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WORK PLAN FOR RCRA FACILITY INVESTIGATION AT AREA OF CONCERN (AOC)-S FORT RUCKER, ALABAMA

FINAL

U.S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT

MAY 2007

CH2M HILL

Contract No. DACA21-02-D-0005
Task Order CK28

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Acronyms and Abbreviations

ADEM	Alabama Department of Environmental Management
AOC	Area of Concern
bgs	below ground surface
BRA	Baseline Risk Assessment
CCI	Contaminant Control, Inc.
CMS	Corrective Measures Study
DQO	Data Quality Objective
DPT	Direct Push Technology
EPA	U.S. Environmental Protection Agency
FSP	Field Sampling Plan
ft/ft	feet per foot
FTL	Field Team Leader
HWMMA	Hazardous Waste Management and Minimization Act
IDW	investigation derived waste
MCL	maximum contaminant level
MS/MSD	matrix spike/matrix spike duplicate
msl	mean sea level
NAD	North American Datum
NFA	No Further Action
NGVD	National Geodetic Vertical Datum
OVA	Organic Vapor Analyzer
PM	project manager
PPE	personal protective equipment
PVC	polyvinyl chloride
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SOW	Statement of Work

SSHP	Site Safety and Health Plan
SWMU	Solid Waste Management Unit
μg/L	micrograms per liter
USACE	United States Army Corps of Engineers
VOC	volatile organic compound
WMP	Waste Management Plan

1. Introduction

1.1 Project Overview

This Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Work Plan has been prepared for the United States Army Corps of Engineers (USACE), Mobile District, by CH2M HILL, under Contract No. DACA21-02-D-0005, Task Order CK 28. The RFI Work Plan describes work to be completed at Area of Concern (AOC)–S at Fort Rucker, Alabama. The purpose of the RFI is to assess the potential source(s) and extent of tetrachloroethene detected at concentrations exceeding its maximum contaminant level (MCL) during groundwater sampling events at Solid Waste Management Unit (SWMU) 8, located east of AOC–S. The occurrence of tetrachloroethene is unrelated to past operations at SWMU 8, as described in the *Final Corrective Measures Implementation Plan (CMIP) for SWMU 8* (Contaminant Control, Inc. [CCI], 2007) . The information derived from the RFI will be used to determine if no further action (NFA) is appropriate, further investigation is necessary, or a corrective measures study (CMS) should be prepared to evaluate remediation alternatives for AOC–S.

Field activities include field screening, soil and groundwater sampling, sample handling and shipping, and waste handling. Waste disposal will be performed by subcontractors under CH2M HILL's supervision.

1.2 Organization of the Work Plan

This Work Plan is organized as follows.

- **Section 1**: Introduces the purpose for the RFI and organization of the Work Plan.
- **Section 2**: Describes the project management structure and a schedule for completion of the RFI.
- **Section 3**: Discusses the investigation and site background, including the location, physical setting, hydrogeology of the site, and site history.

- **Section 4**: Presents a review and evaluation of existing data obtained during previous groundwater sampling events at the site.
- **Section 5**: Introduces the field activities, which are described in greater detail in the appendices.
- **Section 6**: Lists the references used in preparing this Work Plan.

Appendices include the Field Sampling Plan (FSP) (**Appendix A**) and Quality Assurance Project Plan (QAPP), (**Appendix B**), the Waste Management Plan (WMP) (**Appendix C**), and the Site Safety and Health Plan (SSHP) (**Appendix D**).

2. Project Organization and Schedule

2.1 Organization

The organizational structure for this project includes personnel from USACE and CH2M HILL, and a number of subcontractors. The project organizational structure is summarized on **Figure 2-1**.

CH2M HILL is responsible for the development of the RFI Work Plan, FSP, QAPP, WMP, and SSHP and for the cooperative coordination of field activities. The project manager (PM) is responsible for the overall management of work performed for the RFI. The PM will also coordinate the scheduling of subcontractors and the quality control review of laboratory data. The field team leader (FTL) is responsible for onsite coordination and execution of field activities in compliance with the RFI Work Plan, FSP, QAPP, WMP, and SSHP.

Subcontractors will be used for several of the RFI field activities. The anticipated subcontracted activities are as follows:

- Laboratory analytical services: Empirical Laboratories, LLC;
- Surveying of borings, sample locations, and monitoring wells: Donaldson Garrett & Associates, Inc.;
- Management and disposal of investigation derived waste (IDW): Strong Environmental;
- Drilling and monitoring well installation services: Boart Longyear; and
- Site clearing: C.C. Martin.

2.2 Project Schedule

The project schedule for the AOC–S RFI is presented on **Figure 2-2**. Included on the figure are 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.

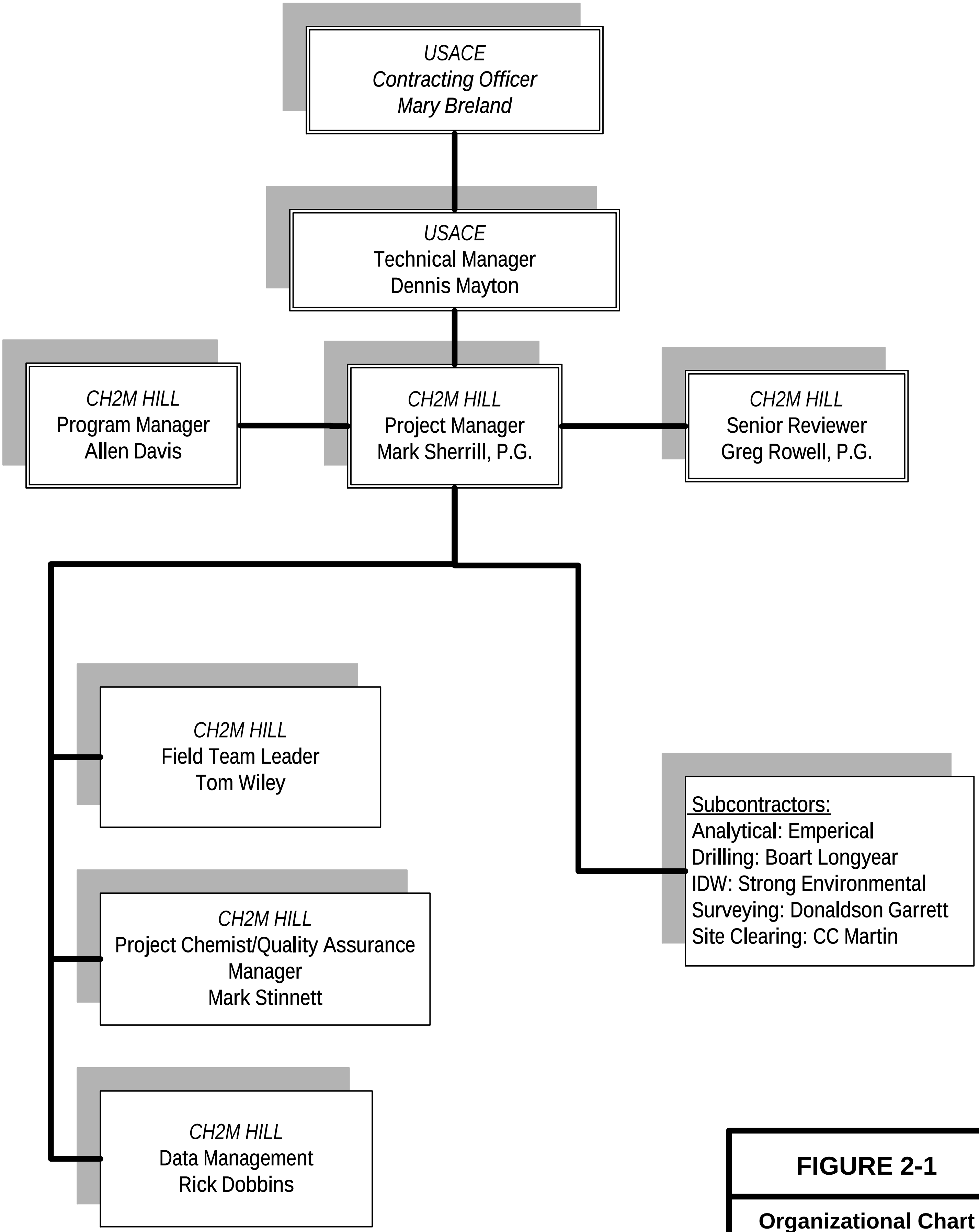

FIGURE 2-1

Organizational Chart
RCRA Facility Investigation
AOC-S
Fort Rucker, Alabama

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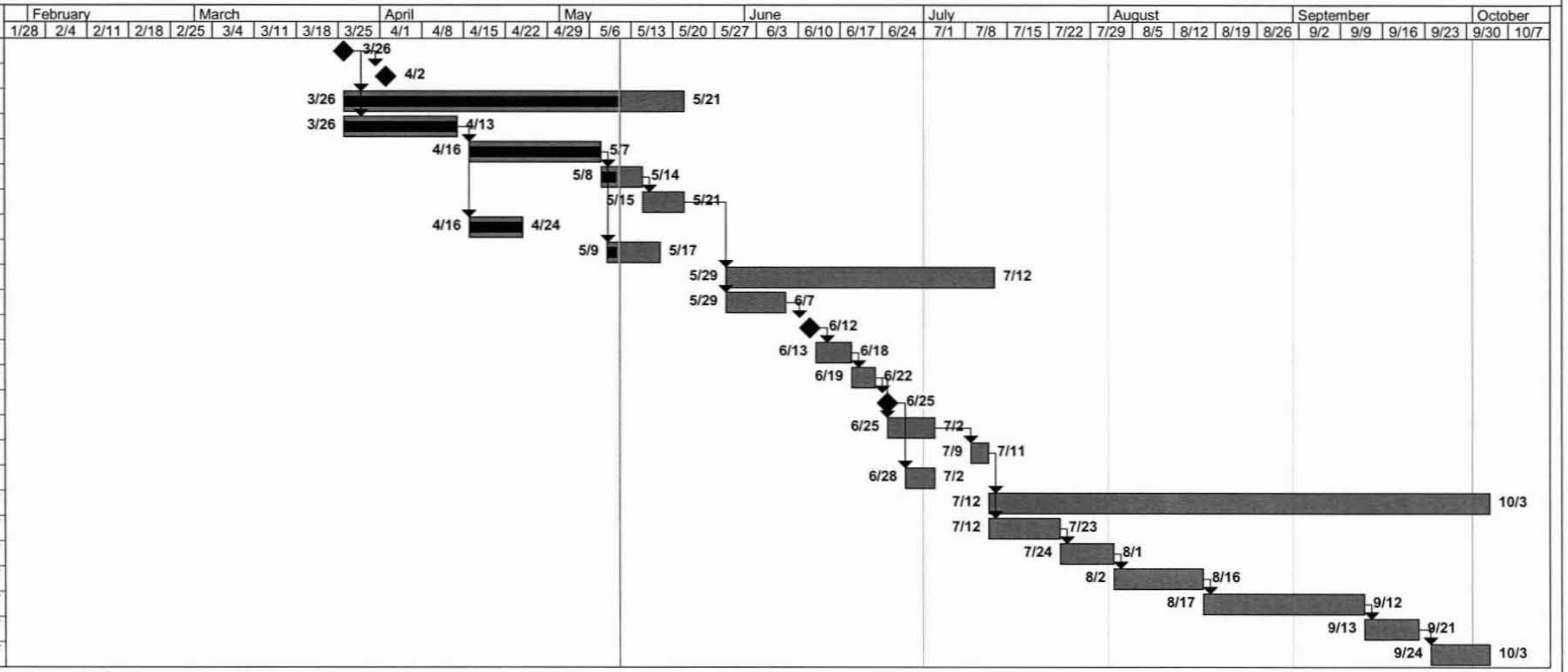
FIGURE 2-2
PROJECT SCHEDULE
RFI
AOC-S
FORT RUCKER, ALABAMA

ID	❶	Task Name	Duration	Start
1	▦	NTP	0 days?	Mon 3/26/07
2	▦	PROGRESS CHART	1 day?	Mon 4/2/07
3	▦	**WORKPLAN**	41 days?	Mon 3/26/07
4	✓	DRAFT WORKPLAN	15 days	Mon 3/26/07
5	✓	COE/ADEM REVIEW	16 days?	Mon 4/16/07
6	▦	FINAL WORKPLAN	5 days?	Tue 5/8/07
7	▦	ACCEPTANCE OF WP	5 days?	Tue 5/15/07
8	✓	**SUBCONTRACTING**	7 days	Mon 4/16/07
9	▦	**DIG PERMIT/SITE CLEARING**	7 days?	Wed 5/9/07
10	▦	**FIELD WORK**	33 days?	Tue 5/29/07
11	▦	DPT Investigation	8 days?	Tue 5/29/07
12	▦	DPT Analytical Complete	1 day?	Tue 6/12/07
13		DPT Tech Memo	4 days?	Wed 6/13/07
14		Tech Memo Review	4 days?	Tue 6/19/07
15		Tech Memo Acceptance	1 day?	Mon 6/25/07
16	▦	MW Installation\DPT Aban.	6 days?	Mon 6/25/07
17	▦	GW Sample Collection	3 days	Mon 7/9/07
18	▦	Site Survey	3 days?	Thu 6/28/07
19	▦	**REPORT**	60 days?	Thu 7/12/07
20	▦	GW Analyses	8 days?	Thu 7/12/07
21		Data Validation	7 days?	Tue 7/24/07
22		Draft Report	11 days?	Thu 8/2/07
23	▦	COE/ADEM Review	19 days?	Fri 8/17/07
24		Final Report	7 days?	Thu 9/13/07
25	▦	Final Report Acceptance	8 days?	Mon 9/24/07



Project: Fig 2-2_RFI_AOC-S
Date: Fri 5/11/07

Task	▬	Milestone	◆	Rolled Up Task	▬	Rolled Up Progress	▬	External Tasks	▬	Group By Summary	▬
Progress	▬	Summary	▬	Rolled Up Milestone	◇	Split	—	Project Summary	▬	Deadline	⇩

3. Site Description

3.1 Installation and Site Background

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 approximately 62,430 acres, most of which is situated in Dale and Coffee Counties.

3.2 Site Location and Description

The area to be investigated during the RFI has been designated as AOC–S in Fort Rucker's Hazardous Waste Management and Minimization Act (HWMMA) permit. AOC–S is located west of SWMU 8 and south of a vehicle storage/maintenance yard. SWMU 8 is a closed ash landfill comprising approximately 4.3 acres along the southern edge of Fort Rucker. The location of AOC–S is presented on **Figure 3-1**. The SWMU 8 landfill was operated from the 1940s until 1952 (M&E, 1995). Ash from the former incinerator buildings 1410, 1411, and 1412 were disposed of at SWMU 8. During previous groundwater sampling events at SWMU 8, tetrachloroethene was detected in the SWMU 8 upgradient well 8-G1 and side-gradient wells 8-G3 and 8-G4. The occurrence of tetrachloroethene is unrelated to past operations at SWMU 8, as described in the *Final Corrective Measures Implementation Plan (CMIP) for SWMU 8* (CCI, 2007). A map of the AOC–S investigation area is presented on **Figure 3-2**.

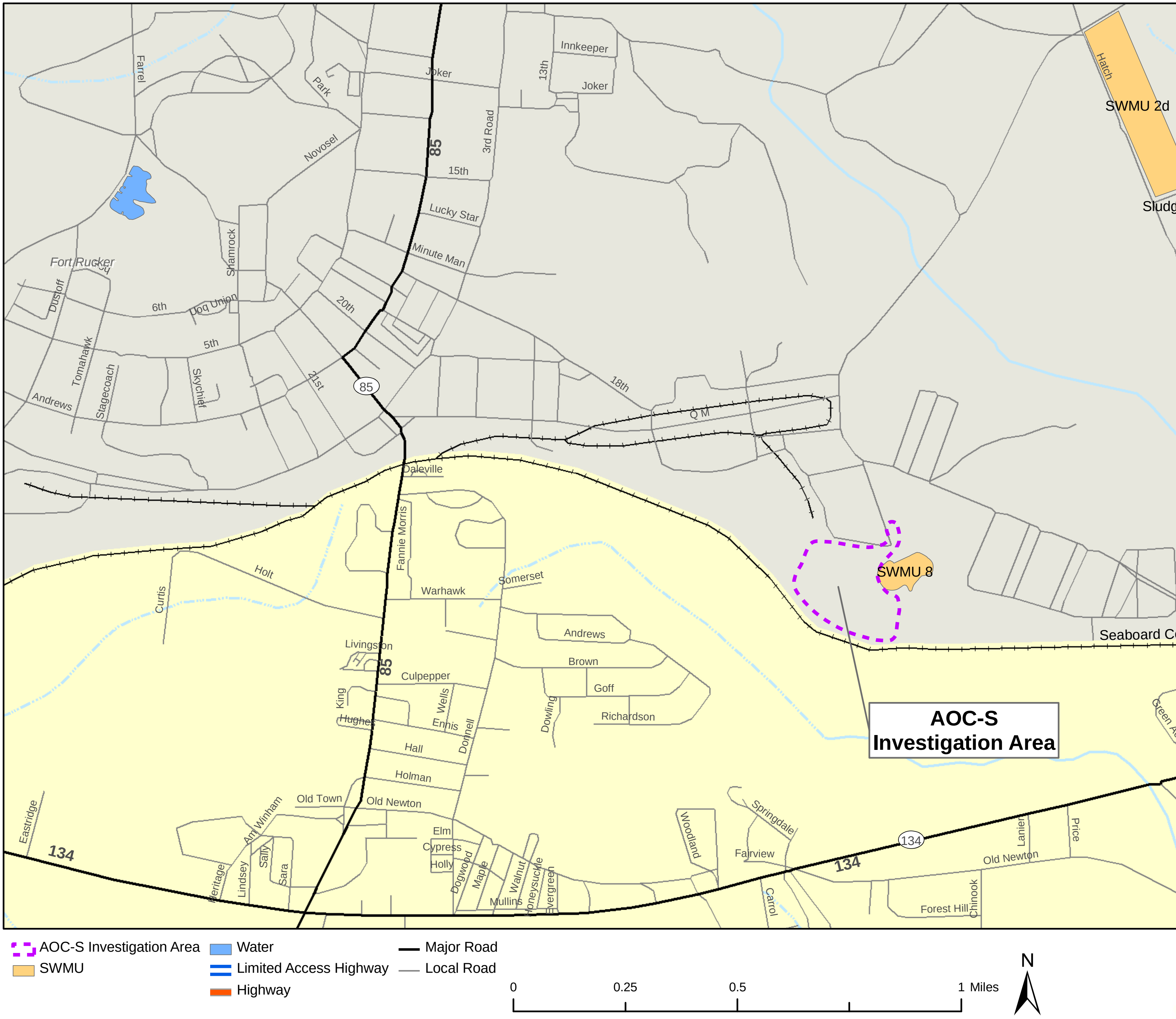


Figure 3-1
Location of AOC-S
Fort Rucker, Alabama

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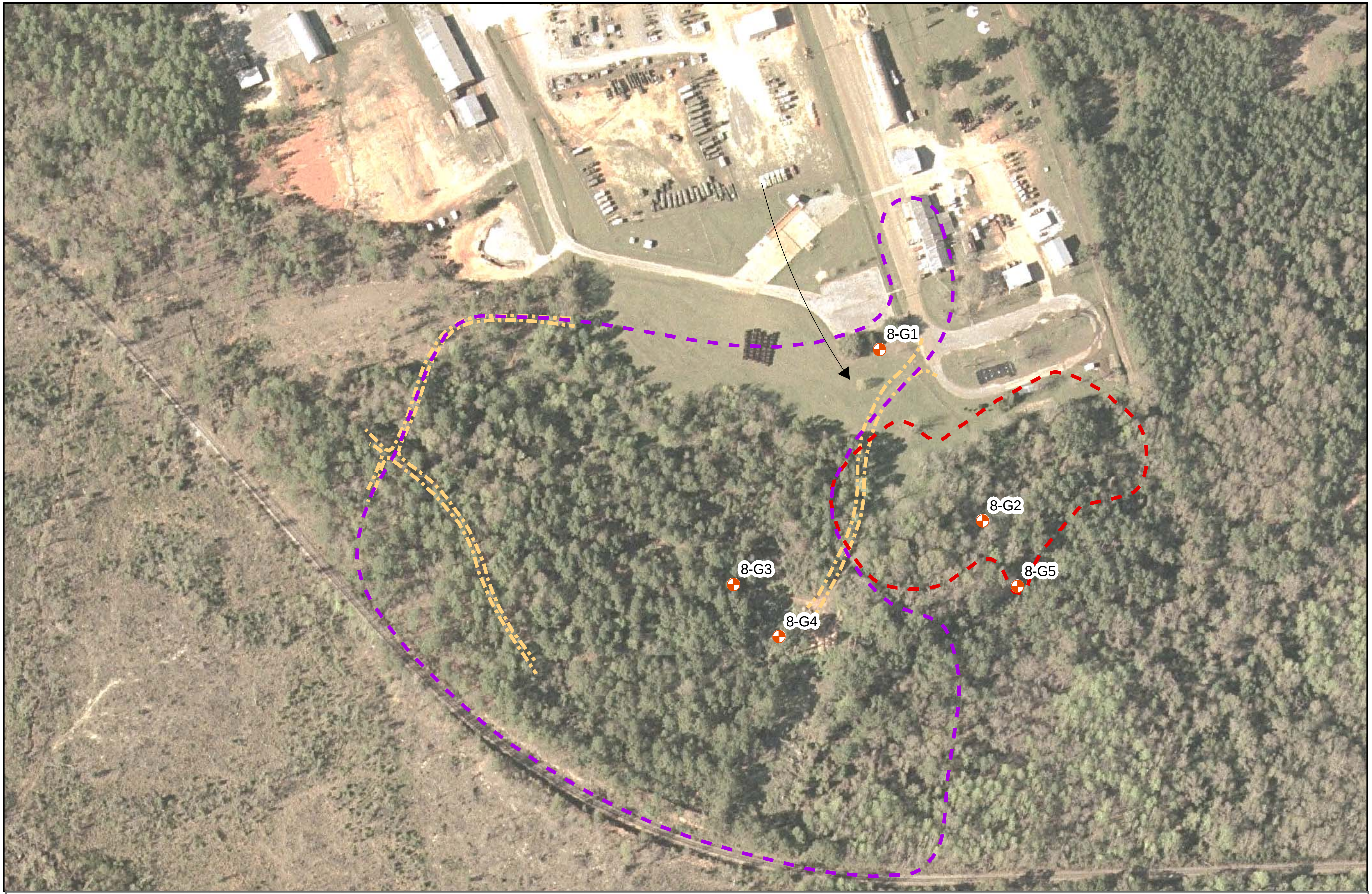

● Existing Monitoring Well

→ Direction of Groundwater Flow

Extent of Closed Incinerator Ash Landfill (SWMU 8)

Trail

AOC-S Investigation Area

Figure 3-2

AOC-S Investigation Area

Fort Rucker, Alabama

CH2MHILL

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The area to be investigated consists of approximately 21 acres, and includes the areas surrounding wells 8-G1, 8-G3 and 8-G4, as well as a former maintenance shop located northeast of well 8-G1. The former maintenance shop was operated from the 1940s until the late 1980s, when the maintenance shop building was demolished. The only remnant of the former maintenance shop is a 100-foot by 30-foot concrete slab. Little is known about waste disposal practices at the former maintenance shop. In addition to the former maintenance shop, the majority of the 21 acres comprising the AOC–S investigation area consists of a relatively flat, grassed area and a gently to steeply sloping wooded area located to the south and west of the former maintenance shop. A review of 1948, 1957, and 1961 historical aerial photographs show that that the area south and west of the former maintenance shop has been disturbed. The majority of the area has been cleared of vegetation down to the soil. However, no structures, tanks, or piles of debris and/or waste are evident in the historical aerial photographs. By 1968, regrowth of trees is evident.

At this time, the source(s) of the tetrachloroethene detected in wells 8-G1, 8-G3 and 8-G4 is unknown. The 21 acres included for investigation in the RFI may be an over estimation of the size of AOC–S.

A stream is located approximately 2,000 feet south of AOC–S and flows southeast into the Choctawhatchee River (M&E, 1995).

3.3 Regional Geology

The subsurface stratigraphy at Fort Rucker and in the surrounding area consists of a thick sequence of unconsolidated formations that are Cretaceous to Tertiary in age. The total thickness of the unconsolidated formations in this area is approximately 1,200 feet. The Cretaceous formations are the Ripley Formation overlain by the Providence Sand. The Tertiary formations, from oldest to youngest, are as follows: the Clayton Formation, Nanafalia Formation, Tuscahoma Formation, Hatchetigee Formation, Tallahatta Formation, and the Lisbon Formation.

Geologic formations that outcrop at Fort Rucker are all Tertiary in age. These formations, from oldest to youngest, are as follows: the Tuscahoma Sand, Hatchetigbee Formation, Tallahatta Formation, and the Lisbon Formation. All SWMUs at Fort Rucker are located where the Tallahatta and Lisbon Formations outcrop. These units range from 50 to 250 feet thick and consist of beds of sand and clay and thin beds of siltstone, sandstone overlain by sand, clay, and limestone.

3.4 Regional Hydrogeology

Three aquifers have been identified in the vicinity of Fort Rucker within the interbedded sands, clays, and limestones that characterize the regional geology. These aquifers are the Lisbon aquifer, Nanafalia-Clayton aquifer, and the Providence-Ripley aquifer. Groundwater in these aquifers is derived from direct precipitation or from streams flowing to the recharge zone, which is located from 20 to 50 miles north of Fort Rucker.

The Lisbon aquifer is the uppermost "water table" aquifer and consists of sand beds in the Lisborn, Tallahatta, and Hatchetigee Formations. The thickness of these beds is variable and the extent is frequently discontinuous. Water levels in the Lisbon aquifer range from land surface in marshy areas to a depth of 40 feet in higher, well-drained areas. Recharge to the Lisbon aquifer is exclusively from precipitation. Discharge is to surface streams and seeps at low points in the stream valleys. Regionally, groundwater in the Lisbon aquifer flows to the south. The Lisbon aquifer is separated from the lower aquifer (Nanafalia-Clayton aquifer) by the Tuscahoma confining unit.

The Nanafalia-Clayton aquifer is a continuous aquifer composed of sand beds in the Clayton Formation. Confining layers separate the Nanafalia-Clayton aquifer from the surficial Lisbon aquifer and the underlying Providence-Ripley aquifer. Recharge occurs in areas north of Fort Rucker where the Nanafalia and Clayton Formations are at the surface. Some discharge occurs through well pumping. Regionally, groundwater flows to the south, but locally, cones of depression have developed at Fort Rucker and in the surrounding towns as a result of extensive pumping. As a result, over the past 40 years, the potentiometric surface at Fort Rucker has declined 50 to 60 feet below its original elevation (CCI, 2007).

The Providence-Ripley aquifer is a confined aquifer composed of sand beds in the Providence Sand and Ripley Formation. A confining clay separates the aquifer from the overlying Nanafalia-Clayton aquifer. Like the Nanafalia-Clayton aquifer, recharge occurs in areas to the north of Fort Rucker, where the Providence and Ripley Formations outcrop. Groundwater within the Providence-Ripley aquifer flows to the south. There are no instances of a depressed potentiometric surface due to well pumping in this aquifer.

3.5 Site Geology and Hydrogeology

The geology in the vicinity of AOC–S has been documented during monitoring well installation performed as part of the RFI and Phase II RFI completed at SWMU 8. Drilling and soil sampling was completed to a vertical depth of 60 feet below ground surface (bgs). Based on the drilling and well installation at SWMU 8, the area including AOC–S appears to be underlain by one major lithologic unit consisting of sand with varying amounts of silt and clay. The sand contains laterally discontinuous beds of silt and extends to a depth of 60 feet bgs.

The sand lithologic unit forms an unconfined aquifer. The water table has been encountered at depths ranging from 25 to 48 feet bgs, which corresponds to groundwater elevations ranging from 269 to 273 feet above mean sea level (msl). Groundwater flow is predominately south-southeast, which is consistent with the topography in the AOC–S investigation area. The hydraulic gradient ranges from approximately 0.009 to 0.011 foot per foot (ft/ft) (CCI, 2007).

The site geology and hydrogeology described above will be confirmed during the drilling and well installations conducted as part of the RFI at AOC–S.

4. Summary of Previous Groundwater Results

CCI completed two groundwater monitoring events at SWMU 8. These events were performed in September 2005 and February 2006. The following sections provide a summary of the groundwater sampling results at SWMU 8.

4.1 September 2005 Groundwater Results

During the September 2005 groundwater sampling event, groundwater samples were collected at SWMU 8 from wells 8-G1 through 8-G5 (see Figure 3-2) and analyzed for the Alabama Department of Environmental Management (ADEM) Appendix I volatile organic compounds (VOCs) and metals. Well 8-G1 is located upgradient of SWMU 8, and wells 8-G3 and 8-G4 are located side-gradient of SWMU 8. A summary of the September 2005 groundwater results follows.

VOC Results

- Tetrachloroethene was detected in wells 8-G1 (estimated at 1.2 micrograms per liter (µg/L), 8-G3 (16.0 µg/L), and 8-G4 (12.1 µg/L).
- Tetrachloroethene was detected above its MCL (5 µg/L) in wells 8-G3 and 8-G4.

Metals Results

- All metals were less than their respective MCLs.

4.2 February 2006 Groundwater Results

During the February 2006 groundwater sampling event, groundwater samples were collected at SWMU 8 from wells 8-G1 through 8-G5 and analyzed for the ADEM Appendix I VOCs and metals. A summary of the February 2006 groundwater results follows.

VOC Results

- Tetrachloroethene was detected in wells 8-G1 (3.6 µg/L), 8-G3 (10.7 µg/L), and 8-G4 (5 µg/L).
- Tetrachloroethene was detected above its MCL (5 µg/L) in well 8-G3.

Metals Results

- All metals were less than their respective MCLs.

4.3 Conclusions

The results from the two groundwater sampling events at SWMU 8 indicated that tetrachloroethene was detected in three SWMU 8 monitoring wells (8-G1, 8-G3, and 8-G4). The detections of tetrachloroethene exceeded its MCL (5 µg/L) in wells 8-G3 (September 2005 and February 2006) and 8-G4 (September 2005). Based on the potentiometric surface maps depicting groundwater flow in September 2005 and February 2006, well 8-G1 is located upgradient of SWMU 8 and wells 8-G3 and 8-G4 are located side-gradient of SWMU 8; therefore, these results were not considered indicative of groundwater quality at SWMU 8 (CCI, 2007).

5. Investigation Activities

The goal of the RFI field activities is to assess the potential source(s) and extent of ADEM Appendix I VOCs, specifically tetrachloroethene in soil and VOCs, specifically tetrachloroethene and metals in groundwater, unrelated to past operations at SWMU 8. The RFI does not include a baseline risk assessment (BRA) for human health or ecological concerns. The RFI includes gathering field data to evaluate the occurrence and extent of ADEM Appendix I VOCs in soil and ADEM Appendix I VOCs and metals in groundwater to determine if NFA is appropriate, further investigation is necessary, or a CMS should be prepared to evaluate remediation alternatives. This section of the RFI Work Plan will discuss the field tasks to be performed at AOC–S and the rationale for the performance of those field tasks.

The field tasks to be performed are summarized in Table 5-1 and discussed in the FSP (see Appendix A).

5.1 Field Task Rationale

The field investigation will be performed in a phased approach. An initial screening phase consisting of a direct push technology (DPT) investigation will be conducted to gather data to identify the potential source(s) and determine the extent of tetrachloroethene contamination at AOC–S. During the screening phase, 21 DPT borings or a maximum of 1,075 linear feet are projected to be drilled and completed as temporary monitoring wells. Groundwater samples will be collected from each temporary monitoring well and analyzed for total chlorinated volatile organic halocarbons using the Color-Tec® field-based analytical test kits in order to gather "real-time" analytical data. Ten percent of the groundwater samples collected from the temporary monitoring wells will also be submitted to the fixed-based analytical laboratory for analysis of ADEM's Appendix I VOCs. In addition, soil samples will also be collected from 12 of the DPT borings and analyzed by the fixed-based analytical laboratory for ADEM's Appendix I VOCs. Following completion of the screening phase, a technical memorandum will be prepared summarizing the screening phase data and recommending the installation of additional permanent groundwater monitoring wells to supplement wells 8-G1, 8-G3, and 8-G4, as appropriate. A minimum of three and a maximum of eight additional permanent groundwater monitoring wells are projected to be installed. A groundwater sample will be collected from each of the new wells, as well as from existing wells 8-G1, 8-G3, and 8-G4. Each groundwater sample will be analyzed for ADEM's Appendix I VOCs and metals to confirm the results of the screening phase and identify the potential source(s) and extent of tetrachloroethene at AOC–S. A field investigation summary and data quality objectives (DQOs) of the planned investigation is shown in Table 5-1.

TABLE 5-1
RFI Field Investigation Summary and Data Quality Objectives
AOC–S, Fort Rucker, Alabama

Data Quality Objective	Activity	Number of Samples	Analytical Testing	Considerations	Justification
Produce laboratory analytical results below regulatory screening criteria and for data to be comparable to previous investigations.	All soil and groundwater sampling laboratory analysis.	Up to 2 soil, 5 groundwater duplicates, and all associated quality control and quality assurance samples.	Applies to all laboratory analytical tests	Proper sampling procedures and analytical methods must be used.	All laboratory analytical results must be usable in comparison to regulatory screening criteria to provide contamination delineation and confirmation of field screening results.
Evaluate the lateral extent of tetrachloroethene in soil (SCREENING PHASE)	Subsurface soil sampling.	One soil sample will be collected within the interval between ground surface to just above the water table smear zone in 12 DPT borings	Soil samples will be analyzed for ADEM Appendix I VOCs using EPA Method SW846 8260B.	One sample exhibiting the highest field screening measurement between ground surface and just above the water table smear zone will be collected at 12 of the DPT borings described below.	Previous investigations have not delineated the extent of contamination in shallow soil.
Evaluate the extent of tetrachloroethene in shallow groundwater at the site and assess the direction of shallow groundwater flow (SCREENING PHASE)	Install temporary monitoring wells.	One groundwater sample will be collected from up to 21 temporary monitoring wells.	Groundwater samples will be analyzed for total chlorinated volatile organic hydrocarbons using the Color-Tech® field screening kits. Ten percent of the groundwater samples will be analyzed by the fixed-based laboratory for the ADEM Appendix I VOCs using EPA Method SW846 8260B.	DPT borings will be drilled on grid pattern that incorporates wells 8-G1, 8-G3, and 8-G4 as data points, along the assumed groundwater flow path.	Previous investigations have not delineated the extent of tetrachloroethene in groundwater.
Evaluate the extent of tetrachloroethene and potential metals in shallow groundwater at the site and assess the direction of shallow	Install permanent monitoring wells.	One groundwater sample will be collected from a mimimum of 3 and a maximum of 8 additional permanent monitoring wells and 3 existing monitoring wells (8-G1, 8-	Groundwater samples will be analyzed for ADEM Appendix I VOCs using EPA Method SW846 8260B and ADEM Appendix I metals using EPA Method	Permanent well locations will be based on results from the screening phase.	Previous investigations have not delineated the extent of tetrachloroethene in groundwater.

TABLE 5-1
RFI Field Investigation Summary and Data Quality Objectives
AOC–S, Fort Rucker, Alabama

Data Quality Objective	Activity	Number of Samples	Analytical Testing	Considerations	Justification
groundwater flow (MONITORING WELL PHASE)		G3, and 8-G4)	SW846 6010B/7000.		

5.2 Field Tasks

5.2.1 Utility Clearances and Permits

Prior to mobilization to the field, CH2M HILL will contact the Fort Rucker utilities to obtain available information regarding subsurface utilities at the AOC–S investigation area and the necessary utility clearances and permits to perform the planned investigation.

5.2.2 DPT Borings and Temporary Monitoring Well Installation (Screening Phase)

A total of 21 DPT borings or a maximum of 1,075 linear feet are projected to be drilled and completed as temporary monitoring wells in the AOC–S investigation area to define the source(s) and extent of tetrachloroethene. Seven DPT borings/temporary monitoring wells will be installed initially at the following locations:

- Four temporary wells will be installed in the area of the former maintenance shop located northeast of existing well 8-G1. The former maintenance shop is a potential source for the tetrachloroethene detected in wells 8-G1, 8-G3, and 8-G4. These temporary wells will be installed approximately 8 feet below the first encountered water-bearing zone. The anticipated termination depth of these source identification wells is approximately 55 feet bgs.
- Three temporary wells will be installed along the northern-most transect (along a line west of existing well 8-G1) perpendicular with the assumed groundwater flow direction, to determine if the potential source of tetrachloroethene is located north of AOC-S. The spacing between these temporary wells will be approximately 200 feet. These temporary wells will be installed approximately eight feet below the first encountered water-bearing zone. The anticipated termination depth of these temporary wells be approximately 50 feet bgs.

Based on the results of the field screening for total chlorinated volatile organic hydrocarbons using the Color-Tech® field-based analytical method, the remaining temporary monitoring well locations will be adjusted as needed to better define the source(s) and extent of tetrachloroethene. If positive results are detected indicating that the source of tetrachloroethene is located north of AOC-S, in the area of the vehicle parking/maintenance yard, the locations of some of the remaining temporary wells will be adjusted to investigate the vehicle parking/maintenance yard (number of DPT borings/temporary monitoring wells and specific location will be determined in the field). However, if positive results are not detected indicating that the source is located north of AOC-S, then the remaining temporary wells will be installed as discussed below.

- Fourteen temporary wells (delineation wells) will be installed along four transects perpendicular with the assumed groundwater flow direction. The spacing between each temporary well will be approximately 200 feet. The transects will include existing wells 8-G3 and 8-G4 as data points. Ten of the 14 temporary wells will be installed approximately eight feet below the first encountered water-bearing zone. The anticipated termination depth of these temporary wells will range from 30 to 50 feet bgs. The remaining four temporary wells will be installed to assess the potential for vertical migration of tetrachloroethene and will be installed 25 feet below the first encountered water-bearing zone. These four temporary wells will bracket existing wells 8-G3 and 8-G4. One location will be up-gradient of wells 8-G3 and 8-G4 and the other three wells will be located down-gradient of wells 8-G3 and 8-G4, along the southern-most transect.

Potential temporary well locations described above are shown on Figure 5-1.

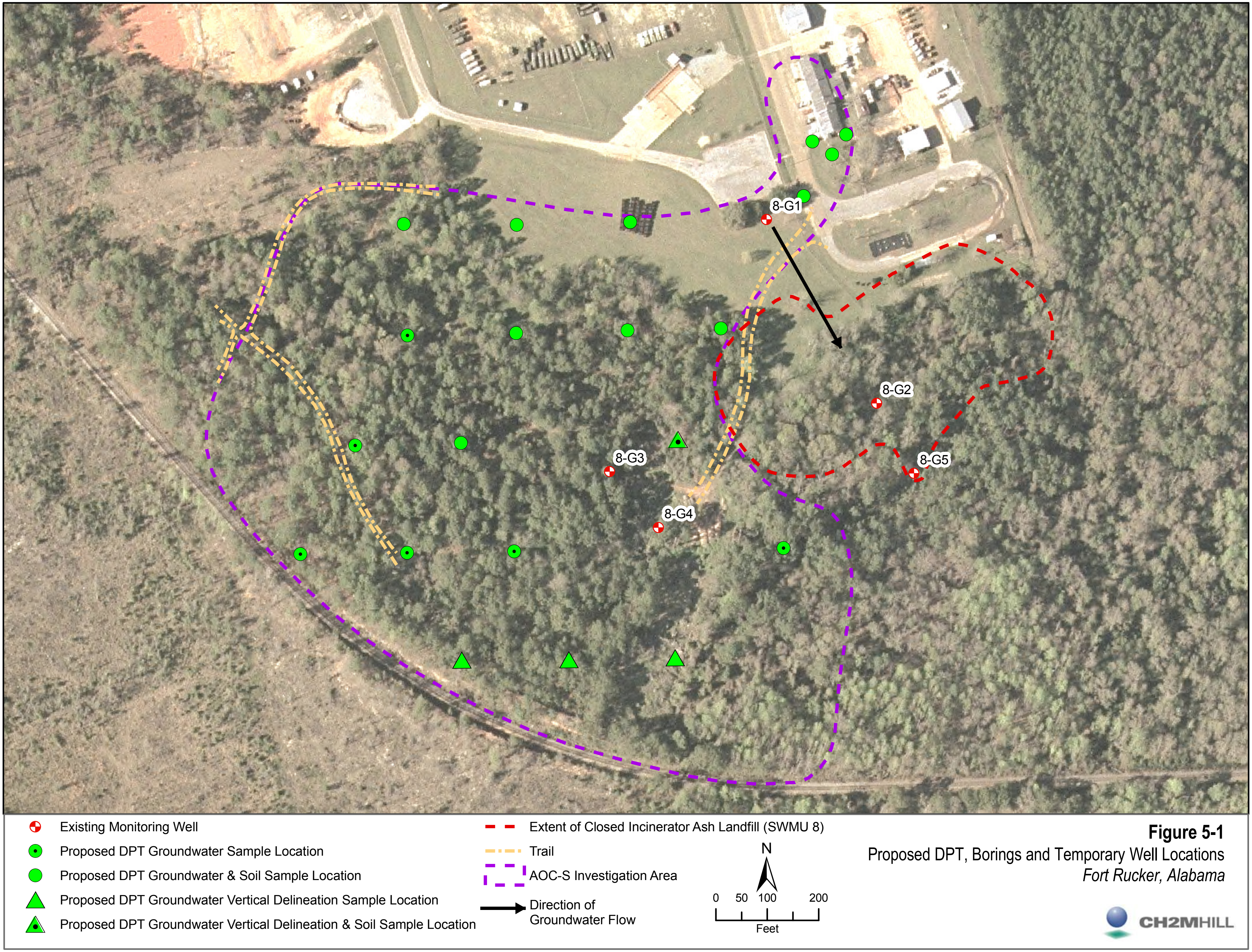

Figure 5-1

Proposed DPT, Borings and Temporary Well Locations

Fort Rucker, Alabama

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Each temporary well will be constructed of 1-inch diameter, threaded, schedule 40, polyvinyl chloride (PVC) riser with 10 feet of 0.010-inch slot size PVC screen. One groundwater sample will be collected from each temporary well and analyzed for total chlorinated volatile organic hydrocarbons using the Color-Tech® field-based analytical method. Ten percent (3 samples) of the groundwater samples will be submitted to the fixed-based analytical laboratory for analysis of ADEM Appendix I VOCs by U.S. Environmental Protection Agency (EPA) Method SW846 8260B. Equipment blanks will be collected at a rate of 1 for every 10 samples. Matrix spike/matrix spike duplicates (MS/MSD) will be collected at a rate of 1 every 20 samples.

Soil samples will also be collected and analyzed for ADEM Appendix I VOCs during drilling for installation of the temporary wells. One soil sample will be collected from 12 DPT borings in the following areas:

- Four DPT borings in the area of the former maintenance shop located northeast of the well 8-G1.
- Three DPT borings installed along the northern-most transect (along a line west of existing well 8-G1).
- The remaining five soil samples locations will be determined in the field, based on the results of the field screening for total chlorinated volatile organic hydrocarbons using the Color-Tech® field-based analytical method.

Field screening of the DPT soil cores using an organic vapor analyzer (OVA) will be performed. The interval exhibiting the highest OVA reading will be selected from each of the 12 borings for analysis of ADEM Appendix I VOCs by EPA Method SW846 8260B. If there are no elevated readings, samples will be collected from the interval just above the water table smear zone. This interval will be verified based on visual observation of the soil core in the field. The potential locations of the 12 DPT borings selected for soil sample collection are shown on Figure 5-1.

5.2.3 Technical Memorandum

After receipt of the preliminary groundwater data from the temporary wells, a Technical Memorandum will be prepared summarizing field sampling activities, analytical results, assessment of findings, and recommendations for the location of additional permanent groundwater monitoring wells to supplement wells 8-G1, 8-G3, and 8-G4, as appropriate. The Technical Memorandum will be submitted to the USACE technical manager, ADEM, and Fort Rucker within 3 days of receipt of the temporary well groundwater analytical data collected during the screening phase.

5.2.4 Permanent Monitoring Well Installation and Groundwater Sampling (Monitoring Well Phase)

During this phase of the field investigation, a minimum of three and a maxiume of eight hollow-stem auger borings are projected to be drilled and completed as permanent groundwater monitoring wells. The locations of the additional permanent monitoring wells will be selected based on the results of the groundwater samples collected during the screening phase, with the concurrence of the USACE technical manager, Fort Rucker, and ADEM. The permanent monitoring wells will be constructed of 2-inch diameter, threaded, schedule 40, PVC riser with 10 feet of 0.010-inch slot PVC screen.

In addition to the installation of the permanent monitoring wells, the temporary wells installed during the screening phase will be abandoned by pulling the casing and screen and filling the borehole with ¼-inch diameter bentonite chips.

After completion of the permanent monitoring wells, one groundwater sampling event will be conducted. Samples will be collected from the eight newly installed monitoring wells and three existing monitoring wells (8-G1, 8-G3, and 8-G4) using a micro-flow purge and sampling technique. Each groundwater sample will be analyzed for ADEM Appendix I VOCs using EPA Method SW846 8260B and metals using EPA Method SW846 6010B/7400. Field duplicates and equipment blanks will be collected at a rate of 1 for every 10 samples. MS/MSDs will be collected at a rate of 1 every 20 samples.

5.2.5 Surveying and Mapping

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

(NGVD). A subcontractor under the supervision of CH2M HILL will provide surveying services. Details of the surveying are presented in the FSP (see Appendix A).

5.3 Investigation Report

Following completion of the field investigation, sample analysis, and laboratory data validation, a RFI report will be prepared. The RFI report and associated appendices will include, at a minimum, the following:

- Discussion of all efforts and information identified to complete the RFI investigation,
- Interpretation of the collected data,
- Determination of the nature and extent of any identified contamination,
- Groundwater elevation map(s),
- Identification of MCLs,
- Recommendation of remedial action or additional work required,
- Data validation report and associated Form I's,
- Field notes, including, but not limited to, soil boring logs and well construction logs,
- Survey data, and
- IDW disposal manifests.

If the data indicate that contamination is within acceptable limits, as defined by ADEM and/or the EPA, the investigation report will identify this and recommend NFA.

5.4 Field Sampling Plan and Quality Assurance Project Plan

The FSP and the QAPP were prepared in accordance with the Statement of Work (SOW) and are included with the Work Plan as Appendix A and Appendix B, respectively.

5.5 Management of Investigation-Derived Waste

Materials likely to be generated during the RFI investigation include soil cuttings; drilling wastes; groundwater; 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 on site pending disposal. The materials will be managed and disposed of by a subcontractor and supervised by CH2M HILL. Details regarding waste storage and handling procedures are presented in the RFI WMP, included as Appendix C to this Work Plan.

5.6 Site Safety and Health

A SSHP was prepared in accordance with the SOW and is included as Appendix D of this Work Plan.

6. References

Contaminant Control, Inc. (CCI). *Final Corrective Measures Implementation Plan (CMIP) for SWMU 8, Fort Rucker, Alabama.* February 13, 2007.

Metcalf & Eddy, Inc. *Phase II RCRA Facility Investigation Final Report, Fort Rucker, Alabama.* November 13, 1995.

Appendix A
Field Sampling Plan

Field Sampling Plan

RCRA Facility Investigation
AOC-S
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Acronyms and Abbreviation

ADEM	Alabama Department of Environmental Management
AOC	Area of Concern
ASTM	American Society for Testing and Materials
bgs	below ground surface
CCI	Contaminant Control, Inc.
CCQC	Contract Chemical Quality Control
CMS	Corrective Measures Study
DQCR	Daily Quality Control Report
DPT	Direct Push Technology
DO	dissolved oxygen
DOT	Department of Transportation
EPA	U.S. Environmental Protection Agency
FSP	Field Sampling Plan
FTL	Field Team Leader
HWMMA	Hazardous Waste Management and Minimization Act
IDW	investigation-derived waste
L/min	liters per minute
MCL	maximum contaminant level
mL	milliter
MS/MSD	matrix spike/matrix spike duplicate
NFA	No Further Action
NROR	Non-Routine Occurrence Report
NTU	nephelometric turbidity units
PID	photoionization detector
PPE	personal protective equipment
PVC	polyvinyl choride
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
SSHP	Site Safety and Health Plan
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
TCLP	Toxicity Characteristic Leaching Procedure
µg/L	micrograms per liter
USACE	U.S. Army Corps of Engineers
USCS	United Soil Classification System
VOC	volatile organic compound
WMP	Waste Management Plan

1. Introduction

This document serves as the project Field Sampling Plan (FSP) for Resource Conservation Recovery Act (RCRA) Facility Investigation (RFI) activities at Area of Concern (AOC)-S at Fort Rucker, Alabama. The FSP sets forth procedures for the collection of field measurements and the handling and analysis of soil and groundwater samples.

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.

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 approximately 62,430 acres, most of which is situated in Dale and Coffee Counties.

The area to be investigated during the RFI has been designated as AOC-S in Fort Rucker's Hazardous Waste Management and Minimization Act (HWMMA) permit. AOC-S is located to the west of Solid Waste Management Unit (SWMU) 8 and south of a vehicle storage/maintenance yard. SWMU 8 is a closed ash landfill comprising approximately 4.3 acres along the southern edge of Fort Rucker. The location of AOC-S is presented on **Figure 3-1** in the Work Plan. The landfill was operated from the 1940s until 1952 (M&E, 1995). Ash from the former incinerator buildings 1410, 1411, and 1412 were disposed of at SWMU 8. During previous groundwater sampling events at SWMU 8, tetrachloroethene was detected in the SWMU 8 upgradient well 8-G1 and side-gradient wells 8-G3 and 8-G4. The occurrence of tetrachloroethene is unrelated to past operations at SWMU 8. A map of AOC-S investigation area is presented on **Figure 3-2** in the Work Plan.

The area to be investigated consists of approximately 21 acres and includes the areas surrounding wells 8-G1, 8-G3 and 8-G4, as well as a former maintenance shop located northeast of well 8-G1. The former maintenance shop was operated from the 1940s until the late 1980s, when the maintenance shop building was demolished. The only remnant of the former maintenance shop is a 100-foot by 30-foot concrete slab. Little is known about waste disposal practices at the former maintenance shop. In addition to the former maintenance shop, the majority of the 21 acres comprising the AOC-S investigation area consists of a relatively flat, grassed area and a gently to steeply sloping wooded area located to the south and west of the former maintenance shop. A review of 1948, 1957, and 1961 historical aerial photographs show that the area south and west of the former maintenance shop has been disturbed. The majority of the area has been cleared of vegetation down to the soil. However, no structures, tanks, or piles of debris or waste are evident in the historical aerial photographs. By 1968, regrowth of trees is evident.

At this time, the source(s) of the tetrachloroethene detected in wells 8-G1, 8-G3 and 8-G4 is unknown. The 21 acres included in the RFI may be an over estimation of the size of AOC-S.

A stream is located approximately 2,000 feet south of AOC-S and flows southeast into the Choctawhatchee River (M&E, 1995).

2.2 Summary of Existing Site Data

Contaminant Control, Inc. (CCI) completed two groundwater monitoring events at SWMU 8. These events were performed in September 2005 and February 2006. The results from these two events at SWMU 8 indicated that tetrachloroethene was detected in three SWMU 8 monitoring wells (8-G1, 8-G3, and 8-G4). The detections of tetrachloroethene exceeded its maximum contaminant level (MCL) (5 micrograms per liter [µg/L]) in wells 8-G3 (September 2005 and February 2006) and 8-G4 (September 2005). Based on the potentiometric surface maps depicting groundwater flow in September 2005 and February 2006, well 8-G1 is located upgradient of SWMU 8 and wells 8-G3 and 8-G4 are located side-gradient of SWMU 8; therefore, these results were not considered indicative of groundwater quality at SWMU 8 (CCI, 2007).

2.3 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 Evaluation and Reporting
- Subcontractor Supervision

CH2M HILL personnel responsible for the above aspects of the project are identified in **Table A-1**. In addition, the project organizational structure is summarized in Section 2 of the Work Plan (see **Figure 2-1**).

TABLE A-1
CH2M HILL HILL Project Responsibilities
RCRA Facility Investigation: AOC-S, Fort Rucker, Alabama

Project Position	Responsible Personnel	Contact Information
Project Manager	Mark Sherrill, PG	CH2M HILL Northpark 400 1000 Abernathy Road Suite 1600 Atlanta, GA 30328 (770) 604-9095 msherril@ch2m.com
Senior Reviewer	Greg Rowell, PG	CH2M HILL Northpark 400 1000 Abernathy Road Suite 1600 Atlanta, GA 30328 (770) 604-9095 growell@ch2m.com
Project Chemist	Mark Stinnett	CH2M HILL 3011 SW Williston Road Gainesville, FL 32608 (352) 335-5877 mstinnet@ch2m.com
Field Team Leader / Site Safety and Health Coordinator/Project Hydrogeologist	Tom Wiley	CH2M HILL Northpark 400 1000 Abernathy Road Suite 1600 Atlanta, GA 30328 (770) 604-9095 twiley@ch2m.com
Health and Safety Manager	Mike Goldman	CH2M HILL Northpark 400 1000 Abernathy Road Suite 1600 Atlanta, GA 30328

TABLE A-1
CH2M HILL HILL Project Responsibilities
RCRA Facility Investigation: AOC-S, Fort Rucker, Alabama

Project Position	Responsible Personnel	Contact Information
		(770) 604-9095 mgoldman@ch2m.com

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 Field Team Leader (FTL) and in accordance with the procedures set forth in the Work Plan, Quality Assurance Project Plan (QAPP) **(Appendix B)**, Waste Management Plan (WMP) (**Appendix C**), and Site Safety and Health Plan (SSHP) (**Appendix D**).

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

TABLE A-2
Subcontractors for Field Activities
RCRA Facility Investigation: AOC-S, Fort Rucker, Alabama

Services Provided	Subcontractor
Laboratory Analytical Services	Empirical Laboratories
Drilling Services	Boart Longyear
Surveying Services	Donaldson and Garrett
Investigation-Derived Waste (IDW) Transport and Disposal	Strong Environmental
Site Clearing	CC Martin

3. Scope and Objectives

The purpose of the RFI is to assess the potential source(s) and extent of tetrachloroethene, which was detected at concentrations exceeding its MCL during groundwater sampling events at SWMU 8, located east of AOC-S. The occurrence of tetrachloroethene is unrelated to past operations at SWMU 8. The information derived from the RFI will be used to determine if no further action (NFA) is appropriate, further investigation is necessary, or a corrective measures study (CMS) should be prepared to evaluate remediation alternatives for AOC-S.

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 QAPP (see Appendix B).

4. Field Activities

The RFI field tasks will be completed in three field mobilizations. Prior to mobilization to the field, CH2M HILL will contact the Fort Rucker utilities to obtain available information regarding subsurface utilities at the AOC-S investigation area and the necessary utility clearances and permits to perform the planned investigation.

4.1 DPT Borings and Soil Sampling

4.1.1 Rationale

Locations

Soil samples will be collected and analyzed for Alabama Department of Environmental Management (ADEM) Appendix I volatile organic compounds (VOCs) during drilling for installation of the temporary wells. One soil sample will be collected from 12 direct-push technology (DPT) borings prior to construction as temporary wells in the following areas:

- Four DPT borings in the area of the former maintenance shop located northeast of the well 8-G1. The anticipated termination depth of these source identification borings is approximately 55 feet below ground surface (bgs).
- Three DPT borings installed along the northern-most transect (along a line west of existing well 8-G1).
- The remaining five soil samples locations will be determined in the field, based on the results of the field screening of groundwater for total chlorinated volatile organic hydrocarbons using the Color-Tech® field-based analytical method from the initial seven temporary wells.

The potential locations of the 12 DPT borings selected for soil sample collection are shown on **Figure 5-1** in the Work Plan.

Sample Collection and Field and Laboratory Analysis

All subsurface soil samples will be analyzed by the subcontract, fixed-base laboratory for ADEM Appendix I VOCs.

QA/QC, and Blank Samples and Frequency

All soil sampling will require 10 percent accompanying QA/QC samples (field duplicates and equipment rinsate blanks) and 5 percent matrix spike/matrix spike duplicate (MS/MSD) samples. The field duplicates and MS/MSD samples will serve as a check on the precision and accuracy of the laboratory. Equipment rinsate blank results will be used to identify problems associated with decontamination procedures in the field.

4.1.2 Procedures

Drilling and Sampling Methods

Prior to initiation of drilling activities, proper clearances and permits will be obtained by CH2M HILL and the drilling locations will be checked for obvious obstructions or hazards. If a proposed drilling location is not suitable, a new location will be chosen. The change will be communicated to United States Army Corps of Engineers (USACE) and approval received prior to implementation in the field. The soil borings will be drilled using DPT methods. Soil cores will be recovered continuously, using a 5-foot-long core sampler.

Boring Logs

A soil boring log (see **Attachment A-1**) will be maintained by the onsite CH2M HILL representative during drilling of each boring. The soil boring log will include a description of the soils encountered following the Unified Soil Classification System (USCS), the soil sample identification numbers, the sample collection depths, the dates and times of initiation and completion of the boring, the name of the driller, and other pertinent information. Color descriptions will be designated using the Munsell Color System.

Field Measurement Procedures and Criteria

Immediately upon recovery and opening of each DPT soil core barrel, the soil core will be screened for organic vapors using a photo-ionization detector (PID). Soil samples will also be collected at 2.5-foot intervals for VOC headspace measurement. Headspace samples will be placed in re-sealable plastic bags and placed in the sun (or other heat source) for a minimum of 15 minutes. The PID probe will be inserted into the bag, and headspace measurement will be recorded. The bag will then be resealed until the boring has been completed and the appropriate soil sample can be selected for analysis following the procedure below.

Sampling for Chemical Analysis

Field screening of the DPT soil cores using a PID will be performed. The soil from the interval exhibiting the highest PID reading will be selected from each of the 12 borings for analysis. If there are no elevated readings, samples will be collected from the interval just above the water table smear zone. This interval will be verified based on visual observation of the soil core in the field.

The sample aliquots will be transferred to the laboratory-supplied containers, properly labeled, and immediately placed into an ice-cooled chest. The aliquot for VOC analysis will be collected first using U.S. Environmental Protection Agency (EPA) Method 5035 and pre-tared, pre-preserved 40-milliliter (mL) glass vials.

The subcontract laboratory will perform the analyses on the soil samples detailed in **Table A-3**.

TABLE A-3
Soil Sample Analysis Requirements
RCRA Facility Investigation: AOC-S, Fort Rucker, Alabama

Parameter	EPA Method	No. of Field Samples	Field Duplicates	MS / MSD	Equipment Blanks	Trip Blanks
ADEM Appendix I VOCs	8260B	12	2	1	2	0

Sample Containers and Preservation Techniques

The analytical laboratory will provide all sample containers. The containers will be cleaned in accordance with EPA protocol and pre-preserved by the laboratory. All samples collected during the field investigation and submitted to laboratories for chemical analyses will be preserved according to EPA standards. Immediately upon sample collection, the sample containers will be properly labeled, then placed into ice-cooled chests for shipment to the laboratory. Sample preservation requirements, holding times, and required sample container types are presented in **Table A-4**. A description of the EZ-Draw Sampling System is presented in **Attachment 2**.

TABLE A-4
Container, Preservative, and Holding Time Requirements for Soil Samples
RCRA Facility Investigation: AOC-S, Fort Rucker, Alabama

Matrix	Test	Method	Container	Preservative	Holding Time
Soil	ADEM Appendix I VOCs	8260B	3 x 5 g EZ-Draw with 3 pre-tared 40 ml vials	1 x Methanol, 2 x Sodium Bisulfite / 4°C	48 hours

Field Quality Control Sampling Procedures

All sampling will require 10 percent accompanying QA/QC samples (field duplicates and equipment rinsate blanks) and 5 percent MS/MSD samples. When QA/QC and MS/MSD samples are collected, all containers for the same analysis will be filled simultaneously (e.g., fill the field, QA/QC, and MS/MSD VOC sample containers all at once, then repeat this procedure for all other analytical methods). When possible, QA/QC and MS/MSD samples will be collected from a location that can be characterized as most likely to exhibit the highest quantity of detectable constituents.

Equipment rinsate blanks will be prepared by rinsing the soil core barrel with reagent grade Type II American Society for Testing and Materials (ASTM) water after the equipment has been decontaminated. The rinsate will be collected directly into the required sample containers. Sample analysis requirements for these water samples are presented in **Table A-5**.

TABLE A-5
Temporary Well Groundwater Sample Analysis Requirements
RCRA Facility Investigation: AOC-S, Fort Rucker, Alabama

Parameter	EPA Method	No. of Field Samples	Field Duplicates	MS / MSD	Equipment Blanks	Trip Blanks
Total Chlorinated Volatile Organic Hydrocarbons	Color-Tech®	21	-	-	-	-
ADEM Appendix I VOCs	8260B	0	3	1	3	1

Decontamination Procedures

The drill rig, drilling tools, and associated sampling equipment will be decontaminated prior to use, after each borehole, and prior to leaving the site. A hot, high-pressure, potable water rinse will be used to decontaminate the drill rig and associated tools.

All other sampling equipment (scoops, bowls, and any other hand sampling tools) will be decontaminated prior to initial use (except for disposable equipment, where items are not reused) and between each sampling event. Decontamination of the small sampling tools will involve scrubbing the equipment with a solution of distilled water and Alconox, or equivalent, followed by a distilled water rinse and an ASTM Type II reagent grade water rinse. All equipment must be allowed to completely air dry prior to reuse. Sampling tools that will not be immediately used after decontamination will be placed in sealable plastic bags or wrapped in aluminum foil for temporary storage.

4.2 Temporary Monitoring Well Installation and Groundwater Sampling

4.2.1 Rationale

Locations

A total of 21 DPT borings or a maximum of 1,075 linear feet are projected to be drilled and completed as temporary monitoring wells in the AOC–S investigation area to define the source(s) and extent of tetrachloroethene. Seven DPT borings/temporary monitoring wells will be installed initially at the following locations:

- Four temporary wells will be installed in the area of the former maintenance shop located northeast of existing well 8-G1. The former maintenance shop is a potential source for the tetrachloroethene detected in wells 8-G1, 8-G3, and 8-G4. These temporary wells will be installed approximately 8 feet below the first encountered water-bearing zone. The anticipated termination depth of these source identification wells is approximately 55 feet bgs.

- Three temporary wells will be installed along the northern-most transect (along a line west of existing well 8-G1) perpendicular with the assumed groundwater flow direction, to determine if the potential source of tetrachloroethene is located north of AOC-S. The spacing between these temporary wells will be approximately 200 feet. These temporary wells will be installed approximately eight feet below the first encountered water-bearing zone. The anticipated termination depth of these temporary wells be approximately 50 feet bgs.

Based on the results of the field screening for total chlorinated volatile organic hydrocarbons using the Color-Tech® field-based analytical method, the remaining temporary monitoring well locations will be adjusted as needed to better define the source(s) and extent of tetrachloroethene. If positive results are detected indicating that the source of tetrachloroethene is located north of AOC-S, in the area of the vehicle parking/maintenance yard, the locations of the remaining temporary wells will be adjusted to investigate the vehicle parking/maintenance yard (number of DPT borings/temporary monitoring wells and specific location will be determined in the field). However, if positive results are not detected indicating that the source is located north of AOC-S, then the remaining temporary wells will be installed as discussed below.

- Fourteen temporary wells (delineation wells) will be installed along four transects perpendicular with the assumed groundwater flow direction. The spacing between each temporary well will be approximately 200 feet. The transects will include existing wells 8-G3 and 8-G4 as data points. Ten of the 14 temporary wells will be installed approximately eight feet below the first encountered water-bearing zone. The anticipated termination depth of these temporary wells will range from 30 to 50 feet bgs. The remaining four temporary wells will be installed to assess the potential for vertical migration of tetrachloroethene and will be installed 25 feet below the first encountered water-bearing zone. These four temporary wells will bracket existing wells 8-G3 and 8-G4. One location will be up-gradient of wells 8-G3 and 8-G4 and the other three wells will be located down-gradient of wells 8-G3 and 8-G4, along the southern-most transect.

Potential temporary well locations described above are shown on Figure 5-1 in the Work Plan.

Sample Collection and Field and Laboratory Analysis

Groundwater samples will be collected from each temporary monitoring well and analyzed for total chlorinated volatile organic halocarbons using the Color-Tec® field-based analytical test kits in order to gather "real-time" analytical data. Ten percent of the groundwater samples collected from the temporary monitoring wells will also be submitted to the subcontract, fixed-based analytical laboratory for analysis of ADEM's Appendix I VOCs.

QA/QC, and Blank Samples and Frequency

All groundwater sampling will require 10 percent accompanying QA/QC samples (field duplicates and equipment rinsate blanks) and 5 percent MS/MSD samples. The field duplicates and MS/MSD samples will serve as a check on the precision and accuracy of the laboratory. Equipment blank results will be used to identify problems associated with decontamination procedures in the field.

4.2.2 Procedures

Temporary Well Construction

The temporary wells will be constructed with 1-inch-diameter, threaded,Schedule 40 polyvinyl chloride (PVC) placed into the direct-push borehole, with a natural gravel pack. The temporary wells will remain in place until the analyses are completed and the horizontal and vertical positions are surveyed. Upon removal of the PVC casing, the borehole will be backfilled by filling with ¼-inch bentonite chips to the ground surface.

Field Measurement Procedures and Criteria

As the temporary wells are being installed and sampled for screening purposes only, field measurements, other than water levels will not be performed.

Groundwater Sampling for Chemical Analysis

Groundwater samples will be collected for chemical analysis from each temporary monitoring well and analyzed for total chlorinated volatile organic hydrocarbons using the Color-Tech® field-based analytical method in order to gather "real time" analytical data. Ten percent of the groundwater samples will be submitted to the subcontract, fixed-based laboratory for analysis of ADEM's Appendix I VOCs. The Color-Tech® Method Description and Standard Operating Procedures are presented in **Attachment 3**. Groundwater sampling activities will be documented on the Groundwater Sampling Form (see **Attachment A-4**). Information recorded on the Groundwater Sampling Form includes static water level, total depth of well (previously measured during development), date/time of sampling, groundwater parameter values, the number and types of sample containers collected, the analyses to be performed, and the sample identification numbers.

The samples will be collected using a peristaltic pump (if depth to water is less than 25 feet) or a small diameter (3/4-inch) teflon bailer. Prior to sample collection, one volume of groundwater will be purged from the well.

After purging is complete, the groundwater samples will be collected. After the initial water is discharged through the pump head, the tubing will be quickly removed from the pump and a gloved thumb will be placed on the tubing to stop the water from draining out. The tubing will be removed from the well and the water will be allowed to gravity drain into the sample vials for VOCs. The sample aliquots will be properly labeled, and immediately placed into an ice-cooled chest. The subcontract laboratory will perform the analyses on the groundwater samples, as detailed in **Table A-5**.

Sample Containers and Preservation Techniques

The analytical laboratory will provide all sample containers. The containers will be cleaned in accordance with EPA protocol and pre-preserved by the laboratory. All samples collected during the field investigation and submitted to laboratories for chemical analyses will be preserved according to EPA standards. Immediately upon sample collection, the sample containers will be properly labeled, then placed into ice-cooled chests for shipment to the laboratory. Sample preservation requirements, holding times, and required sample container types are presented in **Table A-6**.

TABLE A-6
Container, Preservative, and Holding Time Requirements for Temporary Well Groundwater Samples
RCRA Facility Investigation: AOC-S, Fort Rucker, Alabama

Matrix	Test	Method	Container	Preservative	Holding Time
Water	ADEM Appendix I VOC	8260B	3 X 40 ml vial	HCl / 4°C	14 d analysis

Field Quality Control Sampling Procedures

All sampling will require 10 percent accompanying QA/QC samples (field duplicates and equipment rinsate blanks) and 5 percent MS/MSD samples. When QA/QC and MS/MSD samples are collected, all containers for the same analysis will be filled simultaneously (for example, fill in the field, QA/QC, and MS/MSD VOC sample containers all at once, then repeat this procedure for all other analytical methods). When possible, QA/QC and MS/MSD samples will be collected from a location that can be characterized as most likely to exhibit the highest quantity of detectable constituents.

The equipment blanks will be prepared by rinsing the stainless steel bailer with Reagent Grade Type II ASTM water after the equipment has been decontaminated. The rinsate will be collected directly into the required sample containers. Sample container and analysis requirements for these water samples are presented in **Table A-6**.

Decontamination Procedures

All sampling equipment will be decontaminated prior to initial use (except for disposable equipment, where items are not reused). The stainless steel bailer will be decontaminated between each sampling location. Decontamination of the stainless steel bailer will involve scrubbing the equipment with a solution of distilled water and Alconox, or equivalent, followed by a distilled water rinse, and an ASTM Type II Reagent Grade water rinse. All equipment must be allowed to completely air dry prior to reuse. Sampling equipment that will not be immediately used after decontamination will be placed in sealable plastic bags or wrapped in aluminum foil for temporary storage.

4.3 Permanent Monitoring Well Installation and Groundwater Sampling

4.3.1 Rationale

Locations

A minimum of three and a maximum of eight hollow stem auger borings are projected to be drilled and completed as permanent groundwater monitoring wells. The locations of the additional permanent monitoring wells will be selected based on the results of the groundwater samples collected from the temporary wells installed during the screening phase, with the concurrence of the USACE technical manager, Fort Rucker, and ADEM.

Sample Collection and Field and Laboratory Analysis

All groundwater samples collected from the eight additional permanent monitoring wells and three existing monitoring wells 8-G1, 8-G3, and 8-G4 will be analyzed by the subcontract, fixed-base laboratory for ADEM Appendix I VOCs and metals.

Upgradient, QA/QC, and Blank Samples and Frequency

All groundwater sampling will require 10 percent accompanying QA/QC samples (field duplicates and equipment blanks and 5 percent MS/MSD samples. The QA/QC and MS/MSD samples will serve as a check on the precision and accuracy of the laboratory. The equipment blank results will be used to identify problems associated with decontamination procedures in the field. Groundwater samples will be collected from the upgradient wells first to reduce the potential for cross-contamination of samples from sampling equipment.

4.3.2 Procedures

Well Construction

Each monitoring well will be installed using 2-inch-diameter, threaded, Schedule 40, PVC casing and screen (0.010-inch slot size). The screen length will be 10 feet and the well will be constructed such that the screen will be positioned over the apparently most permeable interval of the uppermost groundwater-bearing layer. This will allow assessment of the most likely transport pathway for the lateral migration of low-level dissolved constituents in the groundwater. The screen will not necessarily be placed to intersect the groundwater surface because the presence of free-phase hydrocarbons is not anticipated. Sufficient PVC casing will be used to extend the top of the well approximately 3 feet above the ground surface.

Well construction materials will be installed through the augers to prevent collapse of the hole during well construction. A sand filter pack will be placed using graded silica sand (#20-#40 sieve size). The sand pack will extend from 2 feet below the bottom of the well screen to 3 feet above the top of the well screen. Above the sand pack, bentonite pellets will be placed to create a well seal a minimum of 2 feet thick. The depth of the sand pack and bentonite pellets will be continuously measured during placement to document the sand pack or bentonite depth and to monitor for bridging of the sand or bentonite. Two or three gallons of distilled or de-ionized water will be used to hydrate the bentonite pellets if the bentonite pellets are placed at a depth above the groundwater table. After allowing time for the bentonite pellets to hydrate, the remainder of the well-bore annulus—to within 2 feet of the ground surface—will be filled with a cement-bentonite grout.

Each well will be constructed with an aboveground completion. A locking steel protective outer casing will be mounted over the top of the well, within a 4-foot-square concrete pad. Installed in each concrete pad will be a brass well identification marker. Appropriate well information will be stamped into the identification marker. Well caps and locks will be supplied by the drilling subcontractor.

During monitoring well installation, the CH2M HILL onsite representative will complete a Monitoring Well Completion Log (see **Attachment A-5**). Information recorded on the Monitoring Well Completion Log includes total boring depth, total well depth, casing length, screen length and type, length of well sump, if any, type of surface completion, depth/thickness of installed sand pack, bentonite seal, and grout, amount of water added during construction, if any, and other pertinent well construction data.

Well Development

The drilling subcontractor will develop each well after at least 48 hours and no later than 7 days following monitoring well installation to remove fine-grained sediment from the well and maximize the connection between the sand pack and the formation. Development will be performed by bailing and surging or by using an electric submersible pump.

During development, the CH2M HILL onsite representative will monitor the pH, conductivity, temperature, and turbidity of the produced groundwater. Development will continue until a minimum volume of water equivalent to three times the initial static well volume of the well including thesaturated annulus (assuming a 30% annular porosity) the produced groundwater is clear (less than 20 nephelometric turbidity units [NTU]), and the measurements of pH, conductivity, temperature, and turbidity have stabilized.

Field Measurement Procedures and Criteria

During development, the CH2M HILL onsite representative will monitor the pH, conductivity, temperature, and turbidity of the produced groundwater and will maintain a

Well Development Log (see **Attachment A-6**). The Well Development Log will record development start and end date/times, static water level and total depth of well prior to development, produced volume of groundwater, and measurements of groundwater parameters such as pH, conductivity, temperature, and turbidity. Measurements of the various groundwater parameters will be recorded at the start of development and after each subsequent half-well volume has been produced. Development will continue until a minimum volume of water equivalent to three times the initial static well volume of the well plus three times the volume of any water added during well installation has been removed, the produced groundwater is clear (less than 20 NTU), and the values of pH, conductivity, temperature, and turbidity have stabilized (less than 10 percent change in successive measurements) and pH has stabilized within +/- 0.2 units. All observations and measurements will be recorded on the Well Development Log.

A minimum of 48 hours after completion of development activities, water levels in all 11 monitoring wells (eight new wells and three existing wells) at the investigation site will be measured. The water levels will all be measured on the same day, within as short a time span as possible, after allowing the water levels to equilibrate in order to obtain data for the preparation of a potentiometric surface map.

Groundwater Sampling for Chemical Analysis

Groundwater samples will be collected for chemical analysis from each monitoring well. Groundwater sampling activities will be documented on the Groundwater Sampling Form (**Attachment A-4**). Information recorded on the Groundwater Sampling Form includes static water level, total depth of well (previously measured during development), date/time of sampling, groundwater parameter values, the number and types of sample containers collected, the analyses to be performed, and the sample identification numbers.

The samples will be collected utilizing a peristaltic pump (if water level is less than 25 feet deep) or a bladder pump and low-flow techniques. Prior to sample collection, groundwater will be purged from the well using a peristaltic pump (if water level is less than 25 feet deep) or a bladder pump. Flow rates of 0.5-liter per minute (L/min) or less will be utilized and drawdown minimized to less than 3 feet. Discharged groundwater will be measured with a flow-through cell and will include the parameters of pH, temperature, conductivity, turbidity, dissolved oxygen (DO), and redox potential. Water quality parameters will be considered stabilized when, after three consecutive readings, each parameter has stabilized to the following criteria:

- pH - ± 0.2 units
- Temperature - ± 0.10 °C
- DO – ± 10 percent, conductivity - ± 3 percent
- Turbidity is less than 10 NTUs

After purging is complete, the groundwater samples will be collected. The sample aliquots will be collected directly into the laboratory-supplied containers, properly labeled, and immediately placed into an ice-cooled chest. Aliquot for VOCs will be collected first, then the aliquot for the metals analyses. When using a peristaltic pump: After the initial water is discharged through the pump head, the tubing will be quickly removed from the pump and a gloved thumb will be placed on the tubing to stop the water from draining out. The tubing will be removed from the well and the water will be allowed to gravity drain into the sample vials for VOCs. The subcontract laboratory will perform the analyses on the groundwater samples as detailed in **Table A-7**.

Parameter	EPA Method	No. of Field Samples	Field Duplicates	MS / MSD	Equipment Blanks	Trip Blanks
ADEM Appendix I VOCs	8260B	11	2	1	2	3
ADEM Appendix I Metals	6010B/7000	11	2	1	2	-

Sample Containers and Preservation Techniques

The analytical laboratory will provide all sample containers. The containers will be cleaned in accordance with EPA protocol and pre-preserved by the laboratory. All samples collected during the field investigation and submitted to laboratories for chemical analyses will be preserved according to EPA standards. Immediately upon sample collection, the sample containers will be properly labeled then placed into ice-cooled chests for shipment to the laboratory. Sample preservation requirements, holding times, and required sample container types are presented in **Table A-8**.

TABLE A-8
Container, Preservative, and Holding Time Requirements for Permanent Well Groundwater
RCRA Facility Investigation: AOC-S, 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 d analysis
Water	ADEM Appendix I Metals	6010B/7000	1 X 500 ml HDPE jar	HNO_3 / 4^{o}C	6 months Mercury (28 days)

Field Quality Control Sampling Procedures

All sampling will require 10 percent accompanying QA/QC samples (field duplicates and equipment rinsate blanks and 5 percent MS/MSD samples. When QA/QC and MS/MSD samples are collected, all containers for the same analysis will be filled simultaneously (e.g., fill in the field, QA/QC, and MS/MSD VOC sample containers all at once, then repeat this procedure for all other analytical methods). When possible, QA/QC and MS/MSD samples will be collected from a location that can be characterized as most likely to exhibit the highest quantity of detectable constituents.

Equipment rinsate blanks will be prepared by rinsing the submersible pump and associated wiring, air line, and tubing with Reagent Grade Type II ASTM water after the equipment has been decontaminated. The rinsate will be collected directly into the required sample containers, with sample aliquots collected in order of most volatile parameter class (i.e., VOCs) to least volatile parameter class (that is, metals). Sample container and analysis requirements for these water samples are presented in **Table A-8**.

Decontamination Procedures

All sampling equipment will be decontaminated prior to initial use (except for disposable equipment, where items are not reused). The submersible pump, associated clamps and wiring, and the flow cell will be decontaminated between each sampling event. Decontamination of the equipment will involve scrubbing the equipment with a solution of distilled water and Alconox, or equivalent, followed by a distilled water rinse, and an ASTM Type II Reagent Grade water rinse. All equipment must be allowed to completely air dry prior to reuse. Sampling equipment that will not be immediately used after decontamination will be placed in sealable plastic bags or wrapped in aluminum foil for temporary storage.

5. Documentation

5.1 Field Logbook

All field activities will be documented in a bound field logbook in indelible, waterproof ink. Information about all the onsite activities will be recorded in the logbook in real time and will include, at a minimum, the following:

- Project name and number
- The current date, pertinent times (in military time), and arrival/departure times from the site
- Individuals (team members and non-members) onsite
- Site-safety activities, injuries, and other incidents
- Directions from others
- Site conditions and ambient weather conditions
- Sample locations (well and/or boring number) and depths
- Sample numbers, number/type of containers, sample time and date
- Analyses requested and laboratory assignments
- Sampler's name and signature
- Results of PID measurements
- Type of sample collected
- Other notes and information, as required

Notes will be written on sequentially numbered pages with indelible, waterproof ink. At the end of each day, any unused space at the bottom of the last page will be crossed out, dated, and initialed by the FTL.

5.2 Field Log Sheets

All field log sheets (Soil Boring Logs, Well Development Forms, Well Purging and Sampling Forms, etc.) will be completed using indelible, waterproof ink following the procedures outlined in this FSP. The FTL will be responsible for the collection, on a daily basis, of all field log sheets, including chain-of-custody documentation, from team members.

5.3 Photographs

Photographs of the various RFI field activities will be taken throughout the field activities. Photographs that are representative of field activities are required; however, photographs of each borehole or sampling location are not required. All photographs will be numbered sequentially and the numbers recorded in the field team logbook.

5.4 Sample Documentation

5.4.1 Sample Numbering System

In order to identify and accurately track the various samples, all samples collected during this investigation, including QA/QC samples, will be designated with a unique number. The number will serve to identify the investigation, the site, the sample media, sampling location, the depth (soil) or round (groundwater) of sample, and QA/QC qualifiers.

The sample designation format is as follows:

- Media–Station or Boring #–Depth and QA/QC (if applicable)

An explanation of each of these identifiers is given below.

Media:

- MW = Monitoring Well Boring
- SB = Soil Boring
- DPT = Direct Push Technology Boring
- Station or Boring #: Each soil test boring or monitoring well will be identified with a unique identification number.
- Depth/Round Depth indicators will be used for soil and groundwater samples taken from DPT Investigation.

The top sample depth will used in the identification number. For example:

- 6 to 8 feet bgs will be referenced as 6

QA/QC:

- FB = Field Blank
- FD = Field Duplicate Sample
- TB = Trip Blank
- ER = Equipment Rinsate
- MS/MSD = Matrix Spike/Matrix Spike Duplicate

EXAMPLE: Under this sample designation format, the sample designation DPT-7-6FD refers to: DPT = DPT Sampled Soil Boring, 7 = Boring #7, 6 = Sample depth interval 6 to 8 feet bgs, and FD = Field Duplicate.

The sample identification number for each soil or groundwater sample collected will be documented in the field logbook.

5.4.2 Sample Labels and/or Tags

Each sample container will include a label that identifies, at a minimum: sample identification number, analytical preparation and analysis methods requested, sample date, sample time, initials of the sampler, and client. All information will be written in waterproof ink and the label will be affixed with clear tape.

5.4.3 Sample Field Sheets and/or Logbook

Field sampling activities will be recorded in a bound field logbook with indelible, waterproof ink. The logbook will include, at a minimum, the field team members, sample identification number, sampling locations and depths, sampling dates and times, and any field analysis results. Other details of soil or groundwater sampling activities may also be recorded on field log sheets (soil boring logs, well purging and sampling forms, etc.). Information recorded on field log sheets will also be recorded with indelible, waterproof ink.

5.4.4 Chain of Custody Forms

A chain-of-custody form will be prepared for each cooler of samples shipped to the laboratory. Information recorded will include, at a minimum: investigation site name, sampler name(s), date and time of sample collection, identification code unique to each sample, number of containers with the same sample code, analyses requested for each sample (including the analytical method numbers), and signature blocks for each individual who had custody of the sample(s).

Upon receipt of samples at the laboratory, all samples will proceed through an orderly processing sequence specifically designed to ensure continuous integrity of both the sample and other information pertinent to the analysis. If no discrepancies are identified, the sample chain-of-custody record will be signed, and the samples will be assigned a unique laboratory identification number by the laboratory for tracking and filing. The laboratory QA system and the use of an internal chain-of-custody procedure will ensure that the samples are appropriately tracked by the laboratory from receipt through completion of analysis.

5.4.5 Receipt for Sample Forms

Upon receipt at the laboratory, all samples will be carefully checked and verified for proper chain-of-custody records, preservation, broken or leaking sample containers, proper label identification, and any associated discrepancies. These items will be documented by use of a laboratory cooler receipt form. If any samples arrive leaking or broken, or the custody seal on the shipment coolers is not intact, the project chemist and/or project manager will be notified immediately. The cooler receipt form will become part of the permanent laboratory record.

5.5 Non-Routine Occurrence Report

A written non-routine occurrence report (NROR) of all significant problems resulting from non-routine occurrences in the field or at the laboratory will be submitted to USACE within 48 hours of the occurrence of the event. These NRORs will identify the problems encountered, verbal or written instructions from USACE personnel, corrective actions taken, and any re-sampling or re-analyses that are deemed necessary.

5.6 Corrections to Documentation

Corrections that are required in field logbook(s) or on any field forms must be completed by lining through incorrect entries with a single line and initialing and dating the strikeout.

6. Sample Packaging and Shipping

Samples collected during the field activities will be shipped via an overnight courier to the analytical laboratory. A cooler of suitable strength for packaging and shipping samples will be used and will be manifested to meet U.S. Department of Transportation (DOT) regulations. The bottom and sides of each cooler will be lined with bubble wrap or other cushioning material. Each sample jar or bottle will also be individually wrapped in bubble wrap to prevent breakage. All samples will be kept upright in the cooler. Once the samples are in the cooler, any voids will be filled with additional packaging material. Ice will be double-bagged in re-sealable bags and placed in the cooler with the samples. A sufficient amount of ice will be added to the coolers to ensure that they arrive at the laboratory at a temperature of 4° Celsius (± 2° Celsius). The chain-of-custody record will be placed in a watertight plastic bag and taped to the inside lid of the cooler, with one copy of the chain-of-custody record being retained by the FTL. The shipping airbill tracking number will be written on the chain-of-custody record for reference. If the cooler has an identification number, the identification number will also be recorded on the chain-of-custody record. The cooler will be secured with strapping tape and custody seals will be affixed to the front and back of the cooler. The custody seals will be covered with wide, clear adhesive tape.

7. Investigation-Derived Wastes

7.1 Rationale

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 investigation-derived waste (IDW) expected to be generated during the field activities includes the following.

- Used personal protective equipment (PPE) and disposable sampling equipment
- Soil cuttings generated during drilling of soil borings
- Decontamination fluids
- Monitoring well development and purge waters
- General trash (uncontaminated)
- Empty containers

Details regarding waste management are located in the WMP (**Appendix C**).

7.2 Handling and Management

During the field sampling program, soil cuttings and soil samples will be visually inspected and screened for organic vapors with a PID. It is assumed that field screening and visual observations made during the field activities will be sufficient to characterize the waste as potentially hazardous or non-hazardous for the purpose of segregating the wastes in the field. **Table A-9** identifies the approximate volumes of wastes expected to be generated during this project.

TABLE A-9
Volumes of Waste Expected to be Generated During Field Activities
RCRA Facility Investigation, AOC-S, Fort Rucker, Alabama

Waste Media	Container Type	Total Volume Expected
Used PPE and disposable sampling materials	55-gal. drum	2 drums
Soil cuttings	55-gal. drum	27 drums
Well development/purge water/decontamination fluids	55-gal. drum	15 drums
General trash	55-gal. drum	3 drums
Empty containers	55-gal. drum	1 drum

The FTL will label each waste container to indicate the container contents, type of waste, location where the waste was generated, identification numbers of the soil boring location(s) or well(s) associated with the waste, date that the drum was filled, name of the contractor who filled the drum, and a contractor point of contact name. The container number, contents, and filling date(s) will be recorded in the project field logbook.

7.3 IDW Characterization

To characterize soil IDW for disposal, one composite soil sample will be collected from the drums. Waste characterization and profiling will be performed by CH2M HILL. Waste transportation and disposal will be subcontracted.

To characterize soil IDW for disposal, one composite sample will be collected from the soil cuttings in the drums. The soil IDW sample will be submitted for analysis of toxicity characteristic leaching procedure (TCLP) VOCs, TCLP semivolatile organic compounds (SVOCs), TCLP RCRA metals, TCLP pesticides, TCLP herbicides, as well as, reactivity, corrosivity, ignitability.

Liquid waste, including produced groundwater and decontamination fluids, will be characterized by evaluating analytical results from the discrete samples collected from each of the temporary and permanent monitoring wells. The groundwater samples will be analyzed for the ADEM Appendix I VOCs.

8. Contractor Chemical Quality Control

The Contractor Chemical Quality Control (CCQC) will be summarized in the Daily Quality Control Report (DQCR) (see **Attachment A-7**) and submitted to the USACE Technical Manager. The objective of CCQC is to ensure that QC is maintained through all phases of field work.

8.1 Preparatory Phase

A CCQC review will be conducted by the FTL prior to any field activities. The review will cover, but not be limited to, the following: all work requirements, a physical examination of all project materials and equipment, an examination of the work area to confirm the completion of preliminary work, and a discussion of all field activities. The CCQC review must be repeated if new personnel begin work at the investigation site at a later date.

8.2 Initial Phase

The FTL 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.

8.3 Follow-up Phase

A summary of CCQC activities will be submitted with the DQCR.

9. Daily Quality Control Reports

DQCRs will be completed by the FTL for each day of field activity and forwarded to the PM. The PM will submit the DQCR to the USACE Technical Manager the following morning. If a significant problem arises at the investigation site, the DQCR will be sent to the USACE on the day of occurrence, along with a 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 Workplan
- General remarks
- Expected activities for the following day

10. Corrective Actions

A corrective action program will be implemented to ensure that conditions adverse to quality are identified promptly and corrected as soon as practical. In the case of significant conditions adverse to quality, 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 the exceedance of QC criteria. Follow-up action will be taken to verify implementation of all corrective action.

10.1 Reporting and Resolution Requirements

Significant quality problems and conditions will be identified, reported, and corrected in accordance with the following requirements:

- Existing, developing, or potentially out-of-control 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 problems and their resolution, including lessons learned from significant quality problems and adverse conditions 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.

10.2 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 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.

10.3 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.

11. Project Schedule

The project schedule for the AOC-S RFI is presented in Section 2 of the Work Plan (see **Figure 2-2**). Included on the figure 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.

Attachment A-1

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)				SOIL DESCRIPTION	COMMENTS
	SAMPLE INTERVAL (FT)				
		RECOVERY (IN)			
			#/TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEBRIS ENCOUNTERED, XRF RESULTS, SAMPLE COLLECTION (date, time, sample ID)

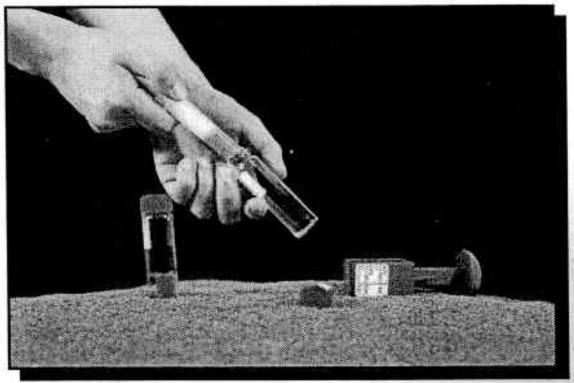
Attachment A-2

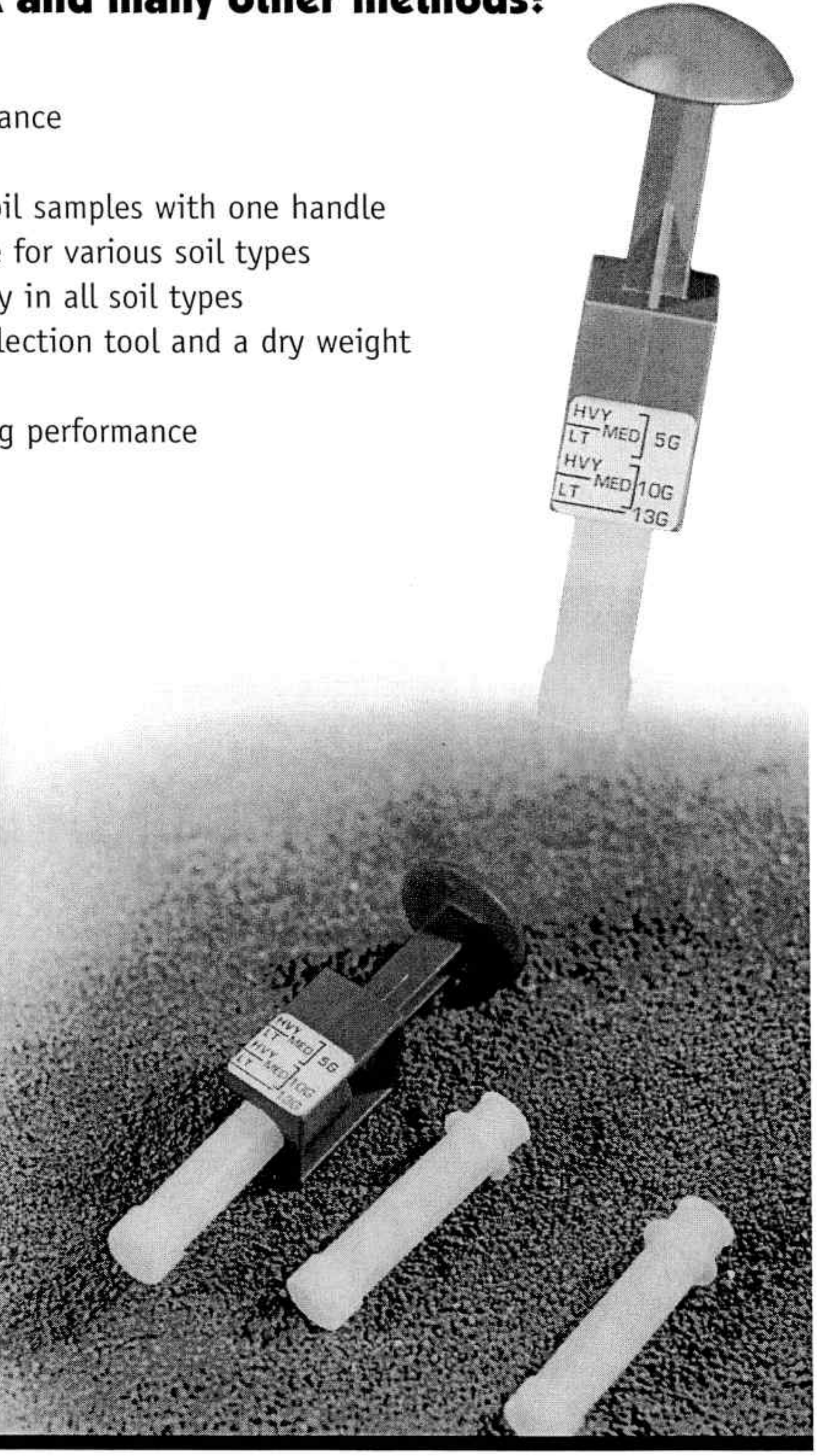
The EasyDraw Syringe® & PowerStop Handle® Sampling System

The Most Versatile, Disposable Soil Sampling System Available For Field Preservation

A Simple Solution for soil sampling as described in EPA SW-846 Method 5035A and many other methods!

- Eliminates the need for a field balance
- PowerStop Handle is reusable
- Ability to take 5, 10 & 13 gram soil samples with one handle
- Adjustable settings to compensate for various soil types
- Sturdy handle makes sampling easy in all soil types
- EasyDraw Syringe doubles as a collection tool and a dry weight sample container
- EasyDraw Syringes meet demanding performance & cleanliness standards





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CHEMISPHERE, INC.

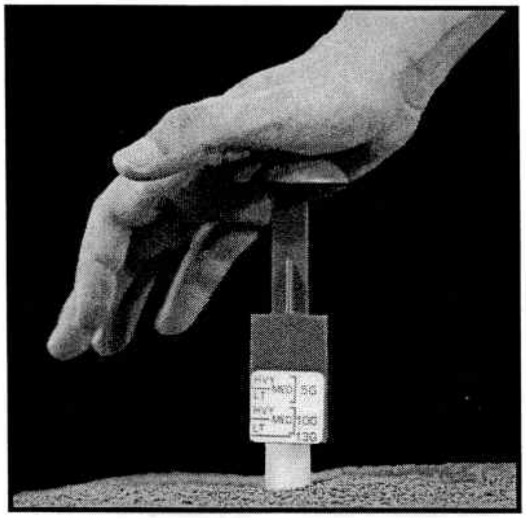
Recommended Use Of The EasyDraw Syringe® and The PowerStop Handle®

Step 1 - Load Sampling Device

Insert the EasyDraw Syringe® into the appropriate slot on the Powerstop Handle® and remove end cap from syringe.

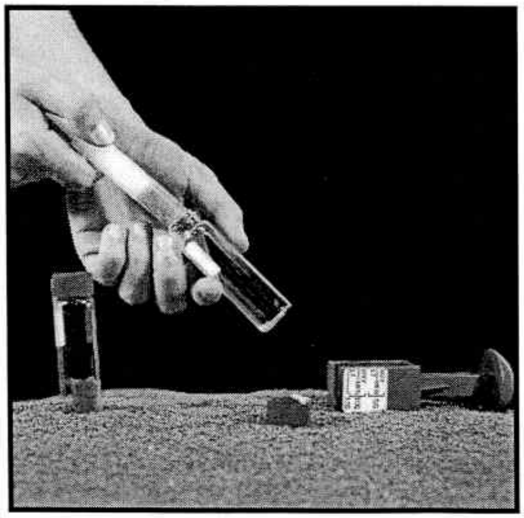
- If sampling for EPA Method 5035A low-level Protocol, insert syringe into one of the three 5 gram positions. Use the heavy position for dense clay, the light position for dry sandy soil, and the medium position for all others.
- There are also three 10 gram and one 13 gram positions to accommodate other methods.

Step 2 - Collect Sample



Push the EasyDraw Syringe® into freshly exposed soil. Continue pushing until the soil column inside the syringe has forced the plunger to the stopping point.
Wipe all debris from the outside of the EasyDraw Syringe®. The soil plug should be flush with the mouth of the sampler. Remove any excess soil that extends beyond the mouth of the sampler. The EasyDraw Syringe delivers approximately 5, 10 or 13 grams. Actual weight will be determined at the laboratory.

Step 3 - Eject Sample Into Vial



Remove the syringe from the Powerstop Handle®. Insert syringe into open end of a pre-tared 40-ml vial containing the appropriate preservative. Extrude the sample into the vial by pushing on the syringe plunger.
Avoid getting dirt on the threads of the the 40-ml vial.

Cap vial immediately and put on ice or in an environment maintained at 4° C.

Option: Refill EasyDraw Syringe® and cap for use as a dry weight container.

Attachment A-3

Color-Tec® Method Description And Standard Operating Procedures

Soil/Water Analysis Procedure for Detection of Total Chlorinated Volatile Organic Halocarbons

Table of Contents

Tables

Figures

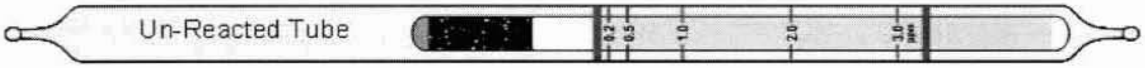
Color-Tec® Method

Soil/Water Analysis Procedure for Detection of Total Chlorinated Volatile Organic Halocarbons

1.0 Introduction (Method Principle)

Color-Tec® is a field-based analytical method which combines the use of colorimetric gas detector tubes (originally designed for occupational breathing-zone monitoring) with sample purging to detect very low (*to <2µg/L*) concentrations of chlorinated volatile organic halocarbons (CVOHs) in liquid and solid samples. The Color-Tec® method provides fast, low-level, economical, decision-quality data which maximizes sampling frequency and sample coverage to locate source zones and delineate dissolve-phase contaminant plumes.

Samples are analyzed by using a hand-operated vacuum pump to purge the volatile compounds from a groundwater or soil sample through the colorimetric tube, which is designed to produce a distinct color change when exposed to chlorinated compounds. The colorimetric tubes and hand pumps used for the Color-Tec® method are manufactured by Gastec®, Inc. Each colorimetric tube contains an oxidizer (PbO_2) and a catalyst (H_2SO_4) which decomposes and converts the chlorinated compounds to hydrogen chloride, which discolors a reagent (4-phenylazodiphenylamine) in the tube from yellow to purple. The reaction formula provided by Gastec® for the PCE tube is as follows:



$$\mathbf{Cl_2C{:}CCl_2 + PbO_2 + H_2SO_4 \rightarrow HCl}$$

$$\mathbf{HCl + (4\text{-}Phenolazo)\ Diphenylamine \rightarrow Chloride}$$

The colorimetric tubes react positively to all chlorinated volatile organic halocarbons, including saturated and unsaturated chlorinated alkenes and alkanes. Therefore, the total response indicated by the detector tube reflects the sum of the concentration of each individual chlorinated compound present in the sample. In comparisons of the colorimetric tube readings to the pre-prepared standards, the method routinely detects these compounds at concentrations of 2 microgram per liter (µg/L) of total CVOCs and below. In comparisons using the field-generated data, the Color-Tec® method routinely detects total chlorinated compounds below the regulatory clean-up levels of the specific chlorinated compounds detected by gas chromatograph/mass spectrometer (GC/MS) analysis in split samples. When used in accordance with Color-Tec® method procedures, the method can detect total chlorinated compounds in water samples at concentrations at or below the quantitation limit of EPA Method 8260 using GC/MS techniques. Detection of concentrations below 1 µg/L is common.

The Color-Tec® method is primarily qualitative (detects the presence/absence of a compound or class of compounds). The colorimetric gas detector tubes used in the

Color-Tec® method are designed to detect CVOHs in ambient air. Color-Tec® method is an alternate use of these tubes, which involves purging CVOHs from a water or soil sample and concentrating them through the colorimetric tube to evoke a color change when any CVOHs are present in the sample at sufficient concentrations to be detected.

When the colorimetric tubes are used in the Color-Tec® method, the units (ppmV) printed on the tubes have no direct relationship to the quantity of CVOHs dissolved in the water sample which is being analyzed. The distance that the color change travels through a tube (the tube reading) is a relative response to the amount of chlorinated-compound molecules that have been purged from the sample and directed into the tube. Therefore, the units printed on the tubes are used only to record the relative response for each analysis in order to facilitate comparison of the response to other sample results or for comparison to laboratory GC/MS methods. The relative response must not be considered a concentration in ppmv (as printed on the tubes), but rather as "relative response units" which must be compared to known values in order to yield an estimate of the actual concentration present in the sample.

Although Color-Tec® does not provide a specific measurement that directly relates to the concentrations in the sample, the level of intensity of a positive colorimetric tube reaction (the relative response) does provide an indication of the magnitude of the concentration. Tube readings may be used to estimate the concentration of CVOHs present in the sample by comparing Color-Tec® results to the results of split samples analyzed by GC/MS. It is customary to select from 5 to 20 percent of the samples in a data set for comparison analysis. Given a sufficient quantity of split sample pairs and sufficient range of concentration values, the GC/MS-to-Color-Tec® comparison data may be used to obtain estimated concentrations for samples in the data set which were analyzed only using the Color-Tec® method. This can be achieved using linear regression analysis of the comparison data. Statistical analysis of the comparison data can also be performed to determine confidence of the Color-Tec® zero values, essentially providing a Color-Tec® method detection limit (MDL) for the data set. This is discussed in further detail below in Sections 9 and 10.

The Gastec® 133-series colorimetric tubes used with the Color-Tec® method, are capable of detecting all chlorinated volatile organic halocarbons at concentrations at or below the EPA Maximum Contaminant Levels (MCL) of any individual compound in that class of compounds. Although Color-Tec® does not identify the specific chlorinated compound in the sample, or yield a specific value related to the concentration in the water or soil sample, the level of intensity of each positive tube reaction provides the general magnitude of the concentration in the sample; such as "very low" (at or below EPA MCLs), "low" (likely above EPA MCLs), "medium" (likely at a concentration in the hundreds of µg/L), and "high" (likely at a concentration in the thousands of µg/L). These capabilities combined with low per-sample cost and speed make the Color-Tec® method a highly effective tool for field-based decision-making at chlorinated solvent sites.

2.0 Color-Tec® Test Kit Parts Description

The Color-Tec® Chlorinated VOH Soil/Water Test Kit System consists of three primary components:

1. Hardware Kit - Contains reusable equipment and carrying case;

2. 20-Sample Expendables Kit - Contains components needed for analysis of 20 water or soil samples (available for low, medium, or high range detection of total CVOHs);
3. QA/QC Kit – Contains components needed to perform suggested QA/QC procedures to insure method performance and provide method confidence

2.1 Materials Provided

2.1.1 Hardware KIT (See Figure 1)

Item	Quantity
RAE® Piston pump	1
Color-Tec® Pump Stand	1
Corning® Hot Plate	1
Stainless Steel Heating Pan	1
Nalgene® VOA Heating Rack	1
Thermometer	1
Decontamination Syringe	1

2.1.2 20-Sample Expendables Kit (analyzes 20 water or soil samples) (See Figure 2)

Item	Quantity
Low-Range (133LL) Colorimetric Detector Tubes	21
300µg/L-TCE reference standard in flame-sealed ampoule	1
10 ml Pipette (for transferring standard)	3
40 Milliliter VOA Vial (filled with water for spike)	1
Medium-Range (133L) Colorimetric Detector Tubes	2
High-Range (133M) Colorimetric Detector Tubes	1
Extraction Needle Assemblies	24
40 Milliliter VOA Vials – empty (for samples)	40
40 Milliliter VOA Vial – no cap (for heating tubes)	1
Carbon Filter	2
Carbon Filter Luer Assembly	2
Purge Needle	2
Nitrile Safety Gloves (pair)	1

2.1.3 QA/QC Kit (See Figure 3)

Item	Quantity
Low-Range (133LL) Colorimetric Detector Tubes	5
Toluene colorimetric Detector Tube	1
60µg/L-TCE reference standard in flame-sealed ampoule	2
300µg/L-TCE reference standard in flame-sealed ampoule	1
600µg/L-TCE reference standard in flame-sealed ampoule	1
10 ml Pipette (for transferring standards)	4
40 ml VOA Vials (empty – (for toluene test samples)	2
40 ml VOA Vials (pre-filled with organic-free water)	4
Extraction Needle Assemblies	5
Purge Needle	1
Carbon Filter	1
Carbon Filter Luer Assembly	1
Nitrile Safety Gloves (pair)	1

Figure 1
Color-Tec® Materials Provided in Hardware Kit

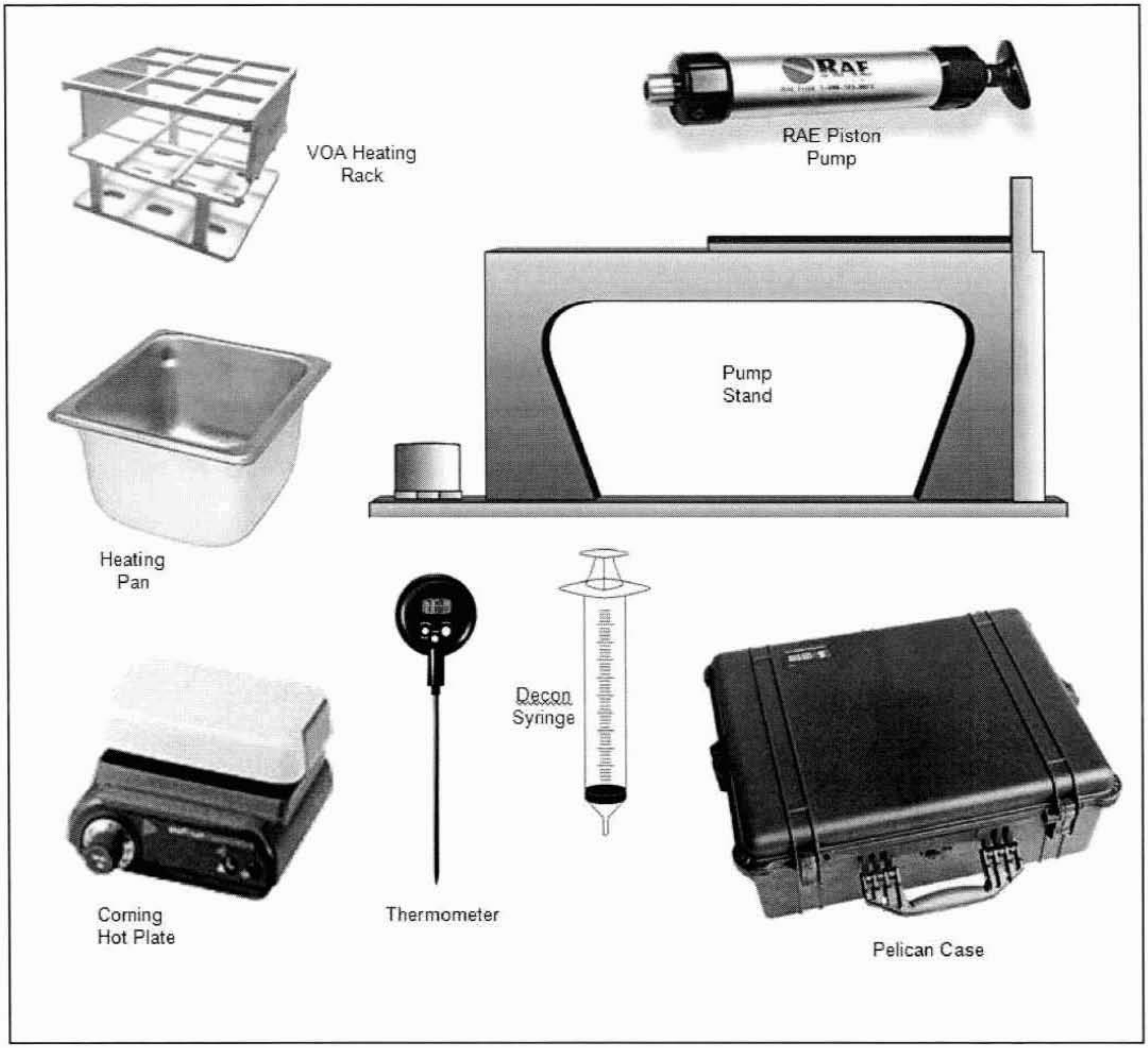


Figure 2
Color-Tec® Materials Provided in 20-Sample Expendables Pack

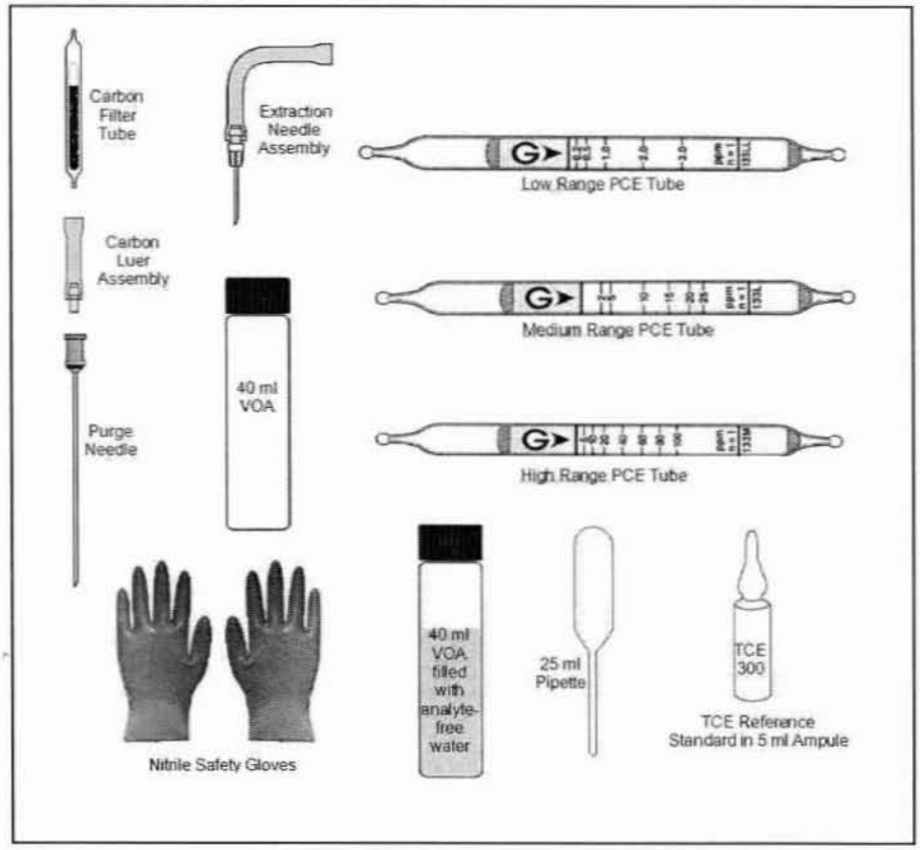
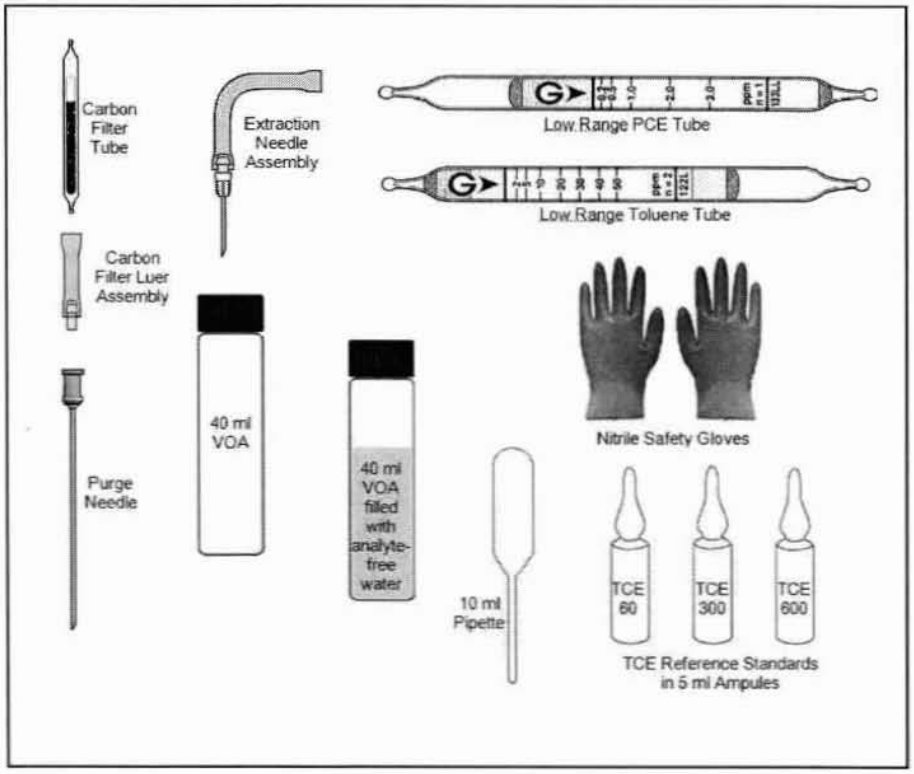


Figure 3
Color-Tec® Materials Provided in QA/QC Test Pack



2.2 Accessories Supplied by User

The following items (not provided in the Color-Tec® kit) are suggested for use with the Color-Tec® method to perform the listed functions.

Item	Purpose
Organic-free water	For soil sample extraction and equipment decontamination
Safety gloves	Personal protection
Safety glasses	Personal protection
120V AC power source	For hot plate
Permanent marker	Labeling sample bottles
40 Milliliter VOA Vials	For split samples to be analyzed by laboratory methods

The VOA vials used to perform the Color-Tec® method are provided in each kit (two vials per sample). The user may wish to collect a quantity of split samples for laboratory analysis to provide comparison data which may be used to determine site-specific method detection limits and/or to tentatively quantify Color-Tec® results.

2.3 Storage & Stability of Colorimetric Tubes and Reference Standard Ampoules

The Gastec colorimetric tubes have a shelf-life of two years with refrigeration. Tubes should be stored at or below a temperature of 10°C/50°F when not in use. Colorimetric detector tubes are single-use (one tube per analysis) and should be used immediately after the tips are broken. Tube readings should be recorded immediately following analysis because the intensity of the color-change fades over time. Each box of tubes has an expiration date printed in red ink on the top of each box. When heating the tubes for use with the Color-Tec® method, it is recommended that the tube temperature does not exceed 40°C/104° F.

Other procedures and guidelines for use of the colorimetric tubes with the Color-Tec® method are presented in this manual. Other procedures and guidelines associated with the use of the tubes for their designed purpose (gas detection in ambient air) are included in the tube manufactures data sheets and tube instructions included in the tube packaging.

The QA/QC reference standards are provided in 5ml flame sealed ampoules to prevent loss of volatiles and generally have a shelf life of one year with refrigeration.

2.4 Field Preparation of QA/QC Standards

Each 20-sample Color-Tec® expendables kit is equipped with a TCE reference standard and a VOA vial pre-filled with analyte-free water used to prepare a 10 µg/L spiked sample. Color-Tec® QA/QC kits are equipped with supplies to perform a variety of QA/QC tests including TCE reference standards and three VOA vials pre-filled with analyte-free water used to prepare 10 µg/L, 50 µg/L, and 100 µg/L spiked samples. The QA/QC reference standards are provided in 5ml, flame sealed glass ampoules labeled TCE-60, TCE-300, and TCE-600. These reference standards are used to prepare sample spikes for field QA/QC testing by transferring the contents of each ampoule into each of three VOA vials pre-filled with analyte-free water. After transferring the reference standards in the ampoules to the VOA vials pre-filled with analyte-free water, these VOAs will contain TCE concentrations of 10 µg/L (green label), 50 µg/L (yellow label), and 100 µg/L (red label). These spiked samples are then analyzed using the Color-Tec® method to analytical confidence. Spiked control samples are used to insure that the method is detecting the target compounds within reasonable limits and to provide a basis for estimating concentrations based on the Color-Tec® responses.

3.0 Sample Collection and Preparation

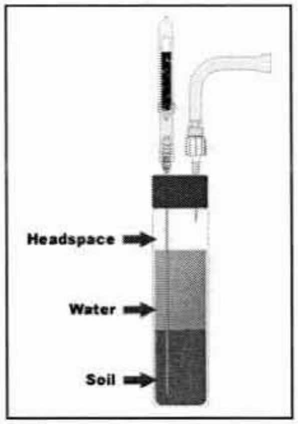
3.1 Liquid Sample Media

Collect the water or other liquid sample media directly from your sampling device into two 40 ml VOA vials by filling each vial to ~70% capacity (i.e. to about 1-inch below the shoulder of each vial). *Note: The second vial serves as a duplicate sample which may be needed later during the Color-Tec® analysis process.* Tightly secure the caps onto the partially-filled VOA vials.

> **IMPORTANT NOTE**: The VOA vials containing the liquid sample to be tested must contain an air-filled headspace to accommodate purging. The caps must be tightened sufficiently to prevent loss of CVOHs during the time between sample collection and analysis (which includes the heating process) and to prevent air leakage during the purging process.

3.2 Solid Sample Media

Place about 1.5 inches of your soil (or other solid sample media) into the bottom of each of two VOA vials (i.e. approximately 30 grams in each vial). *The second vial serves as a duplicate sample which may be needed later during the analysis process.*
Immediately after inserting the soil (or other solid sample media) into the two vials, add organic-free or other "clean" water to each VOA vial until they are both ~70 % full (i.e. to approximately 1-inch below the shoulder of each vial). Tightly secure the caps onto the partially-filled VOA vials. Once the caps are secure, shake the VOA vials vigorously for approximately for 5 to 10 seconds to thoroughly mix the soil and water. Additional mixing may be necessary for soil matrices comprised of clay-sized particles. The purpose of the mixing is to transfer any chlorinated compounds suspended in the soil matrix to the water to facilitate more effective purging.



> **IMPORTANT NOTE**: The VOA vials containing the solid sample media and "clean" water must contain an air-filled headspace to accommodate purging. The caps must be tightened sufficiently to prevent loss of CVOHs during the time between sample collection and analysis (which includes the heating process) and to prevent air leakage during the purging process.

3.3 Purpose of Duplicate Samples

The Color-Tec® method is designed for use with two VOA vials (an original and a duplicate) for each sample collected. In certain situations, the duplicate sample may not be used in the performance of the method. However, the duplicate sample should always be collected in the event that it is needed to complete the analysis process. The duplicate sample may be used in either of the following situations:

- When the initial test does not induce a color change in the colorimetric tube, the second VOA vial containing the duplicate sample, may be purged (using the same colorimetric tube) to increase the probability of detecting very low (< 10 µg/L) concentrations.
- When the initial test induces a color change that exceeds the upper limit of the LL tube (a tube reading > 3), the extra VOA vial can be used to analyze the sample using higher range colorimetric tubes (133L or 133M) to tentatively quantify the higher concentration of chlorinated compounds in the sample.

3.4 Collection of Split Samples for Laboratory Analysis

It is recommended that sample splits be collected for laboratory comparison analysis from 5 to 20 percent of the total quantity of samples analyzed using the Color-Tec® method. Given a sufficient quantity of split sample pairs and sufficient range of concentration values, the GC/MS-to-Color-Tec® comparison data may be used to obtain estimated concentrations for samples in the data set which were analyzed only using the Color-Tec® method. This can be achieved using linear regression analysis of the comparison data. Statistical analysis of the comparison data can also be performed to determine site-specific Color-Tec® method performance data. This is discussed in further detail below in Sections 9 and 10.

4.0 Heating Colorimetric Tubes and Samples

The colorimetric gas detector tubes used in the Color-Tec® method were designed solely for the purpose of detecting volatile organic compounds (CVOHs) in ambient air. When using the tubes for CVOH detection in **ambient air**, the calibrated operating temperature is 20°C/68°F, and the value obtained from the tube in (ppmV) is the actual concentration of CVOHs present in the **ambient air** being tested. Using the tubes at temperatures above or below 20°C/68°F, for the purpose of testing **ambient air**, introduces error into the measurements, thus a correction factor must be applied to correct that error. The temperature correction factors for using the colorimetric tubes for the purpose of analyzing **ambient air** are as follows:

Table 1
Correction Factors for Ambient Air Analysis Using Colorimetric Tubes

Temperature ° C	0°	10°	20°	30°	40°
Temperature ° F	32°	50°	68°	86°	104°
Ambient Air Correction Factor	2	1.3	1	0.7	0.55

Because the Color-Tec® method is an alternate use of the colorimetric tubes which involves purging and concentrating CVOHs from water or soil samples into the tubes, the units (ppmV) printed on the tubes have no direct relationship to the quantity of CVOHs dissolved in the water/soil sample which is being analyzed (i.e. the magnitude of the color change in the tube represents only a relative response to the concentration of CVOHs present in the water/soil sample). *Thus, the temperature corrections discussed above and shown in Table 5 are not used when using the colorimetric tubes as part of the Color-Tec® method.*

Since the colorimetric tubes are more sensitive to the presence of chlorinated compounds at 40°C/104°F, and the purpose of the Color-Tec® method is to detect the presence/absence of CVOHs in water at concentrations at the lowest concentrations possible, *it is strongly recommended that the tubes be heated to their optimum sensitivity (40°C/104°F) and that the samples should also be heated to maximize the transfer of CVOHs from the water sample to the colorimetric tube.*

To heat the samples and colorimetric tubes, connect the hot plate to a United States standard 120V AC power source and switch it on by turning the thermostat to a setting of between 4 and 5 (refer the hot plate manufacturer's manual for complete operating instructions). Place the test tube rack into the steel pan, fill the pan ¾ full of water and place the pan onto the hot plate. Remove the cap from a 40 ml VOA, fill it with clean water, and place it in the test tube rack. Place several un-broken colorimetric tubes into the water-filled VOA for heating. Place the thermometer into the water-filled VOA with the colorimetric tubes. Adjust the hot plate control knob periodically to maintain a water temperature of approximately 40°C/104°F. The samples and colorimetric tubes should not be heated in excess of 40°C/104°F. Special attention must be paid to the temperature of the water to avoid prolonged overheating the samples and tubes.

Given the size of the heating pan and VOA rack, generally only 3 sets of samples are heated at the same time. When a pair of VOAs is removed from the heating rack and placed on the pump stand, it can be replaced with a new pair for heating. After collection, samples should remain in a cool place until ready to be heated and analyzed. It is recommended to avoid heating the samples for more than about 5 minutes to avoid loss of CVOCs.

5.0 Sample Purge and Analysis Procedure

Break both glass tips of a 133LL colorimetric tube.

Attach the 133LL colorimetric tube to an extraction needle assembly by inserting the clear end of the glass tube into the open end of the clear tubing.

Insert the yellow end of the colorimetric tube into the tip of the RAE piston pump. For complete piston pump operation instructions please refer to the RAE® Piston pump manual included in the Color-Tec® hardware kit.

Place both tightly-capped VOA vials containing the pre-heated water sample into the two bottle holders on the pump stand (see Figure 2).

Insert the extraction needle (the short needle attached to vinyl tubing) into the septa of the VOA vial. Be sure that the tip of the extraction needle is positioned within the headspace of the VOA vial (above the water level). *Note: Do not insert the extraction needle as far as it will go into the headspace of the VOA vial, but rather only insert it to a point slightly beneath the inside of the septa to reduce the possibility of sample water entering the extraction needle assembly and colorimetric tube during the purging process.*

Insert a purge needle (the 4-inch needle) into the septa of the VOA vial, and push the tip of the purge needle into the water sample to the bottom of the VOA vial.

Attach a carbon filter and carbon luer assembly to the luer fitting on the top of the purge needle (See Figure 2). Section 6 below further describes the carbon filter assembly set-up procedure.

Pull pump handle out and lock in place at the 50cc position. _Note: For complete piston-pump operation instructions please refer to the RAE® Piston pump manual included in the Color-Tec® Hardware Kit._

Observe the sample in the VOA vial to determine if air bubbles are flowing from the tip of the purge (long) needle through the sample. Air should be flowing (bubbling) through the sample. If air is not flowing through the sample, one of the following problems may have occurred:

- Clogged/blocked purge (long) needle;
- Clogged/blocked extraction (short) needle;
- Colorimetric tube is not securely connected to hand pump;
- Colorimetric tube is not securely connected to extraction needle tubing;
- VOA cap is not tightly sealed;
- Broken/bad seal in hand pump.

Note: A complete troubleshooting guide with causes and solutions to these and other potential problems is presented as Table 6 of this manual.

When the pump handle is locked open at the 100cc position, purging should continue through the sample for approximately 60 seconds. If the 100cc purge cycle ends (bubbling stops) before approximately 60 seconds have elapsed, the pump may require servicing (see the RAE® pump manual for pump operation and servicing instructions).

6.0 Carbon Pre-Filter

Because ambient air is used to purge the samples, a carbon pre-filter is provided for attachment to the purge needle to prevent possible airborne contaminants from passing through the sample and entering the detector tube during the purging process. To use the carbon pre-filter, break both tips of a carbon filter tube and insert the end of the tube onto the carbon lure assembly (make sure the air-flow arrows on the carbon tube point toward the carbon lure assembly), then tightly insert the male lure fitting on the carbon lure assembly into the female lure fitting on the purge needle (see Figure 2). At sites where little or no ambient air contamination is present, a single pre-filter tube may be reused for several days. However, at sites where high concentrations of airborne chlorinated compounds are suspected or have been confirmed in the ambient air, the pre-filter tubes may need to be replaced more frequently. For most situations, one carbon filter per 20 samples is more than sufficient (the Color-Tec 20-sample Expendables Kit contains 2 carbon pre-filters).

7.0 Sample Purging and Detection Methodology

Samples may be purged using 50 cubic centimeters (cc), 100cc, or 200cc purge volumes. These various purge volumes are used in succession to maximize the low-level detection capability and detection range of each tube, thereby reducing the number of tubes needed to tentatively quantify the concentration of total chlorinated compounds in the sample. The pump stand is equipped with two VOA-vial holders to accommodate a second (duplicate) sample to be collected from each sampling location. This duplicate sample (collected and prepared in the same manner as the original sample) serves the following two potential purposes:

1. When purging the initial VOA vial does not induce a color change in the colorimetric tube, the second VOA vial containing the duplicate sample, may be purged (using the same colorimetric tube) to increase the probability of detecting very low (< 10 µg/L) concentrations.
2. When the initial test induces a color change that exceeds the upper limit of the LL tube (a tube reading > 3), the extra VOA vial can be used to analyze the sample using higher range colorimetric tubes (133L or 133M) to tentatively quantify the higher concentration of chlorinated compounds in the sample.

7.1 50cc Purge Volume

Initially, all samples are analyzed using a Gastec® 133-LL tube with a 50cc purge cycle. If the 50cc purge induces a color change reading of 1.5 to 3.0, read the calibration scale value aligned with the stained/unstained interface in the tube and use the pump stroke correction factors provided on the colorimetric tube instruction sheets to determine the correct reading for a 50cc purge volume. If the concentration in the sample exceeds the upper detection limit of the tube (i.e. the color change moves beyond the upper limit of the calibration scale printed on the tube), repeat the analysis using duplicate samples and higher range tubes (133-L and 133-M) until the color change reaction stops within the calibration scale on the tube. If the color change reaction exceeds the upper limit of the calibration scale of the M tube, the sample contains a concentration of chlorinated compounds above the upper detection capability of the Color-Tec® Method.

7.2 100cc Purge Volume

Following completion of the 50cc purge cycle, if the concentration in the sample has induced a color change in the tube which traveled less than half the distance of the calibrated portion of the reagent phase of the tube, pull the pump handle outward and lock it into the 100cc position to complete a full purge cycle. Record the value aligned with the stained/unstained interface on the tube. No correction factor is needed for a 100cc purge.

7.3 200cc Purge Volume

Following completion of the 100cc purge cycle, if the concentration in the sample has induced only a very slight (<0.5) color change reaction or no color change reaction, remove the purge needle and extraction needle assembly from the VOA vial containing the original sample and insert them into the VOA vial containing the duplicate sample (which has also been pre-heating) and repeat the 100cc purge cycle using the same colorimetric tube.

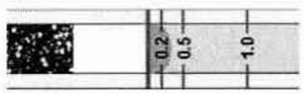
> **Note:** When purging the duplicate sample using a second 100cc purge cycle is necessary, remove both needles from the original VOA vial. With the extraction needle tubing remaining attached to the colorimetric tube, remove both needles from the original VOA vial and immediately insert both needles into the septa of the duplicate sample VOA vial. Before re-inserting the pump handle, temporarily remove the colorimetric tube from the tip of the hand pump and re-insert the pump handle completely into the pump while the tube is un-attached. Re-attach the colorimetric tube into the pump tip and pull the pump handle and lock it into the 100cc position. ***NOTE: DO NOT REPLACE THE COLORIMETRIC TUBE PRIOR TO THE SECOND 100cc PURGE CYCLE – YOU MUST USE THE***

SAME TUBE USED DURING THE FIRST 100cc PURGE OF THE ORIGINAL SAMPLE.

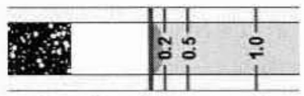
Read the calibration scale value aligned with the stained/unstained interface in the tube and use the pump stroke correction factors provided on the colorimetric tube instruction sheets to determine the correct reading for a 200cc purge volume.

8.0 Reading the Tubes

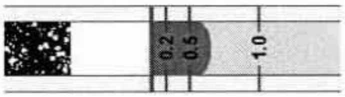
The basic Color-Tec® method procedures are simple and intuitive; however, contaminant detection and semi-quantitative values are obtained through visual observation of the colorimetric reaction in the tubes, which is inherently subjective (especially in samples containing very low [<5 µg/L] total CVOHs). These low-level samples induce only a slight color change (i.e. slight darkening or light purple hue) prior to the 0.5ppm line on the tube scale at the entrance of yellow reagent layer in the LL tube. Samples containing concentrations of total chlorinated compounds above 5 µg/L usually induce a more apparent reaction within the LL tube.



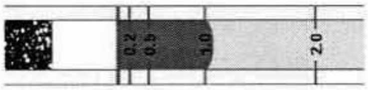
Positive Tube Result
Response Value = 0.2



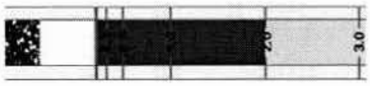
Positive Tube Result
Response Value = 0.1



Positive Tube Result
Response Value = 0.6



Positive Tube Result
Response Value = 1.0



Positive Tube Result
Response Value = 2.0

8.1 Very Low Concentrations

When a sample contains very low concentrations (<10µg/L) of chlorinated compounds, the resulting color change is not immediate or distinct. At these low concentrations the color change does not usually begin until 100 CCs of air have purged through the sample. Furthermore, the color change induced at these low concentrations is very slight (below 0.5 on the tube scale) and appears as a slight darkening or light purple hue at the entrance of yellow reagent layer in the LL tube.

8.2 Low to Medium Concentrations

When the sample contains higher concentrations (>10 µg/L) of chlorinated compounds, the resulting color change is an obvious light to dark purple, which propagates through the yellow reagent layer toward the pump end of the colorimetric tube. The detected concentration level is obtained by matching the linear extent of the discolored reagent inside the tube to the calibration scale printed on the outside of the tube.

8.3 High Concentrations

When the sample contains high concentrations (>100 µg/L) of chlorinated compounds, the color change reaction occurs quickly and usually exceeds the upper detection level of the Gastec® 133LL tube. The higher the concentration of chlorinated compounds in the sample, the faster the color change reaction occurs and the further it propagates through colorimetric tube. Samples containing percent-range concentrations (>1000 µg/L) of chlorinated compounds, often discolor the entire yellow reagent layer in the LL tube before the pump handle has been fully extended. In these cases, the purging can be discontinued to allow for the current sample bottle to be re-tested using a higher range detector tube. There is no need to continue purging the sample when the detection level of the tube is exceeded. Each subsequently higher range tube is used to purge each new duplicate sample in succession until the color change reaction does not exceed the calibration range of the tube being used.

8.4 Recording Tube Readings

It is recommended to record the observed concentration value (tube reading), the range of the colorimetric tube (LL, L, or M), and the final purge volume when logging Color-Tec® results. For example, a reading of 2.5 observed on an LL tube using a 100 ml purge should be recorded as **2.5/LL/100**. Purge volume correction factors must be applied for Color-Tec® values which were obtained using any purge volume other than 100cc. For example, a reading of 0.2 observed on an LL tube using a 200 ml purge should be recorded as **0.1/LL/200**. A reading of 60 observed on an M tube using a 50 ml purge should be recorded as **150/M/50.** Purge volume correction factors for the 133 Series tubes are presented on Table 1 (pump stroke correction factors are also presented on the colorimetric tube instruction sheet included with the tubes).

Table 2
Purge Volume Correction Factors for 133-Series Tubes

Colorimetric Tube	Purge Volume	Quantity of Pump Pulls	Correction Factor
133LL	50cc	½	Tube Reading x 3
133LL	100cc	1	Tube Reading x 1
133LL	200cc	2	Tube Reading ÷ 2
133L	50cc	½	Tube Reading x 3
133L	100cc	1	Tube Reading x 1
133L	200cc	2	Tube Reading ÷ 2
133M	50cc	½	Tube Reading x 2.5
133M	100cc	1	Tube Reading x 1
133M	200cc	2	Tube Reading ÷ 2.5

9.0 **Estimating Sample Concentrations**

Although the Color-Tec® method does not provide a specific measurement that directly quantifies the concentration in a sample, the level of intensity of a positive colorimetric tube reaction does provide a general indication of the magnitude of the concentration present in a sample (i.e. low, medium, or high). The colorimetric tube responses "readings" may be used to estimate the concentration of CVOHs present in a water sample only by comparing Color-Tec® results to the results of split samples analyzed by GC/MS. Given a sufficient quantity of split sample pairs and sufficient range of concentration values,

Table 3
Estimated Analytical Results for Color-Tec® Values Less Than 10
($y = 52.62x + 5.44$)

Color-Tec® Value (x)	Estimated Analytical Value (y)(µg/L)
0.1	11
0.2	16
0.3	21
0.4	26
0.5	32
0.6	37
0.7	42
0.8	48
0.9	53

this GC/MS-to-Color-Tec® comparison data can be used to obtain estimated concentrations for other samples which were analyzed only using the Color-Tec® method. This can be achieved using linear regression analysis of the split sample comparison data. Given the site-to-site variability of factors that may affect the colorimetric response (such as the ratio of the various chlorinated compounds present), site specific comparison data sets are preferable over data sets collected from several different sites. The following is an example of a comparison performed using a groundwater sample data set collected from a drycleaner site in South Carolina:

To estimate total chlorinated solvent concentrations from Color-Tec® readings, a linear regression analysis was performed using the results from 97 split water samples collected from the site, which were analyzed using both Color-Tec® analysis and laboratory-based GC/MS analysis. Because the Color-Tec® method does not distinguish between species of chlorinated solvents, the analytical results for solvent (PCE, TCE, Cis-1,2 DCE, Trans-1,2 DCE, 1,1 –DCE, and vinyl chloride) were summed to provide a total analytical result for chlorinated solvents.

Due to the nature of the Color-Tec® method, the range of corresponding analytical values associated with each finite Color-Tec® reading above zero is broad. For this reason, the regression analysis was performed for three ranges of color tech values: 0.1 to 0.9, 1 – 10, and >10. However, there were insufficient paired values for sample pairs exhibiting Color-Tec® readings above 10 to estimate an analytical value. Table 1 provides the equation developed from the linear regression analysis for the 0.1 to 0.9 data range and the associated Color-Tec® and estimated analytical values. Table 2 provides the equation developed from the linear regression analysis for the 1 to 10 data range and the associated Color-Tec® and estimated analytical values. The "y" value is the estimated analytical value (µg/L) and the 'x' value is the Color-Tec® reading. It should be emphasized that the analytical result calculated from the regression analysis is an estimate only. This estimate represents the central tendency. Actual analytical values may differ substantially from this estimate.

Table 4
Estimated Analytical Results for Color-Tec® Values Between 1 and 10 (y = 49.88x + 18.63)

Color-Tec® Value (x)	Estimated Analytical Value (y)(µg/L)
1	69
2	118
3	168
4	218
5	268
6	318
7	368
8	418
9	468
10	517

10.0 Method Performance

A key item to note from comparison analysis is that an Color-Tec® value of zero almost certainly represents an analytical result below most regulatory limits for chlorinated compounds. Further statistical comparison of the Color-Tec® zero values with the split sample GC/MS data was performed to determine the confidence of the Color-Tec® zero values (non-detects or

Table 5

Parameter (Total Chlorinated Solvents as Detected by GS/MS for Color-Tec® Values of Zero)	Value
Mean (µg/L)	0.362
Range (µg/L)	0 – 2.55
Standard Deviation (µg/L)	0.736
95% UCL of the mean (µg/L)	0.857
90th Percentile Value (µg/L)	1.626
95th Percentile Value (µg/L)	2.37
Percentile less then 2 µg/L	93.4

no response of the tube). This data set included 42 Color-Tec® zero values. The percentile value was 93.4 for detection of total chlorinated compounds at 2 µg/L (i.e., Color-Tec® detected 93.4% of concentrations detected by GC/MS at or above the MCL of vinyl chloride). The percentile value was 100% for detection of total chlorinated compounds at 5 µg/L (i.e., Color-Tec® detected 100% of concentrations detected by GC/MS at or above the MCL of PCE and TCE).

11.0 QA/QC Procedures

To insure that consistent results and the lowest possible detection levels are achieved for all samples analyzed using this method, standard sample preparation procedures tailored to specific project goals should be developed by the user and followed precisely and consistently throughout the sampling and analysis program.

This section of the manual is intended only to provide the user with a basic methodology for conducting quality assurance/quality control (QA/QC) procedures for the Color-Tec® method. Users of the method are encouraged to develop project-specific QA/QC and sample handling procedures that insure the level of consistency and accuracy required for the user's sampling program. This section presents some basic method-specific, QA/QC procedures developed to insure overall **method performance**, provide **analytical confidence**, identify potential **false positives** such as contaminants in the ambient air (since ambient air is used as the purge gas), and identify potential **false negatives** such as the presence chemical inhibitors that may be present in the samples or in the ambient air.

11.1 Method Performance and Analytical Confidence

Using the method to analyze 10ug/L, 50ug/L, and 100ug/L sample spikes will provide a comparison of Color-Tec® readings to known concentrations, which provides a basis for estimating approximate concentrations in the field samples based on the Color-Tec® responses. Testing of the higher range tubes using spiked samples is unnecessary because the high range tubes are usually not used unless the sample being tested has already exceeded the upper range of the low range tube, thus revealing that the sample being tested contains a sufficient quantity of chlorinated compounds to evoke a positive reaction from the next higher range tube.

11.2 False Negatives

The presence of Toluene and Xylenes inhibits/diminishes the ability of the colorimetric tubes to detect CVOHs. At sites where the presence of these compounds is suspected to be present in the samples or in the ambient air (since ambient air is used as the purge gas), QA procedures may include periodic testing of groundwater or soil samples and ambient air for the presence of toluene and xylenes using a Gastec® Toluene tube (the Toluene tube also detects xylenes).

11.3 False Positives

Because the Color-Tec® method uses ambient air as the purge gas, airborne chlorinated compounds at low concentrations can enter the sample and activate the detector tube. To prevent airborne contaminants from entering the sample and detector tube during sample purging and analysis, the method is used with a carbon pre-filter attached to the purge needle. To determine whether airborne chlorinated contaminants are present, a colorimetric tube may used periodically to test the ambient air at the location where the field testing is being performed. It airborne contaminants are present and the carbon filter is being used, the carbon filters can also be tested periodically using a colorimetric tube to determine if breakthrough is occurring. A build-up of water vapor in the colorimetric tube past the catalyst stage (black portion of the tube) can induce a subtle color change similar to that of a low-level positive result. This problem is easily avoided by observing the build-up of condensation inside the tube in the catalyst stage during purging, and stopping the airflow before the condensation reaches the end of the catalyst stage. This condition rarely occurs before the maximum required purge volume of 200 CCs is achieved and contaminant presence or absence has been determined.

11.4 Preparation of Spiked Samples for Method Performance QA/QC Tests

Color-Tec® sample spikes are prepared by combining the Cerilliant® TCE reference standards (provided in the three 5 ml glass ampoules) with the pre-measured, analyte-free water (provided in the three VOA vials labeled with red yellow and green stickers on the caps). Transfer each reference standard (in the glass ampoules) to each water-filled VOA as follows:

Reference Standard (Glass Ampoule)		Add the contents of each glass ampoule to each water-filled VOA	VOA Vial for Spike (pre-filled with water)	
Ampoule Label	**Concentration Before Dilution**		**Sticker Color**	**Concentration after Dilution**
TCE-60	60 µg/L	⟶	Green	10 µg/L
TCE-300	300 µg/L	⟶	Yellow	50 µg/L
TCE-600	600 µg/L	⟶	Red	100 µg/L

After transferring the reference standards in the ampoules to the VOA vials pre-filled with analyte-free water, the VOA vials will contain TCE concentrations of 10 µg/L (green label), 50 µg/L (yellow label), and 100 µg/L (red label). These spiked samples are then analyzed using the Color-Tec® method to analytical confidence. Spiked control samples are used to insure that the method is detecting the target compounds within reasonable limits and to provide a basis for estimating concentrations based on the Color-Tec® responses.

Step 1 - Carefully break open the TCE-60 ampoule by inserting the ampoule into the plastic breaking collar and apply bending pressure against the neck of the ampoule using your thumbs and index fingers. The tip of the ampoule should break along the scored restriction in the neck of the ampoule.

Step 2 - After breaking the ampoule, use a clean 10 ml pipette to carefully transfer all of the liquid from the ampoule into the VOA vial containing analyte-free water marked with the green label. Tightly re-seal the VOA cap and shake the sample for 5 seconds to mix. The 10 µg/L spiked sample is now ready to pre-heat and test using the Color-Tec® method.

To prepare the 50 µg/L spiked sample, repeat steps 1 and 2 using the TCE-300 ampoule and the VOA vial containing analyte-free water marked with a yellow label.

To prepare the 100 µg/L spiked sample, repeat steps 1 and 2 using the TCE-600 ampoule and the VOA vial containing analyte-free water marked with a red label.

Important Note: *Be sure to transfer all of the liquid in the ampoule to the VOA vial and use care to prevent any spillage of the liquid from the VOA vial. The liquid in the* *ampoules and VOA vials have been precisely pre-measured to result in 10 µg/L, 50 µg/L, and 100 µg/L sample spikes after mixing.*

11.5 Method Performance QA/QC Test Procedure

Following preparation of the 10 µg/L, 50 µg/L, and 100 µg/L sample spikes, heat the spiked samples and three 133LL tubes as described in Section 4. After heating, conduct Color-Tec® analyses on the samples as described in Section 7 and record the results in your field log as described in Section 8. A positive result from testing the 10 µg/L spiked sample will confirm that the method is being conducted properly to detect low-level concentrations. The Color-Tec® readings obtained from testing the 10ug/L, 50ug/L, and 100ug/L sample spikes provides comparison to known concentrations to provide a basis for estimating approximate concentrations in the field samples based on theColor-Tec® responses.

11.6 Negative Interference (Xylenes/Toluene) QA/QC Test Procedure

To conduct a test for the presence of compounds which could inhibit the detection of CVOHs use the Toluene (122L) tube to analyze a duplicate soil or water sample using the procedures described in Sections 5 through 8.

11.7 Positive Interference (Ambient Air) QA/QC Test Procedure

To conduct a test for the presence of chlorinated VOHs in the ambient air, break the tips of a 133LL colorimetric tube and properly insert it into the hand pump. Pull and lock the pump handle into the 100cc position allowing ambient air to enter the colorimetric tube. *Note: Do not attach an extraction needle assembly to the colorimetric tube while performing this test.* Once the 100cc flow cycle is completed, carefully read the tube and record the results. A positive result indicates the presence of CVOCs in the ambient air at concentrations detectable by Color-Tec® which would affect sample results unless the carbon filter assembly is attached to the purge needle (see Section 6). A negative result indicates that CVOCs are not present in the ambient air at concentrations detectable by Color-Tec® and therefore will not affect sample results. It is recommended that the carbon filter assembly is used regardless of the ambient air testing results.

11.8 Duplicate Sample Testing Procedure

Duplicate or replicate samples are collected from the same sampling location, at the same time, using the same collection methods, and analyzed using the same procedures as the original samples for the purpose of determining both sampling and analytical method variability. Since a second (duplicate) VOA vial is always collected for the Color-Tec® method, a duplicate or replicate analysis may be performed on the second (duplicate) VOA vial any time that a positive result (color change) is evoked by the original sample (first VOA vial) without exceeding the upper limit of the low-level colorimetric tube. In those cases, the duplicate or replicate analysis is simply performed by using a new low-level colorimetric tube to analyze the duplicate sample in the second (unused) VOA vial. If sampling and method variability is low, the result of the duplicate test will be the same or similar to the results obtained from the original test. The relative percent difference (RPD) may be calculated to quantify any variability in the results. *Note: The Color-Tec® QA/QC Test Pack contains an extra low-level colorimetric tube to perform a duplicate or replicate analysis test.*

12.0 Safety Precautions

As with the use of any product, it is recommended that the user carefully review all product manuals and Material Safety Data Sheets (MSDS) provided with this product prior to use. Several components of the Color-Tec® kit are products obtained from other manufacturers which have manuals including safety precautions. Users of the Color-Tec® method should carefully review the manuals and safety precautions and should become familiar with the proper use of all components included in the Color-Tec® kit. It is recommended that the procedures involved with the method be incorporated into the user's Site-specific Safety and Health Plan (SSHP). MSDSs for all chemicals provided as part of the Color-Tec® kit are available upon request. The following precautions should be considered to reduce potential user safety risks associated with the performance of the Color-Tec® method.

Activity	Potential Risk	Precaution
Breaking tube tips	eye injury, dermal puncture	safety glasses
Accidental tube breakage	dermal cuts, exposure to reagent	safety gloves
Use of purge/extraction needles	dermal puncture	use caution
Use of the hot plate	dermal burns, electric shock	limited setting
Use of PCE standards	dermal contact, dermal cuts	safety gloves

Additional Safety Notes:

- Use skin and eye protection while breaking colorimetric and carbon filter tubes;
- The thermostat dial setting of the Corning® Hot Plate should never be set above 5 for any heating purposes required by the Color-Tec method®;
- Do not over-fill the water bath pan while heating the samples and tubes;
- Always conduct sample and tube heating activities on a flat, stabile, surface.
- Keep all flammable or combustible materials away from the Corning® Hot Plate during sample and tube heating activities.
- Always use the stainless-steel water-bath pan properly filled with water for heating the samples and tubes – do not heat samples or tubes directly on the surface of the Corning® Hot Plate;
- Do not use any heat source to heat the water-bath, tubes, or samples other than the Corning® Hot Plate provided in the hardware kit.

Disposal of Expendable Materials:

- Re-cap all needles before disposal;
- After re-capping each extraction needle, dispose of the extraction needle assembly while leaving the vinyl tubing attached to the colorimetric tube – Do not attempt to remove the extraction needle assembly from the tip of the colorimetric tube for disposal;
- Dispose of all sharps (needles and broken glassware) in accordance with any and all applicable local and/or federal rules or guidance.
- Dispose of all colorimetric tubes as specified in the Gastec® MSDS and/or in accordance with any and all applicable local and/or federal rules or guidance.
- Dispose of any remaining spiked-sample liquids as specified in the Cerilliant® MSDS and/or in accordance with any and all applicable local and/or federal rules or guidance.
- Dispose of all VOA vials used to contain sample materials in accordance with any and all applicable local and/or federal rules or guidance.

Table 6

Troubleshooting Guide

Problem	Possible Cause	Solution
Sample does not appear to be purging (bubbling) after the pump handle has been pulled.	Clogged/blocked purge (long) needle.	Use the decontamination syringe to check the purge needle for clogs. If clogged, clean the needle or use a new purge needle.
	Clogged/blocked extraction (short) needle.	Use decontamination syringe to check the extraction needle for clogs. Use decontamination syringe to clean the needle or use a new extraction needle.
	Colorimetric tube is not securely connected to hand pump.	Remove and re-insert the colorimetric tube from the hand pump. If the fit seems loose, replace the hand pump inlet gasket.
	Colorimetric tube is not securely connected to extraction needle tubing.	Check the connection between the extraction needle tubing and the colorimetric tube. If loose, insert the colorimetric tube further into the extraction needle tubing.
	VOA cap is not tightly sealed.	Check the tightness of the VOA cap. Tighten if necessary.
	Colorimetric tube tips were not broken before connecting to hand pump and tubing.	Break both tips of the colorimetric tube before connecting to hand pump and tubing.
	Broken/bad plunger seal in hand pump.	Check the pump seal by holding your finger over the hand pump inlet while pulling the pump handle and lock into the 50cc position. If no vacuum is apparent, open the pump, remove the plunger, replace the plunger seal, and grease the new seal. Re-assemble the pump.
The colorimetric tube shows no reaction after purging a sample that contains chlorinated compounds.	Colorimetric tube is below the optimum operating temperature.	Heat the colorimetric tube to 40°C/104° F before using. It is also recommended to heat the sample. The recommended temperature for tubes and samples when using the Color-Tec® Method is 40°C/104° F.
	Colorimetric tube was connected using reversed flow direction.	Use the flow direction arrows to properly align the tube. The purged air must pass through the black oxidizer phase and the white catalyst phase before entering the yellow reagent phase.
	The sample also contains a detectable concentration of xylenes or toluene.	Samples can be tested for the presence of xylenes and toluene using the **Gastec 122L** colorimetric tube. The detection of chlorinated compounds may be diminished when xylenes or toluene are present in a sample.
The colorimetric tube indicates a reaction after purging a sample that contains no chlorinated compounds.	Chlorinated compounds are present at detectable concentrations the ambient air.	Test the ambient air using an LL tube to determine if chlorinated compounds are present at detectable concentrations. Attach the charcoal filter to the purge needle prior to purging samples.
	HCl vapor is present in the sample VOA or in the ambient air.	Avoid use of HCl in the area where Color-Tec® is in use. Use only unpreserved VOAs for samples to be screened with Color-Tec®.
	Water vapor has entered the yellow reagent phase of the tube indicating a positive reaction	NEVER purge more that 200 CCs through any sample. Stop purging before condensation inside the tube reaches the end of the black oxidizer phase. Avoid drawing any water from the sample VOA into the colorimetric tube.

Attachment A-4

CH2MHILL

PROJECT NUMBER

PROJECT NAME

GROUNDWATER SAMPLING LOG

SITE:

DATE:

FIELD CREW:

WELL NUMBER:

WEATHER:

PURGE VOLUME CALCULATION:

WELL DEPTH (FT):

DEPTH TO WATER (FT): -

WATER COLUMN (FT): =

GAL/FT OF CASING (from table at right): x

CASING VOLUME (GALs): =

NO. OF VOLUMES (min. 3): x

PURGE VOLUME (GAL): =

CASING DIAMETER	GAL/FT OF CASING
2 IN.	**0.1632**
4 IN.	**0.6528**
6 IN.	**1.4688**
8 IN.	**2.611**
10 IN.	**4.0797**
12 IN.	**5.8748**

METHOD OF PURGING (circle one)

PUMP: SUB., CENT., PERIST.

TIME ON:

FLOW RATE (gpm):

PUMP TIME (min):

VOL. PURGED (gals):

OTHER:

BAILER : TEFLON, SS ,OTHER:

BAILER VOL.. (gal) .25 / .33 / .75

REQUIRED PULLS:

VOL. PURGED (gals):

OTHER:

FIELD PARAMETER MEASUREMENTS Field Equipment Used:

No.	Time	Volume	pH	Temperature	Conductivity	Turbidity	Other
1							
2							
3							
4							
5							
6							
7							
8							

OBSERVATIONS (circle as appropriate)

COLOR: CLEAR , AMBER , TAN , BROWN , GREY , MILKY WHITE , OTHER:

ODOR: NONE , LOW , MEDIUM , HIGH , VERY STRONG , H2S , FUEL LIKE , CHEMICAL ?, UNKNOWN

TURBIDITY: NONE , LOW , MEDIUM , HIGH , VERY TURBID. HEAVY SILTS

COMMENTS:

Please use back of sheet for sketching maps, well location notes, etc. **See back of sheet? Y / N**

SAMPLE DATA:

Sample ID Number	No. and Types of Containers	Parameters Analyzed	Laboratory	QA/QC sample? Y /N

SIGNED/SAMPLER:

Attachment A-5

CH2MHILL

PROJECT NUMBER

WELL NUMBER

SHEET 1 OF 1

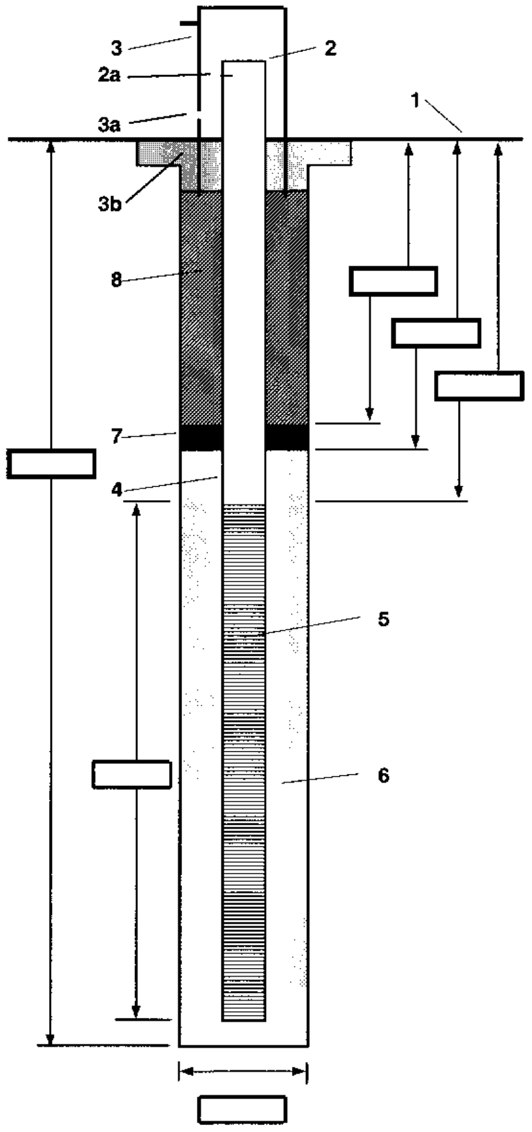
WELL COMPLETION LOG

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 A-6

CH2MHILL

PROJECT NUMBER	WELL NUMBER SHEET 1 OF 1

WELL DEVELOPMENT LOG

PROJECT : LOCATION :

DEVELOPMENT CONTRACTOR :

DEVELOPMENT METHOD AND EQUIPMENT USED :

START WATER LEVELS : START : END : LOGGER :

MAXIMUM DRAWDOWN DURING PUMPING:

RANGE AND AVERAGE DISCHARGE RATE:

TOTAL QUANTITY OF WATER DISCHARGED:

DISPOSITION OF DISCHARGE WATER:

Time	Water Volume Discharged (gal)	Water Level (ft BTOC)	Turbidity (NTU)	Temperature (°C)	pH	Conductivity (µmhos/cm)	Remarks (color, odor, sheen, sediment, etc.)

Attachment A-7

ATTACHMENT A-7
DAILY 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:

Appendix B
Quality Assurance Project Plan

Quality Assurance Project Plan (QAPP)

RCRA Facility Investigation
AOC-S
Fort Rucker, Alabama

Contents

Section **Page**

Attachments-Tables

Acronyms and Abbreviations

ASTM	American Society for Testing and Materials
CCV	All Continuing Calibration Verification
CL	Control Limits
DI	de-ionized
DO	dissolved oxygen
DQE	Data Quality Evaluation
DQO	Data Quality Objective
EDD	electronic data deliverable
ELAB	Empirical Laboratories
ERB	equipment rinsate blanks
FB	Field Blank
FSP	Field Sampling Plan
FTL	Field Team Leader
GC	gas chromatograph
GFAA	Graphite Furnace Atomic Absorption
ICP-AES	Inductively Coupled Plasma-Atomic Emission Spectrometry
ICPES	Inductively Coupled Plasma Emission Spectrometry
ICS	interference check sample
ICV	initial calibration verification
IDL	instrument detection limit
IRF	Incident Report Form
IS	Internal standards
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
MQO	Method Quality Objectives
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
PARCCS	precision, accuracy, representativeness, completeness, comparability, and sensitivity
PC	Project Chemist
PDM	Project Data Manager
PDS	post-digestion spike
PLM	Polorized 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	spiked sample result
TB	trip blank
TCLP	toxicity characteristic leaching procedure
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
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. Rick Davis has been identified as the laboratory project manager (LPM), and her back-up is Renee Vogel. 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; and
- 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.

1.3 Quality Assurance Laboratory

No samples will be collected as QA samples and submitted to a United States 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 project manager (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 Resource Conservation Recovery Act (RCRA) Facility Investigation (RFI) report.

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 United States 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 shall 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.

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 1 and 2** 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 and A-2**. 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:

$$\mathrm{RPD} = \left\{ \frac{\left|X_1 - X_2\right|}{\frac{\left(X_1 + X_2\right)}{2}} \right\} x\,100$$

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:

$$\mathrm{P} = \left[\frac{(\mathrm{SSR} - \mathrm{SR})}{\mathrm{SA}} \right] \mathrm{x}\ 100$$

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 Quality Assurance Manual (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 or guidance.

4.7 Analytical Holding Times

The holding times for the requested analyses are listed in **Attachment A-3**.

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 6.**

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, 1983)

5.1 Laboratory Facility and Equipment

5.1.1 Laboratory Facility Requirements

The laboratory shall 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 shall provide sufficient equipment, instruments, and related supplies for proper performance of work. All equipment used shall be reflective of the measurement accuracy necessary. The laboratory shall 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 shall be maintained.

Equipment Preventative Maintenance

To minimize downtime and interruption of analytical work, preventive maintenance shall 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 shall 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 shall be on file or the information incorporated into method SOPs/Laboratory Quality Management Plan (LQMP) that describes preventive maintenance procedures and schedules. The laboratory shall maintain detailed logs for each instrument documenting the preventive maintenance and repairs performed.

Equipment Backup Capabilities

Backup instruments shall 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 shall 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 shall 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 shall 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; and
- 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 shall 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, 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-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 °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 interelement 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 (MQO) is not met.

When errors, deficiencies, or out-of-control situations exist, the laboratory's QA program shall 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 shall 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.

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 shall be documented on an appropriate form (the “Cooler Receipt Form”). The project manager or appropriate technical personnel shall 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 shall be immediately notified so that an appropriate corrective action plan can be generated. If holding times are exceeded and results reported, the resulting data shall be flagged, and a discussion of the impact included within the case narrative.

5.5.3 Instrument Calibration

Sample analysis shall 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 shall 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 shall 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 shall be flagged, 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, MBs, LCSs, MSs, MDs, MSDs, surrogate spikes, and other method-specified QC. All QC shall 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 shall be required. Failure of method QC shall 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 shall be performed at no cost to CH2M HILL. If the situation is not corrected and results reported, then the corresponding data shall be flagged and a discussion of the impact included within the case narrative. The project manager or appropriate technical personnel shall be notified as soon as possible to discuss possible corrective actions should unusually difficult sample matrices be encountered.

Method Blanks (MB)

These criteria shall be used to evaluate the acceptability of the MB data if project DQOs do not specify otherwise. The concentration of all target analytes shall 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 shall 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 shall be taken to find the source of the problem and correct it. The case narrative shall 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 shall 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 shall 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 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 shall 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 shall 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 shall be reissued if calculation or reporting errors are noted with any given data package. The case narrative shall 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–ADEM Appendix I Metals or SW846 7421 (Lead), 7740 (Selenium), 7841 (Thallium).

SW846 Methods 6010 or Methods 7421, 7740, and 7841 will be used for the determination of the selected parameters listed above. The 7000 series methods will be used if SW846 Method 6010 detection limits are not below the regulatory criteria for the project. SW846 Method 6010 - Inductively coupled plasma emission spectrometry (ICPES) determines trace elements. The 7000 series methods listed utilize Graphite Furnace Atomic Absorption spectrometry technique. In this technique, an aliquot of sample is gradually heated to the temperature at which it is disassociated into the Free State, making the analyte atoms available for absorption of light. 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 7470/7471 – Mercury

SW846 Methods 7470/7471 will be used for the determination of mercury. These methods utilize a chemical reduction to reduce mercury selectively.

5.7.3 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.

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-2** 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 **Attachment A-5**.

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 shall establish MDLs for each method, matrix, and analyte for each instrument the laboratory plans to use for the project. The laboratory shall revalidate these MDLs at least once per 12-month period. The laboratory shall provide the MDL at the beginning of the project. Project/laboratory specific MDLs shall be included in the project-specific addendum.

Where multiple instruments are used, the MDL used for reporting purposes shall 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 shall 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 shall 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 70-130%. All results shall be reported at or above the MDL values. No numerical results shall be reported below the MDL; however, for those results falling between the MDL and the RL, a "J" flag shall be applied to the results indicating the variability associated with the result. The MDLs are provided in **Attachment A-6 and A-7.**

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 USEPA 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 shall 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 shall 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 shall 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 shall 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 post-digestion spike duplicates (PDS), 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, USEPA national functional guidelines, USEPA regional functional guidelines, and project-specific guidelines for validation may all have distinct reporting formats. Additionally, the laboratory's QC limits will be reviewed to verify that they are equal to or within established criteria of DoD QSM 3.

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-9**.

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 lab 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 shall provide a total overview of the data package, including sample receipt, to ensure its consistency and compliance with project-specific requirements. All errors noted shall be corrected and documented. Based on the errors noted, samples may need to be reprepared and reanalyzed. Administrative reviews shall 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 electronic data deliverables (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.)

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 straightforward 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-9

ATTACHMENT A-1
Precision and Accuracy Limits for EPA Method 8260B – ADEM Appendix I VOC
RCRA Facility Investigation, AOC –S, Fort Rucker, Alabama

Analyte	Limits		DOD Limits
1,1,1,2-Tetrachloroethane	70-140		80-130
1,1,1-Trichloroethane	80-125		65-130
1,1,2,2-Tetrachloroethane	70-130		65-130
1,1,2-Trichloroethane	80-130		75-125
1,1-Dichloroethane	75-130		70-135
1,1-Dichloroethene	70-125		70-130
1,2,3-Trichloropropane	70-140		75-125
1,2-Dibromo-3-chloropropane	70-130		50-130
1,2-Dibromoethane	75-130		80-120
1,2-Dichlorobenzene	70-130		70-120
1,2-Dichloroethane	70-135		70-130
1,2-Dichloropropane	75-130		75-125
1,4-Dichlorobenzene	70-125		75-125
2-Butanone	65-145		30-150
2-Hexanone	70-140		55-130
4-Methyl-2-pentanone	75-135		60-135
Acetone	35-175		40-140
Acrylonitrile	35-180		
Benzene	75-125		80-120
Bromochloromethane	80-125		65-130
Bromodichloromethane	85-135		75-120
Bromoform	70-140		70-130
Bromomethane	45-150		30-145
Carbon disulfide	65-130		35-160
Carbon Tetrachloride	75-135		65-140
Chlorobenzene	75-120		80-120
Chloroethane	65-145		60-135
Chloroform	75-125		65-135
Chloromethane	45-145		40-125
Dibromochloromethane	80-140		60-135
Dibromomethane	65-140		75-125
Ethylbenzene	75-130		75-125
Iodomethane	50-140		
Methylene chloride	70-130		55-140
Styrene	75-125		65-135
Tetrachloroethene	70-125		45-150
Toluene	75-125		75-120
Trichloroethene	80-125		70-125
Trichlorofluoromethane	70-140		60-145
Vinyl acetate	60-150		
Vinyl chloride	65-140		50-145
Xylene(total)	75-125		
cis-1,2-Dichloroethene	80-120		70-125

ATTACHMENT A-1

Precision and Accuracy Limits for EPA Method 8260B – ADEM Appendix I VOC

RCRA Facility Investigation, AOC –S, Fort Rucker, Alabama

Analyte	Limits		DOD Limits
cis-1,3-Dichloropropene	75-130		70-130
trans-1,2-Dichloroethene	70-125		60-140
trans-1,3-Dichloropropene	70-130		55-140
trans-1,4-Dichloro-2-butene			50-140

ATTACHMENT A-2

Precision and Accuracy Limits for EPA Method 6010B/7000 – ADEM Appendix I Metals

RCRA Facility Investigation, AOC–S, Fort Rucker, Alabama

Analyte	Method	Limits	DOD Limits
Arsenic	3050A/6010B/200.7	80-120	80-120
Barium	3050A/6010B/200.7	80-120	80-120
Beryllium	3050A/6010B/200.7	80-120	80-120
Cadmium	3050A/6010B/200.7	80-120	80-120
Cobalt	3050A/6010B/200.7	80-120	80-120
Chromium	3050A/6010B/200.7	80-120	80-120
Copper	3050A/6010B/200.7	80-120	80-120
Silver	3050A/6010B/200.7	80-120	80-120
Nickel	3050A/6010B/200.7	80-120	80-120
Lead	7421	80-120	80-120
Selenium	7740	80-120	80-120
Antimony	3050A/6010B/200.7	80-120	80-120
Thallium	7841	80-120	80-120
Vanadium	3050A/6010B/200.7	80-120	80-120
Zinc	3050A/6010B/200.7	80-120	80-120
Mercury	7470/7471	80-120	80-120

ATTACHMENT A-3

Container, Preservative, and Holding Time Requirements for Groundwater, Soil, and Liquid IDW Samples

RCRA Facility Investigation, AOC–S, 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	ADEM Appendix I Metals	6010B/7000	1 X 1L HDPE	HNO_3 / 4^{o}C	6 months Mercury (28 days)
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-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 d/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/7days/40 days
Soil-IDW	Reactivity	SW-846 7.3.3.2/ 7.3.4.2	8-oz glass	None	As soon as possible
Soil-IDW	Ignitability	SW-846 1010/1020A	8-oz glass	None	As soon as possible
Soil-IDW	Corrosivity	SW-846 1110/9040	8-oz glass	None	As soon as possible

ATTACHMENT A-4
Data Package Deliverables
RCRA Facility Investigation, AOC–S, Fort Rucker, Alabama

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-5
Analytical Target Lists and Reporting Limits
RCRA Facility Investigation, AOC–S, Fort Rucker, Alabama

		ADEM Appendix I List		
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**
6010	7440-36-0	Antimony	ug/l	5
6010	7440-38-2	Arsenic	ug/l	10
6010	7440-39-3	Barium	ug/l	200
6010	7440-41-7	Beryllium	ug/l	4
6010	7440-43-9	Cadmium	ug/l	5
6010	7440-47-3	Chromium	ug/l	10
6010	7440-48-4	Cobalt	ug/l	50
6010	7440-50-8	Copper	ug/l	25
6010	7440-02-0	Nickel	ug/l	40
6010	7440-22-4	Silver	ug/l	10
6010	7440-62-2	Vanadium	ug/l	50
6010	7440-66-6	Zinc	ug/l	20
7421	7439-92-1	Lead	ug/l	5
7470	7439-97-6	Mercury	ug/l	1
7740	7782-49-2	Selenium	ug/l	10
7841	7440-28-0	Thallium	ug/l	1
8260	630-20-6	1,1,1,2-Tetrachloroethane	ug/l	2
8260	71-55-6	1,1,1-Trichloroethane	ug/l	2
8260	79-34-5	1,1,2,2-Tetrachloroethane	ug/l	2
8260	79-00-5	1,1,2-Trichloroethane	ug/l	2
8260	75-34-3	1,1-Dichloroethane	ug/l	2
8260	75-35-4	1,1-Dichloroethylene	ug/l	2
8260	96-18-4	1,2,3-Trichloropropane	ug/l	3
8260	96-12-8	1,2-Dibromo-3-chloropropane	ug/l	0.2
8260	106-93-4	1,2-Dibromoethane (EDB)	ug/l	0.05
8260	107-06-2	1,2-Dichloroethane	ug/l	2
8260	78-87-5	1,2-Dichloropropane	ug/l	2
8260	591-78-6	2-Hexanone	ug/l	10
8260	108-10-1	4-Methyl-2-pentanone (MIBK)	ug/l	10
8260	67-64-1	Acetone	ug/l	25
8260	107-13-1	Acrylonitrile	ug/l	20
8260	71-43-2	Benzene	ug/l	2
8260	74-97-5	Bromochloromethane	ug/l	2
8260	75-27-4	Bromodichloromethane	ug/l	2
8260	75-25-2	Bromoform	ug/l	2
8260	74-83-9	Bromomethane (Methyl bromide)	ug/l	3
8260	75-15-0	Carbon disulfide	ug/l	3
8260	56-23-5	Carbon tetrachloride	ug/l	2
8260	108-90-7	Chlorobenzene	ug/l	2
8260	75-00-3	Chloroethane	ug/l	3
8260	67-66-3	Chloroform	ug/l	2
8260	74-87-3	Chloromethane (Methyl chloride)	ug/l	3
8260	156-59-2	cis-1,2-Dichloroethene	ug/l	2
8260	10061-01-5	cis-1,3-Dichloropropene	ug/l	2
8260	124-48-1	Dibromochloromethane	ug/l	2
8260	74-95-3	Dibromomethane (Methylene bromide)	ug/l	2
8260	95-56-1	o-dichlorobenzene	ug/l	2
8260	106-46-7	p-dichlorobenzene	ug/l	2
8260	100-41-4	Ethylbenzene	ug/l	2
8260	74-88-4	Iodomethane (Methyl iodide)	ug/l	10
8260	78-93-3	Methyl ethyl ketone	ug/l	10
8260	75-09-2	Methylene chloride (Dichloromethane)	ug/l	2
8260	100-42-5	Styrene	ug/l	2
8260	127-18-4	Tetrachloroethene	ug/l	2

ATTACHMENT A-5
Analytical Target Lists and Reporting Limits
RCRA Facility Investigation, AOC–S, Fort Rucker, Alabama

		ADEM Appendix I List		
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL**
8260	108-88-3	Toluene	ug/l	2
8260	156-60-5	trans-1,2-Dichloroethene	ug/l	2
8260	10061-02-6	trans-1,3-Dichloropropene	ug/l	2
8260	110-57-6	trans-1,4-Dichloro-2-butene	ug/l	20
8260	79-01-6	Trichloroethene	ug/l	2
8260	75-69-4	Trichlorofluoromethane	ug/l	2
8260	108-05-4	Vinyl acetate	ug/l	20
8260	75-01-4	Vinyl chloride	ug/l	2
8260	1330-20-7	Xylenes, Total	ug/l	5

ATTACHMENT A-6
Analytical Method Detection Limits for EPA Method 8260B – ADEM Appendix I VOCs
RCRA Facility Investigation, AOC–S, Fort Rucker, Alabama

		ADEM Appendix I List		
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL/MDL**
8260	630-20-6	1,1,1,2-Tetrachloroethane	ug/l	1/0.5
8260	71-55-6	1,1,1-Trichloroethane	ug/l	1/0.5
8260	79-34-5	1,1,2,2-Tetrachloroethane	ug/l	1/0.5
8260	79-00-5	1,1,2-Trichloroethane	ug/l	1/0.5
8260	75-34-3	1,1-Dichloroethane	ug/l	1/0.5
8260	75-35-4	1,1-Dichloroethylene	ug/l	1/0.5
8260	96-18-4	1,2,3-Trichloropropane	ug/l	2/1
8260	96-12-8	1,2-Dibromo-3-chloropropane	ug/l	2/1
8260	106-93-4	1,2-Dibromoethane (EDB)	ug/l	2/1
8260	107-06-2	1,2-Dichloroethane	ug/l	1/0.5
8260	78-87-5	1,2-Dichloropropane	ug/l	1/0.5
8260	591-78-6	2-Hexanone	ug/l	5/2
8260	108-10-1	4-Methyl-2-pentanone (MIBK)	ug/l	5/2
8260	67-64-1	Acetone	ug/l	10/5
8260	107-13-1	Acrylonitrile	ug/l	20/10
8260	71-43-2	Benzene	ug/l	2/1
8260	74-97-5	Bromochloromethane	ug/l	2/1
8260	75-27-4	Bromodichloromethane	ug/l	2/1
8260	75-25-2	Bromoform	ug/l	2/1
8260	74-83-9	Bromomethane (Methyl bromide)	ug/l	2/1
8260	75-15-0	Carbon disulfide	ug/l	2/1
8260	56-23-5	Carbon tetrachloride	ug/l	2/1
8260	108-90-7	Chlorobenzene	ug/l	2/1
8260	75-00-3	Chloroethane	ug/l	2/1
8260	67-66-3	Chloroform	ug/l	2/1
8260	74-87-3	Chloromethane (Methyl chloride)	ug/l	2/1
8260	156-59-2	cis-1,2-Dichloroethene	ug/l	2/1
8260	10061-01-5	cis-1,3-Dichloropropene	ug/l	2/1
8260	124-48-1	Dibromochloromethane	ug/l	2/1
8260	74-95-3	Dibromomethane (Methylene bromide)	ug/l	2/1
8260	95-56-1	o-dichlorobenzene	ug/l	2/1
8260	106-46-7	p-dichlorobenzene	ug/l	2/1
8260	100-41-4	Ethylbenzene	ug/l	2/1
8260	74-88-4	Iodomethane (Methyl iodide)	ug/l	10/5
8260	78-93-3	Methyl ethyl ketone	ug/l	10/5
8260	75-09-2	Methylene chloride (Dichloromethane)	ug/l	2/1
8260	100-42-5	Styrene	ug/l	2/1
8260	127-18-4	Tetrachloroethene	ug/l	2/1
8260	108-88-3	Toluene	ug/l	2/1
8260	156-60-5	trans-1,2-Dichloroethene	ug/l	2/1
8260	10061-02-6	trans-1,3-Dichloropropene	ug/l	2/1
8260	110-57-6	trans-1,4-Dichloro-2-butene	ug/l	20/10
8260	79-01-6	Trichloroethene	ug/l	2/1
8260	75-69-4	Trichlorofluoromethane	ug/l	2/1
8260	108-05-4	Vinyl acetate	ug/l	20/10
8260	75-01-4	Vinyl chloride	ug/l	2/1
8260	1330-20-7	Xylenes, Total	ug/l	5/2

ATTACHMENT A-7

Analytical Method Detection Limits for EPA Method 6010B/7000 – ADEM Appendix I Metals

RCRA Facility Investigation, AOC–S, Fort Rucker, Alabama

		ADEM Appendix I List		
Analysis Method	**CAS Number**	**Analyte**	**Units**	**RL/MDL**
6010	7440-36-0	Antimony	ug/l	5/2
6010	7440-38-2	Arsenic	ug/l	10/5
6010	7440-39-3	Barium	ug/l	200/100
6010	7440-41-7	Beryllium	ug/l	5/2
6010	7440-43-9	Cadmium	ug/l	5/2
6010	7440-47-3	Chromium	ug/l	10/5
6010	7440-48-4	Cobalt	ug/l	50/25
6010	7440-50-8	Copper	ug/l	25/10
6010	7440-02-0	Nickel	ug/l	40/20
6010	7440-22-4	Silver	ug/l	10/5
6010	7440-62-2	Vanadium	ug/l	50/20
6010	7440-66-6	Zinc	ug/l	20/10
7421	7439-92-1	Lead	ug/l	5/2.5
7470	7439-97-6	Mercury	ug/l	1/0.5
7740	7782-49-2	Selenium	ug/l	10/5
7841	7440-28-0	Thallium	ug/l	2/1

ATTACHMENT A-8
TCLP Reporting Limits
RCRA Facility Investigation, 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
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

ATTACHMENT A-8
TCLP Reporting Limits
RCRA Facility Investigation, AOC–S, Fort Rucker, Alabama

Method/Analyte	**MDL(mg/L)**	**RL(mg/L)**	**Reg. Limit(mg/L)**
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-9
Electronic Data Deliverable Format for CH2M HILL
RCRA Facility Investigation, AOC–S, Fort Rucker, Alabama

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).

ATTACHMENT A-9
Electronic Data Deliverable Format for CH2M HILL
RCRA Facility Investigation, AOC–S, Fort Rucker, Alabama

EDD Specification Table					
Field Number	**Field Name**	**Data Type**	**Data Length**	**Rqmt**	**Description and Comments**
					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),
					"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.

ATTACHMENT A-9
Electronic Data Deliverable Format for CH2M HILL
RCRA Facility Investigation, AOC–S, Fort Rucker, Alabama

EDD Specification Table

Field Number	Field Name	Data Type	Data Length	Rqmt	Description and Comments
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
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.

ATTACHMENT A-9
Electronic Data Deliverable Format for CH2M HILL
RCRA Facility Investigation, AOC–S, Fort Rucker, Alabama

EDD Specification Table

Field Number	**Field Name**	**Data Type**	**Data Length**	**Rqmt**	**Description and Comments**
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 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.

ATTACHMENT A-9
Electronic Data Deliverable Format for CH2M HILL
RCRA Facility Investigation, AOC–S, Fort Rucker, Alabama

EDD Specification Table

Field Number	Field Name	Data Type	Data Length	Rqmt	Description and Comments
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.
40	RLAdjusted	number		C	Reporting limit adjusted for preparation, dilution **and percent moisture**. Equivalent to PQL

ATTACHMENT A-9
Electronic Data Deliverable Format for CH2M HILL
RCRA Facility Investigation, AOC–S, Fort Rucker, Alabama

EDD Specification Table

Field Number	**Field Name**	**Data Type**	**Data Length**	**Rqmt**	**Description and Comments**
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.

Appendix C
Waste Management Plan

Contents

Section **Page**

Tables

Attachments

1. Introduction

This document is the project-specific Waste Management Plan (WMP) for the Resource Conservation Resource Act (RCRA) Facility Investigation (RFI) Work Plan for Area of Concern (AOC)-S Landfill at Fort Rucker, Alabama. This WMP identifies the types of investigation-derived wastes (IDW) likely to be generated during the RFI field activities; specifies control measures to segregate and minimize the generation of IDW; and sets forth the procedures for the handling, storage, characterization, and disposal of the IDW.

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 investigation site. Waste documentation will be maintained as discussed in this WMP.

2. Identification of Potential Waste Streams

2.1 Types of Wastes Likely to be Generated

During the RFI field activities, the generation of RCRA hazardous wastes or Toxic Substances Control Act (TSCA)-regulated materials is not anticipated. IDW generated during the field activities may include the following:

- Used personal protective equipment (PPE) and disposable sampling materials;
- Soil cuttings generated during drilling of soil borings;
- Produced groundwater from monitoring well development and purging/sampling;
- Decontamination fluids;
- General trash (uncontaminated); and
- Empty containers.

The following sections discuss the types and volumes of wastes expected to be generated.

2.1.1 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 a U.S. Department of Transportation (DOT)-approved, steel 55-gallon drum. Each container will be labeled in accordance with Section 5 of this WMP and stored onsite pending disposal.

2.1.2 Soil Cuttings

Soil cuttings will be generated during the drilling of soil borings. All soil cuttings will be placed into DOT-approved, steel, 55-gallon drums. The drums will be labeled in accordance with Section 5 and stored onsite pending disposal.

2.1.3 Monitoring Well Development and Purge Water

During monitoring well development and sampling activities, groundwater will be produced. This groundwater will be containerized in DOT-approved, steel 55-gallon drums. The drums will be labeled in accordance with Section 5 and stored onsite pending disposal of the water.

2.1.4 Decontamination Fluids

During the field activities, decontamination of sampling equipment (for example, bowls, spoons, and split spoons) 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 Section 5 and stored onsite pending disposal of the decontamination fluids.

2.1.5 General Trash

General trash will consist of miscellaneous uncontaminated waste materials such as wrappers, boxes, empty distilled water containers, paper, and similar materials. General trash will be placed into plastic bags and disposed of offsite as non-regulated solid waste.

2.1.6 Empty Containers

Empty containers may be generated when hazardous materials are used at the investigation site, either for decontamination or equipment maintenance. All containers of hazardous materials brought onsite will be emptied to the degree possible using routine methods such as pouring, pumping, or aspirating. The resulting container will be considered empty, as defined in 40 Code of Federal Regulations (CFR) Part 261.7, if the original hazardous material is acutely hazardous as listed in 40 CFR 261. Empty containers, as defined by the Empty Container Rule found in 40 CFR Part 261.7, will be disposed of as non-hazardous waste. Containers that are confirmed to be empty will be properly disposed of as non-hazardous waste. Empty containers generated from these activities will include items such as empty pre-preserved sample containers and decontamination reagent containers.

2.1.7 Expected Volumes

Table B-1 lists the approximate volumes of wastes expected to be generated during this project.

TABLE C-1
Volumes of Waste Expected to be Generated During Field Activities
RCRA Facility Investigation, AOC-S, Fort Rucker, Alabama

Waste Media	**Container Type**	**Total Volume Expected**
Used PPE and disposable sampling materials	55-gal. Drum	2 drums
Soil cuttings	55-gal. Drum	27 drums
Well development/purge water/decontamination fluids	55-gal. Drum	15 drums
General trash	55-gal. Drum	3 drums
Empty containers	55-gal. Drum	1 drum

3. Waste Characterization

The IDW generated during field activities will be regulated under RCRA as directed in 40 CFR Parts 260-270 by the U.S. Environmental Protection Agency (EPA). In order to characterize soils for disposal, one composite soil sample will be collected from the 55-gallon drums containing soil cuttings. The composite sample will be submitted to CH2M HILL's subcontract laboratory for analysis of toxicity characteristic leaching procedure (TCLP) volatile organic compounds (VOCs), TCLP semivolatile organic compounds (SVOCs), TCLP RCRA metals, TCLP pesticides, TCLP herbicides, reactivity, ignitability, and corrosivity.

Liquid waste, including produced groundwater and decontamination fluids, will be characterized by evaluating analytical results from the discrete samples collected from each of the temporary and permanent monitoring wells. The groundwater samples will be analyzed for the ADEM Appendix I VOCs.

The analytical results for soil and liquid IDW samples will be used indirectly for the characterization of the PPE and sampling equipment waste.

For soil IDW samples, the analytical laboratory will provide all sample containers. The containers will be cleaned in accordance with EPA protocol and pre-preserved by the laboratory. All samples collected during the RFI field investigation and submitted to laboratories for chemical analyses will be preserved according to EPA standards. Immediately upon sample collection, the sample containers will be properly labeled and placed into ice-cooled chests, which will be used for shipping samples to the laboratory. Sample preservation requirements, holding times, and required sample container types are presented in **Table C-2**.

TABLE C-2
Container, Preservative, and Holding Time Requirements for Soil IDW Samples
RCRA Facility Investigation, AOC-S, Fort Rucker, Alabama

Matrix	Test	Method	Container	Preservative	Holding Time
Soil-IDW	VOC	1311/8260B	1 x 2 oz. Glass jar	None / 4^{o}C	14 days/14 days

TABLE C-2
Container, Preservative, and Holding Time Requirements for Soil IDW Samples
RCRA Facility Investigation, AOC-S, Fort Rucker, Alabama

Matrix	Test	Method	Container	Preservative	Holding Time
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	Reactivity	SW-846 7.3.3.2/ 7.3.4.2	8 oz. glass	None	As soon as possible
Soil-IDW	Ignitability	SW-846 1010/1020A	8 oz. glass	None	As soon as possible
Soil-IDW	Corrosivity	SW-846 1110/9040	8 oz. glass	None	As soon as possible

4. Waste Segregation and Minimization

4.1 Waste Segregation

Different types of wastes (for example, water, soil, and PPE) may not be co-mingled in the field, unless the co-mingling is an integral part of the waste collection process. Waste identified in the field as potentially hazardous will not be co-mingled with waste that is presumed to be non-hazardous.

Equipment maintenance activities are not anticipated during field activities. If equipment maintenance activities are required, such maintenance will be done offsite, if possible. The disposal of wastes from equipment maintenance will be the responsibility of the equipment subcontractor(s). Subcontractors will be responsible for removing any such wastes from the investigation site as part of general cleanup prior to or during demobilization.

4.2 Waste Minimization

A primary goal of this WMP is to minimize, to the extent practical, the volume of wastes generated and stored and the amount of material removed from the investigation site for disposal. In order to minimize the volume of wastes, these general rules will be followed:

- Plan ahead to reduce the amount of wastes generated.
- Avoid contaminating materials unnecessarily.
- Decontaminate and reuse material, PPE, and equipment when practical.
- Solidly pack waste containers to minimize the number of containers (keeping in mind weight/capacity requirements for containers) and use only the container size needed.
- Minimize the amount of water and detergent solution needed to decontaminate sampling and heavy equipment.
- Avoid mixing potential or actual RCRA-regulated materials with non-RCRA wastes.
- Avoid over-drilling beyond the planned investigation depth.
- Use no more drums or other waste containers than are necessary for the field activities.

5. Container Management

Wastes other than office-type wastes or general trash will be placed into DOT-approved, steel 55-gallon drums, as discussed in previous sections. No more drums or other containers than is necessary for the field activities will be used. The containers will be inspected upon receipt for visually obvious defects and to verify that needed appurtenances are present (for example, lids, bungs, bolts, pallets, and labels). All defective containers will be segregated from the accepted containers and returned to the source.

Waste containers will be secured at all times. When the containers are not being filled, all lids, bungs, and covers will be in place and secured. Should a container develop a leak, the contents of the drum will be transferred into another container that is both in good condition and compatible with the waste. The new container will be properly labeled with the same information shown on the original container label.

Waste containers will be stored onsite while the fieldwork is conducted. The storage location will be near the access gate for the investigation site for easy access by the waste transporter to pick up the waste. While waste containers are stored onsite, the container storage area will be delineated using tape, barricades, or plastic fencing.

The FTL will label each waste container as soon as waste is added to the container. Each container will be labeled to indicate contents, type of waste, location where the waste was generated, identification numbers for the soil boring location(s) associated with the waste, date(s) that the container was filled, name of the contractor that filled the drum, and a contractor point of contact name and telephone number. A waste container tracking form is shown in **Attachment C-1**. Each container will be marked with a sequential identification number (1, 2, 3, etc.) using a paint pen or other means in indelible ink. The container, container contents, and filling date(s) will be recorded in the FTL field logbook and on the IDW tracking form. The IDW container tracking form will be forwarded to the U.S. Army Corps of Engineers (USACE) and other personnel as directed by the USACE upon completion of the field sampling activities.

Although the waste to be generated during the field activities is assumed to be non-hazardous, all containerized waste will be handled as hazardous waste until the analytical results of characterization sampling indicate that the waste is non-hazardous. A self-sticking label will be affixed to each waste container indicating that analysis of the waste is pending. Upon receipt of the characterization analytical results, a commercially available EPA "Non-Hazardous Waste" or "Hazardous Waste" label, as appropriate, will be affixed to each drum.

6. Waste Disposal

CH2M HILL will perform waste characterization sampling and profiling for disposal, as described in Section 3. Upon completion of the waste profiling, CH2M HILL will prepare a memorandum to the USACE with recommendations for disposal of the waste. A copy of the supporting laboratory analytical data will accompany the memorandum. Upon acceptance of the disposal recommendations by the USACE, CH2M HILL will prepare a waste disposal manifest for signature by the USACE. CH2M HILL's waste transport subcontractor will then transport the waste to the approved disposal facility.

The project Scope of Work (SOW) does not include provisions for the disposal of IDW that is found to be RCRA hazardous waste, exceeds RCRA TCLP regulatory limits, or is found to be characteristically hazardous. If hazardous waste is identified, the project manager will contact the USACE technical manager to discuss how to proceed with waste profiling and disposal.

7. Spill Control Plan

During work around waste containers, a potential exists for a spill of the waste materials. For this RFI, materials with a potential to be spilled include decontamination fluids, produced groundwater, and soil cuttings. In order to prevent spilling waste materials, the following spill prevention measures will be followed:

- Use proper container-handling techniques (such as observance of weight restrictions, use of drum dollies, and secondary containment for liquids).
- Secure drum and container lids/rings properly.
- Use caution when placing material in waste containers.
- Place plastic sheeting on ground during sampling activities.

In the event of a spill of soil or liquid materials, the USACE technical manager will be contacted and spill containment and cleanup activities will be initiated. CH2M HILL will be responsible for all spill containment, cleanup, and reporting to appropriate agencies. The USACE representative to be contacted is:

Dennis Mayton
Mobile District, Corps of Engineers
Phone: 251-694-3684
Phone: 251-656-2180 (Mobile telephone number)

Notification will include, but will not be limited to, the name of the person reporting, name of contractor, location of the spill, material spilled, estimate of the quantity spilled, description of the potential hazards (fire, health, environment, etc.), and action taken to contain the spill.

In preparation for potential spills, a spill cleanup kit will be kept at the investigation site during sampling activities and during container handling activities. The spill cleanup kit will include:

- 20 pounds of absorbent material (only if liquids are present)
- 10-mil plastic sheeting (10 foot by 40 foot)

- Barricade tape
- Four pair of nitrile latex gloves with 10-inch gauntlet
- Extra drum (55-gallon, DOT-approved)

Attachment C-1

CH2MHILL

PROJECT NUMBER	**PROJECT NAME**

IDW Container Inventory

DATES OF PROJECT : PAGE ____ OF ____

CONTAINER NUMBER	DATE FILLING BEGUN	DATE FILLED	CONTENTS	NAME OF PERSON FILLING CONTAINER
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
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26				

Appendix D
Site Safety and Health Plan

CH2M HILL HEALTH AND SAFETY PLAN

This Health and Safety Plan (HSP) will be kept on the 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 Standards of Practice (SOP) in the CH2M HILL *Corporate Health and Safety Program, Program and Training Manual*, as appropriate. In addition, this plan adopts procedures in the project Work Plan. The Site Safety Coordinator (SSC) is to be familiar with these SOPs and the contents of this plan. CH2M HILL's personnel and subcontractors must sign Attachment 1.

Project Information and Description

PROJECT NO: 356163

CLIENT: USACE - Mobile District

PROJECT/SITE NAME: Resource Conservation Recovery Act (RCRA) Facility Investigation of 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: March 30, 2007

DATE(S) OF SITE WORK: May – June 2007

SITE ACCESS: Right-of-entry from USACE

SITE SIZE: Approximately 21 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 to be investigated during the RFI has been designated as AOC – S in Fort Rucker's Hazardous Waste Management and Minimization Act (HWMMA) permit. AOC – S is located to the east of SWMU 8. SWMU 8 is a closed ash landfill comprising approximately 4.3 acres along the southern edge of Fort Rucker. The landfill was operated from the 1940s until 1952. Ash from the former incinerator buildings 1410, 1411, and 1412 were disposed of at SWMU 8. During previous groundwater sampling events at SWMU 8, PCE was detected in the SWMU 8 up-gradient well 8-G1 and side gradient wells 8-G3 and 8-G4. The occurrence of PCE is unrelated to past operations at SWMU 8. The area to be investigated consists of approximately 21 acres, and includes the areas surrounding wells 8-G1, 8-G3 and 8-G4, as well as a former maintenance shop located northeast of well 8-G1. The former maintenance shop was operated from the 1940s until the the late 1980s, when the maintenance shop building was demolished. The only remnant of the former maintenance shop is a 100 feet by 30 feet concrete slab. Little is know about waste disposal practices at the former maintenance shop. At this time the source(s) of the PCE detected in wells 8-G1, 8-G3 and 8-G4 is unknown. The 21 acres included in the RFI, may be an over estimation of the size of AOC – S.

DESCRIPTION OF SPECIFIC TASKS TO BE PERFORMED:
1) Clearing of trails to boring/well locations using bulldozer
2) Oversee direct push technology drilling and temporary 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 and monitoring well locations.
6) Collect IDW characterization samples from drums.

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Attachment 1: Employee Signoff Form – Field Safety Instructions
Attachment 2: Project-Specific Chemical Product Hazard Communication Form
Attachment 3: Chemical-Specific Training Form
Attachment 4: Emergency Contacts
Attachment 5: Job Activity Hazard Analysis
Attachment 6: Project Activity Self-Assessment Checklists
Attachment 7: Applicable Material Safety Data Sheets

1 Tasks to be Performed Under this Plan

1.1 Description of Tasks

(Reference Field Project Start-up Form)

Refer to project documents (i.e., Work Plan) for detailed task information. A health and safety risk analysis (Section 1.2) 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 Suburface 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 Health and Safety Manager (HSM) is required before these tasks are conducted on regulated hazardous waste sites.

TASKS	CONTROLS
Waste removal/hauling	Brief on hazards, limits of access, and emergency procedures
Site clearing	Post contaminant areas as appropriate (refer to Section 8.2 for details)
	Sample and monitor as appropriate (refer to Section 5.0)

1.2 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	
Flying debris/ Objects	X	X			X	X	
Noise > 85dBA	X	X				X	
Electrical		X	X				
Suspended loads	X	X				X	
Buried utilities, drums, tanks	X	X					
Slip, trip, fall	X	X	X	X	X	X	
Back injury	X	X	X		X		
Confined space Entry				X			
Trenches/excavations							
Visible lightning	X	X	X	X	X	X	
Vehicle traffic	X					X	
Elevated work areas/falls							
Fires	X	X			X		
Entanglement	X	X					
Drilling		X					
Heavy equipment	X	X				X	
Working near Water							
Working from boat							
IDW Drum Sampling					X		

2 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 SSC for clarification.

In addition to the controls specified in this section, Project-Activity Self-Assessment Checklists are contained in Attachment 6. 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 for 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 HSM. The self-assessment checklists, including documented corrective actions, should be made a part of the permanent project records, and be promptly submitted to the HSM.

Project-specific frequency for completing self-assessments: **Weekly or at each new phase of work.**

2.1 Project-Specific Hazards

2.1.1 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.

2.1.2 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.

2.1.3 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.

2.1.4 Drilling

(Reference CH2M HILL SOP HS-35, *Drilling*)

Only authorized personnel are permitted to operate drill rigs.

Stay clear of areas surrounding drill rigs during every startup.

Stay clear of the rotating augers and other rotating components of drill rigs.

Stay as clear as possible of all hoisting operations. Loads shall not be hoisted overhead of personnel.

Do not wear loose-fitting clothing or other items such as rings or watches that could get caught in moving parts. Long hair should be restrained.

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 the line de-energized prior to approaching the equipment.

Smoking around drilling operations is prohibited.

2.2 General Hazards

2.2.1 General Practices and Housekeeping

(Reference CH2M HILL SOP HS-20, *General Practices*)

Site work should be performed during daylight hours whenever possible. Work conducted during hours of darkness require enough illumination intensity to read a newspaper without difficulty.

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.

2.2.2 Hazard Communication

(Reference CH2M HILL SOP HS-05, *Hazard Communication)*

The SSC is to perform the following:
Complete an inventory of chemicals brought onsite by CH2M HILL using Attachment 2.
Confirm that an inventory of chemicals brought onsite by CH2M HILL subcontractors is available.
Request or confirm locations of Material Safety Data Sheets (MSDS) from the client, contractors, and subcontractors for chemicals to which CH2M HILL employees potentially are exposed.
Before or as the chemicals arrive onsite, 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.

2.2.3 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 HSM or the Equipment Coordinator for additional information.

2.2.4 Lifting

(Reference CH2M HILL SOP HS-29, *Lifting*)

Proper lifting techniques must be used when lifting any object.

- Plan storage and staging to minimize lifting or carrying distances.
- Split heavy loads into smaller loads.
- Use mechanical lifting aids whenever possible.
- Have someone assist with the lift -- especially for heavy or awkward loads.
- Make sure the path of travel is clear prior to the lift.

2.2.5 Fire Prevention

(Reference CH2M HILL SOP HS-22, *Fire Prevention*)

Fire extinguishers shall be provided so that the travel distance from any work area to the nearest extinguisher is less than 100 feet.
When 5 gallons or more of a flammable or combustible liquid is being used, an extinguisher must be within 50 feet. Extinguishers must:

- be maintained in a fully charged and operable condition,
- be visually inspected each month, and
- undergo a maintenance check each year.

The area in front of extinguishers must be kept clear.
Post "Exit" signs over exiting doors, and post "Fire Extinguisher" signs over extinguisher locations.
Combustible materials stored outside should be at least 10 feet from any building.
Solvent waste and oily rags must be kept in a fire resistant, covered container until removed from the site.
Flammable/combustible liquids must be kept in approved containers, and must be stored in an approved storage cabinet.

2.2.6 Electrical

(Reference CH2M HILL SOP HS-23, *Electrical*)

Only qualified personnel are permitted to work on unprotected energized electrical systems.
Only authorized personnel are permitted to enter high-voltage areas.
Do not tamper with electrical wiring and equipment unless qualified to do so. All electrical wiring and equipment must be considered energized until lockout/tagout procedures are implemented.
Inspect electrical equipment, power tools, and extension cords for damage prior to use. Do not use defective electrical equipment, remove from service.
All temporary wiring, including extension cords and electrical power tools, must have ground fault circuit interrupters (GFCI) installed.
Extension cords must be:

- equipped with third-wire grounding.
- covered, elevated, or protected from damage when passing through work areas.
- protected from pinching if routed through doorways.

not fastened with staples, hung from nails, or suspended with wire.

Electrical power tools and equipment must be effectively grounded or double-insulated UL approved.

Operate and maintain electric power tools and equipment according to manufacturers' instructions.

Maintain safe clearance distances between overhead power lines and any electrical conducting material unless the power lines have been de-energized and grounded, or where insulating barriers have been installed to prevent physical contact. Maintain at least 10 feet from overhead power lines for voltages of 50 kilovolt (KV) or less, and 10 feet plus 1/2-inch for every 1 KV over 50 KV.

Temporary lights shall not be suspended by their electric cord unless designed for suspension. Lights shall be protected from accidental contact or breakage.

Protect all electrical equipment, tools, switches, and outlets from environmental elements.

2.2.8 Heat Stress

(Reference CH2M HILL SOP HS-09, *Heat and Cold Stress*)

Drink 16 ounces of water before beginning work. Disposable cups and water maintained at 50°F to 60°F 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 SSC/DSC to avoid progression of heat-related illness.

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!

Monitoring Heat Stress

These procedures should be considered when the ambient air temperature exceeds 70°F, the relative humidity is high (>50 percent), or when workers exhibit symptoms of heat stress.

The heart rate (HR) should be measured by the radial pulse for 30 seconds, as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 100 beats/minute, or 20 beats/minute above resting pulse. If the HR 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 100 beats/minute at the beginning of the next rest period, the work cycle should be further shortened by 33 percent. The procedure is continued until the rate is maintained below 100 beats/minute, or 20 beats/minute above resting pulse.

2.2.9 Cold Stress

(Reference CH2M HILL SOP HS-09, *Heat and Cold Stress*)

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 cool 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 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, hypothermia should consult the SSC/DSC 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.

2.2.10 Compressed Gas Cylinders

Valve caps must be in place when cylinders are transported, moved, or stored.
Cylinder valves must be closed when cylinders are not being used and when cylinders are being moved.
Cylinders must be secured in an upright position at all times.
Cylinders must be shielded from welding and cutting operations and positioned to avoid being struck or knocked over; contacting electrical circuits; or exposed to extreme heat sources.
Cylinders must be secured on a cradle, basket, or pallet when hoisted; they may not be hoisted by choker slings.

2.2.11 Procedures for Locating Buried Utilities

Local Utility Mark-Out Service:
Name: Fort Rucker
Phone: 334-255-9041
Where available, obtain utility diagrams for the facility.
Review locations of sanitary and storm sewers, electrical conduits, water supply lines, natural gas lines, and fuel tanks and lines.
Review proposed locations of intrusive work with facility personnel knowledgeable of locations of utilities. Check locations against information from utility mark-out service.
Where necessary (e.g., uncertainty about utility locations), excavation or drilling of the upper depth interval should be performed manually
Monitor for signs of utilities during advancement of intrusive work (e.g., sudden change n advancement of auger or split spoon).
When the client or other onsite party is responsible for determining the presence and locations of buried utilities, the SSC should confirm that arrangement.

2.2.12 Confined Space Entry

(Reference CH2M HILL SOP HS-17, *Confined Space Entry*)
No confined space entry will be permitted. Confined space entry requires additional health and safety procedures, training, and a permit. If conditions change such that confined-space entry is necessary, contact the HSM to develop the required entry permit.

When planned activities will not include confined-space entry, permit-required confined spaces accessible to CH2M HILL personnel are to be identified before the task begins. The SSC is to confirm that permit spaces are properly posted or that employees are informed of their locations and hazards.

2.3 Biological Hazards and Controls

2.3.1 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. Seek medical attention 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.

2.3.2 Poison Ivy 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. Become familiar with the identity of these plants. 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.

2.3.3 Ticks

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. 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 only with DEET; and check yourself frequently for ticks.

If bitten by a tick, grasp it at the point of attachment and carefully remove it. After removing the tick, wash your hands and disinfect and press the bite areas. Save the removed tick. Report the bite to human resources. Look for 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 cases, chills, fever, headache, fatigue, stiff neck, and bone pain may develop. If symptoms appear, seek medical attention.

2.3.4 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 the SSC 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; seek medical attention if a reaction develops.

2.3.5 Bloodborne Pathogens

(Reference CH2M HILL SOP HS-36, *Bloodborne Pathogens*)

Exposure to bloodborne pathogens may occur when rendering first aid (FA) or cardiopulmonary resuscitation (CPR), or when coming into contact with landfill waste or waste streams containing potentially infectious material. Exposure controls and PPE are required as specified in CH2M HILL SOP HS-36, *Bloodborne Pathogens*. Hepatitis B vaccination must be offered before the person participates in a task where exposure is a possibility.

2.3.6 Other Anticipated Biological Hazards

2.4 Radiological Hazards and Controls

Refer to CH2M HILL's Corporate Health and Safety Program, Program and Training Manual, and Corporate Health and Safety Program, Radiation Protection Program Manual, for standards of practice in contaminated areas.

Hazards	Controls
None Known	None Required

2.5 Contaminants of Concern

(Refer to Project Files for more detailed contaminant information)

Contaminant	Location and Maximum[a] Concentration (ppb)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Tetrachloroethylene	GW: Well 8-G3 16 ppb	25 ppm (1)	100 (1)	Irritation eyes, skin, nose, throat, respiratory system; nausea; flush face, neck; dizziness, incoordination; headache, drowsiness; skin erythema (skin redness); liver damage; [potential occupational carcinogen]	9.32

Footnotes:

(1) Respiratory Exposure

[a] Specify sample-designation and media: GW (Groundwater)

[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.

2.6 Potential Routes of Exposure

Dermal: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specifie 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 rout should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smokin

3 Project Organization and Personnel

3.1 CH2M HILL Employee Medical Surveillance and Training

(Reference CH2M HILL SOPs HS-01, Medical Surveillance, and HS-02, Health and Safety Training)

The employees listed below are enrolled in the CH2M HILL Comprehensive Health and Safety Program and 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 "SSC" have completed a 12-hour site safety coordinator course, and have documented requisite field experience. An SSC 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's SOP HS-04, *Reproduction Protection*, including obtaining a physician's statement of the employee's ability to perform hazardous activities before being assigned fieldwork.

Employee Name	Office	Responsibility	SSC/FA-CPR
Tom Wiley	Atlanta, GA	Field Team Leader/Site Safety Coordinator	X
Adrian Teal	Atlanta, GA	Field Team Member	
Mark Sherrill	Atlanta, GA	Project Manager	X

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:
Phone: 334-255-1899

3.2.2 CH2M HILL

Project Manager: Mark Sherrill/ATL
Health and Safety Manager: Michael Goldman/ATL
Field Team Leader: Tom Wiley/ATL
Site Safety Coordinator: Tom Wiley/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.

3.2.3 CH2M HILL Subcontractors

(Reference CH2M HILL SOP HS-55, *Subcontractor, Contractor, and Owner*)

Subcontractor: Boart Longyear (Drilling)
Subcontractor Contact Name: Michael Magnin
Telephone: 256-858-5004

Subcontractor: Donaldson & Garrett (Surveying)
Subcontractor Contact Name: Tommie Donaldson
Telephone: 478-474-5350

Subcontractor: Strong Environmental (IDW)
Subcontractor Contact Name: Richard Verch
Telephone: 770-409-1500

Subcontractor: C.C. Martin (Site Clearing)
Subcontractor Contact Name: C.C. Martin
Telephone: 334-464-2917

The subcontractors listed above are covered by this HSP and must be provided a copy of this plan. However, this plan does not address hazards associated with the tasks and equipment with which the subcontractor has expertise (e.g., drilling, excavation work, electrical). Subcontractors are responsible for the health and safety procedures specific to their work, and are required to submit these procedures to CH2M HILL for review before the start of field work. Subcontractors must comply with the established health and safety plan(s). The CH2M HILL SSC should verify that subcontractor employee training, medical clearance, and fit test records are current and must monitor and enforce compliance with the established plan(s). CH2M HILL's oversight does not relieve subcontractors of their responsibility for effective implementation and compliance with the established plan(s).

CH2M HILL should continuously endeavor to observe subcontractors' safety performance. 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. In addition to this level of observation, the SSC is responsible for confirming CH2M HILL subcontractor performance against both the subcontractor's safety plan and applicable self-assessment checklists. Self-assessment checklists contained in Attachment 6 are to be used by the SSC to review subcontractor performance.

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 the 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 Project Manager and HSM as appropriate.
Document all oral health and safety related communications in project field logbook, daily reports, or other records.

3.2.4 Contractors

(Reference CH2M HILL SOP HS-55, Subcontractor, Contractor, and Owner)

Contractor:
Contractor Contact Name:
Telephone:

This plan does not cover contractors that are contracted directly to the client or the owner. CH2M HILL is not responsible for the health and safety or means and methods of the contractor's work, and we must never assume such responsibility through our actions (e.g., advising on H&S issues). In addition to this plan, CH2M HILL staff should review contractor safety plans so that we remain aware of appropriate precautions that apply to us. Except in unusual situations when conducted by the HSM, CH2M HILL must never comment on or approve contractor safety procedures. Self-assessment checklists contained in Attachment 6 are to be used by the SSC to review the contractor's performance ONLY as it pertains to evaluating our exposure and safety.

Health and safety related communications with contractors should be conducted as follows:

Request the contractor to brief CH2M HILL employees and subcontractors on the precautions related to the contractor's work.
When an apparent contractor non-compliance/unsafe condition or practice poses a risk to CH2M HILL employees or subcontractors:
    Notify the contractor safety representative
    Request that the contractor determine and implement corrective actions
    If needed, stop affected CH2M HILL work until contractor corrects the condition or practice. Notify the client, Project Manager, and HSM as appropriate.
If apparent contractor non-compliance/unsafe conditions or practices are observed, inform the contractor safety representative. Our obligation is limited strictly to informing the contractor of our observation – the contractor is solely responsible for determining and implementing necessary controls and corrective actions.
If an apparent imminent danger is observed, immediately warn the contractor employee(s) in danger and notify the contractor safety representative. Our obligation is limited strictly to immediately warning the affected individual(s) and informing the contractor of our observation – the contractor is solely responsible for determining and implementing necessary controls and corrective actions.
Document all oral health and safety related communications in project field logbook, daily reports, or other records.

4 Personal Protective Equipment (PPE)

(Reference CH2M HILL SOP HS-07, Personal Protective Equipment, HS-08, Respiratory Protection)

PPE Specifications [a]

	Level		Head	Respirator [b]
General site entry Surveying Observation of material loading f 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 (drun sampling and disposal	Modified D	Boots: Steel-toe, chemical-resistant boots O steel-toe, leather work boots with outer rubb 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 O steel-toe, leather work boots with outer rubb 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 equivalen with GME-H cartridg or equivalent[e].

Reasons for Upgrading or Downgrading Level of Protection

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 hazardou 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 tha 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.

5 Air Monitoring/Sampling

(Reference CH2M HILL SOP HS-06, *Air Monitoring)*

Instrument	Tasks	Action Levels[a]		Frequency [b]	Calibration
PID: OVM with 10.6eV lam or equivalent	All intrusive work	< 1 ppm	Level D	Initially and periodically during task	Daily
		1 to 10 ppm	Level C		
		> 10 ppm	Evacuate the work area and contact the HSM		
CGI: MSA model 260 or 26 or equivalent	All intrusive work	0-10% :	No explosion hazard	Continuous during advancement of boring or trench	Daily
		10-25% LEL:	Potential explosion hazard		
		>25% LEL:	Explosion hazard; evacuate or vent		
O_2Meter: MSA model 260 c 261 or equivalent	All intrusive work	>25%[c] O_2:	Explosion hazard; evacuate or vent	Continuous during advancement of boring or trench	Daily
		20.9%[c] O_2:	Normal O_2		
		<19.5%[c] O_2:	O_2 deficient; vent or use SCBA		

[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 SSC; generally, every 5 to 15 minutes acceptable; more frequently may be appropriate. Monitoring results should be recorded. Documentation should include instrument an calibration information, time, measurement results, personnel monitored, and place/location where measurement is taken (e.g., “Breath 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] Refer to SOP HS-10 for instructions and documentation on radiation monitoring and screening.

[e] 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 isobutylen	RF = 1.0	100 ppm	1.5 lpm reg T-tubir
PID: MiniRAE, 10.6 eV bulb	100 ppm isobutylen	CF = 100	100 ppm	1.5 lpm reg T-tubing
PID: TVA 1000	100 ppm isobutylen	CF = 1.0	100 ppm	1.5 lpm reg T-tubing
CGI: MSA 260, 261, 360, or 361	0.75% pentane	N/A	50% LEL ± 5% LEL	1.5 lpm reg direct tubing

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

Additional sampling may be performed at the request of the SSC or the HSM

Personnel and Areas

Results must be sent immediately to the HSM. Regulations may require reporting to monitored personnel. Results reported to:

HSM: Michael Goldman

6 Decontamination

(Reference CH2M HILL SOP HS-13, *Decontamination*)

The SSC must establish and monitor the decontamination procedures and their effectiveness. Decontamination procedures found to be ineffective will be modified by the SSC. The SSC 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 contai
for disposal
Dispose of personnel rinse water to facility
sanitary sewer, or contain for offsite disposa

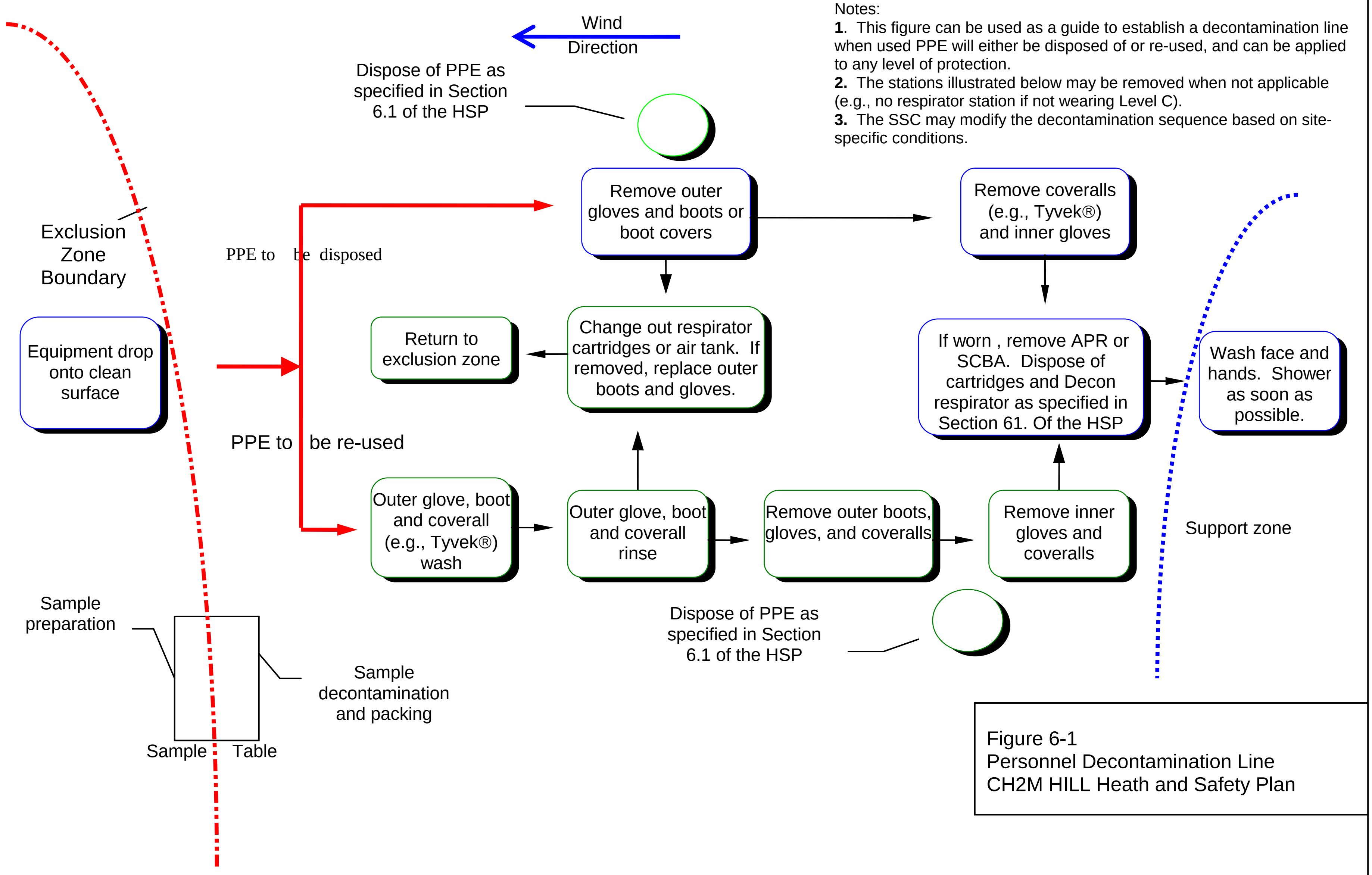
Sample Equipment
Wash/rinse equipment
Solvent-rinse equipment
Contain solvent waste for offsite disposal

Heavy Equipment
Power wash
Steam clean
Dispose of equipment rinse water to facility
sanitary sewer, or contain for offsite disposa

6.2 Diagram of Personnel-Decontamination Line

No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones. The SSC 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 SSC 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 SSC may modify the decontamination sequence based on site-specific conditions.

Figure 6-1
Personnel Decontamination Line
CH2M HILL Heath and Safety Plan

7 Spill-Containment Procedures

Sorbent material will be maintained in the support zone. Incidental spills will be contained with sorbent and disposed of properly.

8 Site-Control Plan

8.1 Site-Control Procedures

(Reference CH2M HILL SOP HS-11, *Site Control)*

The SSC 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 SSC 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 SOP HS-71, *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 SSC in appropriate level of protection.

The SCC 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 HS-19, Site-Specific Written Safety Plans)

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 are working in proximity to Hazwoper activities. Other data (e.g., soil) also must document that there is no potential for exposure. The HSM must approve the interpretation of these data. Refer to subsections 2.5 and 5.3 for contaminant data and air sampling requirements, respectively.

When non-Hazwoper-trained personnel are at risk of exposure, the SSC 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 Emergency Response Plan

(Reference CH2M HILL, SOP HS-12, *Emergency Response*)

9.1 Pre-Emergency Planning

The SSC 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 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.
Brief new workers on the emergency response plan.
The SSC will evaluate emergency response actions and initiate appropriate follow-up actions.

9.2 Emergency Equipment and Supplies

The SSC should mark the locations of emergency equipment on the site map and post the map.

Emergency Equipment and Supplies	Location
20 LB (or two 10-lb) fire extinguisher (A, B, and C classes)	Support Zone/Heavy Equipment
First aid kit	Support Zone/Field Vehicle
Eye Wash	Support & Decon Zone/Field Vehicle
Potable water	Support & Decon Zone/Field Vehicle
Bloodborne-pathogen kit	Support Zone/Field Vehicle
Additional equipment (specify):	

9.3 Incident Response

In fires, explosions, or chemical releases, actions to be taken include the following:
Shut down CH2M HILL operations and evacuate the immediate work area.
Notify appropriate response personnel.
Account for personnel at the designated assembly area(s).
Assess the need for site evacuation, and evacuate the site as warranted.

Instead of implementing a work-area evacuation, note that small fires or spills posing minimal safety or health hazards may be controlled.

9.4 Emergency Medical Treatment

The procedures listed below may also be applied to non-emergency incidents. Injuries and illnesses (including overexposure to contaminants) must be reported to Human Resources. If there is doubt about whether medical treatment is necessary, or if the injured person is reluctant to accept medical treatment, contact the CH2M HILL medical consultant. During non-emergencies, follow these procedures as appropriate.

Notify appropriate emergency response authorities listed in Section 9.8 (e.g., 911).
The SCC 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.
Initiate first aid and CPR where feasible.
Get medical attention immediately.
Perform decontamination where feasible; lifesaving and first aid or medical treatment take priority.
Make certain that the injured person is accompanied to the emergency room.
When contacting the medical consultant, state that the situation is a CH2M HILL matter, and give your name and telephone number, the name of the injured person, the extent of the injury or exposure, and the name and location of the medical facility where the injured person was taken.
Report incident as outlined in Section 9.7.

9.5 Evacuation

Evacuation routes and assembly areas (and alternative routes and assembly areas) are specified on the site map.

Evacuation route(s) and assembly area(s) will be designated by the SSC before work begins.

Personnel will assemble at the assembly area(s) upon hearing the emergency signal for evacuation.

The SSC 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 SSC will account for all personnel in the onsite assembly area.

A designated person will account for personnel at alternate assembly area(s).

The SSC will write up the incident as soon as possible after it occurs and submit a report to the Corporate Director of Health and Safety.

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

Upon any project incident (fire, spill, injury, near miss, death, etc.), immediately notify the PM and HSM. Call emergency beeper number if HSM is unavailable.

For CH2M HILL work-related injuries or illnesses, contact and help Human Resources administrator complete an Incident Report Form (IRF). IRF must be completed within 24 hours of incident.

For CH2M HILL subcontractor incidents, complete the Subcontractor Accident/Illness Report Form and submit to the HSM.

Notify and submit reports to client as required in contract.

10 Approval

This site-specific Health and Safety Plan 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.

10.1 Original Plan

Written By: Tom Wiley	Date: March 30, 2007
Approved By: Michael Goldman CIH, CSP,CHMM	Date: April 6, 2007

10.2 Revisions

Revisions Made By:	Date:
Revisions to Plan:	
Revisions Approved By:	Date:

11 Attachments

Attachment 1: Employee Signoff Form – Field Safety Instructions
Attachment 2: Project-Specific Chemical Product Hazard Communication Form
Attachment 3: Chemical-Specific Training Form
Attachment 4: Emergency Contacts
Attachment 5: Project H&S Forms/Permits
Attachment 6: Project Activity Self-Assessment Checklists
Attachment 7: Applicable Material Safety Data Sheets

CH2M HILL HEALTH AND SAFETY PLAN

Attachment 1

Employee Signoff Form

CH2MHILL

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 understo it, and agree to abide by its provisions.

Project Name: RFI at AOC-S, Fort Rucker, Alabama **Project Number:**

EMPLOYEE NAME (Please print)	**EMPLOYEE SIGNATURE**	**COMPANY**	**DATE**

CH2M HILL HEALTH AND SAFETY PLAN

Attachment 2

Project-Specific Chemical Product Hazard Communication Form

Project-Specific Chemical Product Hazard Communication Form

This form must be completed prior to performing activities that expose personnel to hazardous chemicals products. Upon completion of this form, the SSC shall verify that training is provided on the hazards associated with these chemicals and the control measures to be used to prevent exposure to CH2M HILL and subcontractor personnel. Labeling and MSDS systems will also be explained.

Project Name: RFI at AOC-S, Fort Rucker, Alabama **Project Number:**

MSDSs will be maintained at the following location(s): In field vehicle

Hazardous Chemical Products Inventory

Chemical	Quantity	Location	MSDS Available	Container labels	
				Identity	Hazard
Methane	1 liter, compressed	Support Zone			
Isobutylene	1 liter, compressed	Support Zone			
Pentane	1 liter, compressed	Support Zone			
Hydrochloric acid	< 500 ml	Support Zone / sample bottles			
Nitric acid	< 500 ml	Support Zone / sample bottles			
Hexane	< 1 Gallon	Support/Decon Zones			
pH buffers	< 500 ml	Support Zone			
MSA Sanitizer	< 1 liter	Support/Decon Zones			
Alconox/Liquinox	< 1liter	Support/Decon Zones			
Hydrogen	1liter compressed	Support Zone			
Diesel Fuel	5 gallon container	Support Zone			
Cement	94-lb bag	Support Zone			
Silica Sand	50-lb bag	Support Zone			

Refer to SOP HS-05 *Hazard Communication* for more detailed information.

CH2M HILL HEALTH AND SAFETY PLAN

Attachment 3

Chemical-Specific Training Form

CH2MHILL

CHEMICAL-SPECIFIC TRAINING FORM

Location:	Project #:
HCC:	Trainer:

TRAINING PARTICIPANTS:

NAME	SIGNATURE	NAME	SIGNATURE

REGULATED PRODUCTS/TASKS COVERED BY THIS TRAINING:

Tetrachloroethylene	

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

Emergency Contacts

Emergency Contacts

24-hour CH2M HILL Emergency Contact – 800/756-1130

Medical Emergency – 334-255-7800 Facility Medical Response #: N/A Local Ambulance #:	CH2M HILL Medical Consultant Dr. Peter Greaney GMG WorkCare, Orange, CA 800/455-6155 (After hours calls will be returned within 20 minutes)
Fire/Spill Emergency – 911 Facility Fire Response #: N/A Local Fire Dept #:	Local Occupational Physician
Security & Police – 334-255-3215 Facility Security #: N/A Local Police #: 405-321-1600 non emergency	Corporate Director Health and Safety Name: Keith Christopher Phone: 703-365-1113
Utilities Emergency Water: Fort Rucker 334-255-9041 Gas: Fort Rucker 334-255-9041 Electric: Fort Rucker 334-255-9041	Health and Safety Manager (HSM) Name: Michael Goldman Phone: 678-530-4133 Cell: 770-331-3127
Designated Safety Coordinator (DSC) Name: Bret Rahe/SAN Phone: 210-377-3085x647	Regional Human Resources Department Name: Mary Jo Jordan/GNV Phone: 352-335-5877x633
Project Manager Name: Mark Sherrill/ATL Phone: 678-530-4320	Corporate Human Resources Department Name: John Monark/COR Phone: 303-771-0900
Federal Express Dangerous Goods Shipping Phone: 800/238-5355 CH2M HILL Emergency Number for Shipping Dangerous Goods Phone: 800/255-3924	Worker's Compensation and Auto Claims Sterling Administration Services Phone: 800/420-8926 After hours: 800/497-4566 Report fatalities AND report vehicular accidents involving pedestrians, motorcycles, or more than two cars.
Contact the Project Manager. Generally, the Project Manager will contact relevant government agencies.	
Facility Alarms: None	Evacuation Assembly Area(s): Outside the entrance gate for the investigation are
Facility/Site Evacuation Route(s): Proceed north toward the entrance gate for the investigation area.	
Hospital Name/Address: Dale Medical Center, 100 Hospital Avenue, Ozark, AL 36330	Hospital Phone #: 334-774-2601

Directions to Hospital

Include written directions here, and attach or post a highlighted map if needed.

From investigation area turn left. Travel approx. ¼ mile, turn right on to Quartermaster Road. Travel approx. 1/8 mile. Turn left on to En Engineer Road. Travel approx. 1 mile. Turn left on to Hatch Road. Travel approximately 3 miles. Turn right on to Andrews Ave. Travel approx. 9 miles to Ozark, AL. Cross Highway 231 and travel approx. 1.2 miles and turn right on to Union Ave. Travel approx. 0.65 miles and turn left on to Adams St. then travel approx. 0.4 miles and turn right on to Hospital Ave. Dale Medical Center is located at 100 Hospital Ave.

CH2M HILL HEALTH AND SAFETY PLAN

Attachment 5

Job Activity Hazard Analysis (Subcontractor Provided)

Attachment 5

Job Hazard Analysis

A Job Hazard Analysis (JHA) defines the activity being performed, the hazards posed and control measures required to perform the work safely. Workers are briefed on the JHA before doing the work and their input is solicited prior to, during and after the performance of work to further identify the hazards posed and control measures required.

JHAs will be prepared before beginning each project activity posing HS&E hazards to project personnel. The JHA shall identify the work tasks required to perform each activity along with potential HS&E 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.

A JHA shall be prepared for all field activities performed by CH2M HIL`L and/or subcontractors during the course of the project. The JHAs in this attachment are drafts JHAs for CH2M HILL’s work, based on applicable CH2M HILL Standards of Practice (SOPs). These must be updated by the project team, facilitated by the SC, prior to conducting the work.

CH2M HILL subcontractors are required to provide JHAs specific to their scope of work on the project for acceptance by CH2M HILL . Each subcontractor shall submit JHAs for their field activities as defined in their work plan/scope of work along with their project-specific HSP. Additions or changes in CH2M HILL or subcontractor field activities, equipment, tools, or material to perform work, or any additional/different hazards encountered that require additional/different hazard control measures require either a new JHA to be prepared or an existing JHA to be revised.

Additions or changes in CH2M HILL or subcontractor field activities, equipment, tools, or material to perform work, or any additional/different hazards encountered that require additional/different hazard control measures require either a new JHA to be prepared or an existing JHA to be revised

Job Hazard Analysis

ctivity:	**Date: ____** **Project: ____** **Site Supervisor: ____** **Site Safety Officer: ____** **(Review for latest use before the job is performed)**	
escription of the work:		
ork Activity Sequence dentify the principal steps involved and the sequence of work tivities)	**Potential Health and Safety Hazards** (Analyze each principal step for potential hazards)	**Hazard Controls** (Develop specific controls for each potential hazar

CH2M HILL HEALTH AND SAFETY PLAN

Attachment 6

Project Activity Self-Assessment Checklists

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 hazards associated with drilling operations (complete Sections 1 and 3), and/or 2) CH2M HILL oversight of a drilling subcontractor is required (complete entire checklist).

SSC/DSC 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.

Completed checklists shall be sent to the health and safety manager for review.

Project Name: ____ Project No.: ______________________
Location: ____ PM: __________________________________
Auditor: ____________________________________ Title: _________________________________ Date: _____________

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposures to drilling hazards
☐ Evaluate a CH2M HILL subcontractor's compliance with drilling H&S requirements
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 Standard of Practice HS-35.

SECTION 1 Yes No N/A
N/O

PERSONNEL SAFE WORK PRACTICES (3.1)

1.	Only authorized personnel operating drill rig	☐	☐	☐	☐
2.	Personnel cleared during rig startup	☐	☐	☐	☐
3.	Personnel clear of rotating parts	☐	☐	☐	☐
4.	Personnel not positioned under hoisted loads	☐	☐	☐	☐
5.	Loose clothing and jewelry removed	☐	☐	☐	☐
6.	Personnel instructed not to approach equipment that has become electrically energized	☐	☐	☐	☐
7.	Smoking is prohibited around drilling operation	☐	☐	☐	☐
8.	Personnel wearing appropriate PPE, per HSP/FSI	☐	☐	☐	☐

	SECTION 2 N/O		Yes	No	N/A
GENERAL (3.2.1)					
9.	Daily safety briefing/meeting conducted with crew	☐	☐	☐	☐
10.	Daily inspection of drill rig and equipment conducted before use	☐	☐	☐	☐
DRILL RIG PLACEMENT (3.2.2)					
11.	Location of underground utilities identified	☐	☐	☐	☐
12.	Safe clearance distance maintained from overhead powerlines	☐	☐	☐	☐
13.	Drilling pad established, when necessary	☐	☐	☐	☐
14.	Drill rig leveled and stabilized	☐	☐	☐	☐
DRILL RIG TRAVEL (3.2.3)					
15.	Rig shut down and mast lowered and secured prior to rig movement	☐	☐	☐	☐
16.	Tools and equipment secured prior to rig movement	☐	☐	☐	☐
17.	Only personnel seated in cab are riding on rig during movement	☐	☐	☐	☐
18.	Safe clearance distance maintained while traveling under overhead powerlines	☐	☐	☐	☐
19.	Backup alarm or spotter used when backing rig	☐	☐	☐	☐
DRILL RIG OPERATION (3.2.4)					
20.	Kill switch clearly identified and operational	☐	☐	☐	☐
21.	All machine guards are in place	☐	☐	☐	☐
22.	Rig ropes not wrapped around body parts	☐	☐	☐	☐
23.	Pressurized lines and hoses secured from whipping hazards	☐	☐	☐	☐
24.	Drill operation stopped during inclement weather	☐	☐	☐	☐
25.	Air monitoring conducted per HSP/FSI for hazardous atmospheres	☐	☐	☐	☐
26.	Rig placed in neutral when operator not at controls	☐	☐	☐	☐
DRILL RIG MAINTENANCE (3.2.5)					
27.	Defective components repaired immediately	☐	☐	☐	☐
28.	Lockout/tagout procedures used prior to maintenance	☐	☐	☐	☐
29.	Cathead in clean, sound condition	☐	☐	☐	☐
30.	Drill rig ropes in clean, sound condition	☐	☐	☐	☐
31.	Fall protection used for fall exposures of 6 feet or greater	☐	☐	☐	☐
32.	Rig in neutral and augers stopped rotating before cleaning	☐	☐	☐	☐
33.	Good housekeeping maintained on and around rig	☐	☐	☐	☐
DRILLING AT HAZARDOUS WASTE SITES (3.2.6)					
34.	Waste disposed of according to HSP	☐	☐	☐	☐
35.	Appropriate decontamination procedures being followed, per HSP	☐	☐	☐	☐

SECTION 3

Complete this section for all items checked “No” in Sections 1 or 2. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

CH2M HILL HEALTH AND SAFETY PLAN

Attachment 7

Applicable Material Safety Data Sheets

MSDS Number: **B5642** * * * * * *Effective Date:* ***08/10/04*** * * * * * *Supercedes:* ***11/02/01***

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

J.T.Baker®

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: 5655

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Water	7732-18-5	> 99%	No
Boric Acid	10043-35-3	< 1%	No
Potassium Hydroxide	1310-58-3	< 1%	Yes
C.I. Acid Blue 9 Disodium Salt	3844-45-9	< 1%	No
Citric Acid	77-92-9	< 1%	No
Sodium Benzoate	532-32-1	< 1%	No
Propylene Glycol	57-55-6	< 1%	

```
No
  FD & C Red No. 40                           25956-17-6         < 1%
No
  Propyl Paraben                              94-13-3            < 1%
No
```

---

3. Hazards Identification

Emergency Overview

DANGER! CORROSIVE. HARMFUL IF SWALLOWED OR INHALED. CAUSES BURNS TO ANY AREA OF CONTACT.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate
Flammability Rating: 0 - None
Reactivity Rating: 0 - None
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
C.I. Acid Blue 9 Disodium Salt (3844-45-9)	No	No	3
Citric Acid (77-92-9)	No	No	None
Sodium Benzoate (532-32-1)	No	No	None
Propylene Glycol (57-55-6)	No	No	None
FD & C Red No. 40 (25956-17-6)	No	No	None
Propyl Paraben (94-13-3)	No	No	None

12. Ecological Information

Environmental Fate:
No information found.
Environmental Toxicity:
Potassium Hydroxide: TLm: 80 ppm/Mosquito fish/ 24 hr./ Fresh water

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
  C.I. Acid Blue 9 Disodium Salt (3844-45-9)        Yes  Yes   Yes
Yes
  Citric Acid (77-92-9)                             Yes  Yes   Yes
Yes
  Sodium Benzoate (532-32-1)                        Yes  Yes   Yes
Yes
  Propylene Glycol (57-55-6)                        Yes  Yes   Yes
Yes
  FD & C Red No. 40 (25956-17-6)                    Yes  Yes   No
```

Yes

Propyl Paraben (94-13-3)	Yes	Yes	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
C.I. Acid Blue 9 Disodium Salt (3844-45-9)	Yes	Yes	No	Yes
Citric Acid (77-92-9)	Yes	Yes	No	Yes
Sodium Benzoate (532-32-1)	Yes	Yes	No	Yes
Propylene Glycol (57-55-6)	Yes	Yes	No	Yes
FD & C Red No. 40 (25956-17-6)	Yes	Yes	No	Yes
Propyl Paraben (94-13-3)	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
C.I. Acid Blue 9 Disodium Salt (3844-45-9)	No	No	No	No
Citric Acid (77-92-9)	No	No	No	No
Sodium Benzoate (532-32-1)	No	No	No	No
Propylene Glycol (57-55-6)	No	No	No	No
FD & C Red No. 40 (25956-17-6)	No	No	No	No
Propyl Paraben (94-13-3)	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
C.I. Acid Blue 9 Disodium Salt (3844-45-9)	No	No	No
Citric Acid (77-92-9)	No	No	No
Sodium Benzoate (532-32-1)	No	No	No
Propylene Glycol (57-55-6)	No	No	No
FD & C Red No. 40 (25956-17-6)	No	No	No
Propyl Paraben (94-13-3)	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:
No Changes.
Disclaimer:
****
Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no 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 Number: **B5641** * * * * * *Effective Date:* ***03/14/07*** * * * * * *Supercedes:* ***02/16/06***

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

J.T.Baker®

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: 5657

---

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Water	7732-18-5	97 - 98%	No
Potassium Acid Phthalate	877-24-7	1 - 2%	Yes
Propylene Glycol	57-55-6	< 1%	No
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, incompatibilities.

---

11. Toxicological Information

No LD50/LC50 information found relating to normal routes of occupational exposure.

```
--------\Cancer Lists\------------------------------------------------------
                                      ---NTP Carcinogen---
Ingredient                             Known    Anticipated    IARC Category
------------------------------------   -----    -----------    -------------
Water (7732-18-5)                       No          No            None
Potassium Acid Phthalate (877-24-7)     No          No            None
Propylene Glycol (57-55-6)              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
Propylene Glycol (57-55-6)	Yes	Yes	Yes	Yes
FD & C Red No. 40 (25956-17-6)	Yes	Yes	No	Yes

--------\Chemical Inventory Status - Part 2\---------------------------------

		--Canada--		
Ingredient	Korea	DSL	NDSL	Phil.
Water (7732-18-5)	Yes	Yes	No	Yes
Potassium Acid Phthalate (877-24-7)	Yes	Yes	No	Yes
Propylene Glycol (57-55-6)	Yes	Yes	No	Yes
FD & C Red No. 40 (25956-17-6)	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
Potassium Acid Phthalate (877-24-7)	No	No	No	No

Propylene Glycol (57-55-6)	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
Propylene Glycol (57-55-6)	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: 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: **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: 3.
Disclaimer:
****
Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no 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 Number: **B5639** * * * * * *Effective Date:* ***08/17/06*** * * * * * *Supercedes:* ***11/12/03***

MSDS **Material Safety Data Sheet**

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

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: 5656

---

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
Propylene Glycol	57-55-6	< 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$^{\textbf{(tm)}}$ 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.

---

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\--

	---NTP Carcinogen---		
Ingredient	Known	Anticipated	IARC Category
Potassium Phosphate Monobasic (7778-77-0)	No	No	None
Sodium Phosphate, Dibasic (7558-79-4)	No	No	None
Propylene Glycol (57-55-6)	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
Propylene Glycol (57-55-6)	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\---------------------------------

		--Canada--		
Ingredient	Korea	DSL	NDSL	Phil.
Potassium Phosphate Monobasic (7778-77-0)	Yes	Yes	No	Yes
Sodium Phosphate, Dibasic (7558-79-4)	Yes	Yes	No	Yes
Propylene Glycol (57-55-6)	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\----------------
                                              -SARA 302-    ------SARA 313------
  Ingredient                                  RQ    TPQ     List  Chemical Catg.
  -----------------------------------------   ---   -----   ----  --------------
  Potassium Phosphate Monobasic (7778-77-0)  No    No      No         No
  Sodium Phosphate, Dibasic (7558-79-4)      No    No      No         No
  Propylene Glycol (57-55-6)                 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\----------------
                                                         -RCRA-    -TSCA-
  Ingredient                                  CERCLA     261.33     8(d)
  -----------------------------------------   ------     ------    ------
  Potassium Phosphate Monobasic               No         No         No
  (7778-77-0)
  Sodium Phosphate, Dibasic (7558-79-4)      5000       No         No
  Propylene Glycol (57-55-6)                 No         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: 3.
Disclaimer:
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****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

MSDS Number: **H2381** * * * * * *Effective Date:* ***08/10/04*** * * * * * *Supercedes:* ***11/02/01***

MSDS **Material Safety Data Sheet**

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

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: 9262, 9304, 9308, N168

---

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.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 0 - None
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES; LAB COAT; 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.

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.

---

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.

---

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\--

	---NTP Carcinogen---		
Ingredient	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.

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

15. Regulatory Information

--------\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\----------------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ 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

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.)

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.

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MSDS Number: **H3886** * * * * * *Effective Date:* ***02/16/06*** * * * * * *Supercedes:* ***05/07/03***

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.

HYDROCHLORIC ACID (10%-33%)

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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

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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.

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.

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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.

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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.

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9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.
Odor:
Pungent odor.
Solubility:
Infinitely soluble.
Density:
1.05 @ 15C (59F)
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.

---

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.

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11. Toxicological Information

Hydrochloric acid: Inhalation rat LC50: 3124 ppm/1H; Oral rabbit LD50: 900 mg/kg. Investigated as a tumorigen, mutagen, reproductive effector.

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--------\Cancer Lists\------------------------------------------------------
                                       ---NTP Carcinogen---
Ingredient                             Known    Anticipated    IARC Category
------------------------------------   -----    -----------    -------------
Hydrogen Chloride (7647-01-0)           No          No               3
Water (7732-18-5)                       No          No             None
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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.

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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 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.

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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\---------------------------------

		--Canada--		
Ingredient	Korea	DSL	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\----------------

	-SARA 302-		------SARA 313------	
Ingredient	RQ	TPQ	List	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\----------------

		-RCRA-	-TSCA-
Ingredient	CERCLA	261.33	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:
No Changes.
Disclaimer:
****

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****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

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. CYLINDER 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.

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 HEAVILY 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.

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

Disclaimer (provided with this information by the compiling agencies): This information is formulated for use by elements of the Department of Defense. The United States of America in no manner whatsoever,

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.

MINE SAFETY APPLIANCES COMPANY -- CM-34337,MSA CLEANER-SANITIZER -- 6840-00-570-5299

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====================  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.

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 ppm (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:TWA 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) OEL-SWITZERLAND:TWA 2 ppm (5 mg/m3);STEL 4 ppm (1 mg/m3) OEL-THAILAND:TWA 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

PACIFIC COAST CEMENT CORP. -- PORTLAND CEMENT -- 5610-00-242-3793

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====================  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
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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.

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

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.