Name**	**Data Type**	**Data Length**	**Rqmt**	**Description and Comments**
					example, less sample used for standard VOC analysis).
28	MDL	number		C	Minimum detection limit adjusted for preparation and dilution. Note that this value may be the method detection limit or the instrument detection limit, depending on the method and the project requirements. This value is **not** adjusted for percent moisture.
29	RL	number		C	Reporting limit adjusted for preparation and dilution. Value is **not** adjusted for percent moisture. Equivalent to PQL.
30	LabQualifier	text	6	R	Lab qualifier for the results, as reported on the hard copy. Use "=" as first (or only) qualifier value for detected results.
31	Surrogate	text	1	R	Is the chemical a surrogate? Report "Y" for yes or "N" for no.
32	Comments	text	240	O	Comment field
33	ParValUncert	text	16	C	Radiological parameter value uncertainty.
34	Recovery	number		C	Percent recovery for MS, SD, LCS, and surrogate compounds.
35	LowerControlLimit	number		C	Lower control limit value for spiked compounds, expressed in units of Percent. A value in this field is required if there is a value in the Recovery field (Field No. 34).
36	UpperControlLimit	number		C	Upper control limit value for spiked compounds, expressed in units of Percent. A value in this field is required if there is a value in the Recovery field (Field No. 34).
37	Basis	text	1	R	Weight basis for soil (or solid) sample analysis. Use "D" for dry-weight basis, "W" for wet-weight basis, or "X" if not applicable.
38	ConcQual	text	1	R	Concentration qualifier. Use "=" for detects, "J" for estimated value (value between detection limit and reporting limit), "U" for undetected result, or "E" for exceeded result.
39	MDLAdjusted	number		C	Minimum detection limit adjusted for preparation, dilution **and percent moisture**. See the description of the MDL field (Field No. 28) for an explanation of the contents of this field.

EDD Specification Table					
Field	**Field**	**Data**	**Data**		
Number	**Name**	**Type**	**Length**	**Rqmt**	**Description and Comments**
40	RLAdjusted	number		C	Reporting limit adjusted for preparation, dilution **and percent moisture**. Equivalent to PQL
41	SampleDescription	text	20	C	Full sample identifier value as it appears on the COC. In some cases, this may be the name of the sampling location instead of the sample. Required for all samples that are either collected in the field and specified on the COC, or derived from samples that are collected in the field and specified on the COC.
42	LeachMethod	text	20	R	Analytical method used for leaching the sample. This applies to TCLP, SPLP, or other leaching or pre-extraction leaching procedures. Use “NONE” if the sample was not leached.
43	LeachDate	date		C	Date that the leaching method was performed (start date for multi-date leaching procedures). Value is required if the LeachMethod field value is other then “NONE”. Format: mm/dd/yyyy.
44	LeachTime	time		C	Time that the leaching procedure started. Value is required if the LeachMethod field value is other then “NONE”. 24-hour format: hh:mm.
45	LeachLot	text	20	C	Identifier of an autonomous group of environmental samples and associated QC samples **leached** at the same time. If the sample was not leached, leave this field blank.
46	AnalysisLot	text	20	R	Identifier of an autonomous group of environmental samples and associated QC samples **analyzed** together. A value in this field is mandatory (that is, it should not be blank).
47	CalRefID	text	20	C	Identifier of a group of environmental and QC samples linked by a common set of calibration records. All results with the same CalRefID value will have had the same initial calibration run.

Site Safety and Health Plan

Site-Wide
Site Safety and Health Plan

Environmental Remediation Services
Fort Rucker, Alabama

FINAL

Contract No. W91ZLK-05-D-0014
Contract Task Order No. 0001

Prepared for:

U.S. Army Environmental Command

Prepared by:

CH2MHILL

Northpark 400
1000 Abernathy Road
Suite 1600
Atlanta, GA 30328

January 2010

Contents

CH2M HILL SITE-WIDE SITE SAFETY AND HEALTH PLAN

This Site Safety and Health Plan (SSHP) has been prepared for the U.S. Army Environmental Command (USAEC) during field activities associated with environmental remediation services at Area of Concern (AOC) – S at Fort Rucker, Alabama, under Contract W91ZLK-05-D-0014, Task Order (TO) 0001. This SSHP is intended to also serve as a site-wide SSHP that will cover anticipated field activities at other Installation Restoration Program (IRP) sites, as necessary. This SSHP will be amended to address other IRP sites, as necessary. This SSHP is not intended to serve as the SSHP for field activities associated with the military munitions response (MMRP) sites. A site-specific SSHP will be prepared as part of the site-specific work plan addressing the MMRP sites.

This Health and Safety Plan (HSP) will be kept on site during field activities and will be reviewed as necessary. The plan will be amended or revised as project activities or conditions change or when supplemental information becomes available. The plan adopts, by reference, the Enterprise-wide Core Standards (CS) and standard operating procedures (SOPs), as appropriate. In addition, this plan adopts procedures in the project Work Plan. The safety coordinator (SC) is to be familiar with the CSs and SOPs and the contents of these instructions. CH2M HILL's personnel and subcontractors must be trained on this plan and sign Attachment 1.

Project Information and Background

PROJECT NO: 394076

CLIENT: USACE - Mobile District

PROJECT/SITE NAME: Environmental Remediation Services at Area of Concern (AOC) - S, Fort Rucker, Alabama

SITE ADDRESS: Not Applicable

CH2M HILL PROJECT MANAGER: Sherrill, Mark (ATL)

CH2M HILL OFFICE: Atlanta, Georgia

DATE HEALTH AND SAFETY PLAN PREPARED: September 8, 2009

DATE(S) OF SITE WORK: August 2009 – December 2015

SITE ACCESS: Right-of-entry from USACE

SITE SIZE: Approximately 60 acres

SITE TOPOGRAPHY: Gently to steeping sloping, wooded, some infrastructure (roads, buildings, etc)

PREVAILING WEATHER: Warm to hot, occasional rain/thunderstorms, chance for severe thunderstorms and tornadoes

SITE DESCRIPTION AND HISTORY: The area where the remedial action will be performed has been designated as AOC – S in Fort Rucker's Hazardous Waste Management and Minimization Act (HWMMA) permit. AOC-S is located within the southern portion of Fort Rucker's cantonment area. Land use within this portion of Fort Rucker consists of various industrial buildings and vehicle maintenance yards.

CH2M HILL performed a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) for AOC-S in 2007 and 2008. The RFI showed that groundwater within the investigation area has been impacted with tetrachloroethene (PCE) at concentrations exceeding its maximum contaminant level (MCL) of 5 micrograms per liter (µg/L). The apparent source of the PCE in groundwater was a wash rack that was operated from the 1950s to the late 1980s. PCE was not detected in soil in the vicinity of the wash rack, indicating that the source may have been removed during removal of the wash rack.

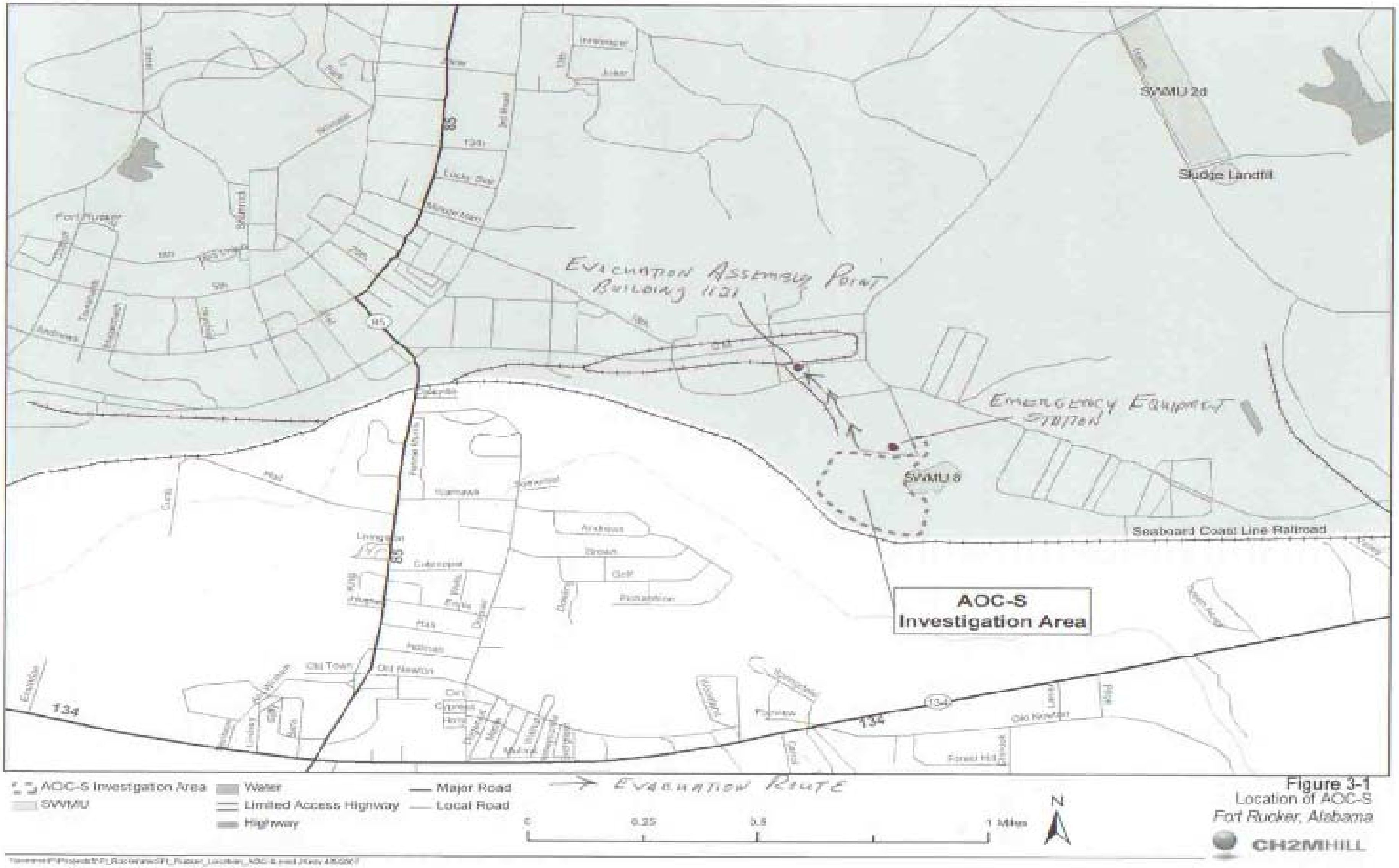
The PCE plume's dimensions are approximately 2,900 feet by 900 feet, and it covers approximately 60 acres. The plume has migrated southward, following groundwater flow past the Fort Rucker boundary. PCE concentrations range from 120 µg/L at approximately 500 feet downgradient of the apparent source to 17 µg/L at the installation boundary. The maximum PCE concentration off-post is 4 µg/L, which is below the MCL.

CH2M HILL will install a zerovalent iron (ZVI) permeable reactive barrier (PRB) approximately 100 feet north of the southern post boundary to prevent migration of site chemicals of concern (COCs) (specifically PCE and its potential degradation products) to the adjacent off-post property.

DESCRIPTION OF SPECIFIC TASKS TO BE PERFORMED:

1) Clear trails to boring/well locations using bulldozer.
2) Oversee direct push technology drilling and monitoring well installation. Collect surface and subsurface soil samples and groundwater samples.
3) Oversee hollow-stem auger drilling and monitoring well installation. Collect surface and subsurface soil samples.
4) Oversee well development and perform groundwater sampling.
5) Oversee site survey of soil boring, monitoring well locations, and PRB alignment.
6) Collect investigation-derived waste (IDW) characterization samples from drums.
7) Improve existing haul roads.
8) Prepare (clear and grub) a 60 feet x 400 feet work area.
9) Construct a stable, compacted, and level work platform along the ZVI PRB alignment.
10) Prepare reactive media (sand and ZVI mixing).
11) Excavate the trench and place the reactive media using a one-pass trencher.
12) Perform geophysical investigations.

Site Map


SWMU 2d
Sludge Landfill
Evacuation Assembly Point
Building 1121
Emergency Equipment
Station
SWMU 8
Seaboard Coast Line Railroad
AOC-S
Investigation Area
Fort Rucker
134
85
AOC-S Investigation Area
SWMU
Water
Limited Access Highway
Highway
Major Road
Local Road
Evacuation Route
0
0.25
0.5
1 Miles
N
Figure 3-1
Location of AOC-S
Fort Rucker, Alabama
CH2MHILL

Emergency Contacts

24-hour CH2M HILL Serious Incident Reporting Contact/Pager – 720-286-4911

If injured on the job, notify your supervisor and then call 1-866-893-2514 to contact CH2M HILL'S Occupational Nurse

Medical Emergency -- 911 **Facility Medical Response #:** 334-255-7800 **Local Ambulance #:**	**CH2M HILL- Medical Consultant** WorkCare Dr. Peter Greaney M.D. 300 S. Harbor Blvd, Suite 600 Anaheim , CA 92805 800-455-6155 714-978-7488
Urgent Care Facility 1051 Talbotton Road Columbus, GA 31904 Phone #: 706-322-2511	**CH2M HILL Director Security Operations** Thomas Horton/DEN 720-273-3100 (cell) or 720-286-0022 (office)
Fire/Spill Emergency -- 911 **Facility Fire Response #:** **Local Fire Dept #:**	**Responsible Health and Safety Manager (RHSM)** Name: Michael Goldman Phone: 770-331-3127
Security & Police – 911 **Facility Security #:** 334-255-7800 **Local Police #:**	**Human Resources Department** Name: Sherri Huntley Phone: 703-376-5192
Utilities Emergency Phone Numbers Water: Fort Rucker 334-255-9041 Gas: Fort Rucker 334-255-9041 Electric: Fort Rucker 334-255-9041	**Worker's Compensation:** Contact Business Group HR dept. to have form completed or contact Jennifer Rindahl after hours: 720-891-5382
Designated Safety Coordinator (DSC) Name: Bret Rahe/SAN Phone: 210-377-3085 x647	**Media Inquiries Corporate Strategic Communications** Name: John Corsi Phone: 720-286-2087
Project Manager Name: Mark Sherrill/ATL Phone: 678-938-0923	**Automobile Accidents** Rental: Linda Anderson/COR 720/286-2401 CH2M HILL owned vehicle: Linda George 720-286-2057
Federal Express Dangerous Goods Shipping Phone: 800-238-5355	**CH2M HILL Dangerous Goods Shipping** **Phone:** 800-255-3924
Facility Alarms: None	Evacuation Assembly Area(s): Outside the entrance gate for the investigation area at Building 1121.

Facility/Site Evacuation Route(s): Proceed north toward the entrance gate for the investigation area.

Directions to Local Hospital

Hospital Name/Address: Dale Medical Center, 100 Hospital Avenue
Ozark, AL 36330

Hospital Phone #: 334-774-2601

Sorry! When printing directly from the browser your map may be incorrectly cropped. To print the entire map, try clicking the **"Printer-Friendly"** link at the top of your results page.

MAPQUEST.
An AOL Company

START **Fort Rucker, AL US**

END **Dale Medical Ctr:** 334-774-2601
100 Hospital Ave, Ozark, AL 36360, US

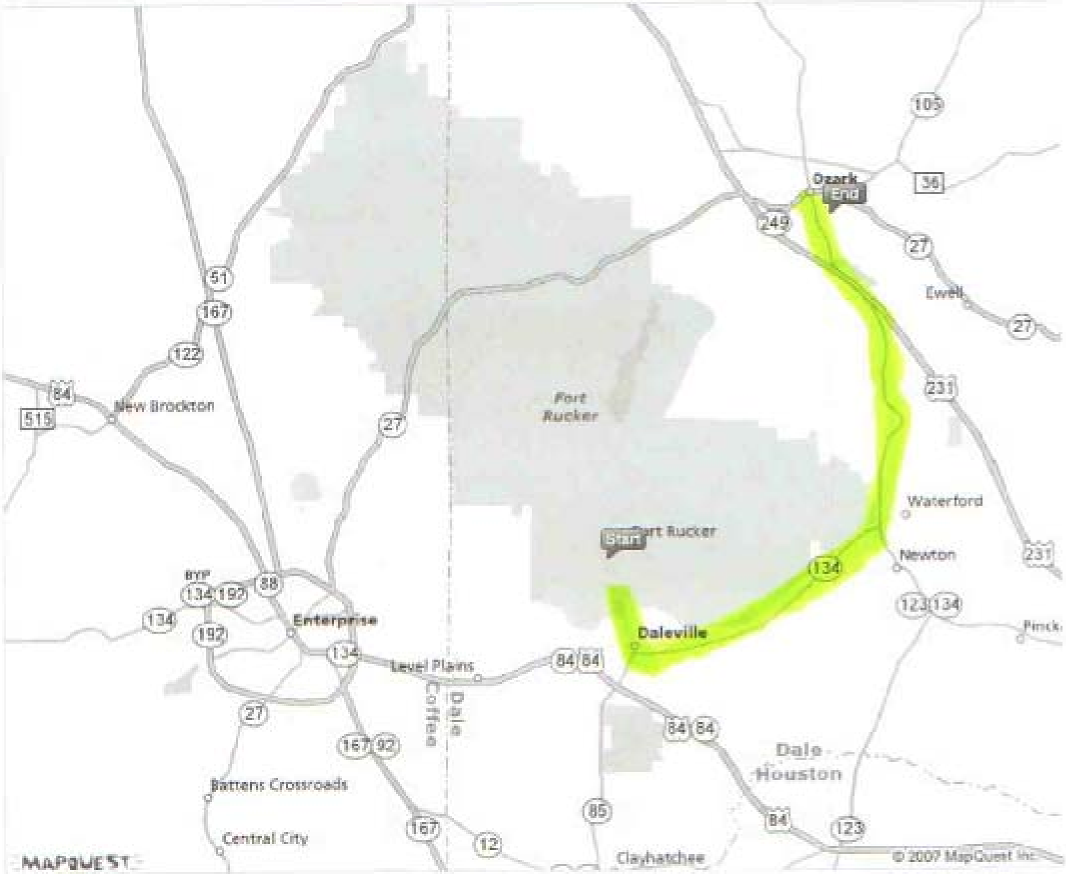
Total Est. Time:
27 minutes

Total Est. Distance:
16.36 miles

	Maneuvers	Distance
	There are 1.53 miles between your starting location and the beginning of your driving directions. Use maps to get from your starting location to the beginning of your route.	
START	**1:** Start out going SOUTH on AL-85 / DALEVILLE AVE toward DONNELL BLVD.	1.0 miles
	2: Turn LEFT onto AL-134.	6.9 miles
	3: Turn LEFT onto AL-123 / AL-134. Continue to follow AL-123.	5.9 miles
	4: Turn RIGHT onto AL-123 / S UNION AVE.	<0.1 miles
NORTH 231	**5:** Turn LEFT onto US-231 N / AL-123 N / AL-53 N.	0.6 miles
	6: Turn SLIGHT RIGHT onto AL-123 / LAKEVIEW RD. Continue to follow AL-123.	1.1 miles
	7: Turn RIGHT onto HOLMAN DR.	0.3 miles
	8: Turn LEFT onto HOSPITAL AVE.	0.1 miles
	9: Turn RIGHT onto JAMES ST.	<0.1 miles
END	**10:** End at **Dale Medical Ctr:** 100 Hospital Ave, Ozark, AL 36360, US	

Total Est. Time: 27 minutes **Total Est. Distance:** 16.36 miles

Sorry! When printing directly from the browser your map may be incorrectly cropped. To print the entire map, try clicking the **"Printer-Friendly"** link at the top of your results page.



1.0 Tasks to be Performed under this Plan

1.1 Description of Tasks

Refer to project documents (i.e., Work Plan) for detailed task information. A health and safety risk analysis (Table 1) has been performed for each task and is incorporated in this plan through task-specific hazard controls and requirements for monitoring and protection. Tasks other than those listed below require an approved amendment or revision to this plan before tasks begin. Refer to Section 8.2 for procedures related to "clean" tasks that do not involve hazardous waste operations and emergency response (Hazwoper).

1.1.1 Hazwoper-Regulated Tasks

Drilling
Monitoring Well Installation
Hand Augering
Groundwater monitoring
Surface and Subsurface Soil Sampling
Surveying
Investigation-derived waste (drum) sampling and disposal

1.1.2 Non-Hazwoper-Regulated Tasks

Under specific circumstances, the training and medical monitoring requirements of federal or state Hazwoper regulations are not applicable. It must be demonstrated that the tasks can be performed without the possibility of exposure in order to use non-Hazwoper-trained personnel. **Prior approval from the Responsible Health and Safety Manager (RHSM) is required before these tasks are conducted on regulated hazardous waste sites.**

TASKS

- Waste removal/hauling
- Site clearing

CONTROLS

- Brief on hazards, limits of access, and emergency procedures
- Post contaminant areas as appropriate (refer to Section 8.2 for details)
- Sample and monitor as appropriate (refer to Section 5.0)

1.2 Change Management

PROJECT HS&E Change Management Form		
This evaluation form should be reviewed on a ***continuous*** *basis to determine if the current site health and safety plan adequately addresses ongoing project work, and should be completed whenever new tasks are contemplated or changed conditions are encountered.*		
Project Task:	Project/Task Manager:	
Project Number:	Project Name:	

	Evaluation Checklist	Yes	No
1.	Has the CH2M HILL staff listed in the original HASP changed?		
2.	Has a new subcontractor been added to the project?		
3.	Is any chemical or product to be used that is not listed in Attachment 2 of the plan?		
4.	Have additional tasks been added which were not originally addressed in Section 1.1 of the plan?		
5.	Have new contaminants or higher than anticipated levels of original contaminants been encountered?		
6.	Has other safety, equipment, activity or environmental hazards been encountered that are not addressed in Section 2.1 of the plan?		

If the answer is "YES" to Questions 1-3, an HSP revision is NOT needed. Please take the following actions:

- Confirm that staff's medical and training status is current – check training records at: http://www.int.ch2m.com/hands (or contact your regional SPA), and confirm subcontractor qualifications.
- Confirm with the project KA that subcontractor safety performance has been reviewed and is acceptable.
- Confirm with H&S that subcontractor safety procedures have been reviewed and are acceptable.

If the answer is "YES" to Questions 4-6, an HSP revision MAY BE NEEDED.

1.3 Task Hazard Analysis

(Refer to Section 2 for hazard controls)

POTENTIAL HAZARDS	TASKS						
	Site Clearing	Drilling and well installation	Groundwater monitoring	Surveying	IDW drum sampling and disposal	Observation of loading material for offsite disposal	ZVI PRB Installation
Flying Debris/ Objects	X	X			X	X	
Noise > 85dBA	X	X				X	X
Electrical		X	X				
Suspended Loads	X	X				X	X
Buried Utilities, Drums, Tanks	X	X					X
Slip, trip, fall	X	X	X	X	X	X	X
Back injury	X	X	X		X		
Confined Space Entry				X			
Trenches/ Excavations							X
Visible Lightning	X	X	X	X	X	X	X
Vehicle traffic	X					X	X
Elevated Work Areas/Falls							

1.3 Task Hazard Analysis

(Refer to Section 2 for hazard controls)

POTENTIAL HAZARDS	TASKS						
	Site Clearing	Drilling and well installation	Groundwater monitoring	Surveying	IDW drum sampling and disposal	Observation of loading material for offsite disposal	ZVI PRB Installation
Fires	X	X			X		
Entanglement	X	X					
Drilling		X					
Heavy Equipment	X	X				X	X
Working Near Water							
Working from Boat							
IDW Drum Sampling					X		

2.0 Hazard Controls

This section provides safe work practices and control measures used to reduce or eliminate potential hazards. These practices and controls are to be implemented by the party in control of either the site or the particular hazard. CH2M HILL employees and subcontractors must remain aware of the hazards affecting them regardless of who is responsible for controlling the hazards. CH2M HILL employees and subcontractors who do not understand any of these provisions should contact the RHSM for clarification.

The health and safety hazards posed by field activities have been identified for each project activity and are provided in the Hazard Analysis Table (Table 1). Hazard control measures for project-specific and general H&S hazards are provided in Sections 2.1, 2.2, and 2.3.

In addition to the controls specified in this section, Project-Activity Self-Assessment Checklists are contained in Attachment 4. These checklists are to be used to assess the adequacy of CH2M HILL and subcontractor site-specific safety requirements. The objective of the self-assessment process is to identify gaps in project safety performance and prompt corrective actions in addressing these gaps. Self-assessment checklists should be completed early in the project, when tasks or conditions change, or when otherwise specified by the RHSM. The self-assessment checklists, including documented corrective actions, should be made part of the permanent project records.

Applicable project activity self-assessment checklists (see Attachment 4) shall be completed weekly by a CH2M HILL representative during the course of the project depending on the work performed at the time.

2.1 Project-Specific Hazards

2.1.1 Drilling Safety

- The drill rig is not to be operated in inclement weather.
- The driller is to verify that the rig is properly leveled and stabilized before raising the mast.
- Personnel should be cleared from the sides and rear of the rig before the mast is raised.
- The driller is not to drive the rig with the mast in the raised position.
- The driller must check for overhead power lines before raising the mast. A minimum distance of 15 feet between mast and overhead lines (<50 kV) is recommended. Increased separation may be required for lines greater than 50 kV.
- Personnel should stand clear before rig startup.
- The driller is to verify that the rig is in neutral when the operator is not at the controls.
- Become familiar with the hazards associated with the drilling method used (cable tool, air rotary, hollow-stem auger, etc.).
- Do not wear loose-fitting clothing, watches, etc., that could get caught in moving parts.
- Do not smoke or permit other spark-producing equipment around the drill rig.
- The drill rig must be equipped with a kill wire or switch, and personnel are to be informed of its location.
- Be aware and stand clear of heavy objects that are hoisted overhead.
- The driller is to verify that the rig is properly maintained in accordance with the drilling company's maintenance program.

- The driller is to verify that all machine guards are in place while the rig is in operation.
- The driller is responsible for housekeeping (maintaining a clean work area).
- The drill rig should be equipped with at least one fire extinguisher.
- If the drill rig comes into contact with electrical wires and becomes electrically energized, do not touch any part of the rig or any person in contact with the rig, and stay as far away as possible. Notify emergency personnel immediately

2.1.2 Field Vehicles

- Field vehicles may be personal vehicles, rental vehicles, fleet vehicles or project vehicles.
- Fleet vehicles are equipped with emergency supplies. It is a project responsibility to equip all project vehicles with emergency equipment.
- Maintain both a First Aid kit and Fire Extinguisher in the field vehicle at all times.
- Utilize a rotary beacon on vehicle if working adjacent to active roadway.
- Car rental must meet the following requirements:
  - Dual air bags
  - Antilock brakes
  - Be midsize or larger
- Familiarize yourself with rental vehicle features:
  - Mirror adjustments
  - Seat adjustments
  - Cruise control features, if offered
  - Pre-program radio stations
- Always wear seatbelt while operating vehicle.
- Adjust headrest to proper position.
- Tie down loose items if utilizing a van.
- Pull off the road, put the car in park and turn on flashers before talking on a mobile phone.
- Close car doors slowly and carefully. Fingers can get pinched in doors.
- Park vehicle in a location where it can be accessed easily in the event of an emergency. If not possible, carry a phone.
- Have a designated place for storing the field vehicle keys when not in use.

2.1.3 Knife Use

Open-bladed knives (e.g., box cutters, utility knives, pocket knives, machetes, and multi-purpose tools with fixed blades such as a Leathermen™) are prohibited at worksites except where the following three conditions are met:

- The open-bladed knife is determined to be the best tool for the job.
- An approved Activity Hazard Analysis (AHA) or written procedure is in place that covers the necessary safety precautions (work practices, PPE, and training).
- Knife users have been trained and follow the AHA.

Responsibilities	• Supervisors with assistance from the FTL/SC are responsible for funding and ensuring the correct tool is being used, employees wear the proper PPE when using knives, and they have reviewed this policy. • Employees are responsible for having and utilizing the proper PPE while performing an activity requiring the use of a knife. Employees are also responsible for understanding the proper use of a knife.
Glove Requirements	• In general, Kevlar cut resistant gloves are to be worn when using a knife in an occupational setting. • Other types of gloves may be required and will be identified within the AHA / written procedure. Example - Leather gloves may be worn when using the acetate sleeve cutter.

Training (Ref. VO for additional hand safety topics)

All employees that will use a knife must be trained in the proper use.

- When using a knife always cut away from yourself.
- Many tasks using a utility knife require a knife edge but not a sharp point. For these tasks you can add protection against puncture wounds by using a rounded-tip blade.
- If you use a folding knife, it must be a locking blade type.
- Never use a knife that will fold under pressure.
- If you use a fixed blade knife, make sure there is a handle guard to keep your hand from slipping forward. Also, make sure the handle is dry and non- greasy/slippery to assure a better grip.
- When cutting, make the force of the cut carry the blade away from any part of your body. If you have a peculiar situation where this is not possible, protect yourself with a leather apron, or other material placed between you and the blade. Consider putting the material to be cut in a vise, or other holding device.
- If you carry a fixed blade knife, use a sheath or holder.
- Store utility knives safely, retract the blade or sheath an open blade before storing. Never, leave a knife with the blade exposed on the floor, on a pallet, on a work surface, or in a drawer or cabinet.
- Keep your knife sharp. A dull blade requires you to use more force to cut, and consequently increases the risk of slip or mistake.
- Knives used on the job, but not carried with you , must be properly stored when not in use
- Never use a defective knife.
- Utility knife blades are brittle and can snap easily. Don’t bend them or apply side loads to them by using them to open cans or pry loose objects. Use the knife only to cut. It was not designed to work as a prybar, screw driver, hole punch, and other assorted things that make it seem so easy.
- If you do get cut, seek medical attention to treat the injury by notifying your supervisor and contacting WorkCare at 1-866-893-2514.

Examples of preferred tools and Kevlar cut resistant gloves:

A safety spring provides for automatic blade "shoot-back" into the handle when contact w/cutting surface is lost

Stay focused on the cutting job. It only takes a second of inattention with a sharp blade to produce a serious cut. Letting the mind wander or talking with others while using a knife greatly increases the risk of an accident and injury. If you are interrupted while working with a knife, stop cutting, retract the blade, and place the knife down on a secure surface before dealing with the interruption. You should never continue cutting while distracted!

As always, utilize the hierarchy of controls and first attempt to engineer out the hazard and frequently ask ourselves do we have the right tool for the job.

2.1.4 Earthmoving Equipment

(Reference CH2M HILL SOP HS-27, *Earthmoving Equipment*)

- Only authorized personnel are permitted to operate earthmoving equipment.
- Maintain safe distance from operating equipment and stay alert of equipment movement. Avoid positioning between fixed objects and operating equipment and equipment pinch points, remain outside of the equipment swing and turning radius. Pay attention to backup alarms, but not rely on them for protection. Never turn your back on operating equipment.
- Approach operating equipment only after receiving the operator's attention. The operator shall acknowledge your presence and stop movement of the equipment. Caution shall be used when standing next to idle equipment; when equipment is placed in gear it can lurch forward or backward. Never approach operating equipment from the side or rear where the operator's vision is compromised.
- When required to work in proximity to operating equipment, wear high-visibility vests to increase visibility to equipment operators. For work performed after daylight hours, vests shall be made of reflective material or include a reflective stripe or panel.
- Do not ride on earthmoving equipment unless it is specifically designed to accommodate passengers. Only ride in seats that are provided for transportation and that are equipped with seat belts.
- Stay as clear as possible of all hoisting operations. Loads shall not be hoisted overhead of personnel.
- Earthmoving equipment shall not be used to lift or lower personnel.
- If equipment becomes electrically energized, personnel shall be instructed not to touch any part of the equipment or attempt to touch any person who may be in contact with the electrical

current. The utility company or appropriate party shall be contacted to have line de-energized prior to approaching the equipment.

2.1.5 Exposure to Public Vehicular Traffic

The following precautions must be taken when working around traffic, and in or near an area where traffic controls have been established by a contractor.

- Exercise caution when exiting traveled way or parking along street – avoid sudden stops, use flashers, etc.
- Park in a manner that will allow for safe exit from vehicle, and where practicable, park vehicle so that it can serve as a barrier.
- All staff working adjacent to traveled way or within work area must wear reflective/high-visibility safety vests.
- Eye protection should be worn to protect from flying debris.
- Remain aware of factors that influence traffic related hazards and required controls – sun glare, rain, wind, flash flooding, limited sight-distance, hills, curves, guardrails, width of shoulder (i.e., breakdown lane), etc.
- Always remain aware of an escape route -- behind an established barrier, parked vehicle, guardrail, etc.
- Always pay attention to moving traffic – never assume drivers are looking out for you
- Work as far from traveled way as possible to avoid creating confusion for drivers.
- When workers must face away from traffic, a "buddy system" should be used, where one worker is looking towards traffic.
- When working on highway projects, obtain a copy of the contractor's traffic control plan.
- Work area should be protected by a physical barrier – such as a K-rail or Jersey barrier.
- Review traffic control devices to ensure that they are adequate to protect your work area. Traffic control devices should: 1) convey a clear meaning, 2) command respect of road users, and 3) give adequate time for proper traffic response. The adequacy of these devices are dependent on limited sight distance, proximity to ramps or intersections, restrictive width, duration of job, and traffic volume, speed, and proximity.
- Either a barrier or shadow vehicle should be positioned a considerable distance ahead of the work area. The vehicle should be equipped with a flashing arrow sign and truck-mounted crash cushion (TMCC). All vehicles within 40 feet of traffic should have an orange flashing hazard light atop the vehicle.
- Except on highways, flaggers should be used when 1) two-way traffic is reduced to using one common lane, 2) driver visibility is impaired or limited, 3) project vehicles enter or exit traffic in an unexpected manner, or 4) the use of a flagger enhances established traffic warning systems.
- Lookouts should be used when physical barriers are not available or practical. The lookout continually watches approaching traffic for signs of erratic driver behavior and warns workers. Vehicles should be parked at least 40 feet away from the work zone and traffic. Minimize the amount of time that you will have your back to oncoming traffic.

2.1.6 Clearing and Grubbing Operations

- Ensure that environmental-protection considerations are addressed before conducting clearing operations.

- Plan clearing operations to allow disposal of debris in one handling. It is best to travel in one direction when clearing. Changing direction tends to skin and scrape the trees instead of uprooting them or allowing a clean cut. Clearing techniques vary with the type of vegetation being cleared, the ground's soil type, and the soil's moisture condition.
- Moving the dozer, with the blade slightly below ground level, will usually remove small trees and brush. The blade cuts, breaks off, or uproots most of the tree and bends the rest for removal on the return trip. A medium tractor with a dozer blade can clear and pile about 0.25 acres of brush or small trees per hour.
- To remove a medium-size tree (7 to 12 inches in diameter), raise the blade as high as possible to gain added leverage and then push the tree over slowly. As the tree starts to fall, back the dozer quickly to avoid the rising roots. Then lower the blade and drive the dozer forward, lifting out the roots. The average time for a medium tractor with a dozer blade to clear and pile medium trees is 2 to 9 minutes per tree.
- Removing large trees (12 to 30 inches in diameter) is much slower and more difficult than clearing brush and smaller trees. First, gently and cautiously probe the tree for dead limbs that could fall. Determine the tree's natural direction of lean, if any; this is the best direction for pushing the tree over. Then, position the blade high and center it on the tree for maximum leverage. If possible, push the tree over the same as a medium tree.
- Never operate clearing tractors too close together.
- Do not follow a tree too closely when pushing it, because when it begins to fall, its stump and roots may catch under the front of the dozer.
- Clean out accumulated debris in the dozer's belly pan often to prevent fires in the engine compartment.
- Unauthorized personnel are required to remain clear of the clearing and grubbing operations.

2.1.7 Utilities (underground)

Do not begin subsurface construction activities (e.g., trenching, excavation, drilling, etc.) until a check for underground utilities and similar obstructions has been conducted. The use of as-built drawings and utility company searches must be supplemented with a geophysical or other survey by a qualified, independent survey contractor to identify additional and undiscovered buried utilities.

Examples of the type of geophysical technologies include:

- Ground Penetrating Radar (GPR), which can detect pipes, including gas pipes, tanks, conduits, cables, etc., both metallic and non-metallic, at depths up to 30 feet depending on equipment. Sensitivity for both minimum object size and maximum depth detectable depends on equipment selected, soil conditions, etc.
- Radio Frequency (RF), involves inducing an RF signal in the pipe or cable and using a receiver to trace it. Some electric and telephone lines emit RF naturally and can be detected without an induced signal. This method requires knowing where the conductive utility can be accessed to induce RF field if necessary.
- Dual RF, a modified version of RF detection using multiple frequencies to enhance sensitivity but with similar limitations to RF.
- Ferromagnetic Detectors, are metal detectors that will detect ferrous and non-ferrous utilities. Sensitivity is limited, e.g. a 100 mm iron disk to a depth of about one meter or a 25 mm steel paper clip to a depth of about 20 cm.

- Electronic markers, are emerging technologies that impart a unique electronic signature to materials such as polyethylene pipe to facilitate location and tracing after installation. Promising for future installations but not of help for most existing utilities already in place.

Procedure

The following procedures shall be used to identify and mark underground utilities during subsurface construction activities on the project:

- The survey contractor shall determine the most appropriate geophysical technique or combinations of techniques to identify the buried utilities on the project, based on the survey contractor's experience and expertise, types of utilities anticipated to be present, and specific site conditions.
- The survey contractor shall employ the same geophysical techniques used on the project to identify the buried utilities, to survey the proposed path of subsurface construction work, and to confirm no buried utilities are present.
- Identify customer specific permit and/or procedural requirements for excavation and drilling activities. For military installations contact the Base Civil Engineer and obtain the appropriate form to begin the clearance process.
- Contact utility companies or the state/regional utility protection service at least two (2) working days prior to excavation activities to advise of the proposed work, and ask them to establish the location of the utility underground installations prior to the start of actual excavation.
- Schedule the independent survey.
- Obtain utility clearances for subsurface work on both public and private property.
- Clearances are to be in writing, signed by the party conducting the clearance.
- Underground utility locations must be physically verified by hand digging using wood or fiberglass-handled tools when any adjacent subsurface construction activity (e.g. mechanical drilling, excavating) work is expected to come within 5 feet of the marked underground system. If subsurface construction activity is within 5 feet and parallel to a marked existing utility, the utility location must be exposed and verified by hand digging every 100 feet.
- Protect and preserve the markings of approximate locations of facilities until the markings are no longer required for safe and proper excavations. If the markings of utility locations are destroyed or removed before excavation commences or is completed, the Project Manager must notify the utility company or utility protection service to inform them that the markings have been destroyed.
- Conduct a site briefing for employees regarding the hazards associated with working near the utilities and the means by which the operation will maintain a safe working environment. Detail the method used to isolate the utility and the hazards presented by breaching the isolation.

2.1.8 Utilities (overhead)

Proximity to Power Lines

No work is to be conducted within 50 feet of overhead power lines without first contacting the utility company to determine the voltage of the system. No aspect of any piece of equipment is to be operated within 50 feet of overhead power lines without first making this determination.

Operations adjacent to overhead power lines are PROHIBITED unless one of the following conditions is satisfied:

- Power has been shut off, positive means (such as lockout) have been taken to prevent the lines from being energized, lines have been tested to confirm the outage, and the utility company has provided a signed certification of the outage.
- The minimum clearance from energized overhead lines is as shown in the table below, or the equipment will be repositioned and blocked to ensure that no part, including cables, can come within the minimum clearances shown in the table.

MINIMUM DISTANCES FROM POWERLINES

Powerlines Nominal System Kv	Minimum Required Distance, Feet
0-50	10
51-100	12
101-200	15
201-300	20
301-500	25
501-750	35
751-1000	45

(These distances have been determined to eliminate the potential for arcing based on the line voltage.)

- The power line(s) has been isolated through the use of insulating blankets which have been properly placed by the utility. If insulating blankets are used, the utility will determine the minimum safe operating distance; get this determination in writing with the utility representative's signature.
- All inquiries regarding electric utilities must be made in writing and a written confirmation of the outage/isolation must be received by the Project Manager/Construction Manager prior to the start of work.

2.1.9 Visible Lighting

- While work is in progress outside construction areas shall have at least 33 lux (lx).
- Construction work conducted inside buildings should be provided with at least 55 lux light.
- The means of egress shall be illuminated with emergency and non-emergency lighting to provide a minimum 11 lx measured at the floor. Egress illumination shall be arranged so that the failure of any single lighting unit, including the burning out of an electric bulb will not leave any area in total darkness.

2.1.10 Working Around Material Handling Equipment

- Never approach operating equipment from the rear. Always make positive contact with the operator, and confirm that the operator has stopped the motion of the equipment.
- Never approach the side of operating equipment; remain outside of the swing and turning radius.
- Maintain distance from pinch points of operating equipment.
- Never turn your back on any operating equipment.
- Never climb onto operating equipment or operate contractor/subcontractor equipment.
- Never ride contractor/subcontractor equipment unless it is designed to accommodate passengers and equipped with firmly attached passenger seat.
- Never work or walk under a suspended load.
- Never use equipment as a personnel lift; do not ride excavator buckets or crane hooks.

- Always stay alert and maintain a safe distance from operating equipment, especially equipment on cross slopes and unstable terrain.

2.2 General Hazards

2.2.1 General Practices and Housekeeping

- Site work should be performed during daylight hours whenever possible.
- Good housekeeping must be maintained at all times in all project work areas.
- Common paths of travel should be established and kept free from the accumulation of materials.
- Keep access to aisles, exits, ladders, stairways, scaffolding, and emergency equipment free from obstructions.
- Provide slip-resistant surfaces, ropes, and/or other devices to be used.
- Specific areas should be designated for the proper storage of materials.
- Tools, equipment, materials, and supplies shall be stored in an orderly manner.
- As work progresses, scrap and unessential materials must be neatly stored or removed from the work area.
- Containers should be provided for collecting trash and other debris and shall be removed at regular intervals.
- All spills shall be quickly cleaned up. Oil and grease shall be cleaned from walking and working surfaces.
- Review the safety requirements of each job you are assigned to with your supervisor. You are not expected to perform a job that may result in injury or illness to yourself or to others.
- Familiarize yourself with, understand, and follow jobsite emergency procedures.
- Do not fight or horseplay while conducting the firm's business.
- Do not use or possess firearms or other weapons while conducting the firm's business.
- Report unsafe conditions or unsafe acts to your supervisor immediately.
- Report occupational illnesses, injuries, and vehicle accidents.
- Do not remove or make ineffective safeguards or safety devices attached to any piece of equipment.
- Report unsafe equipment, defective or frayed electrical cords, and unguarded machinery to your supervisor.
- Shut down and lock out machinery and equipment before cleaning, adjustment, or repair. Do not lubricate or repair moving parts of machinery while the parts are in motion.
- Do not run in the workplace.
- When ascending or descending stairways, use the handrail and take one step at a time.
- Do not apply compressed air to any person or clothing.
- Do not wear steel taps or shoes with metal exposed to the sole at any CH2M HILL project location.
- Do not wear finger rings, loose clothing, wristwatches, and other loose accessories when within arm's reach of moving machinery.

- Remove waste and debris from the workplace and dispose of in accordance with federal, state, and local regulations.
- Note the correct way to lift heavy objects (secure footing, firm grip, straight back, lift with legs), and get help if needed. Use mechanical lifting devices whenever possible.
- Check the work area to determine what problems or hazards may exist.

2.2.2 Personal Hygiene

- Keep hands away from nose, mouth, and eyes.
- Keep areas of broken skin (chapped, burned, etc.) covered.
- Wash hands with hot water and soap frequently prior to eating and smoking.

2.2.3 Substance Abuse

(Reference CH2M HILL SOP HSE-105, *Drug-Free Workplace*)

Employees who work under the influence of controlled substances, drugs, or alcohol may prove to be dangerous or otherwise harmful to themselves, other employees, clients, the company, the company's assets and interests, or the public. CH2M HILL does not tolerate illegal drug use, or any use of drugs, controlled substances, or alcohol that impairs an employee's work performance or behavior. Drug and/or alcohol testing is applicable under CCI and munitions response projects performed in the United States. In addition, employees may be required to submit to drug and/or alcohol testing as required by clients. When required, this testing is performed in accordance with SOP HSE-105, Drug-Free Workplace. Employees who are enrolled in drug or alcohol testing are required to complete annual training located on the VO.

Prohibitions onsite include:

- Use or possession of intoxicating beverages while performing CH2M HILL work.
- Abuse of prescription or nonprescription drugs.
- Use or possession of illegal drugs or drugs obtained illegally.
- Sale, purchase, or transfer of legal, illegal or illegally obtained drugs.
- Arrival at work under the influence of legal or illegal drugs or alcohol.

2.2.4 Driving

- Always be aware of surroundings while operating a vehicle. Avoid intellectual stress & worries, talking on a cellular phone, eating, drinking, smoking, reading a map, adjusting controls or looking at a passenger while driving.
- Use prudent speed limits, assure that backup warning devices are working, be aware of blind spots or other hazards associated with low visibility, etc. Use a spotter if necessary.
- Do no drive while drowsy. Drowsiness can occur at any time, but is most likely after 18 hours or more without sleep.

2.2.5 Hazard Communication

(Reference CH2M HILL SOP HSE-107, *Hazard Communication)*

The Hazard Communication Coordinator is to perform the following:

- Complete an inventory of chemicals brought on site by CH2M HILL using Attachment 2.
- Confirm that an inventory of chemicals brought on site by CH2M HILL subcontractors is available.

- Request or confirm locations of Material Safety Data Sheets (MSDSs) from the client, contractors, and subcontractors for chemicals to which CH2M HILL employees potentially are exposed.
- Before or as the chemicals arrive on site, obtain an MSDS for each hazardous chemical.
- Label chemical containers with the identity of the chemical and with hazard warnings, and store properly.
- Give employees required chemical-specific HAZCOM training using Attachment 3.
- Store all materials properly, giving consideration to compatibility, quantity limits, secondary containment, fire prevention, and environmental conditions.

2.2.6 Inclement Weather

Sudden inclement weather can rapidly encroach upon field personnel. Preparedness and caution are the best defenses. Field crew members performing work outdoors should carry clothing appropriate for inclement weather. Personnel are to take heed of the weather forecast for the day and pay attention for signs of changing weather that indicate an impending storm. Signs include towering thunderheads, darkening skies, or a sudden increase in wind. If stormy weather ensues, field personnel should discontinue work and seek shelter until the storm has passed.

Protective measures during a lightning storm include seeking shelter; avoiding projecting above the surrounding landscape (don't stand on a hilltop--seek low areas) and ceasing intrusive work inside a building (i.e. DPT), staying away from open water, metal equipment, railroad tracks, wire fences, and metal pipes; and positioning people several yards apart. Some other general precautions include:

- Know where to go and how long it will take to get there. If possible, take refuge in a large building or vehicle. Do not go into a shed in an open area.
- The inclination to see trees as enormous umbrellas is the most frequent and most deadly mistake. Do not go under a large tree that is standing alone. Likewise, avoid poles, antennae and towers.
- If the area is wide open, go to a valley or ravine, but be aware of flash flooding.
- If you are caught in a level open area during an electrical storm and you feel your hair stand on end, drop to your knees, bend forward and put your hands on your knees or crouch. The idea is to make yourself less vulnerable by being as low to the ground as possible and taking up as little ground space as possible. Lying down is dangerous, since the wet earth can conduct electricity. Do not touch the ground with your hands.
- Do not use telephones during electrical storms, except in the case of emergency

Remember that lightning may strike several miles from the parent cloud, so work should be stopped/restarted accordingly. The lightning safety recommendation is 30-30: Seek refuge when thunder sounds within 30 seconds after a lightning flash; and do not resume activity until 30 minutes after the last thunder clap.

High winds can cause unsafe conditions, and activities should be halted until wind dies down. High winds can also knock over trees, so walking through forested areas during high-wind situations should be avoided. If winds increase, seek shelter or evacuate the area. Proper body protection should be worn in case the winds hit suddenly, because body temperature can decrease rapidly.

2.2.7 Shipping and Transportation of Chemical Products

(Reference CH2M HILL's Procedures for Shipping and Transporting Dangerous Goods)
Chemicals brought to the site might be defined as hazardous materials by the U.S. Department of Transportation (DOT). All staff who ship the materials or transport them by road must receive CH2M

HILL training in shipping dangerous goods. All hazardous materials that are shipped (e.g., via Federal Express) or are transported by road must be properly identified, labeled, packed, and documented by trained staff. Contact the RHSM or the Warehouse Coordinator for additional information.

2.2.8 Ultraviolet (UV) Radiation (sun exposure)

Health effects regarding UV radiation are confined to the skin and eyes. Overexposure can result in many skin conditions, including erythema (redness or sunburn), photoallergy (skin rash), phototoxicity (extreme sunburn acquired during short exposures to UV radiation while on certain medications), premature skin aging, and numerous types of skin cancer.

Acute overexposure of UV radiation to the eyes may lead to photokeratitis (inflammation of the cornea), also known as snow blindness. Symptoms include redness of the eyes and a gritty feeling, which progresses to pain and an inability to tolerate any kind of light. This condition can also occur when working in or around water and other UV radiation reflectors. In addition, long-term exposure to sunlight is thought to cause cataracts or clouding of the lens of the eye.

Limit Exposure Time

- Rotate staff so the same personnel are not exposed all of the time.
- Limit exposure time when UV radiation is at peak levels (approximately 2 hours before and after the sun is at its highest point in the sky).
- Avoid exposure to the sun, or take extra precautions when the UV index rating is high.

Provide Shade

- Take lunch and breaks in shaded areas.
- Create shade or shelter through the use of umbrellas, tents, and canopies.
- Fabrics such as canvas, sailcloth, awning material and synthetic shade cloth create good UV radiation protection.
- Check the UV protection of the materials before buying them. Seek protection levels of 95 percent or greater, and check the protection levels for different colors.

Clothing

- Reduce UV radiation damage by wearing proper clothing; for example, long sleeved shirts with collars, and long pants. The fabric should be closely woven and should not let light through.
- Head protection should be worn to protect the face, ears, and neck. Wide-brimmed hats with a neck flap or “Foreign Legion” style caps offer added protection.
- Wear UV-protective sunglasses or safety glasses. These should fit closely to the face. Wrap-around style glasses provide the best protection.

Sunscreen

- Apply sunscreen generously to all exposed skin surfaces at least 20 minutes before exposure, allowing time for it to adhere to the skin.
- Re-apply sunscreen at least every 2 hours, and more frequently when sweating or performing activities where sunscreen may be wiped off.
- Choose a sunscreen with a high sun protection factor (SPF). Most dermatologists advocate SPF 30 or higher for significant sun exposure.

- Waterproof sunscreens should be selected for use in or near water, and by those who perspire sufficiently to wash off non-waterproof products.
- Check for expiration dates, because most sunscreens are only good for about 3 years. Store in a cool place out of the sun.
- Remember—no sunscreen provides 100% protection against UV radiation. Other precautions must be taken to avoid overexposure.

2.2.9 Temperature Extremes

- Each employee is responsible for the following:
- Recognizing the symptoms of heat or cold stress
- Taking appropriate precautionary measures to minimize their risk of exposure to temperature extremes
- Communicating any concerns regarding heat and cold stress to their supervisor or SC

2.2.9.1 Heat Stress

General

Physical fitness influences a person's ability to perform work under heat loads. At a given level of work, the more fit a person is, the less the physiological strain, the lower the heart rate, the lower the body temperature (indicates less retrained body heat—a rise in internal temperature precipitates heat injury), and the more efficient the sweating mechanism.

Acclimatization is the degree to which a worker's body has physiologically adjusted or acclimatized to working under hot conditions. Acclimatization affects their ability to do work. Acclimatized individuals sweat sooner and more profusely than unacclimatized individuals. Acclimatization occurs gradually over 1 to 2 weeks of continuous exposure, but it can be lost in as little as 3 days in a cooler environment.

Dehydration reduces body water volume. This reduces the body’s sweating capacity and directly affects its ability to dissipate excess heat.

The ability of a body to dissipate heat depends on the ratio of its surface area to its mass (surface area/weight). **Heat dissipation** is a function of surface area, while heat production depends on body mass. Therefore, overweight individuals (those with a low ratio) are more susceptible to heat-related illnesses because they produce more heat per unit of surface area than if they were thinner. Monitor these persons carefully if heat stress is likely.

When wearing **impermeable clothing**, the weight of an individual is not as important in determining the ability to dissipate excess heat because the primary heat dissipation mechanism, evaporation of sweat, is ineffective.

SYMPTOMS AND TREATMENT OF HEAT STRESS					
	Heat Syncope	Heat Rash	Heat Cramps	Heat Exhaustion	Heat Stroke
Signs and Symptoms	Sluggishness or fainting while standing erect or immobile in heat.	Profuse tiny raised red blister-like vesicles on affected areas, along with prickling sensations during heat exposure.	Painful spasms in muscles used during work (arms, legs, or abdomen); onset during or after work hours.	Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or flushed; may faint on standing; rapid thready pulse and low blood pressure; oral temperature normal or low	Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature.
Treatment	Remove to cooler area. Rest lying down. Increase fluid intake. Recovery usually is prompt and complete.	Use mild drying lotions and powders, and keep skin clean for drying skin and preventing infection.	Remove to cooler area. Rest lying down. Increase fluid intake.	Remove to cooler area. Rest lying down, with head in low position. Administer fluids by mouth. Seek medical attention.	Cool rapidly by soaking in cool–but not cold–water. Call ambulance, and get medical attention immediately!

Precautions

- Drink 16 ounces of water before beginning work. Disposable cups and water maintained at 50oF to 60oF should be available. Under severe conditions, drink 1 to 2 cups every 20 minutes, for a total of 1 to 2 gallons per day. Do not use alcohol in place of water or other nonalcoholic fluids. Decrease your intake of coffee and caffeinated soft drinks during working hours.
- Acclimate yourself by slowly increasing workloads (e.g., do not begin with extremely demanding activities).
- Use cooling devices, such as cooling vests, to aid natural body ventilation. These devices add weight, so their use should be balanced against efficiency.
- Use mobile showers or hose-down facilities to reduce body temperature and cool protective clothing.
- Conduct field activities in the early morning or evening and rotate shifts of workers, if possible.
- Avoid direct sun whenever possible, which can decrease physical efficiency and increase the probability of heat stress. Take regular breaks in a cool, shaded area. Use a wide-brim hat or an umbrella when working under direct sun for extended periods.
- Provide adequate shelter/shade to protect personnel against radiant heat (sun, flames, hot metal).
- Maintain good hygiene standards by frequently changing clothing and showering.
- Observe one another for signs of heat stress. Persons who experience signs of heat syncope, heat rash, or heat cramps should consult the SC to avoid progression of heat-related illness.

Thermal Stress Monitoring

The following procedures should be implemented when the ambient air temperature exceeds 70° F, the relative humidity is high (greater than 50 percent), or when the workers exhibit symptoms of heat stress.

- The heart rate should be measured by the radial pulse for 30 seconds, as early as possible in the resting period.

- The heart rate at the beginning of the rest period should not exceed 110 beats per minute, or 20 beats per minute above resting pulse.
- If the heart rate is higher, the next work period should be shortened by 33 percent, while the length of the rest period stays the same.
- If the pulse rate still exceeds 110 beats per minute at the beginning of the next rest period, the following work cycle should be further shortened by 33 percent.
- Continue this procedure until the rate is maintained below 110 beats per minute, or 20 beats per minute above resting pulse.
- Alternately, the oral temperature can be measured before the workers have something to drink.
- If the oral temperature exceeds 99.6 degrees F at the beginning of the rest period, the following work cycle should be shortened by 33 percent.
- Continue this procedure until the oral temperature is maintained below 99.6 degrees F. While an accurate indication of heat stress, oral temperature is difficult to measure in the field.

2.2.9.2 Cold

General

Low ambient temperatures increase the heat lost from the body to the environment by radiation and convection. In cases where the worker is standing on frozen ground, the heat loss is also due to conduction.

Wet skin and clothing, whether because of water or perspiration, may conduct heat away from the body through evaporative heat loss and conduction. Thus, the body cools suddenly when chemical protective clothing is removed if the clothing underneath is perspiration soaked.

Movement of air across the skin reduces the insulating layer of still air just at the skin's surface. Reducing this insulating layer of air increases heat loss by convection.

Non-insulating materials in contact or near-contact with the skin, such as boots constructed with a metal toe or shank, conduct heat rapidly away from the body.

Certain common drugs, such as alcohol, caffeine, or nicotine, may exacerbate the effects of cold, especially on the extremities. These chemicals reduce the blood flow to peripheral parts of the body, which are already high-risk areas because of their large surface area to volume ratios. These substances may also aggravate an already hypothermic condition.

Precautions

- Be aware of the symptoms of cold-related disorders, and wear proper, layered clothing for the anticipated fieldwork. Appropriate rain gear is a must in wet weather.
- Consider monitoring the work conditions and adjusting the work schedule using guidelines developed by the U.S. Army (wind-chill index) and the National Safety Council (NSC).
- Wind-Chill Index (below) is used to estimate the combined effect of wind and low air temperatures on exposed skin. The wind-chill index does not take into account the body part that is exposed, the level of activity, or the amount or type of clothing worn. For those reasons, it should only be used as a guideline to warn workers when they are in a situation that can cause cold-related illnesses.
- NSC Guidelines for Work and Warm-Up Schedules can be used with the wind-chill index to estimate work and warm-up schedules for fieldwork. The guidelines are not absolute; workers

should be monitored for symptoms of cold-related illnesses. If symptoms are not observed, the work duration can be increased.

- Persons who experience initial signs of immersion foot, frostbite, and/or hypothermia should report it immediately to their supervisor/PM to avoid progression of cold-related illness.
- Observe one another for initial signs of cold-related disorders.
- Obtain and review weather forecast – be aware of predicted weather systems along with sudden drops in temperature, increase in winds, and precipitation.

SYMPTOMS AND TREATMENT OF COLD STRESS			
	Immersion (Trench) Foot	**Frostbite**	**Hypothermia**
Signs and Symptoms	Feet discolored and painful; infection and swelling present.	Blanched, white, waxy skin, but tissue resilient; tissue cold and pale.	Shivering, apathy, sleepiness; rapid drop in body temperature; glassy stare; slow pulse; slow respiration.
Treatment	Seek medical treatment immediately.	Remove victim to a warm place. Re-warm area quickly in warm–but **not** hot–water. Have victim drink warm fluids, but **not** coffee or alcohol. Do not break blisters. Elevate the injured area, and get medical attention.	Remove victim to a warm place. Have victim drink warm fluids, but **not** coffee or alcohol. Get medical attention.

Wind Chill Chart

Wind (mph)	Temperature (°F)																	
Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

Wind Chill (°F) = $35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

2.3

2.4 Biological Hazards and Controls

2.4.1 Bees and Other Stinging Insects

Bees and other stinging insects may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic. Watch for and avoid nests. Keep exposed skin to a minimum. Carry a kit if you have had allergic reactions in the past, and inform your supervisor and/or buddy. If a stinger is present, remove it carefully with tweezers. Wash and disinfect the wound, cover it, and apply ice. Watch for allergic reaction; contact the occupational nurse at 1-866-893-2514 immediately if a reaction develops or 911 if the reaction is severe.

2.4.2 Bloodborne Pathogens

(Reference CH2M HILL SOP HSE-202, *Bloodborne Pathogens*)

Exposure to bloodborne pathogens may occur when rendering first aid or CPR, or when coming into contact with landfill waste or waste streams containing potentially infectious material (PIM).

- Employees trained in first-aid/CPR or those exposed to PIM must complete CH2M HILL's 1-hour bloodborne computer-based training module annually.
- Hepatitis B vaccine (HBV) is offered to employees who may be exposed to PIM when they complete training and within 10 working days of assignment. (Note: Employees whose exposure stems only from rendering first aid as a collateral duty receives the vaccine after exposure.)
- Employees who decline the HBV vaccine must sign the declination form (contact regional Safety Program Assistant [SPA]) indicating they declined the vaccination. Anyone who declines the vaccination and chooses to receive the vaccination at a later time may still receive the vaccination by contacting the SPA.
- Hepatitis B and tetanus vaccinations can be requested by completing the medical portion of the enrollment form, located under Tools & Forms at the HS&E web page, or by contacting the regional SPA.

Work Controls

- Observe universal precautions to prevent contact with blood or other PIMs. Where differentiation between body fluid types is difficult or impossible, consider all body fluids to be potentially infectious materials.
- Consider all sharps encountered at industrial, medical, dental, or biological waste facilities or sampling locations to be contaminated and PIMs.
- Always wash your hands and face with soap and running water after contacting PIMs. If washing facilities are unavailable, use an antiseptic cleanser with clean paper towels or moist towelettes. These must be provided for employees who have been exposed to PIMs. When antiseptic cleansers or towelettes are used, always rewash your hands and face with soap and running water as soon as available. Do not consume food or beverages until after thoroughly washing your hands and face.
- Decontaminate all potentially contaminated equipment and environmental surfaces with chlorine bleach as soon as possible. Clean and decontaminate on a regular basis (and immediately upon visible contamination) all bins, pails, cans, and other receptacles intended for reuse that have the potential for becoming contaminated.
- Use one part chlorine bleach (5.25 percent sodium hypochlorite solution) diluted with 10 parts water for decontaminating equipment or surfaces after initially removing blood or other PIMs. Remove contaminated PPE as soon as possible before leaving a work area.
- Place regulated waste in containers that are closable; are constructed to contain all contents and prevent leakage of fluids during handling, storage, transport or shipping; are labeled with a Biological warning label or color-coded; and are tightly closed prior to removal to prevent spillage or protrusion of contents during handling, storage, transport, or shipping.

Employees who participate in waste characterization studies, sort or sample refuse, or contact medical, dental, or biological waste streams should follow these procedures:

- If exposure is anticipated, this group of employees should wear safety goggles or glasses, puncture-resistant utility gloves with inner latex glove liners, Tyvek coveralls or cotton coveralls with a rubber apron, and puncture-resistant shoes or boots.

- If splash potential is present, employees should wear a full-face shield.
- If a respiratory hazard is present, a full-face respirator with HEPA filters should be worn.

Post Exposure

CH2M HILL will provide exposed employees with a confidential medical examination should an exposure to PIM occur. This examination includes the following procedures:

- Documenting the exposure
- Testing the exposed employee's and the source individual's blood (with consent)
- Administering post-exposure prophylaxis

2.4.3 Coyotes

Coyotes are found in some areas of the base. While far from domesticated, coyotes show little fear of humans and have become comfortable living in close proximity to our communities. Although they tend to do most of their hunting after dusk, coyotes can be active at any time. Under normal circumstances, a coyote is not a danger to humans. They are, however, territorial and will respond aggressively if they or their family are threatened.

If you encounter a coyote that behaves aggressively, you have probably gotten too close to its prey or its family. Try to scare the coyote by yelling and waving your arms. Throw rocks, sticks or other objects. Do not turn away and run.

2.4.4 Feral Dogs

Avoid all dogs – both leashed and stray. Do not disturb a dog while it is sleeping, eating, or caring for puppies. If a dog approaches to sniff you, stay still. An aggressive dog has a tight mouth, flattened ears and a direct stare. If you are threatened by a dog, remain calm, do not scream and avoid eye contact. If you say anything, speak calmly and firmly. Do not turn and run, try to stay still until the dog leaves, or back away slowly until the dog is out of sight or you have reached safety (e.g. vehicle). If attacked, retreat to vehicle or attempt to place something between you and the dog. If you fall or are knocked to the ground, curl into a ball with your hands over your head and neck and protect your face. If bitten, immediately scrub the bite site vigorously with soap and water. Report the incident to the local authorities. Seek medical attention as soon as possible.

2.4.5 Mosquito Bites

Due to the recent detection of the West Nile Virus in the Southwestern United States it is recommended that **preventative measures** be taken to reduce the probability of being bitten by mosquitoes whenever possible. Mosquitoes are believed to be the primary source for exposure to the West Nile Virus as well as several other types of encephalitis. The following guidelines should be followed to reduce the risk of these concerns for working in areas where mosquitoes are prevalent.

- Stay indoors at dawn, dusk, and in the early evening.
- Wear long-sleeved shirts and long pants whenever you are outdoors.
- Spray clothing with repellents containing permethrin or DEET since mosquitoes may bite through thin clothing.
- Apply insect repellent sparingly to exposed skin. An effective repellent will contain 35% DEET (N,N-diethyl-meta-toluamide). Repellents may irritate the eyes and mouth, so avoid applying repellent to the hands.

- Whenever you use an insecticide or insect repellent, be sure to read and follow the manufacturer's DIRECTIONS FOR USE, as printed on the product.
- Note: Vitamin B and "ultrasonic" devices are NOT effective in preventing mosquito bites.

Symptoms of Exposure to the West Nile Virus

Most infections are mild, and symptoms include fever, headache, and body aches, occasionally with skin rash and swollen lymph glands. More severe infection may be marked by headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, paralysis, and, rarely, death.

The West Nile Virus incubation period is from 3-15 days.

Contact the project RHSM with questions, and immediately report any suspicious symptoms to your supervisor/PM and contact the occupational nurse at 1-866-893-2514.

2.4.6 Poison Ivy, Poison Oak, and Poison Sumac

Poison ivy, poison oak, and poison sumac typically are found in brush or wooded areas. They are more commonly found in moist areas or along the edges of wooded areas. Shrubs are usually 12 to 30 inches high, or can also be a tree-climbing vine, with triple leaflets and short, smooth hair underneath. Plants are red and dark green in Spring and Summer, with yellowing leaves anytime especially in dry areas. Leaves may achieve bright reds in Fall, but plants lose its (yellowed, then brown) leaves in Winter, leaving toxic stems. All parts of the plant remain toxic throughout the seasons. These plants contain urushiol (you-ROO-shee-ol), a colorless or pale yellow oil that oozes from any cut or crushed part of the plant, including the roots, stems and leaves and causes allergic skin reactions when contacted. The oil is active year round.

Become familiar with the identity of these plants (see below). Wear protective clothing that covers exposed skin and clothes. Avoid contact with plants and the outside of protective clothing. If skin contacts a plant, wash the area with soap and water immediately. If the reaction is severe or worsens, seek medical attention.

Poison Ivy

Poison Sumac

Poison Oak

Contamination with poison ivy, sumac or oak can happen through several pathways, including:

- Direct skin contact with any part of the plant (even roots once above ground foliage has been removed).
- Contact with clothing that has been contaminated with the oil.
- Contact from removing shoes that have been contaminated (shoes are coated with urishol oil).

- Sitting in a vehicle that has become contaminated.
- Contact with any objects or tools that have become contaminated.
- Inhalation of particles generated by weed whacking, chipping, vegetation clearing.

If you must work on a site with poison ivy, sumac or oak the following precautions are necessary:

- Do not drive vehicles onto the site where it will come into contact with poison ivy, sumac or oak. Vehicles which need to work in the area, such as drill rigs or heavy equipment must be washed as soon as possible after leaving the site.
- All tools used in the poison ivy, sumac or oak area, including those used to cut back poison oak, surveying instruments used in the area, air monitoring equipment or other test apparatus must be decontaminated before they are placed back into the site vehicle. If on-site decontamination is not possible, use plastic to wrap any tools or equipment until they can be decontaminated.
- Personal protective equipment, including Tyvek coveralls, gloves, and boot covers must be worn. PPE must be placed into plastic bags and sealed if they are not disposed immediately into a trash receptacle.
- As soon as possible following the work, shower to remove any potential contamination. Any body part with suspected or actual exposure should be washed with "Tecnu" or other product designed for removing urushiol. If you do not have Tecnu wash with cold water. Do not take a bath, as the oils can form and invisible film on top of the water and contaminate your entire body upon exiting the bath.
- Tecnu may also be used to decontaminate equipment.
- Use IvyBlock or similar products to prevent poison oak, ivy and sumac contamination. Check with the closest CH2M HILL warehouse to see if these products are available. Follow all directions for application.

If you do come into contact with one of these poisonous plants and a reaction develops, contact your supervisor and the occupational nurse 1-866-893-2514.

2.4.7 Snakes

Snakes typically are found in underbrush and tall grassy areas. If you encounter a snake, stay calm and look around; there may be other snakes. Turn around and walk away on the same path you used to approach the area. If a person is bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart if possible. Call the occupational nurse at 1-866-893-2514 immediately. **DO NOT** apply ice, cut the wound, or apply a tourniquet. Try to identify the type of snake: note color, size, patterns, and markings.

2.4.8 Spiders - Brown Recluse

It is regarded by many as the most dangerous spider in the United States. Because of interstate shipping/transportation, the Brown Recluse spider can be found most anywhere in the United States. Brown Recluse Spiders are usually 1 inch or larger in size, including the legs and can grow as large as 3 inches. Young Brown Recluse spiders are smaller. Brown recluse spider bites don't always hurt right away. away. In fact, you may not know that you have been bitten until other symptoms appear. Symptoms of a brown recluse spider bite may include the following:

- Reddened skin followed by a blister that forms at the bite site

- Mild to intense pain and itching for 2 to 8 hours following the bite.
- An open sore with a breakdown of tissue (necrosis) that develops within a few hours to 3 to 4 days following the bite and the area may become painful, itchy, hot, swollen, red and tender. An irregular ulcerous sore, caused by necrosis, will often appear that is from 1/4 inch to 10 inches in diameter. Prompt attention is the best defense against preventing the necrosis. The wound is often described as being reddish and surrounded by a bluish area with a narrow whitish separation in between the red and the blue. This gives it the famous "bull's eye" pattern. In just hours, a bite from the highly venomous Brown Recluse spider can create blisters and cause tissue damage.

Some people have a severe, systemic (whole-body) reaction to brown recluse spider bites, including the rapid destruction of red blood cells and anemia. Signs and symptoms include:

- Fever and chills.
- Skin rash all over the body with many tiny, flat purple and red spots.
- Nausea or vomiting.
- Joint pain.
- If you think you have been bitten by a brown recluse spider:
- Remain calm. Too much excitement or movement will increase the flow of venom into the blood.
- Try to collect the spider, without being bitten, (even a mangled specimen has diagnostic value), if possible, for positive identification by a spider expert. A plastic bag, small jar, or pill vial is useful and no preservative is necessary, but rubbing alcohol helps to preserve the spider.
- Apply a cool, wet cloth to the bite or cover the bite with a cloth and apply an ice bag to the bite.
- Do not apply a tourniquet. It may cause more harm than benefit.
- Try to positively identify the spider to confirm its type.
- Seek prompt medical attention.

A brown recluse bite can be serious and will likely require immediate medical care. Seek medical attention if you believe you have been bitten by a recluse spider, especially if severe symptoms develop throughout your body or an open sore and necrosis develop. A brown recluse spider bite is diagnosed through a physical examination and questions about the bite. You should be prepared to describe the spider, where and when the bite took place, and what you were doing at the time. Your health professional will ask what your main symptoms are, when they began, and how they have developed, progressed, or changed since the bite.

2.4.9 Widow Spiders

The Northern Black Widow spider may be encountered in Northern Regions of the United States. Other similar widow spiders are the Red Widow and the Brown Widow. Female widow spiders range from 8-15 mm in body length; males are smaller, sometimes very small (2 mm). Most have globose, shiny abdomens that are predominantly black with red markings (although some may be pale and/or have lateral stripes), with moderately long, slender legs. These spiders are nocturnal and build a three-dimensional tangled web, often with a conical tent of dense silk in a corner where the spider hides during the day. In nature, most species are found under rocks and logs, but they readily adapt to human-altered environments, where they are most commonly found in outbuildings (sheds, barns, privies), water meter holes, nursery cans, and under any item or structure (*e.g.*, barbeque grill, slide, sand box) that has been undisturbed for a lengthy period. Formerly, most bites by black widows (almost all by female spiders) occurred in outhouses, but presently, widow bites occur most frequently when the spider is trapped against human skin, either by reaching under objects where the spider is hiding or when putting on clothing, gloves or shoes containing the spider. Widow spiders are generally very timid and only bite in self-defense when they accidentally contact humans.

Black Widow

Red Widow

Brown Widow

Bite symptoms are systemic, spreading through the lymphatic system, and usually start about 1-3 hours after the bite. The most common symptoms are intense pain, rigid abdominal muscles, muscle cramping, malaise, local sweating, nausea, vomiting, and hypertension. Other symptoms may includetremors, labored breathing, restlessness, increased blood pressure, and fever. If left untreated, widow bite symptoms usually last 3-5 days.

If bitten, remain calm, and immediately seek medical attention (contact your physician, hospital and/or poison control center). Apply an ice pack directly to the bite area to relieve swelling and pain. Try to collect the spider, without being bitten, (even a mangled specimen has diagnostic value), if possible, for positive identification by a spider expert. A plastic bag, small jar, or pill vial is useful and no preservative is necessary, but rubbing alcohol helps to preserve the spider. A hospital stay may be recommended, particularly for those with a heart condition or with health problems. A physician may administer a specific antivenin to counteract the venom or calcium gluconate to relieve pain. Calcium gluconate and/or antivenin may be administered to relieve or counteract symptoms.

2.4.10 Scorpions

Basic Information

Only a very small number of the over 1050 known species are dangerous to humans. Most produce a bee-sting like reaction in humans. It is very painful, but not life-threatening. Scorpions are part of the natural environment. Most in the U.S. are not dangerously harmful; however, it is also important to remember that even a nearly nontoxic species can cause death if the victim has a severe allergic reaction to the venom.

Symptoms

Some components in scorpion venom appear to have no other function than to cause localized pain or discomfort in the victim. In vertebrates, the systemic effects observed after scorpion envenomation are probably the result of the release of massive quantities of catecholamines from the victim's adrenal glands. The scorpion's venom, therefore, is not directly responsible for the severe manifestations we see in some cases. Instead, the neurotoxins induce the victim's own chemical communication system to destroy the victim's homeostatic functions.

Scorpions not considered of any medical importance (typical Southern Calif. Species) normally have venoms that are of low toxicity. These scorpions normally produce a localized reaction similar to that a honeybee sting. They would have to be several feet long before they could produce and inject enough venom into a person to kill them.

The presence of pre-existing medical conditions such as pneumonia, hypertension, and certain heart ailments can turn otherwise normal systemic reactions into life threatening situations. Persons with such conditions are at greater risk of severe envenomation than are healthy persons. Some people are allergic to scorpion venom in the same way that some are allergic to honey bee venom. In such cases, very severe effects, including death, can occur very rapidly and are not related to the toxicity of the venom. Deaths due to envenomation by non-medically important species are usually the result of allergy induced anaphylactic shock.

Envenomations are usually categorized into two or three levels of severity: 1) localized effects, 2) systemic effects, and 3) systemic effects with central nervous system involvement. Localized effects are common to nearly all scorpion stings regardless of the toxicity of the venom. These symptoms are restricted to the site of sting and include intense pain, minor swelling, redness or induration, numbness, tenderness, and tingling. Intense pain normally subsides within one hour, giving way to numbness, tenderness, and tingling at the site of the sting. This normally results in the favoring of an affected limb. These symptoms normally fade after 24 hours.

If you are stung by a scorpion, call the occupational nurse 1-866-893-2514 and try to note the description of the scorpion.

Prevention

When entering an area that has the potential to contain scorpions, the following PPE is recommended: long pants, long sleeved shirts with collars, hard hat with brim, leather work gloves and leather work boots. Reaching into enclosures or recesses without prior visual inspection is not recommended. Thoroughly inspect each area before accessing.

2.4.11 Ticks

Every year employees are exposed to tick bites at work and at home putting them at risk of illness. Ticks typically are in wooded areas, bushes, tall grass, and brush. Ticks are black, black and red, or brown and can be up to one-quarter inch in size.

In some geographic areas exposure is not easily avoided. Wear tightly woven light-colored clothing with long sleeves and pant legs tucked into boots; spray **only outside** of clothing with permethrin or permanone and spray skin with only DEET; and check yourself frequently for ticks.

Where site conditions warrant (vegetation above knee height, tick endemic area) or when tasks warrant (e.g., having to sit/kneel in vegetation) that diminish the effectiveness of the other controls mentioned above, bug-out suits (obtained from MKE warehouse)/Tyvek shall be used. Bug-out suits are more breathable than Tyvek.

Take precautions to avoid exposure by including pre-planning measures for biological hazards prior to starting field work. Contact the MKE Warehouse for preventative equipment such as repellants, protective clothing and tick removal kits. Use the buddy system and perform tick inspections prior to entering the field vehicle. If ticks were not planned to be encountered and are observed, do not continue field work until these controls can be implemented.

See Tick Fact Sheet attached to this HSP for further precautions and controls to implement when ticks are present. Information includes the procedure for submitting a removed tick for testing. If bitten by a tick, follow the removal procedures found in the tick fact sheet, call the occupational nurse at 1-866-893-2514.

Be aware of the symptoms of Lyme disease or Rocky Mountain spotted fever (RMSF). Lyme: a rash might appear that looks like a bullseye with a small welt in the center. RMSF: a rash of red spots under the skin 3 to 10 days after the tick bite. In both RMSF and Lyme disease, chills, fever, headache, fatigue, stiff neck, and bone pain may develop. If symptoms appear, again contact the occupational nurse at 1-866-893-2514.

Be sure to complete an Incident Report (either use the HITS system on the VO) or see Attachment 5 if you do come in contact with a tick. For more detailed information go to HSSE website or contact the RHSM.

2.5 Radiological Hazards and Controls

Refer to CH2M HILL's Core Standard, Radiological Control and Radiological Controls Manual for additional requirements.

Hazards	Controls
None Known	None Required

2.6 Contaminants of Concern

Contaminants of Concern

Contaminant	Location and Maximum[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Tetrachloroethylene (PCE)	Well 8-G3 16 ppb	25 ppm	150 Ca	Eye, nose, and throat irritation; nausea; flushed face and neck; vertigo; dizziness; sleepiness; skin redness; headache; liver damage	9.32

Footnotes:

[a] Specify sample-designation and media: SB (Soil Boring), A (Air), D (Drums), GW (Groundwater), L (Lagoon), TK (Tank), S (Surface Soil), SL (Sludge), SW (Surface Water).
[b] Appropriate value of PEL, REL, or TLV listed.
[c] IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen.
[d] PIP = photoionization potential; NA = Not applicable; UK = Unknown.

Potential Routes of Exposure

Dermal: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 4.	**Inhalation:** Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring, as specified in Sections 4 and 5, respectively.	**Other:** Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

3.0 Project Organization and Personnel

3.1 CH2M HILL Employee Medical Surveillance and Training

(Reference CH2M HILL- SOPs HSE-113, *Medical Surveillance*, and HSE-110, *Training*)

3.1.1 Hazardous Waste Operations Training

All employees engaging in hazardous waste operations or emergency response shall receive appropriate training as required by 29 CFR 1910.120 and 29 CFR 1926.65. At a minimum, the training shall have consisted of instruction in the topics outlined in the 29 CFR 1910.120 and 29 CFR 1926.65. Personnel who have not met these training requirements shall not be allowed to engage in hazardous waste operations or emergency response activities.

3.1.1.1 Initial Training

General site workers engaged in hazardous waste operations shall, at the time of job assignment, have received a minimum of 40 hours of initial health and safety training for hazardous waste site operations, unless otherwise noted in the above-referenced standards.

Employees who may be exposed to health hazards or hazardous substances at treatment, storage, and disposal (TSD) operations shall receive a minimum of 24 hours of initial training to enable the employee to perform their assigned duties and functions in a safe and healthful manner.

Employees engaged in emergency response operations shall be trained to the level of required competence in accordance with 29 CFR 1910.120.

3.1.1.2 Three-Day Actual Field Experience

General site workers for hazardous waste operations shall have received three days of actual experience (on-the-job training) under the direct supervision of a trained, qualified supervisor and shall be documented. If the field experience has not already been received and documented at a similar site, this supervised experience shall be accomplished and documented at the beginning of the assignment of the project.

3.1.1.3 Refresher Training

General site workers and TSD workers shall receive 8-hours of refresher training annually (within the previous 12-month period) to maintain qualifications for fieldwork. Employees engaged in emergency response operations shall receive annual refresher training of sufficient content and duration to maintain their competencies or shall demonstrate competency in those areas at least annually.

3.1.1.4 Eight-Hour Supervisory Training

On site management or supervisors who will be directly responsible for, or supervise employees engaged in hazardous waste site operations, will have received at least 8 hours of additional specialized training on managing such operations. Employees designated as SC-HW employees are considered 8-hour HAZWOPER Site Safety Supervisor trained.

The employees listed meet state and federal hazardous waste operations requirements for 40-hour initial training, 3-day on-the-job experience, and 8-hour annual refresher training. Employees designated "SC" have completed a 12-hour site safety coordinator course, and have documented requisite field experience. An SC with a level designation (D, C, B) equal to or greater than the level of protection being used must be present during all tasks performed in exclusion or decontamination zones. Employees designated "FA-CPR" are currently certified by the American Red Cross, or equivalent, in first aid and CPR. At least one FA-CPR designated employee must be present during all tasks performed in exclusion or decontamination zones. The employees listed below are currently active in a medical surveillance program that meets state and federal regulatory requirements for hazardous waste operations. Certain tasks (e.g., confined-space entry) and contaminants (e.g., lead) may require additional training and medical monitoring.

Pregnant employees are to be informed of and are to follow the procedures in CH2M HILL- SOP HSE-120, *Reproductive Health*, including obtaining a physician's statement of the employee's ability to perform hazardous activities before being assigned fieldwork.

Employee Name	Office	Responsibility	SC/FA-CPR
Rob Plsek	San Antonio, TX / CH2M HILL	Field Team Leader/Site Safety Coordinator	SC/FA-CPR
Adrian Teal	Atlanta, GA / CH2M HILL	Field Team Leader/Site Safety Coordinator	SC/FA-CPR
Tom Wiley	Atlanta, GA / CH2M HILL	Task Manager	SC/FA-CPR
Mark Sherrill	Atlanta, GA / CH2M HILL	Project Manager	SC/FA-CPR
Greg DeWind	DeWind One-pass Trenching	Supervisor	FA/CPR
Jeff DeWind	DeWind One-pass Trenching	Assistant	FA/CPR
Thomas Burnette	AE Drilling	Senior Driller	FA/CPR
Carlos Swain	AE Drilling	Driller Helper	FA/CPR

3.2 Field Team Chain of Command and Communication Procedures

3.2.1 Client

Contact Name: Mr. Dennis Mayton, Technical Manager, USACE Mobile District
Phone: 251-694-3684
Facility Contact Name: Mr. Jim Swift, Ft. Rucker
Phone: 334-255-1899

3.2.2 CH2M HILL

Project Manager: Mark Sherrill/ATL
Health and Safety Manager: Michael Goldman/ATL
Field Team Leader: Rob Plsek/ATL
Site Safety Coordinator: Rob Plsek/ATL
The SSC is responsible for contacting the Field Team Leader and Project Manager. In general, the Project Manager will contact the client. The Health and Safety Manager should be contacted as appropriate.

The PM is responsible for providing adequate resources (budget and staff) for project-specific implementation of the HS&E management process. The PM has overall management responsibility for the tasks listed below. The PM may explicitly delegate specific tasks to other staff, as described in sections that follow, but retains ultimate responsibility for completion of the following in accordance with this SOP:

- Include standard terms and conditions, and contract-specific HS&E roles and responsibilities in contract and subcontract agreements (including flow-down requirements to lower-tier subcontractors).

- Select safe and competent subcontractors by:
  - Obtaining, reviewing and accepting or rejecting subcontractor pre-qualification questionnaires.
  - Ensuring that acceptable certificates of insurance, including CH2M HILL as named additional insured, are secured as a condition of subcontract award.
  - Including HS&E submittals checklist in subcontract agreements, and ensuring that appropriate site-specific safety procedures, training and medical monitoring records are reviewed and accepted prior to the start of subcontractor's field operations.
- Maintain copies of subcontracts and subcontractor certificates of insurance (including CH2M HILL as named additional insured), bond, contractor's license, training and medical monitoring records, and site-specific safety procedures in the project file accessible to site personnel.
- Provide oversight of subcontractor HS&E practices per the site-specific safety plan.
- Manage the site and interfacing with 3rd parties in a manner consistent with our contract and subcontract agreements and the applicable standard of reasonable care.
- Ensure that the overall, job-specific, HS&E goals are fully and continuously implemented.

The CH2M HILL RHSM is responsible for:

- Review and accept or reject subcontractor pre-qualification questionnaires that fall outside the performance range delegated to the Contracts Administrator (KA).
- Review and accept or reject subcontractor training records and site-specific safety procedures prior to start of subcontractor's field operations.
- Support the oversight of subcontractor (and lower-tier subcontractors) HS&E practices and interfaces with on-site 3rd parties per the site-specific safety plan.

The SC is responsible for verifying that the project is conducted in a safe manner including the following specific obligations:

- Verify this HSP is current and amended when project activities or conditions change.
- Verify CH2M HILL site personnel and subcontractor personnel read the HSP and sign Attachment 1, Employee Sign-Off Form, prior to commencing field activities.
- Verify CH2M HILL site personnel and subcontractor personnel have completed any required specialty training (e.g., fall protection, confined space entry) and medical surveillance as identified in Section 2.
- Verify compliance with the requirements of this HSP and applicable subcontractor health and safety plan(s).
- Act as the project "Hazard Communication Coordinator" and perform the responsibilities outlined in Section 2.2.2.
- Act as the project "Emergency Response Coordinator" and perform the responsibilities outlined in Section 9.
- Post OSHA job-site poster; the poster is required at sites where project field offices, trailers, or equipment-storage boxes are established.
- Verify that safety meetings are conducted and documented in the project file initially and as needed throughout the course of the project (e.g., as tasks or hazards change).

- Verify that project H&S forms and permits, found in Attachment 4 and 5, are being used as outlined in Section 2.
- Perform oversight and/or assessments of subcontractor HS&E practices per the site-specific safety plan and verify that project activity self-assessment checklists, found in Attachment 4, are being used as outlined in Section 2.
- Verify that project files available to site personnel include copies of executed subcontracts and subcontractor certificates of insurance (including CH2M HILL as named additional insured), bond, contractors license, training and medical monitoring records, and site-specific safety procedures prior to start of subcontractor's field operations.
- Manage the site and interfacing with 3rd parties in a manner consistent with our contract/subcontract agreements and the applicable standard of reasonable care.
- Coordinate with the RHSM regarding CH2M HILL and subcontractor operational performance, and 3rd party interfaces.
- Ensure that the overall, job-specific, HS&E goals are fully and continuously implemented.

The training required for the SC is as follows:

- SC-Initial and SC-Construction or SC-HW
- OSHA 10-hour course for Construction
- First Aid and CPR
- Relevant Competent Person Courses (excavation, confined space, scaffold, fall protection, etc.).

The SC is responsible for contacting the Field Team Leader and Project Manager. In general, the Project Manager will contact the client. The RHSM should be contacted as appropriate.

3.2.3 CH2M HILL Subcontractors

(Reference CH2M HILL SOP HSE-215, *Contracts and Subcontracts)*
Subcontractor: AE Drilling (Drilling)
Subcontractor Contact Name: Bill Barnes
Telephone: 864-288-1986

Subcontractor: Donaldson & Garrett (Surveying)
Subcontractor Contact Name: David Bennett
Telephone: 478-474-5350

Subcontractor: Capitol Environnmental Services (Transportation and Disposal)
Subcontractor Contact Name: Terri Forts
Telephone: 540-777-6547

Subcontractor: Jacklett Construction (Earthwork)
Subcontractor Contact Name: Lucas Jacklett
Telephone: 770-888-1959

Subcontractor: Singley Environmental and Remediation Services (Waste Handling)
Subcontractor Contact Name: John Matthews
Telephone: 601-736-6393

Subcontractor: DeWind Dewatering One-Pass Trenching (PRB Installation)
Subcontractor Contact Name: Mark Van Hoose
Telephone: 386-527-9530

The subcontractors listed above are required to submit their own Site-Specific HSP. Other plans, such as Lead or Asbestos Abatement Compliance plans may be required as well. Subcontractors are responsible for the health and safety procedures specific to their work, and are required to submit their plans to CH2M HILL for review before the start of field work.

Subcontractors are also required to prepare an Activity Hazard Analysis (AHA) before beginning each activity posing H&S hazards to their personnel using the AHA form provided in Attachment 5 as a guide. The AHA shall identify the principle steps of the activity, potential H&S hazards for each step and recommended control measures for each identified hazard. In addition, a listing of the equipment to be used to perform the activity, inspection requirements and training requirements for the safe operation of the equipment listed must be identified.

CH2M HILL should continuously endeavor to observe subcontractors' safety performance and adherence to their Accident Prevention Plan and AHAs. This endeavor should be reasonable, and include observing for hazards or unsafe practices that are both readily observable and occur in common work areas. CH2M HILL is not responsible for exhaustive observation for hazards and unsafe practices. Self-assessment checklists contained in Attachment 4 are to be used by CH2M HILL personnel to review subcontractor performance. CH2M HILL oversight does not relieve subcontractors of their responsibility for effective implementation and compliance with the established plan(s).

Health and safety related communications with CH2M HILL subcontractors should be conducted as follows:

- Brief subcontractors on the provisions of this plan, and require them to sign the Employee Signoff Form included in Attachment 1.
- Request subcontractor(s) to brief project team on the hazards and precautions related to their work.
- When apparent non-compliance/unsafe conditions or practices are observed, notify the subcontractor safety representative and require corrective action – the subcontractor is responsible for determining and implementing necessary controls and corrective actions.
- When repeat non-compliance/unsafe conditions are observed, notify the subcontractor safety representative and stop affected work until adequate corrective measures are implemented.
- When an apparent imminent danger exists, immediately remove all affected CH2M HILL employees and subcontractors, notify subcontractor safety representative, and stop affected work until adequate corrective measures are implemented. Notify the PM and RHSM as appropriate.
- Document all oral health and safety related communications in project field logbook, daily reports, or other records.

4.0 Personal Protective Equipment (PPE)

(Reference CH2M HILL- SOP HSE-117, *Personal Protective Equipment*)

4.1 Required PPE

- PPE must be worn by employees when actual or potential hazards exist and engineering controls or administrative practices cannot adequately control those hazards.
- A PPE assessment has been conducted by the RHSM based on project tasks (see PPE specifications below). Verification and certification of assigned PPE by task is completed by the RHSM or designee.
- Employees must be trained to properly wear and maintain the PPE.
- In work areas where actual or potential hazards are present at any time, PPE must be worn by employees working or walking through the area.
- Areas requiring PPE should be posted or employees must be informed of the requirements in an equivalent manner.
- PPE must be inspected prior to use and after any occurrence to identify any deterioration or damage.
- PPE must be maintained in a clean and reliable condition.
- Damaged PPE shall not be used and must either be repaired or discarded.
- PPE shall not be modified, tampered with, or repaired beyond routine maintenance.

The table below outlines PPE to be used according to task based on project-specific hazard assessment. If a task other than the tasks described in this table needs to be performed, contact the RHSM so this table can be updated.

PPE Specifications [a]

Task	Level	Required PPE	Head	Respirator [b]
General site entry Surveying Observation of material loading for offsite disposal Oversight of remediation and construction	D	Work clothes; steel-toe, leather work boots; work glove.	Hardhat [c] Safety glasses Ear protection [d]	None required
Groundwater sampling Surface Soil Sampling Soil boring Monitoring Well Installation Investigation-derived waste (drum) sampling and disposal	Modified D	Boots: Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers Gloves: Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Splash shield [c] Safety glasses Ear protection [d]	None required.
Tasks requiring upgrade	C	Coveralls: Polycoated Tyvek® Boots: Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers Gloves: Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Splash shield [c] Ear protection [d] Spectacle inserts	APR, full face, MSA Ultratwin or equivalent; with GME-H cartridges or equivalent[e].

Reasons for Upgrading or Downgrading Level of Protection

PPE Specifications [a]

Task	Level	Required PPE	Head	Respirator [b]

Upgrade[f]	Downgrade
Request from individual performing tasks. Change in work tasks that will increase contact or potential contact with hazardous materials. Occurrence or likely occurrence of gas or vapor emission. Known or suspected presence of dermal hazards. Instrument action levels (Section 5) exceeded.	New information indicating that situation is less hazardous than originally thought. Change in site conditions that decreases the hazard. Change in work task that will reduce contact with hazardous materials.

[a] Modifications are as indicated. CH2M HILL will provide PPE only to CH2M HILL employees.
[b] No facial hair that would interfere with respirator fit is permitted.
[c] Hardhat and splash-shield areas are to be determined by the SSC.
[d] Ear protection should be worn when conversations cannot be held at distances of 3 feet or less without shouting.
[e] Cartridge change-out schedule is at least every 8 hours (or one work day), except if relative humidity is > 85%, or if organic vapor measurements are > midpoint of Level C range (refer to Section 5)--then at least every 4 hours. If encountered conditions are different than those anticipated in this HSP, contact the HSM.
[f] Performing a task that requires an upgrade to a higher level of protection (e.g., Level D to Level C) is permitted only when the PPE requirements have been approved by the HSM, and an SSC qualified at that level is present.

PPE Certification

I certify that the PPE requirements listed in the table above for the associated tasks are based upon the project-specific hazard assessment I performed.

Michael Goldman CIH, CSP, CHMM, CPEA	09/08/09	09/08/09
Name	Date of Certification	Date(s) of Project Hazard Assessment

4.2 Respiratory Protection

(Reference CH2M HILL SOP HSE-121, *Respiratory Protection*)

- Respirator users must have completed appropriate respirator training within the past 12 months. Level C training is required for air-purifying respirators (APR) use
- Respirator users must complete the respirator medical monitoring protocol and been approved for the specific type of respirator to be used.
- Tight-fitting facepiece respirator (negative or positive pressure) users must have passed an appropriate fit test within past 12 months.
- Respirator use shall be limited to those activities identified in this plan. If site conditions change that alters the effectiveness of the specified respiratory protection, the RHSM shall be notified to amend the written plan.
- Tight-fitting facepiece respirator users shall be clean-shaven and shall perform a user seal check before each use.
- Canisters/cartridges shall be replaced according to the change-out schedule specified in this plan. Respirator users shall notify the SC or RHSM of any detection of vapor or gas breakthrough. The SC shall report any breakthrough events to the RHSM for schedule upgrade.

- Respirators in regular use shall be inspected before each use and during cleaning
- Respirators in regular use shall be cleaned and disinfected as often as necessary to ensure they are maintained in a clean and sanitary condition.
- Respirators shall be properly stored to protect against contamination and deformation.
- Field repair of respirators shall be limited to routine maintenance. Defective respirators shall be removed from service.
- The SC or designee shall complete the H&S Self-Assessment Checklist – Respiratory Protection included in Attachment 4 of this plan to verify compliance with CH2M HILL's respiratory protection program.

Respirator Change-Out Schedule

Contaminant	Change-Out Schedule
Tetrachloroethylene (PCE)	End-of-service life or end of shift (whichever occurs first)

5.0 Air Monitoring/Sampling

(Reference CH2M HILL SOP HSE-207, Exposure Monitoring for Airborne Chemical Hazards)

5.1 Air Monitoring Specifications

Instrument	Tasks	Action Levels[a]	Action to be Taken when Action Level reached	Frequency [b]	Calibration
PID: OVM with 10.6eV lamp or equivalent	All intrusive work	< 1 ppm 1 to 10 ppm > 10 ppm	Level D Level C Evacuate the work area and contact the HSM	Initially and periodically during task	Daily
CGI: MSA model 260 or 261 or equivalent	All intrusive work.	0-10% : 10-25% LEL: >25% LEL:	No explosion hazard Potential explosion hazard Explosion hazard; evacuate or vent	Continuous during advancement of boring or trench	Daily
O_2Meter: MSA model 260 or 261 or equivalent	All intrusive work	>25%[c] O_2: 20.9%[c] O_2: <19.5%[c] O_2:	Explosion hazard; evacuate or vent Normal O_2 O_2 deficient; vent	Continuous during advancement of boring or trench	Daily

[a] Action levels apply to sustained breathing-zone measurements above background.
[b] The exact frequency of monitoring depends on field conditions and is to be determined by the SC; generally, every 5 to 15 minutes if acceptable; more frequently may be appropriate. Monitoring results shall be recorded. Documentation should include instrument and calibration information, time, measurement results, personnel monitored, and place/location where measurement is taken (e.g., "Breathing Zone/MW-3", "at surface/SB-2", etc.).
[c] If the measured percent of O_2 is less than 10, an accurate LEL reading will not be obtained. Percent LEL and percent O_2 action levels apply only to ambient working atmospheres, and not to confined-space entry. More-stringent percent LEL and O_2 action levels are required for confined-space entry (refer to Section 2).
[d]Noise monitoring and audiometric testing also required.

5.2 Calibration Specifications

(Refer to the respective manufacturer's instructions for proper instrument-maintenance procedures)

Instrument	Gas	Span	Reading	Method
PID: OVM, 10.6 or 11.8 eV bulb	100 ppm isobutylene	RF = 1.0	100 ppm	1.5 lpm reg T-tubing
PID: MiniRAE, 10.6 eV bulb	100 ppm isobutylene	CF = 100	100 ppm	1.5 lpm reg T-tubing
PID: TVA 1000	100 ppm isobutylene	CF = 1.0	100 ppm	1.5 lpm reg T-tubing
FID: OVA	100 ppm methane	3.0 ± 1.5	100 ppm	1.5 lpm reg T-tubing
5 Gas Meter (MultiRAE) **PID:** OVM, 10.6 eV lamp	100 ppm isobutylene	RF = 1.0	100 ppm	1.5 lpm reg T-tubing/ tedlar bag
LEL/O_2/H_2S/CO Sensors	Methane	NA	2.5% (50% LEL)	1.5 lpm reg T-tubing/ tedlar bag
	Oxygen	NA	20.9%	1.5 lpm reg T-tubing/ tedlar bag
	Hydrogen Sulfide	NA	25	1.5 lpm reg T-tubing/ tedlar bag
	Carbon Monoxide	NA	50	1.5 lpm reg T-tubing/ tedlar bag

5.3 Air Sampling

Sampling, in addition to real-time monitoring, may be required by other OSHA regulations where there may be exposure to certain contaminants. Air sampling typically is required when site contaminants include lead, cadmium, arsenic, asbestos, and certain volatile organic compounds. Contact the HSM immediately if these contaminants are encountered.

Method Description

NA

Personnel and Areas

Results must be sent immediately to the RHSM. Regulations may require reporting to monitored personnel. Results reported to:

HSM: Michael Goldman

6.0 Decontamination

(Reference CH2M HILL SOP HSE-218, *Hazardous Waste Operations*)

The SC must establish and monitor the decontamination procedures and their effectiveness. Decontamination procedures found to be ineffective will be modified by the SC. The SC must ensure that procedures are established for disposing of materials generated on the site.

6.1 Decontamination Specifications

Personnel

- Boot wash/rinse
- Glove wash/rinse
- Outer-glove removal
- Body-suit removal
- Inner-glove removal
- Respirator removal
- Hand wash/rinse
- Face wash/rinse
- Shower ASAP
- Dispose of PPE in municipal trash, or contain for disposal
- Dispose of personnel rinse water to facility or sanitary sewer, or contain for offsite disposal

Sample Equipment

- Wash/rinse equipment
- Solvent-rinse equipment
- Contain solvent waste for offsite disposal

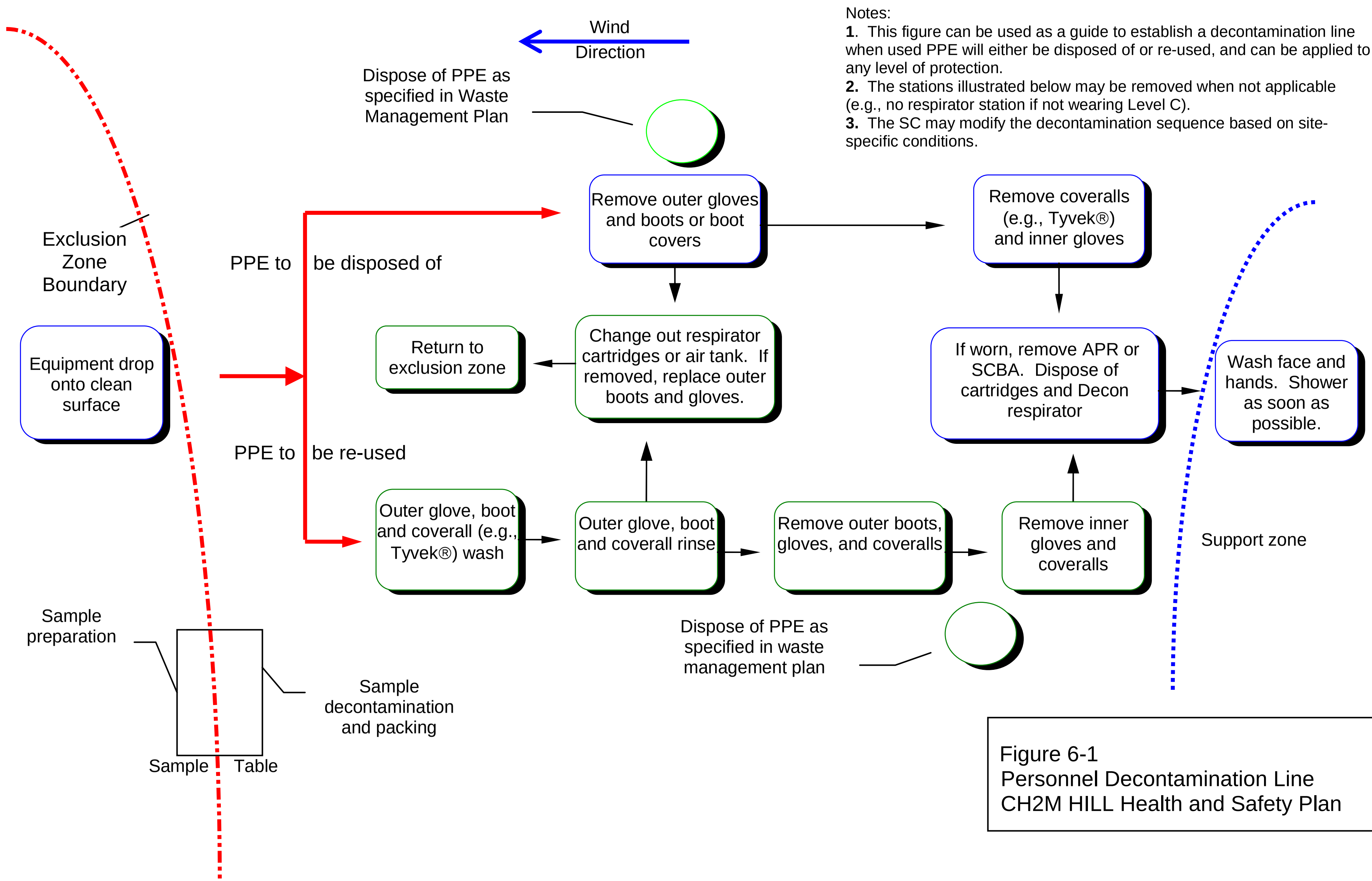
Heavy Equipment

- Power wash
- Steam clean
- Dispose of equipment rinse water to facility or sanitary sewer, or contain for offsite disposal

6.2 Diagram of Personnel-Decontamination Line

No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones. The SC should establish areas for eating, drinking, and smoking. Contact lenses are not permitted in exclusion or decontamination zones.

Figure 6-1 illustrates a conceptual establishment of work zones, including the decontamination line. Work zones are to be modified by the SC to accommodate task-specific requirements.



Notes:
1. This figure can be used as a guide to establish a decontamination line when used PPE will either be disposed of or re-used, and can be applied to any level of protection.
2. The stations illustrated below may be removed when not applicable (e.g., no respirator station if not wearing Level C).
3. The SC may modify the decontamination sequence based on site-specific conditions.

Figure 6-1
Personnel Decontamination Line
CH2M HILL Health and Safety Plan

7.0 Spill Containment Procedures

Sorbent material will be maintained in the support zone. Incidental spills will be contained with sorbent and disposed of properly.

8.0 Site-Control Plan

8.1 Site-Control Procedures

(Reference CH2M HILL SOP HSE-218, *Hazardous Waste Operations)*

- The SC will conduct a site safety briefing (see below) before starting field activities or as tasks and site conditions change.
- Topics for briefing on site safety: general discussion of Health and Safety Plan, site-specific hazards, locations of work zones, PPE requirements, equipment, special procedures, emergencies.
- The SC records attendance at safety briefings in a logbook and documents the topics discussed.
- Post the OSHA job-site poster in a central and conspicuous location in accordance with CH2M HILL- Core Standard, OSHA Postings.
- Establish support, decontamination, and exclusion zones. Delineate with flags or cones as appropriate. Support zone should be upwind of the site. Use access control at entry and exit from each work zone.
- Establish onsite communication consisting of the following:
  - Line-of-sight and hand signals
  - Air horn
  - Two-way radio or cellular telephone if available
- Establish offsite communication.
- Establish and maintain the "buddy system."
- Initial air monitoring is conducted by the SC in appropriate level of protection.
- The SC is to conduct periodic inspections of work practices to determine the effectiveness of this plan – refer to Sections 2 and 3. Deficiencies are to be noted, reported to the HSM, and corrected.

8.2 Hazwoper Compliance Plan

(Reference CH2M HILL SOP HSE-220, Written Plans and HSE-218 Hazardous Waste Operations)

Certain parts of the site work are covered by state or federal Hazwoper standards and therefore require training and medical monitoring. Anticipated Hazwoper tasks (Section 1.1.1) might occur consecutively or concurrently with respect to non-Hazwoper tasks. This section outlines procedures to be followed when approved activities specified in Section 1.1.2 do not require 24- or 40-hour training. Non-Hazwoper-trained personnel also must be trained in accordance with all other state and federal OSHA requirements.

- In many cases, air sampling, in addition to real-time monitoring, must confirm that there is no exposure to gases or vapors before non-Hazwoper-trained personnel are allowed on the site, or while non-Hazwoper-trained staff is working in proximity to Hazwoper activities. Other data (e.g., soil) also must document that there is no potential for exposure. The RHSM must approve the interpretation of these data. Refer to Sections 2.0 and 5.0 for contaminant data and air sampling requirements, respectively.

- When non-Hazwoper-trained personnel are at risk of exposure, the SC must post the exclusion zone and inform non-Hazwoper-trained personnel of the:
  - Nature of the existing contamination and its locations
  - Limitations of their access
  - Emergency action plan for the site
- Periodic air monitoring with direct-reading instruments conducted during regulated tasks also should be used to ensure that non-Hazwoper-trained personnel (e.g., in an adjacent area) are not exposed to airborne contaminants.
- When exposure is possible, non-Hazwoper-trained personnel must be removed from the site until it can be demonstrated that there is no longer a potential for exposure to health and safety hazards.
- Remediation treatment system start-ups: Once a treatment system begins to pump and treat contaminated media, the site is, for the purposes of applying the Hazwoper standard, considered a treatment, storage, and disposal facility (TSDF). Therefore, once the system begins operation, only Hazwoper-trained personnel (minimum of 24 hour of training) will be permitted to enter the site. All non-Hazwoper-trained personnel must not enter the TSDF area of the site.

9.0 Emergency Response Plan

(Reference CH2M HILL SOP HSE-106, *Emergency Planning*)

9.1 Pre-Emergency Planning

- The Emergency Response Coordinator (ERC) performs the applicable pre-emergency planning tasks before starting field activities and coordinates emergency response with CH2M HILL onsite parties, the facility, and local emergency-service providers as appropriate.
- Review the facility emergency and contingency plans where applicable.
- Determine what onsite communication equipment is available (e.g., two-way radio, air horn).
- Determine what offsite communication equipment is needed (e.g., nearest telephone, cell phone).
- Confirm and post emergency telephone numbers, evacuation routes, assembly areas, and route to hospital; communicate the information to onsite personnel.
- Field Trailers: Post "Exit" signs above exit doors, and post "Fire Extinguisher" signs above locations of extinguishers. Keep areas near exits and extinguishers clear.
- Review changed site conditions, onsite operations, and personnel availability in relation to emergency response procedures.
- Where appropriate and acceptable to the client, inform emergency room and ambulance and emergency response teams of anticipated types of site emergencies.
- Designate one vehicle as the emergency vehicle; place hospital directions and map inside; keep keys in ignition during field activities.
- Inventory and check site emergency equipment, supplies, and potable water.
- Communicate emergency procedures for personnel injury, exposures, fires, explosions, and releases.
- Rehearse the emergency response plan before site activities begin, including driving route to hospital. Drills should take place periodically but no less than once a year.
- Brief new workers on the emergency response plan.
- The ERC will evaluate emergency response actions and initiate appropriate follow-up actions.

9.2 Emergency Equipment and Supplies

The ERC should mark the locations of emergency equipment on the site map and post the map.

Emergency Equipment and Supplies	Location
20 (or two 10) class A,B,C fire extinguisher	Support Zone/Project Vehicle
First aid kit (to meet USACE EM 385-1-1 requirement)	Support Zone/Project Vehicle
Eye Wash	Support Zone/Project Vehicle
Emergency Shower	TBD
Potable water	Support Zone/Project Vehicle
Bloodborne-pathogen kit	Support Zone/Project Vehicle
Additional equipment (specify):	Automated External Defibrillator

9.3 Incident Response

In fires, explosions, or chemical releases, actions to be taken include the following:

- Notify appropriate response personnel.
- Shut down CH2M HILL operations and evacuate the immediate work area.
- Account for personnel at the designated assembly area(s).
- Assess the need for site evacuation, and evacuate the site as warranted.
- Implement HSE-111, Incident Notification, Reporting and Investigation.
- Notify and submit reports to clients as required in contract.

Small fires or spills posing minimal safety or health hazards may be controlled with onsite spill kits or fire extinguishers without evacuating the site. When in doubt evacuate. Follow the incident reporting procedures in Section 9.7.

9.4 Emergency Medical Treatment

Emergency medical treatment is needed when there is a life-threatening injury (such as severe bleeding, loss of consciousness, breathing/heart has stopped). When in doubt if an injury is life-threatening or not, treat it as needing emergency medical treatment.

- Notify 911 or other appropriate emergency response authorities as listed in Emergency Contacts at the front of this HSP.
- The ERC will assume charge during a medical emergency until the ambulance arrives or until the injured person is admitted to the emergency room.
- Prevent further injury, perform decontamination (if applicable) where feasible; lifesaving and first aid or medical treatment takes priority.
- Initiate first aid and CPR where feasible.
- Notify supervisor and if the injured person is a CH2M HILL employee, the supervisor will call the occupational nurse at 1-866-893-2514 and make other notifications as required by HSE SOP-111, Incident Notification, Reporting and Investigation.
- Make certain that the injured person is accompanied to the emergency room.
- Follow the Serious Incident Reporting process in HSE SOP-111, Incident Notification, Reporting and Investigation, and complete incident report forms in Attachment 5.
- Notify and submit reports to client as required in contract.

9.5 Evacuation

- Evacuation routes, assembly areas, and severe weather shelters (and alternative routes and assembly areas) are to be specified on the site map.
- Evacuation route(s) and assembly area(s) will be designated by the ERC or designee before work begins.
- Personnel will assemble at the assembly area(s) upon hearing the emergency signal for evacuation.
- The ERC and a “buddy” will remain on the site after the site has been evacuated (if safe) to assist local responders and advise them of the nature and location of the incident.
- The ERC will account for all personnel in the onsite assembly area.

- A designated person will account for personnel at alternate assembly area(s).
- The ERC will follow the incident reporting procedures in Section 9.7.

9.6 Evacuation Signals

Signal	Meaning
Grasping throat with hand	Emergency-help me.
Thumbs up	OK; understood.
Grasping buddy's wrist	Leave area now.
Continuous sounding of horn	Emergency; leave site now.

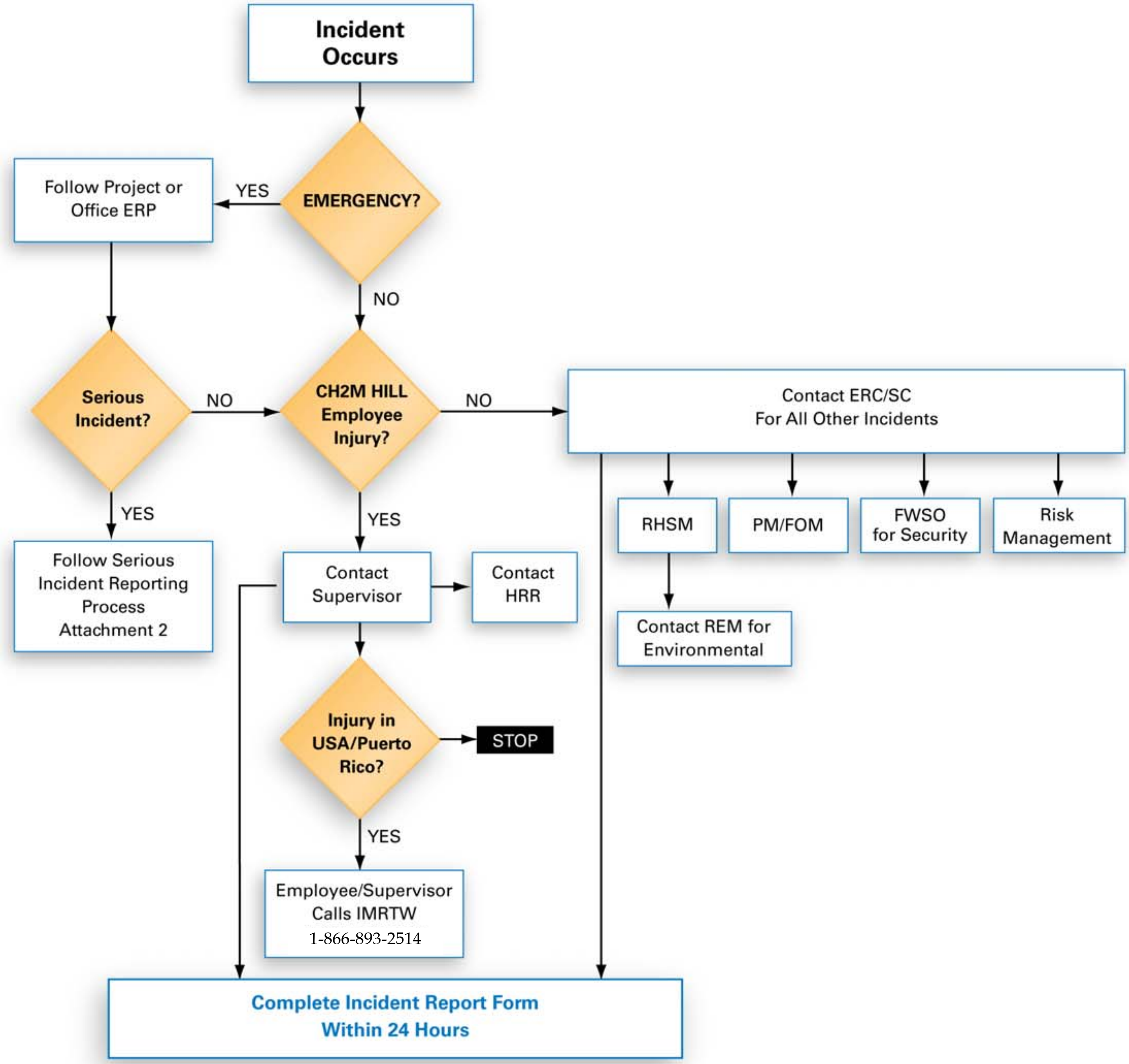
9.7 Incident Notification and Reporting

(Reference CH2M HILL SOP HSE-111, Incident Notification, Reporting and Investigation)

- If you are injured at work, notify your supervisor immediately and contact the Injury Management/Return-to-Work toll free number (for US and Puerto Rico) 1-866-893-2514. All supervisors must contact their Human Resources Representative and complete the employee injury/illness in the Incident Report Form (IRF) in the HITS database within 24 hours of the incident.
- Immediately notify the Project Manager (PM), Emergency Response Coordinator (ERC), and/or Responsible Health and Safety Manager (RHSM) for any project incident (fire, spill/release, injury/illness, near miss, property damage, or security-related).
- Report any serious incidents (life-threatening injury/illness, death, kidnap/missing person, terrorism, property damage greater than $500K, significant environmental release) immediately to your ERC, PM, or RHSM. The Serious Incident Reporting number is 720-286-4911.
- For serious incidents, the Corporate Legal Department will determine who completes the IRF.
- For CH2M HILL subcontractor incidents, immediately notify the ERC and HSM to complete and submit an IRF.
- The RHSM will inform the Responsible Environmental Manager (REM) of any environmental incidents.
- Evaluation and follow-up of the IRF will be completed by the type of incident by the RHSM, REM, or FWSO. The Business Group (BG) HSE Lead will review all BG incidents and modify as required.
- Incident Investigations must be initiated and completed as soon as possible but no later than 72 hours after the incident.

See the following flowcharts for Immediate Incident Reporting and Serious Incident Reporting.

Attachment 1
CH2M HILL Immediate Incident Notification



ERC = Emergency Response Coordinator (designated in Emergency Response Plan)
ERP = Emergency Response Plan
FOM = Facility Office Manager
FWSO = Firm Wide Security Operations
HRR = Human Resources Representative
IMRTW = Injury Management/Return-to-Work
PM = Project Manager
REM = Responsible Environmental Manager
RHSM = Responsible Health & Safety Manager
SC = Safety Coordinator

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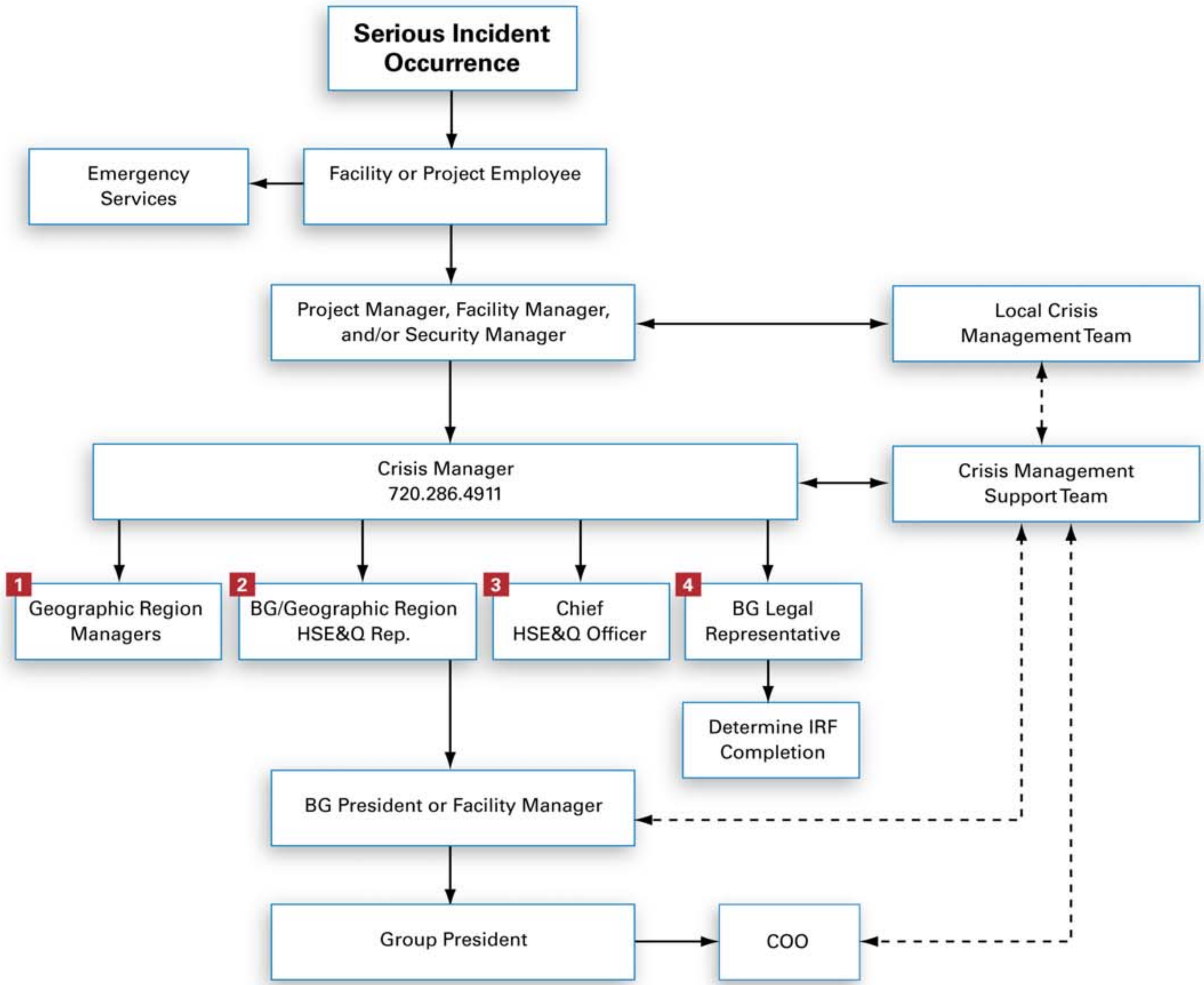
Attachment 2
CH2M HILL Serious Incident Notification



LEGEND:

→ Direct line of communication

←- - -→ Indirect line of communication

DEFINITIONS:

Local Crisis Management Team: Team comprised of key facility, project and/or business group personnel. Team is assembled as necessary and as appropriate to effectively manage and respond to a crisis situation (serious incident) at/on scene.

Crisis Management Support Team: Team comprised of key corporate personnel. Team is assembled as necessary and as appropriate to effectively support, direct, and /or supplement a Local Crisis Management Team.

Crisis Manager: Corporate based Crisis Manager, contactable by pager 24/7.

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10.0 Behavior Based Loss Prevention System

(Reference CH2M HILL SOP HSE-103, Behavior Based Loss Prevention System)
A Behavior Based Loss Prevention System (BBLPS) is a system to prevent or reduce losses using behavior-based tools and proven management techniques to focus on behaviors or acts that could lead to losses.

The four basic Loss Prevention tools that will be used by CH2M HILL projects to implement the BBLPS include:

- Activity Hazard Analysis (AHA)
- Pre-Task Safety Plans (PTSP)
- Safe Behavior Observations (SBO)
- Loss and Near Loss Investigations (NLI)

The SC or designated CH2M HILL representative onsite is responsible for implementing the BBLPS on the project site. The Project Manager remains accountable for its implementation. The SC or designee shall only oversee the subcontractor's implementation of their AHAs and PTSPs processes on the project.

10.1 Activity Hazard Analysis

An Activity Hazard Analysis (AHA) defines the activity being performed, the hazards posed and control measures required to perform the work safely. Workers are briefed on the AHA before doing the work and their input is solicited prior, during and after the performance of work to further identify the hazards posed and control measures required.

Activity Hazard Analysis will be prepared before beginning each project activity posing H&S hazards to project personnel using the AHA form provided in Attachment 5. The AHA shall identify the work tasks required to perform each activity, along with potential H&S hazards and recommended control measures for each work task. In addition, a listing of the equipment to be used to perform the activity, inspection requirements and training requirements for the safe operation of the equipment listed must be identified. Consult Corps of Engineers Safety and Health Manual (EM385-1-1, 01.A. 13-14 & Figure 1-2) when preparing AHAs.

An AHA shall be prepared for all field activities performed by CH2M HILL and subcontractor activities during the course of the project. Hazard Controls (found in Sections 2.0 and its subsections of the HSP), the Hazard Analysis Table (Table 1), and applicable CH2M HILL CSs and SOPs should be used as a basis for preparing AHAs.

CH2M HILL subcontractors are required to provide AHAs specific to their scope of work on the project for acceptance by CH2M HILL. Each subcontractor shall submit AHAs for their field activities, as defined in their work plan/scope of work, along with their project-specific safety plan/accident prevention plan. Additions or changes in CH2M HILL or subcontractor field activities, equipment, tools or material to perform work or additional/different hazard encountered that require additional/different hazard control measures requires either a new AHA to be prepared or an existing AHA to be revised.

10.2 Pre-Task Safety Plans

Daily safety meetings are held with all project personnel in attendance to review the hazards posed and required H&S procedures/AHAs, which apply for each day's project activities. The PTSPs serve the same purpose as these general assembly safety meetings, but the PTSPs are held between the crew supervisor and their work crews to focus on those hazards posed to individual work crews. At the start of each day's activities, the crew supervisor completes the PTSP, provided in Attachment 5, with input from the work crew, during their daily safety meeting. The day's tasks, personnel, tools and equipment that will be used to perform these tasks are listed, along with the hazards posed and required H&S procedures, as identified in the AHA. The use of PTSPs, better promotes worker participation in the hazard recognition and control process, while reinforcing the task-specific hazard and required H&S procedures with the crew each day. The use of PTSPs is a common safety practice in the construction industry.

10.3 Safe Behavior Observations

Safe Behavior Observations (SBOs) shall be conducted by SC or designee for specific work tasks or operations comparing the actual work process against established safe work procedures identified in the project-specific HSP and AHAs. SBOs are a tool to be used by supervisors to provide positive reinforcement for work practices performed correctly, while also identifying and eliminating deviations from safe work procedures that could result in a loss. The SC or designee shall perform at least one SBO each week for tasks/operations addressed in the project-specific HSP or AHA. The SC or designee shall complete the SBO form in **Attachment 5** for the task/operation being observed and submit the SBO form weekly to the SER SBO Mailbox.

10.4 Loss/Near Loss Investigations

Loss/Near Loss Investigations shall be performed for CH2M HILL and subcontractor incidents involving:

- Person injuries/illnesses and near miss injuries,
- Equipment/property damage,
- Spills, leaks, regulatory violations,
- Motor vehicle accidents.

The cause of loss and near loss incidents are similar, so by identifying and correcting the causes of near loss causes, future loss incidents may be prevented. The following is the Loss/Near Loss Investigation Process:

- Gather all relevant facts, focusing on fact-finding, not fault-finding, while answering the who, what, when, where and how questions.
- Draw conclusions, pitting facts together into a probable scenario.
- Determine incident root cause(s), which are basic causes on why an unsafe act/condition existed.
- Develop and implement solutions, matching all identified root causes with solutions.
- Communicate incident as a Lesson Learned to all project personnel.
- Filed follow-up on implemented corrective active action to confirm solution is appropriate.

The SC or designee shall perform an incident investigation, as soon as practical after incident occurrence during the day of the incident, for all Loss and Near Loss Incidents that occur on the project. Loss and Near Loss incident investigations shall be performed using the following incident investigation forms provided in **Attachment 5.**

- Incident Report Form (IRF)
- Root Cause Analysis Form

All Loss and Near Loss incident involving personal injury, property damage in excess of $1,000 or near loss incidents that could have resulted in serious consequences shall be investigated by completing the incident investigation forms and submitting them to the PM and RHSM within 24 hours of incident occurrence. A preliminary Incident Investigation and Root Cause Analysis shall be submitted to the Project Manager and RHSM within 24 hours of incident occurs. The final Incident Investigation and Root Cause Analysis shall be submitted after completing a comprehensive investigation of the incident.

11.0 Approval

This site-specific HSP has been written for use by CH2M HILL only. CH2M HILL claims no responsibility for its use by others unless that use has been specified and defined in project or contract documents. The plan is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if those conditions change.

Original Plan

Written By: Tom Wiley **Date: September 2, 2009**

Approved By: Michael Goldman **Date: September 8, 2009**

Revisions

Revisions Made By: Maxwell Bertram **Date: December 10, 2009**

Revisions to Plan: Added Automated External Defibrillator to Section 9.2; Added COE H&S Manual Reference regarding AHA development to Section 10.1; SBO routing updated to include SER SBO Mailbox routing.

Revisions Approved By: **Date:**

12.0 Attachments

Attachment 1:	Employee Signoff Form – Health and Safety Plan
Attachment 2:	Chemical Inventory/Register Form
Attachment 3:	Chemical-Specific Training Form
Attachment 4:	Project Activity Self-Assessment Checklists/Permits/Forms
Attachment 5:	Behavior Based Loss Prevention Forms
Attachment 6:	Material Safety Data Sheets
Attachment 7:	Working Alone Standard
Attachment 8:	Tick Fact Sheet
Attachment 9:	Notice of Safety Violation Form
Attachment 10:	Stop Work Order Form
Attachment 11:	Vehicle Accident Guidance

CH2M HILL Health and Safety Plan

Attachment 1

Employee Sign-off Form – Health and Safety Plan

EMPLOYEE SIGNOFF FORM
Health and Safety Plan

The CH2M HILL project employees and subcontractors listed below have been provided with a copy of this HSP, have read and understood it, and agree to abide by its provisions.

Project Name: **Project Number:** 394076

EMPLOYEE NAME (Please print)	**EMPLOYEE SIGNATURE**	**COMPANY**	**DATE**

Chemical Inventory/Register Form

CH2MHILL

CHEMICAL INVENTORY/REGISTER FORM

Refer to SOP HSE-107, Attachment 1, for instructions on completing this form.

Location: ____

HCC: ____

☐ Office ☐ Warehouse ☐ Laboratory ☐ Project: ____________________

Project No.: ________________

Regulated Product	Location	Container labeled (✓if yes)	MSDS available (✓if yes)

MSDS for the listed products will be maintained at: ____________________

Chemical-Specific Training Form

CH2MHILL

CHEMICAL-SPECIFIC TRAINING FORM

Refer to SOP HSE-107 Attachment 1 for instructions on completing this form.

Location: Project # :

HCC: Trainer:

TRAINING PARTICIPANTS:

NAME	SIGNATURE	NAME	SIGNATURE

REGULATED PRODUCTS/TASKS COVERED BY THIS TRAINING:

The HCC shall use the product MSDS to provide the following information concerning each of the products listed above.

- ☐ Physical and health hazards
- ☐ Control measures that can be used to provide protection (including appropriate work practices, emergency procedures, and personal protective equipment to be used)
- ☐ Methods and observations used to detect the presence or release of the regulated product in the workplace (including periodic monitoring, continuous monitoring devices, visual appearance or odor of regulated product when being released, etc.)

Training participants shall have the opportunity to ask questions concerning these products and, upon completion of this training, will understand the product hazards and appropriate control measures available for their protection.

Copies of MSDSs, chemical inventories, and CH2M HILL's written hazard communication program shall be made available for employee review in the facility/project hazard communication file.

CH2M HILL Health and Safety Plan

Attachment 4

Project Activity Self-Assessment Checklists/Permits/Forms

- **Drilling**
- **Earthmoving Equipment**

CH2MHILL

HS&E Self-Assessment Checklist - DRILLING

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's written safety plan.

This checklist is to be used at locations where: 1) CH2M HILL employees are potentially exposed to drilling hazards, 2) CH2M HILL staff are providing support function related to drilling activities, and/or 3) CH2M HILL oversight of a drilling subcontractor is required.

Safety Coordinator may consult with drilling subcontractors when completing this checklist, but shall not direct the means and methods of drilling operations nor direct the details of corrective actions. Drilling subcontractors shall determine how to correct deficiencies and we must carefully rely on their expertise. Items considered to be imminently dangerous (possibility of serious injury or death) shall be corrected immediately, or all exposed personnel shall be removed from the hazard until corrected.

Project Name: ____ Project No.: ___________________

Location: ____ PM: ______________________________

Auditor: _______________________________ Title: ____________________________ Date: ___________

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposures to drilling hazards (complete Section 1).
☐ Evaluate CH2M HILL support functions related to drilling activities (complete Section 2)
☐ Evaluate a CH2M HILL subcontractor's compliance with drilling safety requirements (complete entire checklist).
Subcontractors Name: ____

- Check "Yes" if an assessment item is complete/correct.
- Check "No" if an item is incomplete/deficient. Deficiencies shall be brought to the immediate attention of the drilling subcontractor. Section 3 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in SOP HSE-204.

SECTION 1 - SAFE WORK PRACTICES (4.1)

	Yes	No	N/A	N/O
1. Personnel cleared during rig startup	☐	☐	☐	☐
2. Personnel clear of rotating parts	☐	☐	☐	☐
3. Personnel not positioned under hoisted loads	☐	☐	☐	☐
4. Loose clothing and jewelry removed	☐	☐	☐	☐
5. Smoking is prohibited around drilling operation	☐	☐	☐	☐
6. Personnel wearing appropriate personal protective equipment (PPE), per written plan	☐	☐	☐	☐
7. Personnel instructed not to approach equipment that has become electrically energized	☐	☐	☐	☐

SECTION 2 - SUPPORT FUNCTIONS (4.2)

FORMS/PERMITS (4.2.1)

	Yes	No	N/A	N/O
8. Driller license/certification obtained	☐	☐	☐	☐
9. Well development/abandonment notifications and logs submitted and in project files	☐	☐	☐	☐
10. Water withdrawal permit obtained, where required	☐	☐	☐	☐
11. Dig permit obtained, where required	☐	☐	☐	☐

UTILITY LOCATING (4.2.2)

	Yes	No	N/A	N/O
12. Location of underground utilities and structures identified	☐	☐	☐	☐

SECTION 2 (Continued)

	Yes	No	N/A	N/O
WASTE MANAGEMENT (4.2.3)				
13. Drill cuttings and purge water managed and disposed properly	☐	☐	☐	☐
DRILLING AT HAZARDOUS WASTE SITES (4.2.4)				
14. Waste disposed of according to project's written safety plan	☐	☐	☐	☐
15. Appropriate decontamination procedures being followed, per project's written safety plan	☐	☐	☐	☐
DRILLING AT MUNITIONS RESPONSE (4.2.5)				
16. MEC plan prepared and approved	☐	☐	☐	☐
17. MEC avoidance provided, routes and boundaries cleared and marked	☐	☐	☐	☐
18. Initial pilot hole established by UXO technician with hand auger	☐	☐	☐	☐
19. Personnel remain inside cleared areas	☐	☐	☐	☐
SECTION 3 - DRILLING SAFETY REQUIREMENTS (4.3)				
GENERAL (4.3.1)				
20. Only authorized personnel operating drill rigs	☐	☐	☐	☐
21. Daily safety briefing/meeting conducted with crew	☐	☐	☐	☐
22. Daily inspection of drill rig and equipment conducted before use	☐	☐	☐	☐
DRILL RIG PLACEMENT (4.3.2)				
23. Location of underground utilities and structures identified	☐	☐	☐	☐
24. Safe clearance distance maintained from overhead power lines	☐	☐	☐	☐
25. Drilling pad established, when necessary	☐	☐	☐	☐
26. Drill rig leveled and stabilized	☐	☐	☐	☐
27. Additional precautions taken when drilling in confined areas	☐	☐	☐	☐
DRILL RIG TRAVEL (4.3.3)				
28. Rig shut down and mast lowered and secured prior to rig movement	☐	☐	☐	☐
29. Tools and equipment secured prior to rig movement	☐	☐	☐	☐
30. Only personnel seated in cab are riding on rig during movement	☐	☐	☐	☐
31. Safe clearance distance maintained while traveling under overhead power lines	☐	☐	☐	☐
32. Backup alarm or spotter used when backing rig	☐	☐	☐	☐
DRILL RIG OPERATION (4.3.4)				
33. Kill switch clearly identified and operational	☐	☐	☐	☐
34. All machine guards are in place	☐	☐	☐	☐
35. Rig ropes not wrapped around body parts	☐	☐	☐	☐
36. Pressurized lines and hoses secured from whipping hazards	☐	☐	☐	☐
37. Drill operation stopped during inclement weather	☐	☐	☐	☐
38. Air monitoring conducted per written safety plan for hazardous atmospheres	☐	☐	☐	☐
39. Rig placed in neutral when operator not at controls	☐	☐	☐	☐
DRILL RIG SITE CLOSURE (4.3.5)				
40. Ground openings/holes filled or barricaded	☐	☐	☐	☐
41. Equipment and tools properly stored	☐	☐	☐	☐
42. All vehicles locked and keys removed	☐	☐	☐	☐
DRILL RIG MAINTENANCE (4.3.6)				
28. Defective components repaired immediately	☐	☐	☐	☐
29. Lockout/tagout procedures used prior to maintenance	☐	☐	☐	☐
30. Cathead in clean, sound condition	☐	☐	☐	☐
31. Drill rig ropes in clean, sound condition	☐	☐	☐	☐
32. Fall protection used for fall exposures of 6 feet (U.S.) 1.5 meters (Australia) or greater	☐	☐	☐	☐
33. Rig in neutral and augers stopped rotating before cleaning	☐	☐	☐	☐
34. Good housekeeping maintained on and around rig	☐	☐	☐	☐

SECTION 4

Complete this section for all items checked "No" in previous sections. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

Auditor: ______________________________ Project Manager: ________________________________

HS&E Self-Assessment Checklist - EARTHMOVING EQUIPMENT

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's HSP/FSI.

This checklist is to be used at locations where: 1) CH2M HILL employees are potentially exposed to the hazards of earthmoving equipment operations, 2) CH2M HILL employees are operating earthmoving equipment, and/or 3) CH2M HILL provides oversight of a subcontractor operating earthmoving equipment.

The CH2M HILL Safety Coordinator may consult with subcontractors operating earthmoving equipment when completing this checklist, but shall not direct the means and methods of equipment operations nor direct the details of corrective actions. Earthmoving equipment subcontractors shall determine how to correct deficiencies and we must carefully rely on their expertise. Items considered to be imminently dangerous (possibility of serious injury or death) shall be corrected immediately or all exposed personnel shall be removed from the hazard until corrected.

Project Name: ____ Project No.: ______________________

Location: ____ PM: __________________________________

Auditor: ____________________________________ Title: _________________________________ Date: _____________

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposures to earthmoving equipment hazards (complete Section 1).
☐ Evaluate CH2M HILL employees operating earthmoving equipment (complete entire checklist).
☐ Evaluate CH2M HILL subcontractor's compliance with earthmoving equipment safety requirements (complete entire checklist). Subcontractors Name: ____

- Check "Yes" if an assessment item is complete/correct.
- Check "No" if an item is incomplete/deficient. Deficiencies shall be brought to the immediate attention of the earthmoving equipment subcontractor. Section 3 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in Standard of Practice HSE-306.

SAFE WORK PRACTICES (5.1) — SECTION 1	Yes	No	N/A	N/O
1. Personnel maintaining safe distance from operating equipment	☐	☐	☐	☐
2. Positioning personnel in close proximity to operating equipment is avoided	☐	☐	☐	☐
3. Personnel wearing high-visibility and/or reflective vests when close to operating equipment	☐	☐	☐	☐
4. Personnel approach operating equipment safely	☐	☐	☐	☐
5. Personnel riding only in seats of equipment cab and using seat belts	☐	☐	☐	☐
6. Personnel not positioned under elevated portions of equipment	☐	☐	☐	☐
7. Personnel not positioned under hoisted loads	☐	☐	☐	☐
8. Personnel not hoisted by equipment	☐	☐	☐	☐
9. Personnel do not to approach equipment that has become electrically energized	☐	☐	☐	☐
10. Personnel wearing appropriate PPE, per HSP/FSI	☐	☐	☐	☐

EQUIPMENT SAFETY REQUIREMENTS **SECTION 2**

PRIOR TO OPERATING EQUIPMENT (5.2.1)

	Yes	No	N/A	N/O
11. Only qualified and authorized personnel operating equipment	☐	☐	☐	☐
12. Daily safety briefing/meeting conducted with equipment operators	☐	☐	☐	☐
13. Daily inspection of equipment conducted and documented	☐	☐	☐	☐
14. Modifications and attachments used approved by equipment manufacturer	☐	☐	☐	☐
15. Backup alarm or spotter used when backing equipment	☐	☐	☐	☐
16. Operational horn provided on bi-directional equipment	☐	☐	☐	☐
17. Seat belts are provided and used	☐	☐	☐	☐
18. Rollover protective structures (ROPS) provided	☐	☐	☐	☐
19. Braking system capable of stopping full payload	☐	☐	☐	☐
20. Headlights and taillights operable when additional light required	☐	☐	☐	☐
21. Brake lights in operable condition	☐	☐	☐	☐
22. Cab glass provides no visible distortion to the operator	☐	☐	☐	☐
23. All machine guards are in place	☐	☐	☐	☐
24. Hauling equipment (dump trucks) provided with cab shield or canopy	☐	☐	☐	☐
25. Dump truck beds provided with positive means of support during maintenance or inspection	☐	☐	☐	☐
26. Dump truck operating levers provided with latch to prevent accidental dumping	☐	☐	☐	☐
27. Air monitoring conducted per HSP/FSI for hazardous atmospheres	☐	☐	☐	☐

EQUIPMENT PLACEMENT (5.2.2)

	Yes	No	N/A	N/O
28. Equipment position on firm/level surface, outriggers used	☐	☐	☐	☐
29. Location of underground utilities identified	☐	☐	☐	☐
30. Safe clearance distance maintained while working under overhead power lines	☐	☐	☐	☐
31. Safe distance is maintained while traveling under power lines	☐	☐	☐	☐
32. Warning system used to remind operator of excavation edge	☐	☐	☐	☐
33. Unattended equipment visibly marked at night	☐	☐	☐	☐
34. Tools lowered/parking brake set when not in use, wheels chocked when parked on incline	☐	☐	☐	☐

EQUIPMENT OPERATION (5.2.3)

	Yes	No	N/A	N/O
35. Equipment operated on safe roadways and grades	☐	☐	☐	☐
36. Equipment operated at safe speed	☐	☐	☐	☐
37. Operators maintain unobstructed view of travel path	☐	☐	☐	☐
38. Equipment not operated during inclement weather, lightning storms	☐	☐	☐	☐
39. Equipment started and moved safely	☐	☐	☐	☐
40. Operators keep body parts inside cab during operation	☐	☐	☐	☐
41. Vehicle occupants in safe position while loading/unloading	☐	☐	☐	☐
42. Signal person visible to operator when required	☐	☐	☐	☐
43. Equipment used for hoisting done according to equipment manufacturer specifications	☐	☐	☐	☐
44. Lifting and hauling capacities are not exceeded	☐	☐	☐	☐

EQUIPMENT MAINTENANCE (5.2.4)

	Yes	No	N/A	N/O
45. Defective components repaired immediately	☐	☐	☐	☐
46. Suspended equipment or attachments supported prior to work under or between	☐	☐	☐	☐
47. Lockout/tagout procedures used prior to maintenance	☐	☐	☐	☐
48. Tires on split rims removed using safety tire rack or cage	☐	☐	☐	☐
49. Good housekeeping maintained on and around equipment	☐	☐	☐	

CH2M HILL Health and Safety Plan

Attachment 5

Behavior Based Loss Prevention System Forms

- **Activity Hazard Analysis Template**
- **Pre-Task Safety Plans**
- **Safe Behavior Observation**
- **Incident Report and Investigation**

(use electronic form when possible)

HITS

Activity:	**Date:**
	Project:
Description of the work:	**Site Supervisor:**
Note to Staff: Consult Corps of Engineer Safety and Health Manual located below when preparing AHA: http://140.194.76.129/publications/eng-manuals/em385-1-1/2008_English/toc.html	**Site Safety Officer:**
	Review for latest use: **Before the job is performed.**

Work Activity Sequence (Identify the principal steps involved and the sequence of work activities)	Potential Health and Safety Hazards (Analyze each principal step for potential hazards)	Hazard Controls (Develop specific controls for each potential hazard)

Equipment to be used (List equipment to be used in the work activity)	Inspection Requirements (List inspection requirements for the work activity)	Training Requirements (List training requirements including hazard communication)

	PRINT NAME	SIGNATURE	
Supervisor Name:	____________	________________	**Date/Time:**____________
Safety Officer Name:	____________	________________	**Date/Time:**____________
Employee Name(s):	____________	________________	**Date/Time:**____________
	____________	________________	**Date/Time:**____________
	____________	________________	**Date/Time:**____________
	____________	________________	**Date/Time:**____________
	____________	________________	**Date/Time:**____________
	____________	________________	**Date/Time:**____________
	____________	________________	**Date/Time:**____________
	____________	________________	**Date/Time:**____________
	____________	________________	**Date/Time:**____________

CH2MHILL

Pre-Task Safety Plan (PTSP)

Project: ________________________ Location: _______________________Date:___________________________

Supervisor: ________________________________ Job Activity:____

____

Task Personnel:

____
____
____
____

List Tasks:

____
____
____
____

Tools/Equipment Required for Tasks (ladders, scaffolds, fall protection, cranes/rigging, heavy equipment, power tools):

____
____
____

Potential H&S Hazards, including chemical, physical, safety, biological and environmental (check all that apply):

__ Chemical burns/contact	__ Trench, excavations, cave-ins	__ Ergonomics
__ Pressurized lines/equipment	__ Overexertion	__ Chemical splash
__ Thermal burns	__ Pinch points	__ Poisonous plants/insects
__ Electrical	__ Cuts/abrasions	__ Eye hazards/flying projectile
__ Weather conditions	__ Spills	__ Inhalation hazard
__ Heights/fall > 6 feet	__ Overhead Electrical hazards	__ Heat/cold stress
__ Noise	__ Elevated loads	__ Water/drowning hazard
__ Explosion/fire	__ Slips, trip and falls	__ Heavy equipment
__ Radiation	__ Manual lifting	__ Aerial lifts/platforms
__ Confined space entry	__ Welding/cutting	__ Demolition

Other Potential Hazards (Describe):

____
____
____
____

CH2MHILL

Hazard Control Measures (Check All That Apply):			
PPE __ Thermal/lined __ Eye __ Dermal/hand __ Hearing __ Respiratory __ Reflective vests __ Flotation device	Protective Systems __ Sloping __ Shoring __ Trench box __ Barricades __ Competent person __ Locate buried utilities __ Daily inspections	Fire Protection __ Fire extinguishers __ Fire watch __ Non-spark tools __ Grounding/bonding __ Intrinsically safe equipment	Electrical __ Lockout/tagout __ Grounded __ Panels covered __ GFCI/extension cords __ Power tools/cord inspected
Fall Protection __ Harness/lanyards __ Adequate anchorage __ Guardrail system __ Covered opening __ Fixed barricades __ Warning system	Air Monitoring __ PID/FID __ Detector tubes __ Radiation __ Personnel sampling __ LEL/O2 __ Other	Proper Equipment __ Aerial lift/ladders/scaffolds __ Forklift/heavy equipment __ Backup alarms __ Hand/power tools __ Crane with current inspection __ Proper rigging __ Operator qualified	Welding & Cutting __ Cylinders secured/capped __ Cylinders separated/upright __ Flash-back arrestors __ No cylinders in CSE __ Flame retardant clothing __ Appropriate goggles
Confined Space Entry __ Isolation __ Air monitoring __ Trained personnel __ Permit completed __ Rescue	Medical/ER __ First-aid kit __ Eye wash __ FA-CPR trained personnel __ Route to hospital	Heat/Cold Stress __ Work/rest regime __ Rest area __ Liquids available __ Monitoring __ Training	Vehicle/Traffic __ Traffic control __ Barricades __ Flags __ Signs
Permits __ Hot work __ Confined space __ Lockout/tagout __ Excavation __ Demolition __ Energized work	Demolition __ Pre-demolition survey __ Structure condition __ Isolate area/utilities __ Competent person __ Hazmat present	Inspections: __ Ladders/aerial lifts __ Lanyards/harness __ Scaffolds __ Heavy equipment __ Cranes and rigging	Training: __ Hazwaste __ Construction __ Competent person __ Task-specific (THA) __ Hazcom
Field Notes:____ ____ ____			

Name (Print): ______________________________

Signature:______________________________ Date:________________

Safe Behavior Observation Form		
Project Name:	Observer:	Date:
Program / Client:	Project Mgr. & No.:	
Position/Title of worker observed:	Background Information/ comments:	
Task/Observation Observed:		

- ❖ Identify and reinforce safe work practices/behaviors
- ❖ Identify and improve on at-risk practices/acts
- ❖ Identify and improve on practices, conditions, controls, and compliance that eliminate or reduce hazards
- ❖ Proactive PM support facilitates eliminating/reducing hazards (do you have what you need?)
- ❖ Positive, corrective, cooperative, collaborative feedback/recommendations

Actions & Behaviors	**Safe**	**At-Risk**	**Observations/Comments**
Current & accurate Pre-Task Planning/Briefing (Project safety plan, STAC, AHA, PTSP, tailgate briefing, etc., as needed)			**Positive Observations/Safe Work Practices:**
Properly trained/qualified/experienced			
Tools/equipment available and adequate			
Proper use of tools			**Questionable Activity/Unsafe Condition Observed:**
Barricades/work zone control			
Housekeeping			
Communication			
Work Approach/Habits			
Attitude			
Focus/attentiveness			**Observer's Corrective Actions/Comments:**
Pace			
Uncomfortable/unsafe position			
Inconvenient/unsafe location			
Position/Line of fire			
Apparel (hair, loose clothing, jewelry)			
Repetitive motion			**Observed Worker's Corrective Actions/Comments:**
Other…			

Material Safety Data Sheets

MSDS Number: **B5641** * * * * * *Effective Date:* ***10/01/08*** * * * * * *Supercedes:* ***04/21/08***

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

MSDS *Material Safety Data Sheet*

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS J.T.Baker

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

Buffer Solution (Biphthalate), pH 4 (Color Coded Red)

1. Product Identification

Synonyms: None.
CAS No.: Not applicable to mixtures.
Molecular Weight: Not applicable to mixtures.
Chemical Formula: Not applicable to mixtures.
Product Codes:
J.T. Baker: 5657
Mallinckrodt: 0097

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Water	7732-18-5	98 - 99%	No
Potassium Acid Phthalate	877-24-7	1 - 2%	Yes
Thymol	89-83-8	< 1%	Yes
FD & C Red No. 40	25956-17-6	< 1%	No

3. Hazards Identification

Emergency Overview

CAUTION! MAY CAUSE IRRITATION TO SKIN AND EYES.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 1 - Slight
Flammability Rating: 0 - None
Reactivity Rating: 0 - None
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES; LAB COAT; PROPER GLOVES
Storage Color Code: Green (General Storage)

Potential Health Effects

Information on the human health effects from exposure to this substance is limited.

Inhalation:
Not expected to be an inhalation hazard. May cause irritation to respiratory tract because of slight acidity. Symptoms may include coughing and sore throat.
Ingestion:
Large doses may produce nausea, vomiting, and abnormal sensations in hands and feet. Because of slight acidity, causes irritation to the mucous membranes.
Skin Contact:
Contact may cause irritation, with redness and pain.
Eye Contact:
May cause eye irritation.
Chronic Exposure:
No information found.
Aggravation of Pre-existing Conditions:
No information found.

4. First Aid Measures

Inhalation:
Remove to fresh air. Get medical attention for any breathing difficulty.
Ingestion:
If large amounts were swallowed, give water to drink and get medical advice.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention if irritation develops.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting upper and lower eyelids occasionally. Get medical attention if irritation persists.

5. Fire Fighting Measures

Fire:
Not expected to be a fire hazard.
Explosion:
No information found.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Contain and recover liquid when possible. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
None established.
Ventilation System:
In general, dilution ventilation is a satisfactory health hazard control for this substance. However, if conditions of use create discomfort to the worker, a local exhaust system should be considered.
Personal Respirators (NIOSH Approved):
Not expected to require personal respirator usage.
Skin Protection:
Wear protective gloves and clean body-covering clothing.
Eye Protection:
Use chemical safety goggles. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Clear, reddish liquid.
Odor:
Odorless.
Solubility:
Completely soluble in water.
Specific Gravity:
No information found.
pH:
4.0
% Volatiles by volume @ 21C (70F):
ca. 98
Boiling Point:
No information found.
Melting Point:
No information found.
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
No information found.
Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:

Will not occur.
Incompatibilities:
No information found.
Conditions to Avoid:
Heat, incompatibles.

11. Toxicological Information

No LD50/LC50 information found relating to normal routes of occupational exposure.

--------\Cancer Lists\--

Ingredient	---NTP Carcinogen--- Known	---NTP Carcinogen--- Anticipated	IARC Category
Water (7732-18-5)	No	No	None
Potassium Acid Phthalate (877-24-7)	No	No	None
Thymol (89-83-8)	No	No	None
FD & C Red No. 40 (25956-17-6)	No	No	None

12. Ecological Information

Environmental Fate:
No information found.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\---------------------------------

Ingredient	TSCA	EC	Japan	Australia
Water (7732-18-5)	Yes	Yes	Yes	Yes
Potassium Acid Phthalate (877-24-7)	Yes	Yes	Yes	Yes
Thymol (89-83-8)	Yes	Yes	Yes	Yes
FD & C Red No. 40 (25956-17-6)	Yes	Yes	No	Yes

--------\Chemical Inventory Status - Part 2\---------------------------------

Ingredient	Korea	--Canada-- DSL	--Canada-- NDSL	Phil.
Water (7732-18-5)	Yes	Yes	No	Yes

Potassium Acid Phthalate (877-24-7)	Yes	Yes	No	Yes
Thymol (89-83-8)	Yes	Yes	No	Yes
FD & C Red No. 40 (25956-17-6)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\---------------

Ingredient	-SARA 302- RQ	-SARA 302- TPQ	------SARA 313------ List	------SARA 313------ Chemical Catg.
Water (7732-18-5)	No	No	No	No
Potassium Acid Phthalate (877-24-7)	No	No	No	No
Thymol (89-83-8)	No	No	No	No
FD & C Red No. 40 (25956-17-6)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\---------------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Water (7732-18-5)	No	No	No
Potassium Acid Phthalate (877-24-7)	No	No	No
Thymol (89-83-8)	No	No	No
FD & C Red No. 40 (25956-17-6)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: No Fire: No Pressure: No
Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: None allocated.
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **1** Flammability: **0** Reactivity: **0**
Label Hazard Warning:
CAUTION! MAY CAUSE IRRITATION TO SKIN AND EYES.
Label Precautions:
Avoid contact with eyes, skin and clothing.
Keep container closed.
Wash thoroughly after handling.
Label First Aid:
In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Get medical attention if irritation develops or persists.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 1, 2, 9, 15.
Disclaimer:
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representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.
****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

MSDS *Material Safety Data Sheet*

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

Buffer Solution (Borate), pH 10 (Color Coded Blue)

1. Product Identification

Synonyms: None.
CAS No.: Not applicable to mixtures.
Molecular Weight: Not applicable to mixtures.
Chemical Formula: Not applicable to mixtures.
Product Codes:
J.T. Baker: 5655
Mallinckrodt: 0099

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Water	7732-18-5	98 - 99%	No
Boric Acid	10043-35-3	< 1%	Yes
Potassium Hydroxide	1310-58-3	< 1%	Yes
Blue Food Coloring	N/A	< 1%	No

3. Hazards Identification

Emergency Overview

DANGER! CORROSIVE. HARMFUL IF SWALLOWED OR INHALED. CAUSES BURNS

TO ANY AREA OF CONTACT.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe
Flammability Rating: 0 - None
Reactivity Rating: 1 - Slight
Contact Rating: 3 - Severe (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: White (Corrosive)

Potential Health Effects

The health effects from exposure to diluted forms of this chemical are not well documented. They are expected to be less severe than those for concentrated forms which are referenced in the descriptions below.

Inhalation:
Respiratory tract irritant, may cause serious burns on acute contact. Severe injury is usually avoided by the self-limiting coughing and sneezing symptoms.
Ingestion:
Toxic! Corrosive to mucous membranes and may cause perforation of the esophagus and stomach. Abdominal pain, nausea, vomiting, general gastro-intestinal upset can be expected.
Skin Contact:
Irritant, possibly corrosive if contact is prolonged. Soreness, redness, destruction of skin may result.

Eye Contact:
Irritant, possibly corrosive to eye tissues. Tearing, redness, pain, impaired vision are symptoms.
Chronic Exposure:
Development of a defatting dermatitis on prolonged contact with potassium hydroxide has been reported. Continued irritation may lead to increased susceptibility to respiratory illness.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems, or impaired kidney or respiratory function may be more susceptible to the effects of the substance.

---

4. First Aid Measures

First aid procedures given apply to concentrated solutions. Exposures to dilute solutions may not require these extensive first aid procedures.
Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Ingestion:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention immediately. Wash clothing before reuse. Thoroughly clean shoes before reuse.

Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard.
Explosion:
Sealed containers may rupture when heated.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Contain and recover liquid when possible. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

7. Handling and Storage

Keep in a tightly closed container. Store in a cool, dry, ventilated area. Protect against physical damage. Separate from acids and alkalis. Protect from freezing. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For Potassium Hydroxide [1310-58-3]:
- ACGIH Threshold Limit value (TLV):
2 mg/m3 Ceiling
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work

area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):

If the exposure limit is exceeded and engineering controls are not feasible, a half facepiece particulate respirator (NIOSH type P95 or R95 filters) may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest.. A full-face piece particulate respirator (NIOSH type P100 or R100 filters) may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency, or respirator supplier, whichever is lowest. Please note that N filters are not recommended for this material. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:

Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

Appearance:
Blue liquid.
Odor:
Odorless.
Solubility:
Complete (100%)
Specific Gravity:
No information found.
pH:
10
% Volatiles by volume @ 21C (70F):
ca. 99 (as water)
Boiling Point:
No information found.
Melting Point:
No information found.
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
No information found.
Evaporation Rate (BuAc=1):
No information found.

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Potassium oxide at very high temperatures.

Hazardous Polymerization:
Will not occur.
Incompatibilities:
Acids.
Conditions to Avoid:
Incompatibles.

---

11. Toxicological Information

For potassium hydroxide: Oral rat LD50: 273 mg/kg; Investigated as a mutagen. Skin Irritation Data (std Draize, 50 mg/24 H): Human, Severe; Rabbit, Severe. Eye Irritation Data(Rabbit, non-std test,1 mg/24 H, rinse): Moderate.

```
--------\Cancer Lists\------------------------------------------------------
                                         ---NTP Carcinogen---
Ingredient                               Known    Anticipated    IARC Category
------------------------------------     -----    -----------    -------------
Water (7732-18-5)                         No         No             None
Boric Acid (10043-35-3)                   No         No             None
Potassium Hydroxide (1310-58-3)           No         No             None
Blue Food Coloring                        No         No             None
```

---

12. Ecological Information

Environmental Fate:
No information found.
Environmental Toxicity:
Potassium Hydroxide: TLm: 80 ppm/Mosquito fish/ 24 hr./ Fresh water

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13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste facility. Although not a listed RCRA hazardous waste, this material may exhibit one or more characteristics of a hazardous waste and require appropriate analysis to determine specific disposal requirements. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

---

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: CORROSIVE LIQUID, BASIC, INORGANIC, N.O.S. (POTASSIUM HYDROXIDE)

Hazard Class: 8
UN/NA: UN3266
Packing Group: III
Information reported for product/size: 20L

International (Water, I.M.O.)

Proper Shipping Name: CORROSIVE LIQUID, BASIC, INORGANIC, N.O.S. (POTASSIUM HYDROXIDE)
Hazard Class: 8
UN/NA: UN3266
Packing Group: III
Information reported for product/size: 20L

International (Air, I.C.A.O.)

Proper Shipping Name: CORROSIVE LIQUID, BASIC, INORGANIC, N.O.S. (POTASSIUM HYDROXIDE)
Hazard Class: 8
UN/NA: UN3266
Packing Group: III
Information reported for product/size: 20L

15. Regulatory Information

```
--------\Chemical Inventory Status - Part 1\---------------------------------
Ingredient                                       TSCA  EC   Japan  Australia
-----------------------------------------------  ----  ---  -----  ---------
Water (7732-18-5)                                 Yes  Yes   Yes      Yes
Boric Acid (10043-35-3)                           Yes  Yes   Yes      Yes
Potassium Hydroxide (1310-58-3)                   Yes  Yes   Yes      Yes
Blue Food Coloring                                Yes  NE*   Yes      Yes

--------\Chemical Inventory Status - Part 2\---------------------------------
                                                         --Canada--
Ingredient                                       Korea  DSL   NDSL  Phil.
-----------------------------------------------  -----  ---   ----  -----
Water (7732-18-5)                                 Yes   Yes   No     Yes
Boric Acid (10043-35-3)                           Yes   Yes   No     Yes
Potassium Hydroxide (1310-58-3)                   Yes   Yes   No     Yes
Blue Food Coloring                                Yes   Yes   No     Yes

--------\Federal, State & International Regulations - Part 1\----------------
                                           -SARA 302-     ------SARA 313------
Ingredient                                 RQ    TPQ      List  Chemical Catg.
-----------------------------------------  ---   -----    ----  --------------
Water (7732-18-5)                          No    No        No         No
Boric Acid (10043-35-3)                    No    No        No         No
Potassium Hydroxide (1310-58-3)            No    No        No         No
Blue Food Coloring                         No    No        No         No

--------\Federal, State & International Regulations - Part 2\----------------
                                                      -RCRA-    -TSCA-
Ingredient                                 CERCLA     261.33     8(d)
-----------------------------------------  ------     ------    ------
Water (7732-18-5)                          No         No         No
Boric Acid (10043-35-3)                    No         No         No
```

Potassium Hydroxide (1310-58-3)	1000	No	No
Blue Food Coloring	No	No	No

```
Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  No
SARA 311/312:  Acute: Yes      Chronic: Yes  Fire: No  Pressure: No
Reactivity: No          (Mixture / Liquid)
```

Australian Hazchem Code: None allocated.
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **3** Flammability: **0** Reactivity: **0**
Label Hazard Warning:
DANGER! CORROSIVE. HARMFUL IF SWALLOWED OR INHALED. CAUSES BURNS TO ANY AREA OF CONTACT.
Label Precautions:
Do not breathe mist.
Do not get in eyes, on skin, or on clothing.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Label First Aid:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. If inhaled, remove to fresh air. If not breathing give artificial respiration. If breathing is difficult, give oxygen. In all cases get medical attention immediately.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 1, 2, 9, 15.
Disclaimer:
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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

MSDS Number: B5639 * * * * * *Effective Date: 10/15/08* * * * * * *Supercedes: 04/21/08*

MSDS *Material Safety Data Sheet*

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

Buffer Solution (Phosphate), pH 7 (Color Coded Yellow)

1. Product Identification

Synonyms: None.
CAS **No.**: Not applicable to mixtures.
Molecular Weight: Not applicable to mixtures.
Chemical Formula: Not applicable to mixtures.
Product Codes:
J.T. Baker: 5656
Mallinckrodt: 0098

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Potassium Phosphate Monobasic	7778-77-0	< 1%	No
Sodium Phosphate, Dibasic	7558-79-4	< 1%	No
FD & C Yellow No. 5	1934-21-0	< 1%	No
Water	7732-18-5	> 98%	No

3. Hazards Identification

Emergency Overview

As part of good industrial and personal hygiene and safety procedure, avoid all unnecessary exposure to the chemical substance and ensure prompt removal from skin, eyes and clothing.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 0 - None
Flammability Rating: 0 - None
Reactivity Rating: 0 - None
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT; PROPER GLOVES
Storage Color Code: Green (General Storage)

Potential Health Effects

Inhalation:
No adverse health effects via inhalation.
Ingestion:
Not expected to be a health hazard via ingestion. Large oral doses may cause irritation to the gastrointestinal tract.
Skin Contact:
Not expected to be a health hazard from skin exposure. May cause mild irritation and redness.
Eye Contact:
No adverse effects expected. May cause mild irritation, possible reddening.
Chronic Exposure:
No information found.
Aggravation of Pre-existing Conditions:
No information found.

---

4. First Aid Measures

Inhalation:
Not expected to require first aid measures. Remove to fresh air. Get medical attention for any breathing difficulty.
Ingestion:
Not expected to require first aid measures. If large amounts were swallowed, give water to drink and get medical advice.
Skin Contact:
Not expected to require first aid measures. Wash exposed area with soap and water. Get medical advice if irritation develops.
Eye Contact:
Not expected to require first aid measures. Wash thoroughly with running water. Get medical advice if irritation develops.

---

5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire.

Special Information:
Use protective clothing and breathing equipment appropriate for the surrounding fire.

---

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Contain and recover liquid when possible. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

---

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

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8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
None established.
Ventilation System:
In general, dilution ventilation is a satisfactory health hazard control for this substance. However, if conditions of use create discomfort to the worker, a local exhaust system should be considered.
Personal Respirators (NIOSH Approved):
Not expected to require personal respirator usage.
Skin Protection:
Wear protective gloves and clean body-covering clothing.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

Appearance:
Yellow liquid.
Odor:
Odorless.
Solubility:
Complete (100%)
Specific Gravity:
No information found.
pH:
7.0

% Volatiles by volume @ 21C (70F):
ca. 98
Boiling Point:
No information found.
Melting Point:
No information found.
Vapor Density (Air=1):
Not applicable.
Vapor Pressure (mm Hg):
Not applicable.
Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Oxides of phosphorous, sodium and carbon may be formed when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
No information found.
Conditions to Avoid:
No information found.

11. Toxicological Information

--------\Cancer Lists\--

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Potassium Phosphate Monobasic (7778-77-0)	No	No	None
Sodium Phosphate, Dibasic (7558-79-4)	No	No	None
FD & C Yellow No. 5 (1934-21-0)	No	No	None
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:
No information found.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

\Chemical Inventory Status - Part 1\

Ingredient	TSCA	EC	Japan	Australia
Potassium Phosphate Monobasic (7778-77-0)	Yes	Yes	Yes	Yes
Sodium Phosphate, Dibasic (7558-79-4)	Yes	Yes	Yes	Yes
FD & C Yellow No. 5 (1934-21-0)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

\Chemical Inventory Status - Part 2\

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Potassium Phosphate Monobasic (7778-77-0)	Yes	Yes	No	Yes
Sodium Phosphate, Dibasic (7558-79-4)	Yes	Yes	No	Yes
FD & C Yellow No. 5 (1934-21-0)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

\Federal, State & International Regulations - Part 1\

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Potassium Phosphate Monobasic (7778-77-0)	No	No	No	No
Sodium Phosphate, Dibasic (7558-79-4)	No	No	No	No
FD & C Yellow No. 5 (1934-21-0)	No	No	No	No
Water (7732-18-5)	No	No	No	No

\Federal, State & International Regulations - Part 2\

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Potassium Phosphate Monobasic (7778-77-0)	No	No	No
Sodium Phosphate, Dibasic (7558-79-4)	5000	No	No
FD & C Yellow No. 5 (1934-21-0)	No	No	No
Water (7732-18-5)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: No Chronic: No Fire: No Pressure: No
Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: None allocated.
Poison Schedule: None allocated.
WHMIS:

This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: **0** Flammability: 0 Reactivity: **0**
Label Hazard Warning:
As part of good industrial and personal hygiene and safety procedure, avoid all unnecessary exposure to the chemical substance and ensure prompt removal from skin, eyes and clothing.
Label Precautions:
None.
Label First Aid:
Not applicable.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 2, 9, 15.
Disclaimer:
****

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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

PHIBRO ENERGY USA, INC. -- DIESEL FUEL -- 9140-00-000-0184

==================== Product Identification ====================

Product ID:DIESEL FUEL
MSDS Date:01/31/1994
FSC:9140
NIIN:00-000-0184
MSDS Number: BVGFN
=== Responsible Party ===
Company Name:PHIBRO ENERGY USA, INC.
Address:500 DALLAS AVE, SUITE 3200
City:HOUSTON
State:TX
ZIP:77002
Country:US
Info Phone Num:713-646-5135
Emergency Phone Num:713-923-6641, CHEMTREC 800-424-9300
Preparer's Name:SUE BOTTOM
CAGE:0V310
=== Contractor Identification ===
Company Name:PHIBRO ENERGY USA INC
Address:500 DALLAS AVE SUITE 3200
Box:City:HOUSTON
State:TX
ZIP:77002
Country:US
Phone:713-923-6641, CHEMTREC800-424-9300
CAGE:0V310

============ Composition/Information on Ingredients ============

Ingred Name:PETROLEUM DISTILLATE, ALIPHATIC AND AROMATIC HYDROCARBONS (VARYING FROM C9 TO C20), CONTAING ALSO INGREDIENT #2 TO 7.
Fraction by Wt: BALANCE
Other REC Limits:NONE SPECIFIED
OSHA PEL:400 PPM NAPHTHA TWA

Ingred Name:N-OCTANE
CAS:111-65-9
RTECS #:RG8400000
Fraction by Wt: <1-2%
Other REC Limits:NONE SPECIFIED

OSHA PEL:300 PPM TWA 1989
ACGIH TLV:300 PPM/375STEL;9394

Ingred Name:N-NONANE
CAS:111-84-2
RTECS #:RA6115000
Fraction by Wt: <1-3%
Other REC Limits:NONE SPECIFIED
OSHA PEL:200 PPM
ACGIH TLV:200 PPM; 9192

Ingred Name:NAPHTHALENE (SARA III)
CAS:91-20-3
RTECS #:QJ0525000
Fraction by Wt: <1-3%
Other REC Limits:NONE RECOMMENDED
OSHA PEL:10 PPM
ACGIH TLV:10 PPM/15 STEL; 9394
EPA Rpt Qty:100 LBS
DOT Rpt Qty:100 LBS

Ingred Name:HEXANE ISOMERS (OTHER THAN N-HEXANE)
Fraction by Wt: <1-3%
Other REC Limits:NONE RECOMMENDED
OSHA PEL:500 PPM
ACGIH TLV:500 PPM

Ingred Name:N-HEXANE
CAS:110-54-3
RTECS #:MN9275000
Fraction by Wt: <1-2%
Other REC Limits:NONE RECOMMENDED
OSHA PEL:50 PPM 1989
ACGIH TLV:50 PPM; 9394
EPA Rpt Qty:1 LB
DOT Rpt Qty:1 LB

Ingred Name:N-HEPTANE
CAS:142-82-5
RTECS #:MI7700000
Fraction by Wt: <1-2%
Other REC Limits:NONE RECOMMENDED
OSHA PEL:400 PPM TWA 1989

ACGIH TLV:400 PPM/500STEL;9394

Ingred Name:HYDROGEN SULFIDE (SARA III)
CAS:7783-06-4
RTECS #:MX1225000
Other REC Limits:NONE RECOMMENDED
OSHA PEL:C, 20 PPM
ACGIH TLV:10 PPM/15 STEL; 9394
EPA Rpt Qty:100 LBS
DOT Rpt Qty:100 LBS

===================== Hazards Identification =====================

Routes of Entry: Inhalation:YES Skin:YES Ingestion:YES
Reports of Carcinogenicity:NTP:NO IARC:NO OSHA:NO
Health Hazards Acute and Chronic:ACUTE-INHALATION:CNS EFFECTS, RESPIRATORY IRRITATION. EYES:SEVERE IRRITATION. INGESTION:HARMFUL OR FATAL, IRRITATION OF GI TRACT. ASPIRATION INTO THE LUNGS CAN CAUSE SEVERE CHEMICAL PNEUMONITIS, WHICH CAN BE FATAL. SKIN:REPEATED EXPOSURE MAY CAUSE IRRITATION. CHRONIC:DERMATITIS. TARGET ORGANS:SKIN, LUNG, CNS.
Explanation of Carcinogenicity:PER NIOSH BULLETIN 50 A POTENTIAL OCCUPATIONAL CARCINOGENIC HAZARD EXISTS DUE TO HUMAN EXPOSURE TO DIESEL EXHAUST.
Effects of Overexposure:EYE:IRRITATION, REDNESS, TEARING, BLURRED VISION, CONJUCTIVITIS. SKIN:IRRITATION, DRYNESS, REDNESS, ITCHING. INHAL:HEADACHE, DIZZINESS, DROWZINESS, NAUSEA, VOMITNING, TREMORS, CONVULSIONS, IRREGULAR H EART BEAT. INGESTION: G/I IRRITATION AND SYMPTOMS SIMILAR TO INHALATION.
Medical Cond Aggravated by Exposure:EYE, SKIN, HEART, CNS, AND RESPIRATORY DISORDERS MAY BE AGGARAVATED BY OVEREXPOSURE.

======================= First Aid Measures =======================

First Aid:SKIN:REMOVE CONTAMINATED CLOTHING. WASH WITH SOAP AND WATER. GET MEDICAL ATTENTION IF IRRITATION PERSISTS. INHALATION:REMOVE TO FRESH AIR & RESTORE BREATHING IF NECESSARY. GET MEDICAL ATTENTION. EYE:I MMEDIATELY FLUSH WITH WATER FOR 15 MINUTES WHILE HOLDING EYELIDS OPEN. GET MEDICAL ATTENTION. INGESTION:GET IMMEDIATE MEDICAL ATTENTION. DO NOT INDUCE VOMITING. NOTHING BY MOUTH IF UNCONSCIOUS.

===================== Fire Fighting Measures =====================

Flash Point:125F,52C
Lower Limits:0.4%
Upper Limits:8.0%
Extinguishing Media:CARBON DIOXIDE, FOAM, OR DRY CHEMICAL.
Fire Fighting Procedures:EVACUATE AREA. USE NIOSH APPROVED SCBA & FULL PROTECTIVE EQUIPMENT TO FIGHT FIRE. USE WATER SPRAY TO COOL EXPOSED CONTAINERS. DIRECT WATER SPRAY MAY SPREAD FIRE
Unusual Fire/Explosion Hazard:VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL ALONG GROUND OR FLOOR, THEN 'FLASH BACK' FROM A DISTANT IGNITION SOURCE. TOXIC FUMES & GASES ARE PRODUCED BY FIRE.

================== Accidental Release Measures ==================

Spill Release Procedures:EVACUATE AREA. WEAR PROTECTIVE EQUIPMENT. SHUT OFF SOURCE IF POSSIBLE & CONTAIN SPILL. REMOVE IGNITION SOURCES. KEEP OUT OF WATER RESOURCES AND SEWERS. ABSORB IN INERT MATERIAL OR RECOVER BY PUMPING. TRANSFER TO DISPOSAL DRUMS.
Neutralizing Agent:NONE

====================== Handling and Storage ======================

Handling and Storage Precautions:KEEP AWAY FROM HEAT, SPARKS, FLAME. STORE IN WELL VENTILATED AREA. GROUND CONTAINERS DURING TRANSFER. STORE IN CLOSED CONTAINER.
Other Precautions:EMPTY CONTAINERS RETAIN RESIDUE. DO NOT PRESSURIZE, CUT, WELD OR EXPOSE TO HEAT, FLAME, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION; THEY MAY EXPLODE AND CAUSE INJURY.

============= Exposure Controls/Personal Protection =============

Respiratory Protection:FOR CONCENTRATIONS EXCEEDING RECOMMENDED LEVEL, USE NIOSH/MSHA APPROVED AIR PURIFYING RESPIRATOR. FOR SPILL OR IF CONCENTRATION IS UNKNOWN, USE NIOSH/MSHA SUPPLIED AIR RESPIRATOR OR SCBA.
Ventilation:GENERAL OR MECHANICAL
Protective Gloves:NEOPRENE OR NITRILE
Eye Protection:SAFETY GLASSES OR CHEMICAL SPLASH GOGGLE
Other Protective Equipment:PROTECTIVE GARMENTS TO PREVENT SKIN CONTACT.
Work Hygienic Practices:DO NOT EAT, DRINK OR SMOKE WHILE WORKING WITH THIS PRODUCT.
Supplemental Safety and Health
DANGER! UNTREATED PRODUCT MAY CONTAIN OR RELEASE HYDROGEN SULFIDE. H2S

IS A HIGHLY TOXIC AND FLAMMABLE GAS WHICH CAN BE FATAL IF INHALED AT CERTAIN CONCENTRATION.

================== Physical/Chemical Properties ==================

HCC:F4
NRC/State Lic Num:NONE
Boiling Pt:B.P. Text:325F,163C
Vapor Pres:<0.1 PSI
Vapor Density:3-7
Spec Gravity:0.84 - 0.93
Viscosity:8 CST @ -4F
Solubility in Water:NEGLIGIBLE
Appearance and Odor:CLEAR TO STRAW COLORED LIQUID, KEROSENE ODOR.
Percent Volatiles by Volume:NEGLIG

================= Stability and Reactivity Data =================

Stability Indicator/Materials to Avoid:YES
STRONG OXIDIZING AGENTS, STRONG ACIDS, CAUSTICS AND HALOGENS.
Stability Condition to Avoid:OPEN FLAMES, SOURCES OF IGNITION, STATIC ELECTRICITY.
Hazardous Decomposition Products:CARBON MONOXIDE, CARBON DIOXIDE AND REACTIVE HYDROCARBONS (LDEHYDES, AROMATICS, ETC) COMPOUNDS.

==================== Disposal Considerations ====================

Waste Disposal Methods:DISPOSE OF IN ACCORDANCE WITH LOCAL, STATE AND FEDERAL REGULATIONS.

MSDS *Material Safety Data Sheet*

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

HEXANE

1. Product Identification

Synonyms: Hexanes,Normal Hexane; Hexyl Hydride; Hexane 95%
CAS No.: 110-54-3 (n-hexane)
Molecular Weight: 86.18
Chemical Formula: CH3(CH2)4CH3 n-hexane
Product Codes:
J.T. Baker: 9200, 9262, 9304, 9308, N168
Mallinckrodt: 5186

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Hexane	110-54-3	85 - 100%	Yes
Methylcyclopentane	96-37-7	1 - 2%	Yes
Trace amount of Benzene (10 ppm)	071-43-2	*	No

3. Hazards Identification

Emergency Overview

DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED.

CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS.

SAF-T-DATA$^{(tm)}$ Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Life)
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 1 - Slight
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

The health hazards addressed are for the major component: n-hexane.

Inhalation:
Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Greater exposure may cause muscle weakness, numbness of the extremities, unconsciousness and death.
Ingestion:
May produce abdominal pain, nausea. Aspiration into lungs can produce severe lung damage and is a medical emergency. Other symptoms expected to parallel inhalation.
Skin Contact:
May cause redness, irritation, with dryness, cracking.
Eye Contact:
Vapors may cause irritation. Splashes may cause redness and pain.
Chronic Exposure:
Repeated or prolonged skin contact may defat the skin and produce irritation and dermatitis. Chronic inhalation may cause peripheral nerve disorders and central nervous system effects.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance. May affect the developing fetus.

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4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:
Aspiration hazard. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Remove any contaminated clothing. Wipe off excess from skin. Wash skin with soap and water for at least 15 minutes. Get medical attention if irritation develops or persists.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:
BEI=2,5-hexadione in urine, sample at end of shift at workweeks end, 5 mg/g creatine. Also, measure n-hexane in expired air. Analgesics may be necessary for pain management, there is no specific antidote. Monitor arterial blood gases in cases of severe aspiration.

5. Fire Fighting Measures

Fire:
Flash point: -23C (-9F) CC
Autoignition temperature: 224C (435F)
Flammable limits in air % by volume:
lel: 1.2; uel: 7.7
Extremely Flammable Liquid and Vapor! Vapor may cause flash fire. Dangerous fire hazard when exposed to heat or flame.
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with oxidizing materials may cause extremely violent combustion.Explodes when mixed @ 28C with dinitrogen tetraoxide. Sensitive to static discharge.
Fire Extinguishing Media:
Dry chemical, foam or carbon dioxide. Water may be ineffective.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Water spray may be used to keep fire exposed containers cool. Vapors can flow along surfaces to distant ignition source and flash back. Vapor explosion hazard exists indoors, outdoors, or in sewers.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB® solvent adsorbent is recommended for spills of this product.

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from direct sunlight and any area where the fire hazard may be acute. Store in tightly closed containers (preferably under nitrogen atmosphere). Outside or detached storage is preferred. Inside storage should be in a standard flammable liquids storage room or cabinet. Separate from oxidizing materials. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

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8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
N-Hexane [110-54-3]:
-OSHA Permissible Exposure Limit (PEL): 500 ppm (TWA)
-ACGIH Threshold Limit Value (TLV): 50 ppm (TWA), Skin
other isomers of hexane
-ACGIH Threshold Limit Value (TLV): 500 ppm (TWA),1000ppm (STEL)
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. Breathing air quality must meet the requirements of the OSHA respiratory protection standard (29CFR1910.134).
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

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9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.
Odor:
Light odor.
Solubility:
Insoluble in water.
Specific Gravity:
0.66
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
ca. 68C (ca. 154F)
Melting Point:

ca. -95C (ca. -139F)
Vapor Density (Air=1):
3.0
Vapor Pressure (mm Hg):
130 @ 20C (68F)
Evaporation Rate (BuAc=1):
9

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Heat will contribute to instability.
Hazardous Decomposition Products:
May produce acrid smoke and irritating fumes when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizers.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

N-Hexane: Oral rat LD50: 28710 mg/kg. Irritation eye rabbit: 10 mg mild. Investigated as a tumorigen, mutagen and reproductive effector.

--------\Cancer Lists\--

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Hexane (110-54-3)	No	No	None
Methylcyclopentane (96-37-7)	No	No	None
Trace amount of Benzene (10 ppm) (071-43-2)	Yes	No	1

12. Ecological Information

Environmental Fate:
When released into the soil, this material may biodegrade to a moderate extent. When released into the soil, this material is not expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material may biodegrade to a moderate extent. When released to water, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life between 1 and 10 days. This material has an estimated bioconcentration factor (BCF) of less than 100. This material has a log octanol-water partition coefficient of greater than 3.0. This material is not expected to significantly bioaccumulate. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material

is expected to have a half-life between 1 and 10 days.
Environmental Toxicity:
No information found.

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13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

---

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: HEXANES
Hazard Class: 3
UN/NA: UN1208
Packing Group: II
Information reported for product/size: 215L

International (Water, I.M.O.)

Proper Shipping Name: HEXANES
Hazard Class: 3
UN/NA: UN1208
Packing Group: II
Information reported for product/size: 215L

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15. Regulatory Information

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--------\Chemical Inventory Status - Part 1\---------------------------------
Ingredient                                       TSCA  EC   Japan  Australia
-----------------------------------------------  ----  ---  -----  ---------
Hexane (110-54-3)                                 Yes  Yes   Yes      Yes
Methylcyclopentane (96-37-7)                      Yes  Yes   No       Yes
Trace amount of Benzene  (10 ppm) (071-43-2)      Yes  Yes   Yes      Yes

--------\Chemical Inventory Status - Part 2\---------------------------------
                                                        --Canada--
Ingredient                                       Korea  DSL   NDSL  Phil.
-----------------------------------------------  -----  ---   ----  -----
Hexane (110-54-3)                                 Yes   Yes   No     Yes
Methylcyclopentane (96-37-7)                      Yes   Yes   No     Yes
Trace amount of Benzene  (10 ppm) (071-43-2)      Yes   Yes   No     Yes

--------\Federal, State & International Regulations - Part 1\----------------
                                           -SARA 302-    ------SARA 313------
Ingredient                                  RQ    TPQ     List  Chemical Catg.
```

Hexane (110-54-3)	No	No	Yes	No
Methylcyclopentane (96-37-7)	No	No	No	No
Trace amount of Benzene (10 ppm) (071-43-2)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\----------------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Hexane (110-54-3)	5000	No	No
Methylcyclopentane (96-37-7)	No	No	No
Trace amount of Benzene (10 ppm) (071-43-2)	10	U019	No

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Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  No
SARA 311/312:  Acute: Yes      Chronic: Yes  Fire: Yes Pressure: No
Reactivity: No          (Mixture / Liquid)
```

WARNING:
THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

Australian Hazchem Code: 3[Y]E
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **1** Flammability: **3** Reactivity: **0**
Label Hazard Warning:
DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS.
Label Precautions:
Keep away from heat, sparks and flame.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Avoid breathing vapor or mist.
Avoid contact with eyes, skin and clothing.
Label First Aid:
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. In all cases call a physician.
Product Use:
Laboratory Reagent.
Revision Information:

No Changes.
Disclaimer:
****

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****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

MSDS Number: **H3886** * * * * * *Effective Date:* *02/13/09* * * * *
** Supercedes:* *10/16/08*

MSDS **Material Safety Data Sheet**

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS J.T.Baker

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

HYDROCHLORIC ACID (10%-33%)

1. Product Identification

Synonyms: This MSDS applies to the concentrated standard used to make laboratory solutions and any solution that contains more than 10% but less than 33% Hydrochloric acid. For diluted product, see MSDS for Hydrochloric Acid (less than 10%).
CAS No.: 7647-01-0
Molecular Weight: 36.46
Chemical Formula: HCl in H2O
Product Codes:
J.T. Baker: 0323, 0327, 0365, 4654, 4657, 5618, 5619
Mallinckrodt: 2608, 2625, H151, H168, V035

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Hydrogen Chloride	7647-01-0	10 - 33%	Yes
Water	7732-18-5	67 - 90%	No

3. Hazards Identification

Emergency Overview

POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 0 - None
Reactivity Rating: 2 - Moderate
Contact Rating: 4 - Extreme (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: White (Corrosive)

Potential Health Effects

Inhalation:
Corrosive! Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death.
Ingestion:
Corrosive! Swallowing hydrochloric acid can cause immediate pain and burns of the mouth, throat, esophagus and gastrointestinal tract. May cause nausea, vomiting, and diarrhea, and in severe cases, death.
Skin Contact:
Corrosive! Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and discolor skin.
Eye Contact:
Corrosive! Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Chronic Exposure:
Long-term exposure to concentrated vapors may cause erosion of teeth. Long term exposures seldom occur due to the corrosive properties of the acid.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye disease may be more susceptible to the effects of this substance.

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4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Ingestion:
DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

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5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard. May react with metals or heat to release flammable hydrogen gas.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Water or water spray. Neutralize with soda ash or slaked lime.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Structural firefighter's protective clothing is ineffective for fires involving hydrochloric acid. Stay away from ends of tanks. Cool tanks with water spray until well after fire is out.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker NEUTRASORB® acid neutralizers are recommended for spills of this product.

7. Handling and Storage

Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Protect from physical damage. Keep out of direct sunlight and away from heat, water, and incompatible materials. Do not wash out container and use it for other purposes. When diluting, the acid should always be added slowly to water and in small amounts. Never use hot water and never add water to the acid. Water added to acid can cause uncontrolled boiling and splashing. When opening metal containers, use non-sparking tools because of the possibility of hydrogen gas being present. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For Hydrochloric acid:
- OSHA Permissible Exposure Limit (PEL):
5 ppm (Ceiling)
- ACGIH Threshold Limit Value (TLV):
2 ppm (Ceiling), A4 Not classifiable as a human carcinogen

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, a full facepiece respirator with an acid gas cartridge may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Rubber or neoprene gloves and additional protection including impervious boots, apron, or coveralls, as needed in areas of unusual exposure to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.
Odor:
Pungent odor.
Solubility:
Infinitely soluble.
Density:
1.05 @ 15 C (59 F)
pH:
For HCL solutions: 0.1 (1.0 N), 1.1 (0.1 N), 2.02 (0.01 N)
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
101 - 103C (214 - 217F)
Melting Point:
No information found.
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
No information found.
Evaporation Rate (BuAc=1):
No information found.

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10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
When heated to decomposition, emits toxic hydrogen chloride fumes and will react with water or steam to produce heat and toxic and corrosive fumes. Thermal oxidative decomposition produces toxic chlorine fumes and explosive hydrogen gas.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
A strong mineral acid, concentrated hydrochloric acid is highly reactive with strong bases, metals, metal oxides, hydroxides, amines, carbonates and other alkaline materials. Incompatible with materials such as cyanides, sulfides, sulfites, and formaldehyde.
Conditions to Avoid:
Heat, direct sunlight.

11. Toxicological Information

Hydrochloric acid: Inhalation rat LC50: 3124 ppm/1H; Oral rabbit LD50: 900 mg/kg. Investigated as a tumorigen, mutagen, reproductive effector.

--------\Cancer Lists\--

Ingredient	NTP Carcinogen Known	NTP Carcinogen Anticipated	IARC Category
Hydrogen Chloride (7647-01-0)	No	No	3
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material is not expected to biodegrade. When released into the soil, this material may leach into groundwater.
Environmental Toxicity:
This material is expected to be toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: HYDROCHLORIC ACID
Hazard Class: 8
UN/NA: UN1789
Packing Group: II
Information reported for product/size: 200L

International (Water, I.M.O.)

Proper Shipping Name: HYDROCHLORIC ACID
Hazard Class: 8
UN/NA: UN1789
Packing Group: II
Information reported for product/size: 200L

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\---------------------------------

Ingredient	TSCA	EC	Japan	Australia
Hydrogen Chloride (7647-01-0)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\---------------------------------

Ingredient	Korea	--Canada-- DSL	--Canada-- NDSL	Phil.
Hydrogen Chloride (7647-01-0)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------------

Ingredient	-SARA 302- RQ	-SARA 302- TPQ	------SARA 313------ List	------SARA 313------ Chemical Catg.
Hydrogen Chloride (7647-01-0)	5000	500*	Yes	No
Water (7732-18-5)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\----------------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Hydrogen Chloride (7647-01-0)	5000	No	No
Water (7732-18-5)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: Yes
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: 2R
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

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16. Other Information

NFPA Ratings: Health: **3** Flammability: **0** Reactivity: **0**
Label Hazard Warning:
POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Avoid breathing vapor or mist.
Keep container closed.

Use with adequate ventilation.
Wash thoroughly after handling.

Label First Aid:

If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases call a physician.

Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 14.

Disclaimer:

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

AGA GAS, INC -- HYDROGEN -- 6830-00N012052

===================== Product Identification =====================

Product ID:HYDROGEN
MSDS Date:11/25/1985
FSC:6830
NIIN:00N012052
MSDS Number: BJLZB
=== Responsible Party ===
Company Name:AGA GAS, INC
Address:6225 OAK TREE BLVD
City:INDEPENDENCE
State:OH
ZIP:44131
Country:US
Info Phone Num:800-424-2427
Emergency Phone Num:216-642-6600
CAGE:HO731
=== Contractor Identification ===
Company Name:AGA GAS INC
Address:6225 OAKTREE BLVD
Box:City:INDEPENDENCE
State:OH
ZIP:44131
Country:US
CAGE:09785
Company Name:AGA GAS, INC
Address:6225 OAK TREE BLVD
Box:City:INDEPENDENCE
State:OH
ZIP:44131
Country:US
Phone:800-424-2427
CAGE:HO731

============= Composition/Information on Ingredients =============

Ingred Name:HYDROGEN
CAS:1333-74-0
RTECS #:MW8900000
OSHA PEL:SIMPLE ASPHYXIANT
ACGIH TLV:SIMPLE ASPHYXIANT

Ingred Name:HNDLG/STOR PREC:OTHER PREC:CYL SHLD BE STORED UPRIGHT&FIRMLY SECURED TO PVNT FALLING/BEING KNOCKED OVER.FULL &(SEE ING 3
RTECS #:9999999ZZ

Ingred Name:ING 2:EMPTY CONTAINERS SHLD BE SEGREGATED.USE 1ST IN-1ST OUT INVENTORY SYS TO PVNT FULL CYLS BEING STORED FOR(SEE ING 4)
RTECS #:9999999ZZ

Ingred Name:ING 3:EXCESS PERIOD OF TIME.POST "NO SMOKING OR OPEN FLAME" SIGN IN STORGE/USE AREA.THERE SHLD BE NO SOURCE OF(SEE ING 5
RTECS #:9999999ZZ

Ingred Name:ING 4:IGNITION IN THE STORAGE OR USE AREA.FOR ADDITIONAL STORAGE RECOMMENDATIONS,CONSULT COMPRESSED GAS ASSOC(SEE ING 6)
RTECS #:9999999ZZ

Ingred Name:ING 5:PAMPHLETS G-5,P-1,P-14 & SAFETY BULLETIN SB-2.EARTH-GROUND & BOND ALL LINES & EQUIP ASSOCIATED WITH THE(SEE ING 7)
RTECS #:9999999ZZ

Ingred Name:ING 6:HYDROGEN SYSTEM.ELECTRICAL EQUIP SHOULD BE NON-SPARKING/EXPLOSION PROOF.COMPRESSED GAS CYLS SHLD NOT BE(SEE ING 8)
RTECS #:9999999ZZ

Ingred Name:ING 7:REFILLED EXCEPT BY QUALIFIED COMPRESSD GAS PRODUCER.SHIPMENT OF COMPRESSD GAS CYL WH HAS NOT BEEN FILLED(SEE ING 9
RTECS #:9999999ZZ

Ingred Name:ING 8:BY OWNER WITH HIS (WRITTEN) CONSENT IS IN VIOLATION OF FEDERAL LAW (49CFR). HYDROGEN IS NONCORROSIVE (SEE ING 10)
RTECS #:9999999ZZ

Ingred Name:ING 9:AND MAY BE USED WITH COMMON STRUCTURAL MATERIAL.
RTECS #:9999999ZZ

===================== Hazards Identification =====================

LD50 LC50 Mixture:NONE SPECIFIED BY MANUFACTURER.

Routes of Entry: Inhalation:YES Skin:NO Ingestion:NO
Reports of Carcinogenicity:NTP:NO   IARC:NO   OSHA:NO
Health Hazards Acute and Chronic:HYDROGEN IS DEFINED AS A SIMPLE ASPHYXIANT.OXYGEN LEVELS SHOULD BE MAINTAINED AT GREATER THAN 18 MOLAR PERCENT AT NORMAL ATMOSPHERIC PRESSURE WHICH IS EQUIVALENT TO A PARTIAL PRESSURE OF 135 MMHG.
Explanation of Carcinogenicity:NOT RELEVANT.
Effects of Overexposure:INHAL:HIGH CONCENTRATIONS OF HYDROGEN SO AS TO EXCLUDE AN ADEQUATE SUPPLY OF OXYGEN TO THE LUNGS CAUSES DIZZINESS, DEEPER BREATHING DUE TO AIR HUNGER, POSSIBLE NAUSEA AND EVENTUAL UNCONSCIOUSNESS.
Medical Cond Aggravated by Exposure:HYDROGEN IS INACTIVE BIOLOGICALLY AND ESSENTIALLY NONTOXIC; THEREFORE, THE MAJOR PROPERTY IS THE EXCLUSION OF AN ADEQUATE SUPPLY OF OXYGEN TO THE LUNGS.

======================= First Aid Measures =======================

First Aid:PROMPT MED ATTN IS MANDATORY IN CASES OF OVEREXPOS TO HYDROGEN.RESCUE PERS SHOULD BE EQUIPPED W/SCBA&BE COGNIZANT OF EXTREME FIRE&EXPLOSION HAZ.INHAL:CONSCIOUS PERSONS SHOULD BE ASSISTED TO UNCONTAMD AREA&INHALE FRESH AIR.QUICK REMOVAL FROM CONTAMD AREA IS MOST IMPORTANT.UNCONSCIOUS PERSONS SHOULD BE MOVED TO UNCONTAMD AREA,GIVE MOUTH-TO-MOUTH RESUSCITATION.FURTHER TREATMENT SHOULD BE SYMPTOMATIC.

===================== Fire Fighting Measures =====================

Flash Point:1058F,570C
Lower Limits:4
Upper Limits:74.5
Extinguishing Media:WATER, CARBON DIOXIDE, DRY CHEMICAL.
Fire Fighting Procedures:IF POSSIBLE,STOP FLOW OF HYDROGEN.COOL SURROUNDING CONTAINERS W/WATER SPRAY.HYRODGEN BURNS WITH AN ALMOST INVISIBLE FLAME OF RELATIVELY LOW THERMAL RADIATION.
Unusual Fire/Explosion Hazard:HYDROGEN IS VERY LIGHT&RISES VERY RAPIDLY IN AIR.SHOULD HYDROGEN FIRE BE EXTING&FLOW OF GAS CONTINUE,INCREASE VENT TO PVNT EXPLOS HAZ,IN UPPER PORTIONS OF BLDG.

================== Accidental Release Measures ==================

Spill Release Procedures:EVACUATE PERSONNEL FROM AFFECTED AREA.USE APPROP PROT EQUIP.IF LEAK IS IN USER'S EQUIP,BE CERTAIN TO PURGE PIPING W/AN INERT GAS PRIOR TO ATTEMPTING REPAIRS.IF LEAK IS IN

CONTAINER OR CONTAINER VALVE, CONTACT CLOSEST SUPPLIER LOCATION.
Neutralizing Agent:NONE SPECIFIED BY MANUFACTURER.

====================== Handling and Storage ======================

Handling and Storage Precautions:USE ONLY IN WELL-VENTILATED AREAS.VALVE PROT CAPS MUST REMAIN IN PLACE UNLESS CONTAINER IS SECURED W/VALVE OUTLET PIPED TO USE POINT. (SEE BELOW)
Other Precautions:DO NOT DRAG,SLIDE/ROLL CYLS. USE SUITABLE HAND TRUCK FOR CYL MOVEMENT. USE PRESS REDUCING REGULATOR WHEN CONNECTING CYL TO LOWER PRESS (<3,000 PSIG)PIPING/SYS. DO NOT HEAT CYL TO INCR DISCH RATE OF PR OD FROM THE CYL.(SEE SUPP DATA)

============= Exposure Controls/Personal Protection =============

Respiratory Protection:POSITIVE PRESSURE AIR LINE WITH MASK OR NIOSH/MSHA SCBA SHOULD BE AVAILABLE FOR EMERGENCY USE.
Ventilation:HOOD W/FORCED VENT.LOCAL EXHST TO PVNT ACCUMULATION ABOVE LEL.MECHANICAL-IN ACCORDANCE WITH ELECTRICAL CODES.
Protective Gloves:PLASTIC OR RUBBER.
Eye Protection:CHEMICAL WORKERS GOGGLES .
Other Protective Equipment:SAFETY SHOES, SAFETY SHOWER.
Work Hygienic Practices:NONE SPECIFIED BY MANUFACTURER.
Supplemental Safety and Health
HNDLG/STOR PREC:OTHER PREC:USE CHECK VALVE OR TRAP IN DISCHARGE LINE TO PVNT HAZ BACK FLOW IN CYL.PROT CYLS FROM PHYSICAL DMG.STORE IN COOL,DRY,WELL-VENT AREA OF NON-COMBUST CONSTRUCTION AWAY FROM HEA VILY TRAFFICKED AREAS AND EMERGENCY EXITS.DO NOT ALLOW TEMP WHERE CYLS ARE STORED TO EXCEED 130F. (SEE INGREDIENT 2)

================== Physical/Chemical Properties ==================

HCC:G2
Boiling Pt:B.P. Text:-423F,-253C
Melt/Freeze Pt:M.P/F.P Text:-435F,-259C
Vapor Pres:>-399.8F
Vapor Density:0.0052
Spec Gravity:0.069 @ 70F
Solubility in Water:VERY SLIGHTLY
Appearance and Odor:COLORLESS, ODORLESS GAS.

================= Stability and Reactivity Data =================

Stability Indicator/Materials to Avoid:YES
OXIDIZERS.
Hazardous Decomposition Products:NONE

==================== Disposal Considerations ====================

Waste Disposal Methods:DO NOT ATTEMPT TO DISPOSE OF WASTE OR UNUSED QUANTITIES.RETURN IN SHIPPING CONTAINER PROPERLY LABELED,WITH ANY VALVE OUTLET PLUGS OR CAPS SECURED AND VALVE PROTECTION CAP IN PLACE TO SUPPLIER.FOR EMER DISP ASSISTANCE,CONT CLOSEST SUPPLIER LOCATION.

HNU SYSTEMS INC -- ISOBUTYLENE SPAN GAS, SEE SUPP DATA -- 6665-01-214-8247

===================== Product Identification =====================

Product ID:ISOBUTYLENE SPAN GAS, SEE SUPP DATA
MSDS Date:12/08/1987
FSC:6665
NIIN:01-214-8247
MSDS Number: BJDVR
=== Responsible Party ===
Company Name:HNU SYSTEMS INC
Address:160 CHARLEMONT ST
City:NEWTON HIGHLANDS
State:MA
ZIP:02161
Country:US
Info Phone Num:617/964-6690
Emergency Phone Num:800/841-4357
CAGE:57631
=== Contractor Identification ===
Company Name:HNU SYSTEMS INC
Address:160 CHARLEMONT ST
Box:City:NEWTON HIGHLANDS
State:MA
ZIP:02161
Country:US
Phone:617/964-6690
CAGE:57631

============= Composition/Information on Ingredients =============

Ingred Name:ISOBUTYLENE
CAS:115-11-7
RTECS #:UD0890000
Fraction by Wt: 0.01%

===================== Hazards Identification =====================

LD50 LC50 Mixture:NONE SPECIFIED BY MANUFACTURER.
Routes of Entry: Inhalation:YES Skin:NO Ingestion:NO
Reports of Carcinogenicity:NTP:NO IARC:NO OSHA:NO
Health Hazards Acute and Chronic:ISOBUTYLENE IS A SIMPLE ASPHYXIANT;
MODERATE CONCENTRATION IN AIR CAUSE UNCONSCIOUSNESS. CONTACT

W/LIQUID CAUSES FROSTBITE.
Explanation of Carcinogenicity:NOT RELEVANT
Effects of Overexposure:SEE HEALTH HAZARDS.
Medical Cond Aggravated by Exposure:NONE SPECIFIED BY MANUFACTURER.

======================= First Aid Measures =======================

First Aid:IF BREATHED, REMOVE INDIVIDUAL TO FRESH AIR. IF BREATHING IS DIFFICULT, ADMINISTER OXYGEN. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. KEEP PERSON WARM, QUIET; GET MEDICAL ATTENTION.

===================== Fire Fighting Measures =====================

Flash Point Method:CC
Flash Point:-76 C OR -105 F
Lower Limits:1.8%
Upper Limits:9.6%
Extinguishing Media:CO2 OR DRY CHEMICAL
Fire Fighting Procedures:STOP FLOW OF ISOBUTYLENE IF POSSIBLE. USE WATER SPRAY TO COOL SURROUNDING CONTAINERS.
Unusual Fire/Explosion Hazard:ISOBUTYLENE IS HEAVIER THAN AIR MAY TRAVEL CONSIDERABLE DISTANCE TO SOURCE OF IGNITION. SHOULD FLAME BE EXTINGUISHED AND FLOW OF GAS CONTINUE SEE SUPP DATA.

================== Accidental Release Measures ==================

Spill Release Procedures:NONE SPECIFIED BY MANUFACTURER.
Neutralizing Agent:NONE SPECIFIED BY MANUFACTURER.

====================== Handling and Storage ======================

Handling and Storage Precautions:STORE AWAY FROM HEAT AND PROTECT CYLINDERS FROM PHYSICAL DAMAGE.
Other Precautions:DO NOT PUNCTURE CYLINDER.

============= Exposure Controls/Personal Protection =============

Respiratory Protection:POSITIVE PRESSURE AIR LINE OR SCBA FOR EMERGENCY USE.
Ventilation:HOOD W/FORCED VENTILATION TO PREVENT ACCUMULATION ABOVE LEL.
Protective Gloves:PLASTIC OR RUBBER.

Eye Protection:SAFETY GOGGLES OR GLASSES.
Other Protective Equipment:SAFETY SHOES, SAFETY SHOWER, EYEWASH FOUNTAIN.
Work Hygienic Practices:NONE SPECIFIED BY MANUFACTURER.
Supplemental Safety and Health
MFR PART NO, TRADE NAME:CALIBRATION GAS 101- 350-N, DC102573.EXPLO HAZ:INCREASE VENTILATION TO PREVENT FORMATION OF FLAMMABLE MIXTURE IN LOW AREAS/POCKETS. NOTE:DATA GIVEN FOR PURE ISOBUTLENE. CYLINDE R OF HNU SPAN GAS/ISOBUTYLENE CALIBRATION GAS CONTAINS 100 PPM IN ZERO AIR OR 0.01% ISOBUTYLENE IN AIR.

================== Physical/Chemical Properties ==================

Boiling Pt:B.P. Text:19.6F,-6.9C
Melt/Freeze Pt:M.P/F.P Text:-221F,-140C
Vapor Pres:@20C 24SIG
Vapor Density:1.95
Spec Gravity:0.59
Solubility in Water:UNAVAILABLE
Appearance and Odor:CLEAR UNPLEASANT ODOR SIMILAR TO COAL GAS

================= Stability and Reactivity Data =================

Stability Indicator/Materials to Avoid:YES
OXIDIZERS.
Stability Condition to Avoid:NONE SPECIFIED BY MANUFACTURER.
Hazardous Decomposition Products:NONE

==================== Disposal Considerations ====================

Waste Disposal Methods:DISPOSAL MUST BE I/A/W FED, STATE AND LOCAL REGULATIONS.

NORLAB CALIBRATION GASES & EQUIPMENT -- METHANE IN AIR 0.0001% TO 2.5% -- 6830-00F048862

==================== Product Identification ====================

Product ID:METHANE IN AIR 0.0001% TO 2.5%
MSDS Date:09/12/1995
FSC:6830
NIIN:00F048862
MSDS Number: BZTZS
=== Responsible Party ===
Company Name:NORLAB CALIBRATION GASES & EQUIPMENT
Address:1121 W AMITY
City:BOISE
State:ID
ZIP:83705
Country:US
Info Phone Num:208-336-1643
Emergency Phone Num:208-336-1643
CAGE:NORLA
=== Contractor Identification ===
Company Name:NORLAB CALIBRATION GASES AND EQUIPMENT
Address:1121 WEST AMITY
City:BOISE
State:ID
ZIP:83705
Country:US
Phone:800-657-6672/208-384-1720(FAX)
CAGE:NORLA
Company Name:NORLAB DIV OF NORCO, INC.
Address:1121 W. AMITY
Box:City:BOISE
State:ID
ZIP:83705
Country:US
Phone:208-336-1643
CAGE:0YFB8

============ Composition/Information on Ingredients ============

Ingred Name:METHANE
CAS:74-82-8
RTECS #:PA1490000

Fraction by Wt: .0001%
ACGIH TLV:SIMPLE ASPHYXIANT

Ingred Name:COMPRESSED AIR, REFRIGERATED LIQUID
RTECS #:AX5271000
Fraction by Wt: <97.5%

===================== Hazards Identification =====================

Routes of Entry: Inhalation:YES Skin:NO Ingestion:NO
Reports of Carcinogenicity:NTP:NO IARC:NO OSHA:NO
Health Hazards Acute and Chronic:EYES: CONTACT MAY CAUSE TISSUE FREEZING. SKIN: METHANE IS A SIMPLE ASPHYXIANT.
Explanation of Carcinogenicity:NONE
Effects of Overexposure:DIZZINESS, DEEPER BREATHING, NAUSEA, UNCONSCIOUSNESS.

======================= First Aid Measures =======================

First Aid:EYES: DON'T WASH W/HOT/EVEN TEPID WATER. IF VICTIM CAN'T TOLERATE LIGHT, PROTECT W/LIGHT BANDAGE/HANDKERCHIEF. INHALATION: REMOVE TO FRESH AIR. GIVE CPR/OXYGEN IF NEEDED. OBTAIN MEDICAL ATTENTION IN A LL CASES.

===================== Fire Fighting Measures =====================

Flash Point:GAS
Lower Limits:5
Upper Limits:15
Extinguishing Media:WATER, CO2, DRY CHEMICAL
Fire Fighting Procedures:SHOULD FLAME BE EXTINGUISED & FLOW OF GAS CONTINUE, INCREASE VENTILATION TO PREVENT FLAMMABLE MIXTURE FORMATION IN LOW AREAS/POCKETS. WEAR SCBA.

================== Accidental Release Measures ==================

Spill Release Procedures:EVACUATE AREA. USE PROTECTIVE EQUIPMENT. IF LEAK IS IN USER'S EQUIPMENT, BE CERTAIN TO PURGE PIPING W/AN INERT GAS PRIOR TO ATTEMPTING REPAIRS. IF LEAK IS IN CONTAINER/CONTAINER VALVE, CONTACT CHEMTRE C/NEAREST NORCO LOCATION. (SEE SUPP)

====================== Handling and Storage ======================

Handling and Storage Precautions:USE IN VENTILATED AREA. VALVE PROTECTION CAPS MUST REMAIN IN PLACE UNLESS CONTAINER IS SECURED W/VALVE OUTLET PIPED TO USE POINT.
Other Precautions:DON'T DRAG/ROLL CYLINDERS. USE A SUITABLE HAND TRUCK FOR CYLINDER MOVEMENTS, A PRESSURE REDUCING REGULATOR WHEN CONNECTING CYLINDERS TO LOWER PRESSURE PIPING/SYSTEMS. DON'T HEAT CYLINDERS, USE A CHECK VALVE/TRAP IN DISCHARGING LINE.

============= Exposure Controls/Personal Protection =============

Respiratory Protection:USE POSITIVE PRESSURE AIR LINE W/MASK/SELF CONTAINED BREATHING APPARATUS.
Ventilation:HOOD W/FORCED VENTILATION. LOCAL/MECHANICAL VENTILATION.
Protective Gloves:PLASTIC/RUBBER
Eye Protection:SAFETY GOGGLES/GLASSES
Other Protective Equipment:SAFETY SHOES, SAFETY SHOWER.
Supplemental Safety and Health
SPILLS CONT'D: INCREASE VENTILATION. EXTINGUISH IGNITION SOURCES. HANDLING & STORAGE CONT'D: PROTECT CYLINDERS. STORE IN COOL, DRY WELL VENTILATED AREA. AVOID TEMP TO EXCEED 130F. STORE UPRIGHT & FIRM LY SECURE. USE A "FIRST IN, FIRST OUT" INVENTORY SYSTEM. NEVER CARRY GAS CYLINDERS/CONTAINERS IN ENCLOSED SPACES.

================== Physical/Chemical Properties ==================

Solubility in Water:NEGLIGIBLE
Appearance and Odor:A COLORLESS GAS W/NO ODOR.

================= Stability and Reactivity Data =================

Stability Indicator/Materials to Avoid:YES
OXIDIZERS

==================== Disposal Considerations ====================

Waste Disposal Methods:DON'T ATTEMPT TO DISPOSE OF WASTE/UNUSED QUANTITIES. RETURN IN SHIPPING CONTAINER PROPERLY LABELED W/ANY VALVE OUTLET PLUGS/CAPS SECURE & VALVE PROTECTION CAP IN PLACE TO NORCO FOR PROPER DISPOSAL. NO NFLAMMABLE GAS UN1956 expressly or implied, warrants this information to be accurate and disclaims all liability for its use. Any person utilizing this document should seek competent professional advice to verify and assume responsibility for the suitability of this information to their particular situation.

MINE SAFETY APPLIANCES COMPANY -- CM-34337,MSA CLEANER-SANITIZER -- 6840-00-570-5299

===================== Product Identification =====================

Product ID:CM-34337,MSA CLEANER-SANITIZER
MSDS Date:01/01/1987
FSC:6840
NIIN:00-570-5299
MSDS Number: BFFPN
=== Responsible Party ===
Company Name:MINE SAFETY APPLIANCES COMPANY
Address:201 N.BRADDOCK AVENUE
Box:430
City:PITTSBURGH
State:PA
ZIP:15230
Country:US
Emergency Phone Num:412-273-5500
CAGE:40912
=== Contractor Identification ===
Company Name:MINE SAFETY APPLIANCE (REPLACED BY CAGE 55799)
Address:201 N BRADDOCK AVENUE
Box:426
City:PITTSBURGH
State:PA
ZIP:15230
Country:US
Phone:412-967-3000
CAGE:40912

============= Composition/Information on Ingredients =============

Ingred Name:TRISODIUM PHOSPHATE
CAS:7601-54-9
RTECS #:TC4940000
Fraction by Wt: 10.0%
EPA Rpt Qty:5000 LBS
DOT Rpt Qty:5000 LBS

Ingred Name:SODIUM CARBONATE
CAS:497-19-8
RTECS #:VZ4050000

Fraction by Wt: 42.2%

Ingred Name:METHYL DODECYL TRIMETHYL AMMONIUM CHLORIDE AND METHYL DODECYXYLENE BIS (TRIMETHYL AMMONIUM CHLORIDE
Fraction by Wt: 3.0%

Ingred Name:PENTASODIUM SALT OF DIETHYLENE TRIANIME PENTA ACETIC ACID
Fraction by Wt: 2.0%

Ingred Name:SODIUM TRIPOLYPHOSPHATE
CAS:13573-18-7
RTECS #:YK4900000
Fraction by Wt: 20.0%

Ingred Name:OCTYL PHENOXY POLYETHOXY ETHANOL
Fraction by Wt: 1.0%

===================== Hazards Identification =====================

Routes of Entry: Inhalation:YES Skin:UNKNOWN Ingestion:YES
Health Hazards Acute and Chronic:ACUTE:CAUSES BURNS OF EYES AND SKIN:INGESTION OF POWDER IS HARMFUL OR FATAL CHRONIC:NO DATA AVAILABLE.
Medical Cond Aggravated by Exposure:PRE-EXISTING CONDITIONS MAY BE WORSEN

======================= First Aid Measures =======================

First Aid:EYES:FLUSH WITH WATER FOR 15 MINS.HOLDING EYELID OPEN;INGESTION:DRINK MILK,RAW EGG WHITE,OR LARGE QUANTITIES OF WATER.AVOID ALCOHOL.CONSULT PLHYSICIAN AS SOON AS POSSIBLE.

===================== Fire Fighting Measures =====================

Extinguishing Media:NONE NOTED;USE SUITABLE MEDIA FOR SURROUNDING FIRE.
Fire Fighting Procedures:NONE NOTED:USE NIOSH/MSHA APPROVED SCBA IN AN ENCLOSED AREA IN CASE OF FIRES.
Unusual Fire/Explosion Hazard:NONE

================== Accidental Release Measures ==================

Spill Release Procedures:SWEEP UP.WASH RESIDUE DOWN WITH COPIOUS AMOUNTS OF WATER.

============= Exposure Controls/Personal Protection =============

Respiratory Protection:USE NIOSH/MSHA APPROVED RESPIRATOR FOR DUST
(MIST , IF THERE IS NO VENTILATION.
Ventilation:NORMAL ROOM VENTILATION.
Protective Gloves:AS REQUIRED
Eye Protection:SAFETY GLASSES
Other Protective Equipment:AS REQUIRED
Work Hygienic Practices:AVOID CONTACT WITH SKIN AND EYES;DO NOT TAKE
INTERNALLY OR BREATHE DUST.
Supplemental Safety and Health
MSDS RECEIVED BY THE DGSC-SLM:JAN08,1988

================== Physical/Chemical Properties ==================

HCC:N1
Solubility in Water:COMPLETE
Appearance and Odor:WHITE,FREE-FLOWING GRANULAR SOLID

================= Stability and Reactivity Data =================

Stability Indicator/Materials to Avoid:YES
OXIDIZING AGENTS
Hazardous Decomposition Products:NONE

==================== Disposal Considerations ====================

Waste Disposal Methods:DISPOSE OF WITH ORDINARY TRASH. REMOVE TO
SANITARY LANDFILL.

ALCONOX MSDS

Section 1 : MANUFACTURER INFORMATION

Product name: Alconox

Supplier: Same as manufacturer.

Manufacturer: Alconox, Inc.
30 Glenn St.
Suite 309
White Plains, NY 10603.

Manufacturer emergency phone number: 800-255-3924.
813-248-0585 (outside of the United States).

Manufacturer: Alconox, Inc.
30 Glenn St.
Suite 309
White Plains, NY 10603.

Supplier MSDS date: 2005/03/09

D.O.T. Classification: Not regulated.

Section 2 : HAZARDOUS INGREDIENTS

C.A.S.	CONCENTRATION %	Ingredient Name	T.L.V.	LD/50	LC/50
25155-30-0	10-30	SODIUM DODECYLBENZENESULFONATE	NOT AVAILABLE	438 MG/KG RAT ORAL 1330 MG/KG MOUSE ORAL	NOT AVAILABLE
497-19-8	7-13	SODIUM CARBONATE	NOT AVAILABLE	4090 MG/KG RAT ORAL 6600 MG/KG MOUSE ORAL	2300 MG/M3/2H RAT INHALATION 1200 MG/M3/2H MOUSE INHALATION
7722-88-5	10-30	TETRASODIUM PYROPHOSPHATE	5 MG/M3	4000 MG/KG RAT ORAL 2980 MG/KG MOUSE ORAL	NOT AVAILABLE
7758-29-4	10-30	SODIUM PHOSPHATE	NOT AVAILABLE	3120 MG/KG RAT ORAL 3100 MG/KG MOUSE ORAL >4640 MG/KG RABBIT DERMAL	NOT AVAILABLE

Section 2A : ADDITIONAL INGREDIENT INFORMATION

Note: (supplier).
CAS# 497-19-8: LD50 4020 mg/kg - rat oral.
CAS# 7758-29-4: LD50 3100 mg/kg - rat oral.

Section 3 : PHYSICAL / CHEMICAL CHARACTERISTICS

Physical state: Solid

Appearance & odor: Almost odourless.
White granular powder.

Odor threshold (ppm): Not available.

Vapour pressure (mmHg): Not applicable.

Vapour density (air=1): Not applicable.

By weight: Not available.

Evaporation rate (butyl acetate = 1): Not applicable.

Boiling point (°C): Not applicable.

Freezing point (°C): Not applicable.

pH: (1% aqueous solution).
9.5

Specific gravity @ 20 °C: (water = 1).
0.85 - 1.10

Solubility in water (%): 100 - > 10% w/w

Coefficient of water\oil dist.: Not available.

VOC: None

Section 4 : FIRE AND EXPLOSION HAZARD DATA

Flammability: Not flammable.

Conditions of flammability: Surrounding fire.

Extinguishing media: Carbon dioxide, dry chemical, foam.
Water
Water fog.

Special procedures: Self-contained breathing apparatus required.
Firefighters should wear the usual protective gear.

Auto-ignition temperature: Not available.

Flash point (°C), method: None

Lower flammability limit (% vol): Not applicable.

Upper flammability limit (% vol): Not applicable.

Not available.

Sensitivity to mechanical impact: Not applicable.

Hazardous combustion products: Oxides of carbon (COx).
Hydrocarbons.

Rate of burning: Not available.

Explosive power: None

Section 5 : REACTIVITY DATA

Chemical stability:	Stable under normal conditions.
Conditions of instability:	None known.
Hazardous polymerization:	Will not occur.
Incompatible substances:	Strong acids. Strong oxidizers.
Hazardous decomposition products:	See hazardous combustion products.

Section 6 : HEALTH HAZARD DATA

Route of entry:	Skin contact, eye contact, inhalation and ingestion.
<u>Effects of Acute Exposure</u>	
Eye contact:	May cause irritation.
Skin contact:	Prolonged contact may cause irritation.
Inhalation:	Airborne particles may cause irritation.
Ingestion:	May cause vomiting and diarrhea. May cause abdominal pain. May cause gastric distress.
Effects of chronic exposure:	Contains an ingredient which may be corrosive.
LD50 of product, species & route:	> 5000 mg/kg rat oral.
LC50 of product, species & route:	Not available for mixture, see the ingredients section.
Exposure limit of material:	Not available for mixture, see the ingredients section.
Sensitization to product:	Not available.
Carcinogenic effects:	Not listed as a carcinogen.
Reproductive effects:	Not available.
Teratogenicity:	Not available.
Mutagenicity:	Not available.
Synergistic materials:	Not available.
Medical conditions aggravated by exposure:	Not available.
<u>First Aid</u>	
Skin contact:	Remove contaminated clothing. Wash thoroughly with soap and water. Seek medical attention if irritation persists.
Eye contact:	Check for and remove contact lenses. Flush eyes with clear, running water for 15 minutes while holding eyelids open: if irritation persists, consult a physician.
Inhalation:	Remove victim to fresh air. Seek medical attention if symptoms persist.
Ingestion:	Dilute with two glasses of water. Never give anything by mouth to an unconscious person. Do not induce vomiting, seek immediate medical attention.

Section 7 : PRECAUTIONS FOR SAFE HANDLING AND USE

Leak/Spill: Contain the spill.
Recover uncontaminated material for re-use.
Wear appropriate protective equipment.
Contaminated material should be swept or shoveled into appropriate waste container for disposal.

Waste disposal: In accordance with municipal, provincial and federal regulations.

Handling procedures and equipment: Protect against physical damage.
Avoid breathing dust.
Wash thoroughly after handling.
Keep out of reach of children.
Avoid contact with skin, eyes and clothing.
Launder contaminated clothing prior to reuse.

Storage requirements: Keep containers closed when not in use.
Store away from strong acids or oxidizers.
Store in a cool, dry and well ventilated area.

Section 8 : CONTROL MEASURES

Precautionary Measures

Gloves/Type:

Neoprene or rubber gloves.

Respiratory/Type:

If exposure limit is exceeded, wear a NIOSH approved respirator.

Eye/Type:

Safety glasses with side-shields.

Footwear/Type: Safety shoes per local regulations.

Clothing/Type: As required to prevent skin contact.

Other/Type: Eye wash facility should be in close proximity.
Emergency shower should be in close proximity.

Ventilation requirements: Local exhaust at points of emission.

Material Safety Data Sheet
Nitric Acid 20%

ACC# 88805

Section 1 - Chemical Product and Company Identification

MSDS Name: Nitric Acid 20%
Catalog Numbers: M-281, MCC-030822
Synonyms: None
Company Identification:
Fisher Scientific
1 Reagent Lane
Fair Lawn, NJ 07410
For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
7732-18-5	Water	80.0	231-791-2
7697-37-2	Nitric acid	20.0	231-714-2

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: Not available. **Danger!** May be fatal if inhaled. Causes eye and skin burns. Causes digestive and respiratory tract burns. Corrosive. May cause severe respiratory tract irritation with possible burns. May cause severe digestive tract irritation with possible burns.
Target Organs: None.

Potential Health Effects
Eye: Causes severe eye burns. May cause irreversible eye injury. May cause chemical conjunctivitis and corneal damage.
Skin: Causes skin burns. May cause deep, penetrating ulcers of the skin. May cause skin rash (in milder cases), and cold and clammy skin with cyanosis or pale color.
Ingestion: May cause severe and permanent damage to the digestive tract. Causes gastrointestinal tract burns. May cause perforation of the digestive tract. May cause systemic effects.
Inhalation: May be fatal if inhaled. Effects may be delayed. May cause irritation of the respiratory tract with burning pain in the nose and throat, coughing, wheezing, shortness of breath and pulmonary edema. Causes chemical burns to the respiratory tract. Aspiration may lead to pulmonary edema. May cause systemic effects.
Chronic: Repeated inhalation may cause chronic bronchitis. Repeated exposure may cause erosion of teeth. Effects may be delayed.

Section 4 - First Aid Measures

Eyes: Get medical aid immediately. Do NOT allow victim to rub eyes or keep eyes closed. Extensive irrigation with water is required (at least 30 minutes).
Skin: Get medical aid immediately. Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Destroy contaminated shoes.

Ingestion: If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately. Do NOT induce vomiting and seek IMMEDIATE MEDICAL ADVICE.
Inhalation: Get medical aid immediately. Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Do NOT use mouth-to-mouth resuscitation. If breathing has ceased apply artificial respiration using oxygen and a suitable mechanical device such as a bag and a mask.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Strong oxidizer. Contact with other material may cause fire. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. Use water spray to keep fire-exposed containers cool. Substance is noncombustible.
Extinguishing Media: Substance is noncombustible; use agent most appropriate to extinguish surrounding fire.
Flash Point: Not applicable.
Autoignition Temperature: Not applicable.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: 3; Flammability: 0; Instability: 0

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Absorb spill with inert material (e.g. vermiculite, sand or earth), then place in suitable container. Clean up spills immediately, observing precautions in the Protective Equipment section. Wear a self contained breathing apparatus and appropriate personal protection. (See Exposure Controls, Personal Protection section). Neutralize spill with sodium bicarbonate. Use water spray to disperse the gas/vapor. Provide ventilation.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use only in a well-ventilated area. Use with adequate ventilation. Do not breathe dust, vapor, mist, or gas. Do not get in eyes, on skin, or on clothing. Keep container tightly closed. Do not get on skin or in eyes. Do not ingest or inhale. Discard contaminated shoes.
Storage: Keep container closed when not in use. Store in a cool, dry, well-ventilated area away from incompatible substances. Do not store near alkaline substances.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate ventilation to keep airborne concentrations low. Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Water	none listed	none listed	none listed
Nitric acid	2 ppm TWA; 4 ppm STEL	2 ppm TWA; 5 mg/m3 TWA 25 ppm IDLH	2 ppm TWA; 5 mg/m3 TWA

OSHA Vacated PELs: Water: No OSHA Vacated PELs are listed for this chemical. Nitric acid: 2 ppm TWA; 5 mg/m3 TWA
Personal Protective Equipment

Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin: Wear appropriate protective gloves to prevent skin exposure.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirators: A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant a respirator's use. Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Always use a NIOSH or European Standard EN 149 approved respirator when necessary.

Section 9 - Physical and Chemical Properties

Physical State: Liquid
Appearance: Not available.
Odor: none reported
pH: Not available.
Vapor Pressure: Not available.
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: Not available.
Freezing/Melting Point: Not available.
Decomposition Temperature: Not available.
Solubility: Not available.
Specific Gravity/Density: Not available.
Molecular Formula: Not available.
Molecular Weight: Not available.

Section 10 - Stability and Reactivity

Chemical Stability: Decomposes when in contact with air, light, or organic matter.
Conditions to Avoid: High temperatures, incompatible materials, moisture.
Incompatibilities with Other Materials: Incompatible with many substances., alcohols, aldehydes, combustible materials, cyanides, metals, reducing agents, strong bases.
Hazardous Decomposition Products: Nitrogen oxides.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 7732-18-5: ZC0110000
CAS# 7697-37-2: QU5775000; QU5900000
LD50/LC50:
CAS# 7732-18-5:
Oral, rat: LD50 = >90 mL/kg;
CAS# 7697-37-2:
Inhalation, rat: LC50 = 260 mg/m3/30M;
Inhalation, rat: LC50 = 130 mg/m3/4H;
Inhalation, rat: LC50 = 67 ppm(NO2)/4H;
Carcinogenicity:
CAS# 7732-18-5: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA. CAS# 7697-37-2: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Epidemiology: No data available.
Teratogenicity: No data available.
Reproductive Effects: No data available.

Neurotoxicity: No data available.
Mutagenicity: No data available.
Other Studies: No data available.

Section 12 - Ecological Information

No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series: None listed.

Section 14 - Transport Information

	US DOT	IATA	RID/ADR	IMO	Canada TDG
Shipping Name:	No information available.				No information available.
Hazard Class:					
UN Number:					
Packing Group:					

Section 15 - Regulatory Information

US FEDERAL

TSCA
CAS# 7732-18-5 is listed on the TSCA inventory.
CAS# 7697-37-2 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
SARA

CERCLA Hazardous Substances and corresponding RQs
CAS# 7697-37-2: 1000 lb final RQ; 454 kg final RQ
SARA Section 302 Extremely Hazardous Substances
CAS# 7697-37-2: 1000 lb TPQ
SARA Codes
CAS # 7697-37-2: acute, chronic, flammable.
Section 313
This material contains Nitric acid (CAS# 7697-37-2, 20 0%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.
Clean Air Act:
This material does not contain any hazardous air pollutants. This material does not contain any Class 1 Ozone depletors. This material does not contain any Class 2 Ozone depletors.
Clean Water Act:

CAS# 7697-37-2 is listed as a Hazardous Substance under the CWA. None of the chemicals in this product are listed as Priority Pollutants under the CWA. None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

CAS# 7732-18-5 is not present on state lists from CA, PA, MN, MA, FL, or NJ.
CAS# 7697-37-2 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.
California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations
European Labeling in Accordance with EC Directives
Hazard Symbols:
C
Risk Phrases:
R 34 Causes burns.

Safety Phrases:

WGK (Water Danger/Protection)
CAS# 7732-18-5: No information available.
CAS# 7697-37-2: 1
Canada - DSL/NDSL
CAS# 7732-18-5 is listed on Canada's DSL List.
CAS# 7697-37-2 is listed on Canada's DSL List.
Canada - WHMIS
This product has a WHMIS classification of E.
Canadian Ingredient Disclosure List
CAS# 7697-37-2 is listed on the Canadian Ingredient Disclosure List.
Exposure Limits
CAS# 7697-37-2: OEL-ARAB Republic of Egypt:TWA 2 ppm (5 mg/m3) OEL-AUSTRALIA:TWA 2 ppm (5 mg/m3);STEL 4 ppm (10 mg/m3) OEL-BELGIUM:TWA 2 ppm (5.2 mg/m3);STEL 4 ppm (10 mg/m3) OEL-CZECHOSLOVAKIA:TWA 2.5 mg/m3;STEL 5 mg/m3 OEL-DENMARK:TWA 2 ppm (5 mg/m3) OEL-FINLAND:TWA 2 pp m (5 mg/m3);STEL 5 ppm (13 mg/m3);Skin OEL-FRANCE:TWA 2 ppm (5 mg/m3) ;STEL 4 ppm (10 mg/m3) OEL-GERMANY:TWA 10 ppm (25 mg/m3) OEL-HUNGARY :STEL 5 mg/m3 OEL-JAPAN:TWA 2 ppm (5.2 mg/m3) OEL-THE PHILIPPINES:TW A 2 ppm (5 mg/m3) OEL-POLAND:TWA 10 mg/m3 OEL-RUSSIA:TWA 2 ppm;STEL 2 mg/m3;Skin OEL-SWEDEN:TWA 2 ppm (5 mg/m3);STEL 5 ppm (13 mg/m3) OE L-SWITZERLAND:TWA 2 ppm (5 mg/m3);STEL 4 ppm (1 mg/m3) OEL-THAILAND:T WA 2 ppm (5 mg/m3) OEL-TURKEY:TWA 2 ppm (5 mg/m3) OEL-UNITED KINGDOM :TWA 2 ppm (5 mg/m3);STEL 4 ppm (10 mg/m3) OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV

Section 16 - Additional Information

MSDS Creation Date: 8/24/1997
Revision #5 Date: 3/18/2003

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

Material Safety Data Sheet
Pentane

ACC# 18210

Section 1 - Chemical Product and Company Identification

MSDS Name: Pentane
Catalog Numbers: AC170070200, AC217240040, AC600180050, S80116SPEC, NC9941939, O4062-20, O4062-4, O4062RS19, P393-1, P399-1, P399-4, P399J4, P399RS28, P399SK-1, P399SK-4, P400-4
Synonyms: Amyl hydride; n-Pentane; normal pentane.
Company Identification:
Fisher Scientific
1 Reagent Lane
Fair Lawn, NJ 07410
For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
109-66-0	n-Pentane	>98	203-692-4

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: clear, colorless liquid. Flash Point: -49 deg C.
Danger! Extremely flammable liquid and vapor. Vapor may cause flash fire. Breathing vapors may cause drowsiness and dizziness. Causes eye and skin irritation. Repeated exposure may cause skin dryness or cracking. Aspiration hazard if swallowed. Can enter lungs and cause damage. May cause respiratory tract irritation.
Target Organs: Central nervous system, respiratory system, eyes, skin.

Potential Health Effects
Eye: Causes eye irritation.
Skin: Causes skin irritation. Repeated or prolonged exposure may cause drying and cracking of the skin. Volunteers suffered from painful burning sensations, accompanied by itching, after topical application of pentane; after 5 hours, blisters formed on the treated areas.
Ingestion: May cause central nervous system depression, characterized by excitement, followed by headache, dizziness, drowsiness, and nausea. Advanced stages may cause collapse, unconsciousness, coma and possible death due to respiratory failure. Aspiration of material into the lungs may cause chemical pneumonitis, which may be fatal.
Inhalation: Inhalation of high concentrations may cause central nervous system effects characterized by nausea, headache, dizziness, unconsciousness and coma. May cause respiratory tract irritation. Vapors may cause dizziness or suffocation.
Chronic: Prolonged or repeated skin contact may cause defatting and dermatitis. Chronic exposure to vapors may produce polyneuropathy. The possibility that chronic exposure to very high concentrations may lead to polyneuropathy cannot be ruled out altogether, despite the substantially lower toxicity of pentane, in comparison with hexane and its neurotoxicity.

Section 4 - First Aid Measures

Eyes: In case of contact, immediately flush eyes with plenty of water for a t least 15 minutes. Get medical aid.
Skin: In case of contact, flush skin with plenty of water. Remove contaminated clothing and shoes. Get medical aid if irritation develops and persists. Wash clothing before reuse.
Ingestion: Potential for aspiration if swallowed. Get medical aid immediately. Do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If vomiting occurs naturally, have victim lean forward.
Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information: Containers can build up pressure if exposed to heat and/or fire. As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Vapors may form an explosive mixture with air. Use water spray to keep fire-exposed containers cool. Extremely flammable liquid and vapor. Vapor may cause flash fire. Vapors are heavier than air and may travel to a source of ignition and flash back. Vapors can spread along the ground and collect in low or confined areas. Sensitive to static discharge.
Extinguishing Media: For small fires, use dry chemical, carbon dioxide, water spray or alcohol-resistant foam. For large fires, use water spray, fog, or alcohol-resistant foam. This material is lighter than water and insoluble in water. The fire could easily be spread by the use of water in an area where the water cannot be contained. Do NOT use straight streams of water.
Flash Point: -49 deg C (-56.20 deg F)
Autoignition Temperature: 260 deg C (500.00 deg F)
Explosion Limits, Lower:1.5
Upper: 7.8
NFPA Rating: (estimated) Health: 1; Flammability: 4; Instability: 0

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Absorb spill with inert material (e.g. vermiculite, sand or earth), then place in suitable container. Remove all sources of ignition. Use a spark-proof tool. Provide ventilation. A vapor suppressing foam may be used to reduce vapors.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Ground and bond containers when transferring material. Use spark-proof tools and explosion proof equipment. Avoid contact with eyes, skin, and clothing. Empty containers retain product residue, (liquid and/or vapor), and can be dangerous. Take precautionary measures against static discharges. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose empty containers to heat, sparks or open flames. Use only with adequate ventilation. Keep away from heat, sparks and flame. Avoid breathing vapor or mist.
Storage: Keep away from heat, sparks, and flame. Keep away from sources of ignition. Store in a tightly closed container. Keep from contact with oxidizing materials. Store in a cool, dry, well-ventilated area away from incompatible substances. Flammables-area.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits. Ventilation fans and other electrical service must be non-sparking and have an explosion-

proof design.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
n-Pentane	600 ppm TWA	120 ppm TWA; 350 mg/m3 TWA 1500 ppm IDLH	1000 ppm TWA; 2950 mg/m3 TWA

OSHA Vacated PELs: n-Pentane: 600 ppm TWA; 1800 mg/m3 TWA
Personal Protective Equipment
Eyes: Wear chemical splash goggles.
Skin: Wear appropriate gloves to prevent skin exposure.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Section 9 - Physical and Chemical Properties

Physical State: Liquid
Appearance: clear, colorless
Odor: mild odor - gasoline-like - pleasant odor
pH: Not applicable.
Vapor Pressure: 514 mm Hg @ 25 deg C
Vapor Density: 2.5 (Air=1)
Evaporation Rate:28.6 (Butyl acetate=1)
Viscosity: Not available.
Boiling Point: 36 deg C
Freezing/Melting Point:-130 deg C
Decomposition Temperature: Not available.
Solubility: Negligible (0.04% at 20°C).
Specific Gravity/Density:0.62
Molecular Formula:C_5H_{12}
Molecular Weight:72.15

Section 10 - Stability and Reactivity

Chemical Stability: Stable at room temperature in closed containers under normal storage and handling conditions.
Conditions to Avoid: Ignition sources, excess heat.
Incompatibilities with Other Materials: Strong oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide, carbon dioxide.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 109-66-0: RZ9450000
LD50/LC50:
CAS# 109-66-0:
Inhalation, rat: LC50 = 364 gm/m3/4H;
Oral, rat: LD50 = >2000 mg/kg;
.

Carcinogenicity:
CAS# 109-66-0: Not listed by ACGIH, IARC, NTP, or CA Prop 65.

Epidemiology: No information found
Teratogenicity: No information found
Reproductive Effects: No information found
Mutagenicity: No information found
Neurotoxicity: n-Hexane is a mild irritant and CNS depressant in acute exposure, but its principal effects are damage to the sensory and motor peripheral nerves, particularly in chronic exposure.Because of the otherwise substantially lower toxicity of pentane, in comparison with hexane, it is believed that such effects, if they occur, would require gross exposures, & the 600-ppm TLV-TWA should minimize potential for development of axonopathies.
Other Studies:

Section 12 - Ecological Information

Ecotoxicity: Fish: Rainbow trout: LC50 = 9.87 mg/L; 96 Hr.; UnspecifiedFish: Fathead Minnow: LC50 = 11.59 mg/L; 96 Hr.; UnspecifiedFish: Bluegill/Sunfish: LC50 = 9.99 mg/L; 96 Hr.; UnspecifiedWater flea Daphnia: LC50 = 9.7 mg/L; 48 Hr.; Unspecified No data available.
Environmental: Photolysis or hydrolysis of n-pentane is not expected to be important in soils. The biodegradation of n-pentane may occur in soils; however, primarily volatilization and to some extent adsorption are expected to be far more important fate processes. A calculated Koc range of 580 to 1600 indicates a low mobility class for n-pentane in soils. Based upon an estimated Henry's Law Constant of 1.26 atm-cu m/mole, n-pentane is expected to rapidly volatilize from surface soils.
Physical: Based on a vapor pressure of 514 mm Hg at 25°C, n-pentane is expected to exist entirely in the vapor phase in ambient air. n-Pentane does not absorb UV light in the environmentally significant range, >290 nm and probably will not undergo direct photolysis in the atmosphere.
Other: Based upon a water solubility of 38.5 mg/l at 25°C and a log Kow of 3.39, the bioconcentration factor (log BCF) for n-pentane has been calculated to be 1.90 and 2.35, respectively, from recommended regression derived equations. These BCF values are not indicative of important bioconcentration in aquatic organisms.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series: None listed.

Section 14 - Transport Information

	US DOT	Canada TDG
Shipping Name:	PENTANES	PENTANES
Hazard Class:	3	3
UN Number:	UN1265	UN1265
Packing Group:	II	II
Additional Info:		FLASHPOINT -49 C

Section 15 - Regulatory Information

US FEDERAL

TSCA
CAS# 109-66-0 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
CAS# 109-66-0: Testing required by manufacturers, processors

Section 12b
CAS# 109-66-0: Section 4
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
CERCLA Hazardous Substances and corresponding RQs
None of the chemicals in this material have an RQ.
SARA Section 302 Extremely Hazardous Substances
None of the chemicals in this product have a TPQ.
SARA Codes
CAS # 109-66-0: immediate, delayed, fire.
Section 313 No chemicals are reportable under Section 313.
Clean Air Act:
This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
None of the chemicals in this product are listed as Hazardous Substances under the CWA.
None of the chemicals in this product are listed as Priority Pollutants under the CWA.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.
OSHA:
None of the chemicals in this product are considered highly hazardous by OSHA.
STATE
CAS# 109-66-0 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.

California Prop 65

California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations
European Labeling in Accordance with EC Directives
Hazard Symbols:
XN F+ N
Risk Phrases:
R 12 Extremely flammable.
R 51/53 Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
R 65 Harmful: may cause lung damage if swallowed.
R 66 Repeated exposure may cause skin dryness or cracking.
R 67 Vapours may cause drowsiness and dizziness.

Safety Phrases:
S 16 Keep away from sources of ignition - No smoking.
S 29 Do not empty into drains.
S 33 Take precautionary measures against static discharges.
S 9 Keep container in a well-ventilated place.
S 61 Avoid release to the environment. Refer to special instructions /safety data sheets.

WGK (Water Danger/Protection)
CAS# 109-66-0: 1
Canada - DSL/NDSL
CAS# 109-66-0 is listed on Canada's DSL List.
Canada - WHMIS
This product has a WHMIS classification of B2.
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.
Canadian Ingredient Disclosure List
CAS# 109-66-0 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information

MSDS Creation Date: 6/01/1999
Revision #6 Date: 6/20/2005

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

PACIFIC COAST CEMENT CORP. -- PORTLAND CEMENT -- 5610-00-242-3793

===================== Product Identification =====================

Product ID:PORTLAND CEMENT
MSDS Date:07/01/1988
FSC:5610
NIIN:00-242-3793
MSDS Number: CDVHC
=== Responsible Party ===
Company Name:PACIFIC COAST CEMENT CORP.
Address:300 N. LAKE AVE. SUITE 1111
City:PASADENA,
State:CA
ZIP:91101
Country:US
Info Phone Num:818-568-1111
Emergency Phone Num:213-435-0195
CAGE:KO799
=== Contractor Identification ===
Company Name:PACIFIC COAST CEMENT CORP.
Address:300 N. LAKE AVE. SUITE 1111
Box:City:PASADENA,
State:CA
ZIP:91101
Country:US
Phone:818-568-1111
CAGE:KO799

============= Composition/Information on Ingredients =============

Ingred Name:TRICALCIUM SILICATE
CAS:12168-85-3
Other REC Limits:NONE RECOMMENDED

Ingred Name:DICALCIUM SILICATE
Other REC Limits:NONE RECOMMENDED

Ingred Name:TRICALCIUM ALUMINATE
CAS:12042-78-3
Other REC Limits:NONE RECOMMENDED

Ingred Name:TETRACALCIUM ALUMINATE FARITE

Other REC Limits:NONE RECOMMENDED

Ingred Name:GYPSUM
CAS:13397-24-5
Other REC Limits:NONE RECOMMENDED

===================== Hazards Identification =====================

LD50 LC50 Mixture:RDUST 5MG/M3 TDUST 10 MG/M3
Routes of Entry: Inhalation:YES Skin:YES Ingestion:YES
Reports of Carcinogenicity:NTP:NO IARC:NO OSHA:NO
Health Hazards Acute and Chronic:SKIN: DRYING, ALKALI BURNS. EYE: IRRIT. INHAL: UPPER RESP IRRIT. INFLAMMATION OF NOSE TISSUE/CORNEA, ALLERGIC DERMATITIS.

======================= First Aid Measures =======================

First Aid:EYE: IRRIGATE OR FLOOD IMMED/REPEATEDLY W/CLEAN WATER. SKIN: WASH W/SOAP & WATER, GET PROMPT MED AID.

===================== Fire Fighting Measures =====================

Flash Point:NONCOMBUSTIBLE

================== Accidental Release Measures ==================

Spill Release Procedures:USE DRY METHODS THAT DO NOT DISPERSE DUST. AVOID BREATHING DUST. EMERGENCY PROCEDURES ARE NOT REQUIRED.

============= Exposure Controls/Personal Protection =============

Respiratory Protection:USE OSHA/MSHA/NIOSH APPROVED RESPIRATOR & TIGHT FITTING GOGGLES.
Ventilation:LOCAL EXHAUST IF NECESSARY TO CONTROL AIRBORNE DUST LEVELS.
Protective Gloves:IMPERVIOUS.
Other Protective Equipment:BARRIER CREAMS, BOOTS, PROTECTIVE CLOTHING.
Work Hygienic Practices:SHOWER W/SOAP & WATER AFTER WORK.
Supplemental Safety and Health
NK

================== Physical/Chemical Properties ==================

Spec Gravity:3.15

Solubility in Water:SLIGHT (0.1 TO 1.04
Appearance and Odor:GRAY COLORED POWDER

================= Stability and Reactivity Data =================

Stability Indicator/Materials to Avoid:YES
MOISTURE.

==================== Disposal Considerations ====================

Waste Disposal Methods:TREAT AS COMMON WASTE FOR DISPOSAL OR RETURN TO CONTAINER FOR LATER USE IF NOT CONTAMINATED OR WET.

MORIE COMPANY, INC - GEORGIA SILICA DIV -- SAND FILTERINGS -- 5610-00F008225

==================== Product Identification ====================

Product ID:SAND FILTERINGS
MSDS Date:06/18/1986
FSC:5610
NIIN:00F008225
MSDS Number: BGTXH
=== Responsible Party ===
Company Name:MORIE COMPANY, INC - GEORGIA SILICA DIV
Address:ROUTE 1
Box:123
City:MAUK
State:GA
ZIP:31058
Info Phone Num:(404) 269-3294
Emergency Phone Num:(404) 269-3294
Preparer's Name:RANDY H. WHITLEY
CAGE:MORIE
=== Contractor Identification ===
Company Name:MORIE COMPANY, INC - GEORGIA SILICA DIV
Address:ROUTE 1
Box:123
City:MAUK
State:GA
ZIP:31058
Phone:(404) 269-3294
CAGE:MORIE

============= Composition/Information on Ingredients =============

Ingred Name:SILICA, CRYSTALLINE - QUARTZ
CAS:14808-60-7
RTECS #:VV7330000
Fraction by Wt: >99%
Other REC Limits:0.05 MG/CUM NIOSH
OSHA PEL:SEE TABLE Z3
ACGIH TLV:0.1 MG/M3 RDUST;9293

==================== Hazards Identification ====================

Routes of Entry: Inhalation:YES Skin:NO Ingestion:NO

Reports of Carcinogenicity:NTP:NO IARC:NO OSHA:NO

Health Hazards Acute and Chronic:HEALTH HAZARDS CAN OCCUR FROM EXCESSIVE INHALATION OF SILICA DUST, OTHERWISE NONTOXIC. CRYSTALLINE SILICA IN THE LUNG CAN PRODUCE A PNEUMOCONIOSIS, COMMONLY CALL SILICOSIS, WHICH IS A CHRONIC, SLOWLY DEVELOPING DISEASE. TOTAL DUST MAY CAUSE IRRITATION OF EYES & RESPIRATORY SYSTEM.

Explanation of Carcinogenicity:NONE

Effects of Overexposure:SYMPTOMS ARE DYSPENA-CAUSED BY MANY LUNG SCARS THAT DEVELOP FROM THE SILICA DUST - PAIN IN THE CHEST, DECREASED VITAL CAPACITY AND COUGH.

Medical Cond Aggravated by Exposure:CHRONIC LUNG SCARRING LEADS TO A PROGRESSIVE MASSIVE FIBROSIS THAT IS OFTEN ACCOMPANIED BY INCREASED SUSCEPTIBILITY TO PULMONARY TUBERCULOSIS/OTHER RESPIRATORY INFECTIONS.

======================= First Aid Measures =======================

First Aid:NONE

===================== Fire Fighting Measures =====================

Fire Fighting Procedures:NONE

Unusual Fire/Explosion Hazard:NONE

================== Accidental Release Measures ==================

Spill Release Procedures:CLEANUP WITH DUSTLESS METHOD (USE VACUUM OR WET SWEEPING). PROVIDE VENTILATION.

====================== Handling and Storage ======================

Handling and Storage Precautions:USE DUSTLESS SYSTEM OF STORAGE AND HANDLING. KEEP WELL VENTILATED.

Other Precautions:USE GOOD HOUSEKEEPING TECHNIQUES.

============= Exposure Controls/Personal Protection =============

Respiratory Protection:WHEN TLV IS EXCEEDED, A RESPIRATOR PROGRAM CONSISTENT WITH THE STANDARD OF THE AMERICAN NATIONAL STANDARDS INSTITUTE.

Ventilation:PROVIDE MECHANICAL VENTILATION TO KEEP <TLV

Eye Protection:YES

Other Protective Equipment:NONE
Work Hygienic Practices:USE GOOD HOUSEKEEPING TECHNIQUES.
Supplemental Safety and Health

================== Physical/Chemical Properties ==================

Spec Gravity:2.65
Evaporation Rate & Reference:NONE
Solubility in Water:NONE
Appearance and Odor:WHITE OR TAN SAND - ODORLESS

================= Stability and Reactivity Data =================

Stability Indicator/Materials to Avoid:YES
REACT W/HYDROFLURIC ACID TO GENERATE VOLATILE SIF4. STRONG ALKALIS, METALLIC OXIDES
Stability Condition to Avoid:NONE
Hazardous Decomposition Products:NONE

==================== Disposal Considerations ====================

Waste Disposal Methods:FOLLOW STATE & LOCAL REGULATIONS FOR SOLID WASTE.

CH2M HILL Health and Safety Plan

Attachment 7

Working Alone Standard

CALL – IN CONTACT FORM

Date of site work:_______________ Expected start time:______________

Name of CH2M HILL employee in the field:_____________________________________

Name of CH2M HILL employee responsible to receive contact:

Client Emergency Contact (if any):

CH2M HILL employee's contact numbers:

Radio #__________________________

Cell Phone #______________________

Address and Location of work:____

Directions/Map:

Planned Activity:____

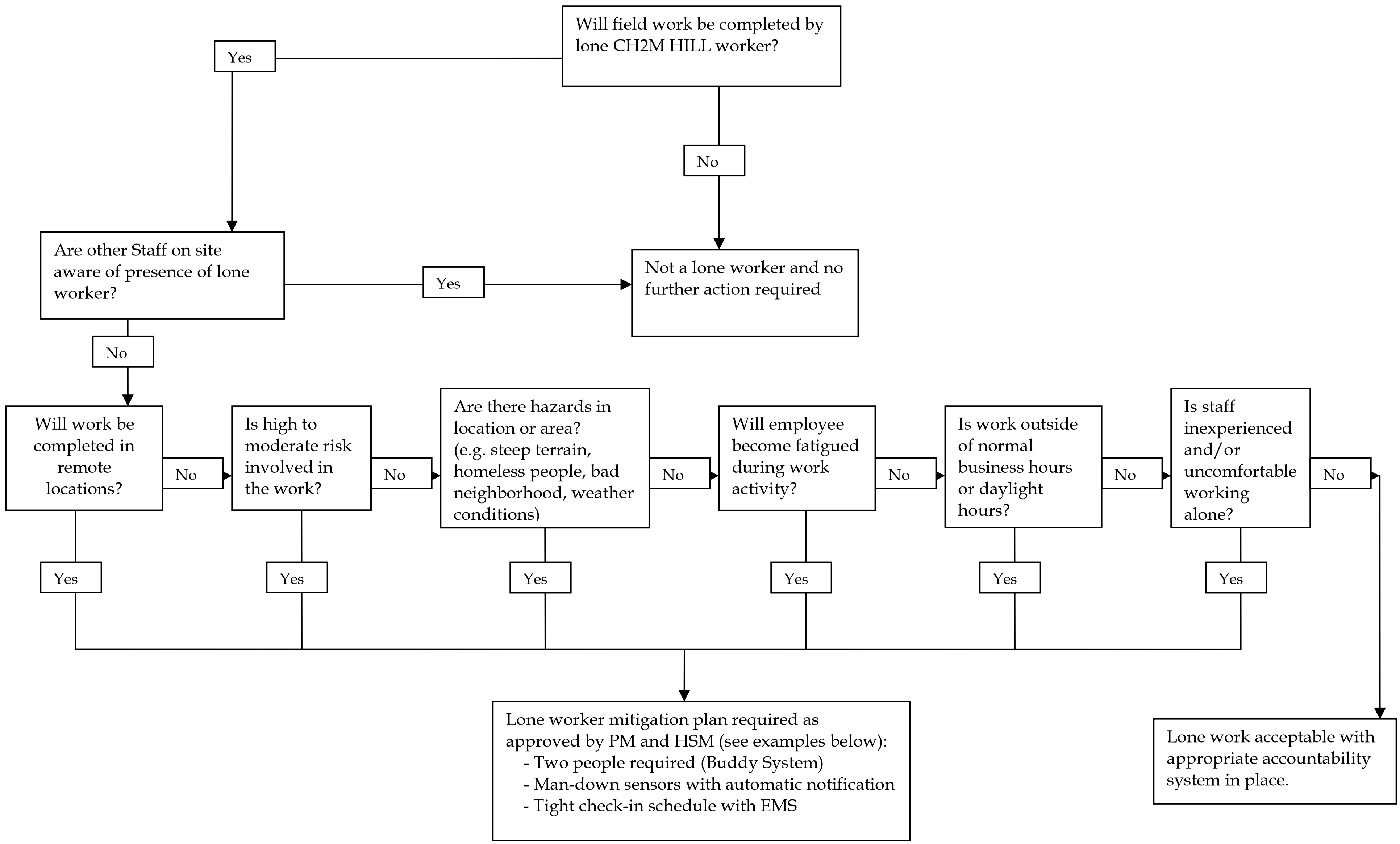
Specified Frequency and time for call in:____

Time	Verified	Location

If lone worker fails to call in at specified frequency/time:

1) Call worker's radio and cell to determine if an emergency exists.
2) If no reply, immediately call Client security/emergency service if there is one at the site.
3) If there is no client security call Emergency Services (911). Inform the dispatcher there is a lone worker that cannot be contacted and there may be an emergency on site. Provide the lone worker's name, their last known location, and your contact information.
4) After Emergency Services have been contacted, call the other emergency contacts, Project Manager, and Health and Safety Manager.

Lone Worker Protocol



Tick Fact Sheet

12.1 Tick-Borne Pathogens — A Fact Sheet

Most of us have heard of Lyme disease or Rocky Mountain Spotted Fever (RMSF), but there are actually six notifiable tick-borne pathogens that present a significant field hazard. In some areas, these account for more than half of our serious field incidents. The following procedures should be applied during any field activity—even in places that are predominantly paved with bordering vegetation.

12.1.1 Hazard Recognition

An important step in controlling tick related hazards is understanding how to identify ticks, their habitats, their geographical locations, and signs and symptoms of tick-borne illnesses.

12.1.1.1 Tick Identification

There are five varieties of hard-bodied ticks that have been associated with tick-borne pathogens. These include:

- Deer (Black Legged) Tick (eastern and pacific varieties)
- Lone Star Tick
- Dog Tick
- Rocky Mountain Wood Tick

These varieties and their geographical locations are illustrated on the following page.

12.1.1.2 Tick Habitat

In eastern states, ticks are associated with deciduous forest and habitat containing leaf litter. Leaf litter provides a moist cover from wind, snow, and other elements. In the north-central states, is generally found in heavily wooded areas often surrounded by broad tracts of land cleared for agriculture.

On the Pacific Coast, the bacteria are transmitted to humans by the western black-legged (deer) tick and habitats are more diverse. For this region, ticks have been found in habitats with forest, north coastal scrub, high brush, and open grasslands. Coastal tick populations thrive in areas of high rainfall, but ticks are also found at inland locations.

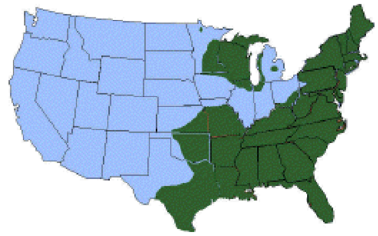
12.1.1.3 Illnesses and Signs & Symptoms

There are six notifiable tick-borne pathogens that cause human illness in the United States. These pathogens may be transmitted during a tick bite—normally hours after attachment. The illnesses, presented in approximate order of most common to least, include:

- Lyme (bacteria)
- RMSF (bacteria)
- Ehrlichiosis (bacteria)
- STARI (Southern Tick-Associated Rash Illness) (bacteria)
- Tularemia (Rabbit Fever) (bacteria)
- Babesia (protozoan parasite)

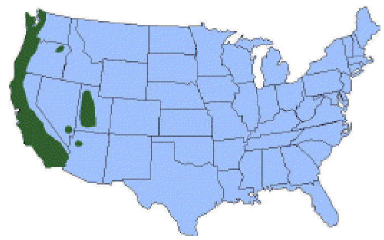
Symptoms will vary based on the illness, and may develop in infected individuals typically between 3 and 30 days after transmission. Some infected individuals will not become ill or may develop only mild symptoms. These illnesses present with some or all of the following signs & symptoms: fever, headache, muscle aches, stiff neck, joint aches, nausea, vomiting, abdominal pain, diarrhea, malaise, weakness, small solid, ring-like, or spotted rashes. The bite site may be red, swollen, or develop ulceration or lesions. For Lyme disease, the bite area will sometimes resemble a target pattern. A variety of long-term symptoms may result if the illness is left untreated, including debilitating effects and death.

Deer Tick



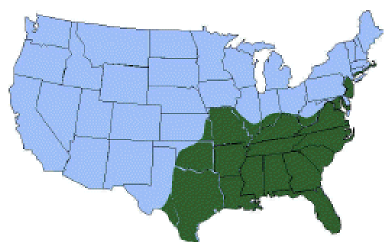
Distribution of Deer Tick (dark green)

From Left: adult female, adult male, nymph, and larvae Deer Tick (cm scale)



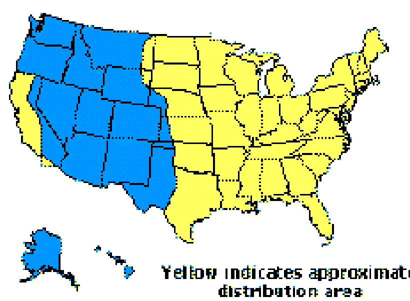
Distribution of Pacific Deer Tick (dark green)

Lone Star Tick

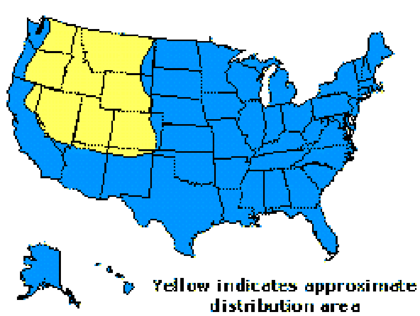


Distribution of Lone Star Tick (Green)

Dog Tick



Rocky Mountain Wood Tick



12.1.2 Hazard Control

The methods for controlling exposure to ticks include, in order of most- to least-preferred:

- Avoiding tick habitats and ceasing operations in heavily infested areas
- Reducing tick abundance through habitat disruption or application of acracide
- Personal protection through use of repellants and protective clothing
- Frequent tick inspections and proper hygiene

Vaccinations are not available and preventative antibiotic treatment after a bite is generally not recommended.

12.1.2.1 Avoidance and Reduction of Ticks

To the extent practical, tick habitats should be avoided. In areas with significant tick infestation, consider stopping work and withdrawing from area until adequate tick population control can be achieved. Stopping and withdrawing should be considered as seriously as entering an area without proper energy control or with elevated airborne contaminants—tick-borne pathogens present risk of serious illness!

In areas where significant population density or infestation exists, tick reduction should be considered. Tick reduction can be achieved by disrupting tick habitats and/or direct population reduction through the use of tick-toxic pesticides (Damminix, Dursban, Sevin, etc.).

Habitat disruption may include only simple vegetative maintenance such as removing leaf litter and trimming grass and brush. Tick populations can be reduced by between 72 and 100 percent when leaf litter alone is removed. In more heavily infested areas, habitat disruption may include grubbing, tree trimming or removal, and pesticide application (Damminix, Dursban, Sevin, etc.). This approach is practical in smaller, localized areas or perimeter areas that require occasional access. Habitat controls are to be implemented with appropriate health and safety controls, in compliance with applicable environmental requirements, and may be best left to the property owner or tenant or to a licensed pesticide vendor. Caution should be exercised when using chemical repellents or pesticides in or around areas where environmental or industrial media samples will be collected for analysis.

12.1.2.2 Personal Protection

After other prevention and controls are implemented, personal protection is still necessary to control exposure to ticks. Personal protection must include all of the following steps:

- Where site conditions warrant (vegetation above knee height, tick endemic area) or when tasks warrant (e.g., having to sit/kneel in vegetation) that diminish the effectiveness of the other controls mentioned above, bug-out suits (obtained from MKE warehouse)/Tyvek shall be used. Bug-out suits are more breathable than Tyvek.
- So that ticks may be easily seen, wear light-colored clothing. Full-body New Tyvek (paper-like disposable coveralls) may also be used
- To prevent ticks from getting underneath clothing tuck pant legs into socks or tape to boots
- Wear long-sleeved shirts, a hat, and high boots
- Apply DEET repellent to exposed skin or clothing per product label
- Apply permethrin repellent to the outside of boots and clothing before wearing, per product label
- Frequently check for ticks and remove from clothing
- At the end of the day, search your entire body for ticks (particularly groin, armpits, neck, and head) and shower
- To prevent pathogen transmission through mucous membranes or broken/cut skin, wash or disinfect hands and/or wear surgical-style nitrile gloves any time ticks are handled

Pregnant individuals and individuals using prescription medications should consult with their physician and/or pharmacists before using chemical repellents. Because human health effects may not be fully known, use of chemical repellents should be kept to a minimum frequency and quantity. Always follow manufacturers' use instructions and precautions. Wash hands after handling, applying, or removing protective gear and clothing. Avoid situations such as hand-to-face contact, eating, drinking, and smoking when applying or using repellents.

Remove and wash clothes per repellent product label. Chemical repellents should not be used on infants and children.

Vaccinations are generally not available for tick-borne pathogens. Although production of the LYMErix™ Lyme disease vaccination has been ceased, vaccination may still be considered under specific circumstances and with concurrence from the consulting physician.

12.1.2.3 Tick Check

A tick check should be performed after field survey before entering the field vehicle (you do not want to infest your field vehicle with ticks). Have your field partner check your back; the backs of your legs, arms, and neck; and your hairline. Shake off clothing as thorough as possible before entering the vehicle. Once the field day is complete, repeat this procedure and perform a thorough self check.

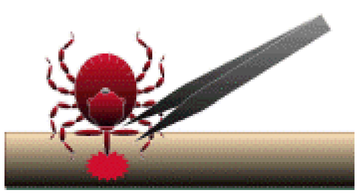
If a tick has embedded itself into the skin, remove the tick as described below.

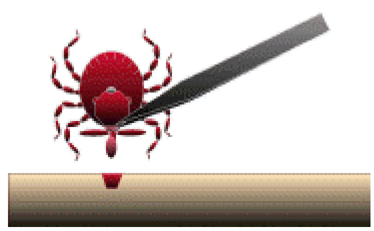
12.1.2.4 Tick Removal

1. Use the tick removal kit obtained through the CH2M HILL Milwaukee warehouse, or a fine-tipped tweezers or shield your fingers with a tissue, paper towel, or nitrile gloves.

Tick Bites\Tick
Remover.pdf

2. Grasp the tick as close to the skin surface as possible and pull upward with steady, even pressure. Do not twist or jerk the tick; this may cause the mouthparts to break off and remain in the skin. If this happens,





remove mouthparts with tweezers. Consult your healthcare provider if infection occurs.

3. Avoid squeezing, crushing or puncturing the body of the tick because its fluids (saliva, hemolymph, gut contents) may contain infectious organisms. Releasing these organisms to the outside of the tick's body or into the bite area may increase the chance of infectious organism transmission.

4. Do not handle the tick with bare hands because infectious agents may enter through mucous membranes or breaks in the skin. This precaution is particularly directed to individuals who remove ticks from domestic animals with unprotected fingers. Children, elderly persons, and immunocompromised persons may be at greater risk of infection and should avoid this procedure.

5. After removing the tick, thoroughly disinfect the bite site and wash your hands with soap and water.

6. You may wish to save the tick for identification in case you become ill. Your doctor can use the information to assist in making an accurate diagnosis. Place the tick in a plastic bag and put it in your freezer. Write the date of the bite on a piece of paper with a pencil and place it in the bag.

Note: Folklore remedies such as petroleum jelly or hot matches do little to encourage a tick to detach from skin. In fact, they may make matters worse by irritating the tick and stimulating it to release additional saliva, increasing the chances of transmitting the pathogen. These methods of tick removal should be avoided. In addition, a number of tick removal devices have been marketed, but none are better than a plain set of fine tipped tweezers.

12.1.2.5 First-Aid and Medical Treatment

Tick bites should always be treated with first-aid. Clean and wash hands and disinfect the bite site after removing embedded tick. Individuals previously infected with Lyme disease does not confer immunity—re-infection from future tick bites can occur even after a person has contracted a tick-borne disease.

CH2M Hill has a protocol in place for employees who have experienced a tick bite due to work-related activities, to test all ticks that have been removed from them for the presence of Borrelia burgdorferi.

The employee should contact the Injury Management/Return To Work provider (IMRTW), WorkCare using the toll-free number 866-893-2514 to report the tick bite. WorkCare will follow-up with each CH2M Hill employee who reports a tick bite and is at risk of developing Lyme disease by monitoring for symptoms up to 45 days, and will refer the employee to a medical provider for evaluation and treatment as necessary

Notice of Safety Violation Form

Notice of Safety Violation

REPORT PREPARED BY:

Name:	**Title:**	**Signature:**	**Date:**

VIOLATION:

Description:	Date:

SUBCONTRACTOR SIGNATURE OF NOTIFICATION:

Name:	**Title:**	**Signature:**	**Date:**

**** Corrective action is to be taken immediately. Note below the action taken, sign and return to CCI.****

SUBCONTRACTOR'S CORRECTIVE ACTION

Description:	Date of Nonperformance:

SUBCONTRACTOR SIGNATURE OF CORRECTION

Name:	**Title:**	**Signature:**	**Date:**

Stop Work Order Form

CH2MHILL
Constructors, Inc.

Stop Work Order

REPORT PREPARED BY:

Name:	**Title:**	**Signature:**	**Date:**

ISSUE OF NONPERFORMANCE:

Description:	Date of Nonperformance:

SUBCONTRACTOR SIGNATURE OF NOTIFICATION:

Name:	**Title:**	**Signature:**	**Date:**

** Corrective action is to be taken immediately. Note below the action taken, sign and return to CCI.* Work may not resume until authorization is granted by CH2M HILL Constructors, Inc. Representative,*

SUBCONTRACTOR'S CORRECTIVE ACTION

Description:	Date of Nonperformance:

SUBCONTRACTOR SIGNATURE OF CORRECTION

Name:	**Title:**	**Signature:**	**Date:**

Vehicle Accident Guidance

Vehicle Accident Guidance

For All Vehicles--Call the Police

For any vehicle accident/damage, it is recommended that the local police (or site security/emergency services if working on a client site that provides such services) be called to determine if a report needs to be filed. In some instances, a report may not be required (during accident alerts, or in public parking lots). Document that the authorities were called and follow up with any guidance they give you. State requirements vary. If a report is filed, obtain a copy.

For Fleet Vehicles:

Definition: These are vehicles **rented for greater than 90 days** or rentals that are **leased** (either through ARI [Automotive Rental, Inc.] or leases from other companies [older fleet vehicles].

Report the accident to the following:

Contact Company Insurance Carrier: Zurich (1-877-246-3478 or 1-800-987-3373).

Contact Corp. Insurance - Linda George/DEN at 720-286-2057.

Note: If you are an ES employee that happens to use an **OMI vehicle** on a project and get into an accident, you must also contact Michelle Garlington/DEN (720-286-4273).

For Rentals:

Report the accident to the following:

Call 1-800-VISA-911 (**only** if the car has been **rented for less than 31 days**—they provide some additional physical damage coverage in this time period).

Call Zurich (1-877-246-3478 or 1-800-987-3373). Carry available insurance cards which can be downloaded from the VO. For short-term rental (non CH2M Owned), carry the insurance card from the state where the driver's license was issued. For fleet vehicles, carry the insurance card from the state where the vehicle is registered. https://communities.int.ch2m.com/legal/insurance/Shared%20Documents/AutoID_Cards.aspx?PageView=Shared

Call the rental company (Budget, National, Enterprise, etc.).

Call Linda Anderson/DEN at 720-286-2401.

For All Vehicles:

Notify Supervisor, (and PM/RHSM if working on a project site)

If you are injured, call 911 for emergency medical treatment or 1-866-893-2514 to contact the CH2M HILL Occupational Nurse/Physician for minor injuries. If you initially feel you have not been injured, contact the RHSM for guidance on whether calling the CH2M HILL Occupation Nurse/Physician is applicable.

Complete a HITS report on the VO.

Personally Owned Vehicles (POVs):

CH2M HILL does not provide auto insurance for POVs, it is responsibility of the owner. If you are in a vehicle accident conducting company business, contact the police as above, supervisor, and 911 or CH2M HILL's occupational nurse/physician as stated above. Complete a HITS report. Refer to the Employee Handbook/Policies, assistance for meeting personal insurance deductibles (up to $500 is available).

If using your POV for extended project use, notify the PM to make sure a rental car is not needed. Check your insurance policy for guidance on using the POV for business use.