DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT CHIEF OF STAFF FOR INSTALLATION MANAGEMENT
600 ARMY PENTAGON
WASHINGTON, DC 20310-0600

REPLY TO
ATTENTION OF

December 20, 2016

MEMORANDUM FOR: DIEDRE LLOYD (USEPA-Region 4) and
JAMIE WOODS (TDEC)

SUBJECT: UFP-QAPP Work Plan – Off Depot Air Sparge Well Installation – Rev. 1
Defense Depot Memphis, Tennessee

1. The purpose of this memorandum is to submit the UFP-QAPP Work Plan for the Off Depot Air Sparge Well Installation at Defense Depot Memphis, Tennessee. The document has been revised to incorporate the approved response to comments from USEPA.

2. For more information, please contact the Trinity Project Manager, Todd Calhoun, at (850) 588-1001 (tcalhoun@trinityadc.com).

Joan Hutton for

JAMES C. FOSTER
Program Manager
Base Realignment and Closure Division

REV. 1

Uniform Federal Policy-Quality Assurance Project Plan
Off Depot Air Sparge Well Installation Work Plan
Dunn Field
Defense Depot Memphis, Tennessee

Prepared for:

Department of the Army

Under Contract to:

U.S. Army Corps of Engineers
Mobile District
109 St. Joseph Street
Mobile, Alabama 36602

Prepared by:

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Shalimar, Florida 32579
850-613-6800

Contract No. W9128F-11-D-0029, Task Order CK01

December 2016

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Acronyms and Abbreviations

µg/L	micrograms per liter
ACSIM-ODB	Assistant Chief of Staff for Installation Management, Base Realignment and Closure Division
AS	air sparge
bgs	below ground surface
BEC	BRAC Environmental Coordinator
BRAC	Base Realignment and Closure
CALIBRE	CALIBRE Systems, Inc.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CESAM	U.S. Army Corps of Engineers, Mobile District
CVOC	chlorinated volatile organic compound
DCE	dichloroethene
DDMT	Defense Depot Memphis, Tennessee
DoD	Department of Defense
DQO	data quality objective
FTL	Field Team Leader
HAZWOPER	hazardous waste operations
HDPE	high density polyethylene
HDR	HDR Inc.
HSO	Health and Safety Officer
IDW	investigation derived waste
IRA	interim removal action
LTM	long-term monitoring
LUC	Land Use Control
MPC	measurement performance criteria
NPT	National Pipe Thread
OSHA	Occupational Safety and Health Administration
PCE	tetrachloroethene
PID	photoionization detector
PLS	professional land surveyor
PPE	personal protective equipment
PVC	polyvinyl chloride
QC	quality control
RA	remedial action
RW	recovery well
SOP	standard operating procedure
SSHO	Site Safety and Health Officer

SVE	soil vapor extraction
TC	target concentration
TCA	trichloroethane
TCE	trichloroethene
TDEC	Tennessee Department of Environment and Conservation
TeCA	tetrachloroethane
Trinity	Trinity Analysis & Development Corp.
UFP-QAPP	Uniform Federal Policy-Quality Assurance Project Plan
USEPA	U.S. Environmental Protection Agency
VC	vinyl chloride
VMP	vapor monitoring point
ZVI	zero valent iron

Worksheet 1 - Title and Approval Page

Document Title:	Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) Off Depot Air Sparge Well Installation Defense Depot Memphis, Tennessee (DDMT) Shelby County, Tennessee
Lead Organization:	Department of the Army
Lead Regulatory Organization:	U.S. Environmental Protection Agency (USEPA) Region 4 Tennessee Department of Environment and Conservation (TDEC)
Preparer's Name and Organizational Affiliation:	Robyn Peterson, Trinity Analysis & Development Corp. (Trinity)
Preparer's Contact Information:	1002 N. Eglin Pkwy Shalimar, Florida 32579 850-613-6800 rpeterson@trinityadc.com
Preparation Date:	December 2016

Todd Calhoun — 11/23/2016

Todd Calhoun, PG
Trinity Project Manager — Date

Laura Roebuck — 11/23/2016

Laura Roebuck
U.S. Army Corps of Engineers, Mobile District (CESAM) Technical Manager — Date

Carolyn Jones — 11/23/2016

Carolyn Jones
Assistant Chief of Staff for Installation Management, Base Realignment and Closure Division (ACSIM-ODB) Program Manager — Date

Diedre Lloyd — 12/9/2016

Diedre Lloyd
USEPA Region 4 Remedial Project Manager — Date

Jamie Woods — 10/11/2016

Jamie Woods
TDEC Remedial Project Manager — Date

Worksheet 2 - QAPP Identifying Information

Project Name:	Off Depot Air Sparge Well Installation Defense Depot Memphis, Tennessee
Site Location:	Memphis, Shelby County, Tennessee
Site Number/Code:	TN4210020570
Contractor Name:	Trinity Analysis & Development Corp. (Trinity)
Contract Number:	W9128F-11-D-0029
Task Order Title:	Environmental Restoration Support 2016 Defense Depot Memphis, Tennessee (DDMT)
Work Assignment Number:	Task Order CK01
Guidance Used to Prepare UFP-QAPP	Uniform Federal Policy for Quality Assurance Project Plans Part 1: UFP-QAPP Manual, EPA-500-B-04-900A, Intergovernmental Data Quality Task Force, March 2005
Dates of Scoping Sessions	No task specific scoping sessions were held. Monthly project team calls held to provide updates as necessary.
Identify Regulatory Programs:	Comprehensive Environmental Response, Compensation, and Liability Act, as amended by the Superfund Amendments and Reauthorization Act (CERCLA) National Priorities List
Generic or Project Specific QAPP:	This is a project-specific QAPP
List organizational partners (stakeholders) and connection with lead organization:	USEPA Region 4 TDEC CESAM
List Data Users:	ACSIM-ODB, CESAM, USEPA Region 4, TDEC, Trinity, HDR Inc. (HDR)
List dates and titles of work plan documents written for previous site work, if applicable:	Remedial Action Operations and Long Term Monitoring Quality Assurance Project Plan (HDR, 2014) Memphis Depot Dunn Field Off Depot Groundwater Final Remedial Design, Rev. 1 (CH2M Hill, 2008) Annual Long-Term Monitoring Report – 2015 Defense Depot Memphis, Tennessee (HDR, 2015)
Preparation Date:	December 2016

QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to UFP-QAPP Worksheet #
Project Management and Objectives		
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2.2 Document Format and Table of Contents 2.2.1 Document Control Format 2.2.2 Document Control Numbering System 2.2.3 Table of Contents 2.2.4 QAPP Identifying Information	 -Table of Contents -QAPP Identifying Information	 Worksheet 2
2.3 Distribution List and Project Personnel Sign-Off Sheet 2.3.1 Distribution List 2.3.2 Project Personnel Sign-Off Sheet	 -Distribution List -Project Personnel Sign-Off Sheet	 Worksheet 3 Worksheet 4; Table 1
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2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping) 2.5.2 Problem Definition, Site History, and Background	 -Project Planning Session Documentation -Project Scoping Session Participants Sheet -Problem Definition, Site History, and Background -Site maps	 Worksheet 9 Worksheet 10; Figures 2-9
2.6 Project Quality Objectives and Measurement Performance Criteria 2.6.1 Development of Project Quality Objectives Using the Systematic Planning Process 2.6.2 Measurement Performance Criteria	-Site-Specific Project Quality Objectives -Measurement Performance Criteria	Worksheet 11; Table 5 Worksheet 12; not applicable
2.7 Secondary Data Evaluation	-Sources of Secondary Data and Information -Secondary Data Criteria and Limitations	 Worksheet 13; Table 6
2.8 Project Overview and Schedule 2.8.1 Project Overview 2.8.2 Project Schedule	-Summary of Project Tasks -Reference Limits and Evaluation -Project Schedule/Timeline	Worksheet 14, Figure 10 Worksheet 15; not applicable Worksheet 16; Table 7

QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to UFP-QAPP Worksheet #
Measurement/Data Acquisition		
3.1 Sampling Tasks		
3.1.1 Sampling Process Design and Rationale	-Sampling Design and Rationale -Sample Location	Worksheet 17; not applicable
3.1.2 Sampling Procedures and Requirements		Worksheet 14, Figure 10
3.1.2.1 Sampling Collection Procedures	-Sampling Locations and Methods/ Standard Operating Procedure (SOP) Requirements	Worksheet 18; not applicable Field SOPs in Attachment 1
3.1.2.2 Sample Containers, Volume, and Preservation	-Analytical Methods/SOP Requirements	Worksheet 19; not applicable
3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures	-Field Quality Control (QC) Sample Summary -Sampling SOPs	Worksheet 20; not applicable Worksheet 21; Table 8; Field SOPs in Attachment 1
3.1.2.4 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures	-Field Equipment Calibration, Maintenance, Testing, and Inspection	Worksheet 22; Table 9
3.1.2.5 Supply Inspection and Acceptance Procedures		
3.1.2.6 Field Documentation Procedures		
3.2 Analytical Tasks		
3.2.1 Analytical SOPs	-Analytical SOPs	Worksheet 23; not applicable
3.2.2 Analytical Instrument Calibration Procedures	-Analytical SOPs References -Analytical Instrument Calibration	
3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures	-Analytical Instrument and Equipment Maintenance, Testing, and Inspection	Worksheet 24; not applicable
3.2.4 Analytical Supply Inspection and Acceptance Procedures		Worksheet 25; not applicable
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures	-Sample Collection Documentation, Handling, Tracking and Custody SOPs	
3.3.1 Sample Collection Documentation	-Sample Container Identification	Worksheet 26; not applicable; Field SOPs in Attachment 1
3.3.2 Sample Handling and Tracking System	-Sample Handling Flow Diagram	
3.3.3 Sample Custody	-Example Chain of Custody Form and Seal	Worksheet 27; not applicable
3.4 Quality Control Samples	-QC Samples	Worksheet 28; not applicable
3.4.1 Sampling Quality Control Samples		
3.4.2 Analytical Quality Control Samples	-Screening/Confirmatory Analysis Decision Tree	Not required for this project.

QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to UFP-QAPP Worksheet #
3.5 Data Management Tasks 3.5.1 Project Documentation and Records 3.5.2 Data Package Deliverables 3.5.3 Data Reporting Formats 3.5.4 Data Handling and Management 3.5.5 Data Tracking and Control	-Project Documents and Records -Analytical Services -Data Management SOPs	Worksheet 29; not applicable Worksheet 30; not applicable Worksheet 14; not applicable
Assessment/Oversight		
4.1 Assessments and Response Actions 4.1.1 Planned Assessments 4.1.2 Assessment Findings and Corrective Action Responses	-Assessments and Response Actions -Planned Project Assessments -Audit Checklists -Assessment Findings and Corrective Actions Responses	Worksheet 31; Table 10 Worksheet 32; Table 11
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5.1 Overview		
5.2 Data Review Steps 5.2.1 Step I: Verification 5.2.2 Step II: Validation 5.2.2.1 Step IIa Validation Activities 5.2.2.2 Step IIb Validation Activities 5.2.3 Step III: Usability Assessment 5.2.3.1 Data Limitations and Actions from Usability Assessment 5.2.3.2 Activities	-Verification (Step I) Process Table -Validation (Steps IIa and IIb) Process Table -Validation (Steps IIa and IIb) Summary Table -Usability Assessment	Worksheet 34; not applicable Worksheet 35; not applicable Worksheet 36; not applicable Worksheet 37; not applicable
5.3 Streamlining Data Review 5.3.1 Data Review Steps to be Streamlined 5.3.2 Criteria for Streamlining Data Review 5.3.3 Amounts and Types of Data Appropriate for Streamlining	Not applicable	Not applicable

Worksheet 3 - Distribution List

Document Title:	Internal Draft Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) Off Depot Air Sparge Well Installation, Defense Depot Memphis, Tennessee, Shelby County, Tennessee
Contract Number:	W9128F-11-D-0029/CK01

Recipient	Title	Organization	Telephone Number	Email Address
Carolyn Jones	Program Manager	ACSIM-ODB	703-545-2508	carolyn.a.jones28.civ@mail.mil
Joan Hutton	BRAC Environmental Coordinator (BEC)	CALIBRE Systems, Inc. (CALIBRE)	770-317-4323	joan.hutton@calibresys.com
Laura Roebuck	CESAM Technical Manager	CESAM	251-690-3480	laura.w.roebuck@usace.army.mil
Diedre Lloyd	Remedial Project Manager	USEPA Region 4	404-562-8855	lloyd.diedre@epa.gov
Jamie Woods	Remedial Project Manager	TDEC Division of Remediation	901-371-3041	jamie.woods@tn.gov
Todd Calhoun	Project Manager	Trinity	850-588-1001	tcalhoun@trinityadc.com
Robyn Peterson	Project Engineer	Trinity	850-613-6800	rpeterson@trinityadc.com
Tom Holmes	Project Manager	HDR	404-295-3279	thomas.holmes@hdrinc.com
Project File	---	Trinity	---	---

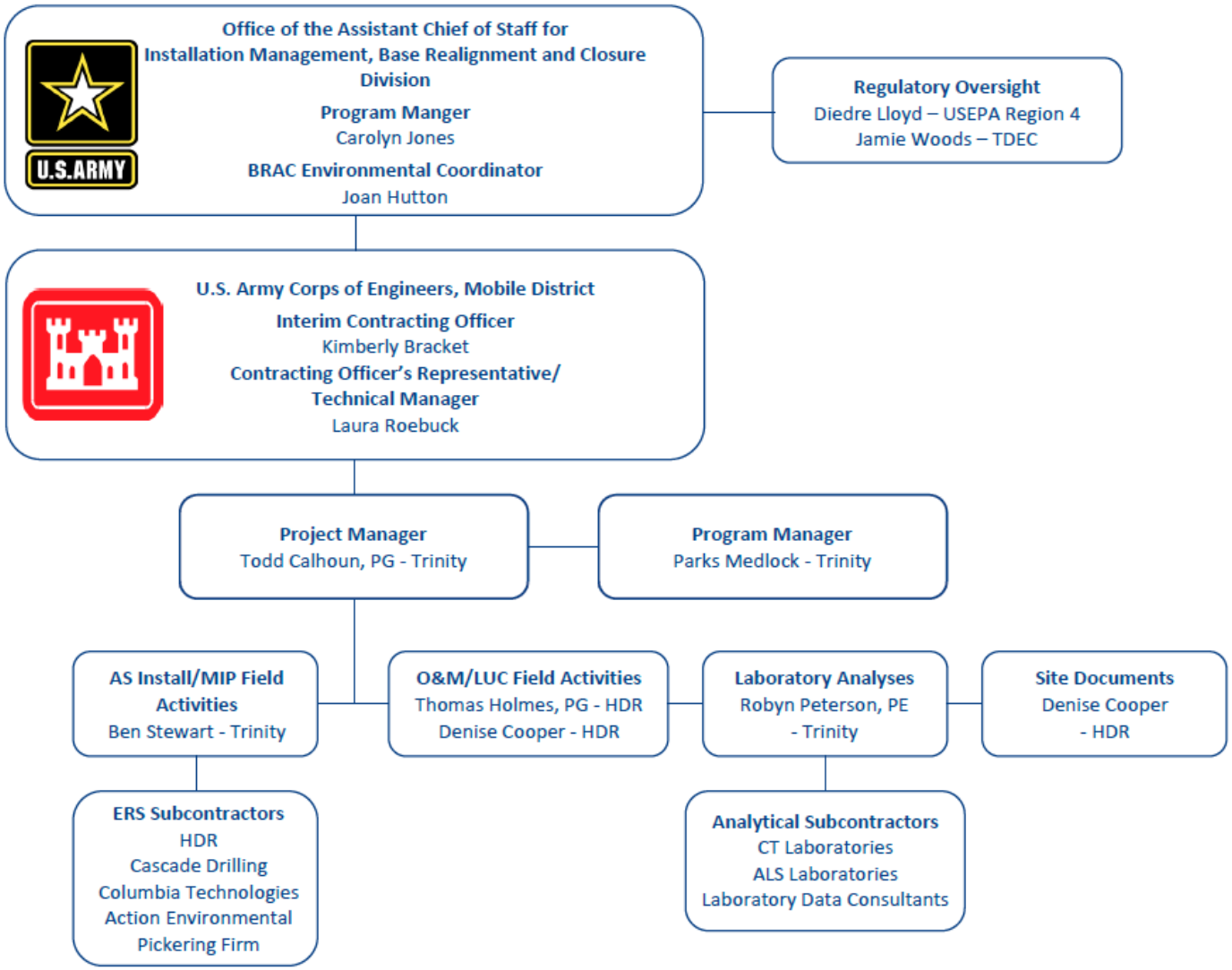
Worksheet 4 - Project Personnel Sign-Off Sheet

Table 1 Personnel Sign-Off Sheet

Project Personnel	Project Title	Telephone Number	Signature/Date QAPP Read Email Receipt
ACSIM-ODB			
Carolyn Jones	Program Manager	703-545-2508	
BEC			
Joan Hutton	BRAC Environmental Coordinator	770-317-4323	
CESAM			
Laura Roebuck	CESAM Technical Manager	251-690-3480	
USEPA Region 4			
Diedre Lloyd	USEPA Remedial Project Manager	404-562-8855	
TDEC			
Jamie Woods	TDEC Remedial Project Manager	901-371-3041	
Trinity			
Parks Medlock	Program Manager	850-588-0706	
Todd Calhoun	Project Manager	850-588-1001	
Robyn Peterson	Project Engineer	850-613-6800	
Ben Stewart	Project Geologist/Field Team Leader (FTL)/Site Safety and Health Officer (SSHO)	850-312-6576	
Jeanette Baldwin	Corporate Health and Safety Officer (HSO)	850-547-6243	

Worksheet 5 - Project Organizational Chart

Figure 1 Project Organizational Chart



Worksheet 6 - Project Communication Pathways

Table 2 Communication Pathways

Communication Drivers	Responsible Entity	Name	Contact Information	Procedure (Timing, Pathways, Documentation, etc.)
Contract Execution	CESAM Technical Manager	Laura Roebuck	laura.w.roebuck@usace.army.mil 251-690-3480	E-mail/communication with Trinity Project Manager.
Manage all Task Order phases	Trinity Project Manager	Todd Calhoun	tcalhoun@trinityadc.com 850-588-1001	All project information will be copied to the BEC and CESAM Technical Manager. Trinity Project Manager will notify BEC and CESAM Technical Manager of field related problems by phone, email, or fax by close of business the day of the event if possible and no later than noon Central Daylight/Standard Time the following day.
Regulatory agency interface	BEC	Joan Hutton	joan.hutton@calibresys.com 770-317-4323	Coordination and communication with regulatory agencies will be completed by the BEC. All regulatory interactions will be documented.
Field progress reports	Trinity FTL/ Trinity Project Manager	Ben Stewart/ Todd Calhoun	bstewart@trinityadc.com 251-709-6509 (cell) tcalhoun@trinityadc.com 850-588-1001	Daily Quality Control Reports (DQCRs) will be prepared by the FTL and provided to the Trinity Project Manager for review and issuance to the BEC and CESAM Technical Manager.
Field corrective actions	Trinity FTL/ Trinity Project Manager	Ben Stewart/ Todd Calhoun	bstewart@trinityadc.com 251-709-6509 (cell) tcalhoun@trinityadc.com 850-588-1001	Corrective actions will be issued in writing by the FTL to the Project Manager for review and approval.

Communication Drivers	Responsible Entity	Name	Contact Information	Procedure (Timing, Pathways, Documentation, etc.)
QAPP changes prior to field work	Trinity FTL/ Trinity Project Manager	Ben Stewart/ Todd Calhoun	bstewart@trinityadc.com 251-709-6509 (cell) tcalhoun@trinityadc.com 850-588-1001	Change pages for the QAPP will be issued to all stakeholders via hard copy for approval.
QAPP changes during project execution	Trinity FTL/ Trinity Project Manager	Ben Stewart/ Todd Calhoun	bstewart@trinityadc.com 251-709-6509 (cell) tcalhoun@trinityadc.com 850-588-1001	Change pages for the QAPP will be issued to all stakeholders via electronic mail (e-mail) and followed up by hard copy.
Health and Safety issues	Trinity FTL/ Trinity Corporate HSO	Ben Stewart/ Jeanette Baldwin	bstewart@trinityadc.com 251-709-6509 (cell) jbaldwin@trinityadc.com 850-547-6243	The on-site FTL/SSHO will verbally report any issue to the HSO and notify the CESAM Technical Manager verbally, at a minimum. An incident form must be completed within 24 hours by the SSHO/FTL and submitted to the Trinity HSO for review and approval.
Stop Work Authority	All Site Workers		jbaldwin@trinityadc.com 850-547-6243	All site workers can issue a stop work order for issues that present immediate and imminent danger. The HSO will be consulted after the Stop Work verbally and then with a follow-up documented report per the Site Safety and Health Plan (Trinity, 2016).

Worksheet 7 - Personnel Responsibilities

Table 3 Personnel Qualifications

Project Personnel	Project Title	Organizational Affiliation	Responsibilities	Education and Experience
Joan Hutton	BEC	CALIBRE	Oversees project and responds to USEPA and TDEC	Master of Science, Marine Science, 30 yrs. experience
Parks Medlock	Program Manager	Trinity	Contract management and provides resource support	Bachelor of Science, Chemistry, 23 yrs. experience
Todd Calhoun, PG	Project Manager	Trinity	Manages project	Bachelor of Science, Geology, 21 yrs. experience
Robyn Peterson, PE	Project Engineer	Trinity	Provides technical direction	Bachelor of Science, Biological Engineering, 21 yrs. experience
Ben Stewart	Field Team Leader	Trinity	Supervises field activities	Bachelor of Science, Geology, 5 yrs. experience

Worksheet 8 - Special Personnel Training Requirements Table

Table 4 Special Personnel Training Requirements

Project Function	Specialized Training – Title or Description of Course	Training Provider	Training Date	Personnel/ Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/ Certificates
Field Investigation Activities	40-Hour Hazardous Waste Operations (HAZWOPER) Training	Cooey Environmental	03/20/2011	Ben Stewart	FTL	Trinity Shalimar, Florida
	8-Hour HAZWOPER Refresher	U.S. Air Force	02/23/2016			
	8-Hour Occupational Safety and Health Administration (OSHA) Supervisor Training	ABAG Training Center	05/14/2013			
	First Aid/Cardiopulmonary Resuscitation	American Red Cross	06/26/2016			
	OSHA Excavation Safety Training for Competent Persons	ABAG Training Center	04/24/2015			
	Department of Transportation (DOT) HazMat Carrier Requirements (Highway)	Compliance Training Online	10/21/2013			

Worksheet 9 - Project Scoping Session Participants Sheet

Routine monthly team meetings are held with the following participants. Agendas and post-meeting notes are submitted to the team members.

Name	Organization	Title/Role	Email/Phone
Carolyn Jones	ACSIM-ODB	Program Manager	carolyn.a.jones28.civ@mail.mil 703-545-2508
Joan Hutton	CALIBRE	BEC	joan.hutton@calibresys.com 770-317-4323
Laura Roebuck	CESAM	Technical Manager	laura.w.roebuck@usace.army.mil 251-690-3480
Diedre Lloyd	USEPA Region 4	Remedial Project Manager	lloyd.diedre@epa.gov 404-562-8855
Jamie Woods	TDEC	Remedial Project Manager	jamie.woods@tn.gov 901-371-3041
Todd Calhoun	Trinity	Project Manager	tcalhoun@trinityadc.com 850-588-1001
Tom Holmes	HDR	Project Manager	thomas.holmes@hdrinc.com 404-295-3279

Worksheet 10 - Problem Definition

Site Location and History

DDMT is in southeastern Memphis, Shelby County, Tennessee approximately 5 miles east of the Mississippi River and 2 miles north of Memphis International Airport (**Figure 2**). DDMT originated as a military facility in the early 1940s; it received, warehoused, and distributed supplies common to all United States military services and some civil agencies located primarily in the southeastern United States, Puerto Rico, and Panama. Stocked items included food, clothing, petroleum products, construction materials, and industrial, medical, and general supplies. In 1995, DDMT was placed on the list of the Department of Defense (DoD) facilities to be closed under BRAC. Storage and distribution of material continued until the facility closed in September 1997.

The property consists of approximately 632 acres and includes the Main Installation and Dunn Field. The Main Installation covers approximately 567 acres and had open storage areas, warehouses, military family housing, and outdoor recreational areas. Dunn Field, which is located across Dunn Avenue from the north-northwest portion of the Main Installation, covers approximately 65 acres and had mineral storage and waste disposal areas (HDR, 2015). The Off Depot study area lies west of Dunn Field, generally northwest of the adjacent railroad tracks (**Figure 3**).

In October 1992, DDMT was added to the National Priorities List (57 Federal Register 47180 No. 199). Responsibility for environmental restoration at DDMT transferred from the Defense Logistics Agency to the Department of the Army in December 2010. The regulatory oversight agencies are USEPA Region 4 and TDEC.

The R*ecord of Decision for Interim Remedial Action of the Groundwater at Dunn Field (OU-1)* (CH2M Hill, 1996) was signed in April 1996 with the objective of hydraulic containment to prevent further contaminant plume migration and reduce contaminant mass in groundwater. The interim remedial action (IRA) groundwater recovery system included 11 recovery wells (RWs) screened in the Fluvial Aquifer along the western boundary of Dunn Field. The system became operational in November 1998. Based on reduction in chlorinated volatile organic compound (CVOC) concentrations in groundwater following implementation of the Dunn Field Source Areas remedial action (RA), five RWs were shut down in June 2008 and the remaining RWs were shut down in January 2009. The IRA system was removed and the RWs abandoned in July 2010.

The groundwater remedial action objectives (RAOs) established in the *Dunn Field Record of Decision* (CH2M Hill, 2004) are:

- to prevent human exposure to contaminated groundwater (i.e., exceeding protective target concentrations [TCs])
- to prevent further off-site migration of VOCs in excess of protective target levels
- to remediate Fluvial Aquifer groundwater to drinking water quality to be protective of the deeper Memphis Aquifer

The remedies were implemented in three phases: Disposal Sites, Source Areas, and Off Depot. The selected remedies for the Source Areas and Off Depot were modified through the *Dunn Field Record of Decision Amendment* (e2M, 2009a).

The Disposal Sites RA included excavation and off-site disposal of soil and waste material from five sites and was completed in 2006.

The Source Areas RA included soil vapor extraction (SVE) in the vadose zone and injection of zero valent iron (ZVI) in groundwater. The Fluvial SVE system was operated from July 2007 to July 2012 and removed approximately 4,000 pounds of VOCs. The Fluvial SVE system was shut down after soil remediation goals were met. Thermal SVE was performed in the loess from May to December 2008 and removed approximately 12,500 pounds of VOCs. ZVI injection was not required due to success of SVE in reducing groundwater impacts. Excavation and off-site disposal of soil and waste material in two additional areas were also conducted in the Source Areas RA.

The Off Depot RA included installation of an air sparge (AS)/SVE system and implementation of Land Use Controls (LUCs) on Dunn Field. The AS/SVE system with 90 AS points and 12 SVE wells began operation in December 2009. LUCs were implemented through deed restrictions, zoning regulations, and Notice of Land Use Restrictions recorded in June 2009, and annual inspections since 2009. The AS/SVE system was installed to reduce individual CVOC concentrations in the treatment area below 50 micrograms per liter (µg/L) and to continue operation until the upgradient concentrations of individual CVOCs in the Dunn Field plume do not exceed 50 µg/L. AS/SVE in combination with natural attenuation processes is expected to reduce groundwater concentrations to USEPA maximum contaminant levels (MCLs) in accordance with RAOs in the Dunn Field Record of Decision. From December 2009 through December 2015, it was estimated that the AS/SVE system had removed approximately 84 pounds of VOCs (HDR, 2016).

The *Dunn Field Off Depot Remedial Action Work Plan* (e2M, 2009b) identifies one of the metrics for determining that the AS/SVE system is operating successfully as "vacuum influence as indicated by negative pressure measurements from the vapor monitoring points (VMPs) extends throughout AS/SVE barrier". The document also states that "the VMPs will allow pressure readings to be collected to evaluate the radius of influence of the SVE wells…". Vacuum measurements for Year 5 of the system operation were reviewed and evaluated and negative pressures were observed at all VMP locations. VMP locations VMP08A/B and VMP09A/B are located north and south of the proposed AS well locations and confirm the effectiveness of the SVE system in that area to capture any vapors created by the proposed AS system modifications. Year 5 Average Vacuum Readings for the VMPs are shown on **Figure 4.**

Previous Investigations

As described above, a phased approach to remedial actions was used, targeting disposal sites then source areas at Dunn Field, followed by the Off Depot area (*Dunn Field Record of Decision*, CH2M Hill, 2004). Initially the selected active remedy for Off Depot groundwater was to be installation of a permeable reactive barrier; however, upon further studies and data analyses, the selected remedy was modified through *Dunn Field Record of Decision Amendment* (e^2M, 2009a) to be installation of an AS/SVE system with long-term monitoring (LTM) of groundwater and implementation of LUCs to prevent access to contaminated groundwater.

According to results from LTM activities at Dunn Field (inclusive of the Off Depot area), the CVOCs in groundwater above USEPA MCLs are carbon tetrachloride, chloroform, 1,1-dichloroethene (DCE), trans-1,2-DCE, cis-1,2-DCE, 1,1,2,2-tetrachloroethane (TeCA), tetrachloroethene (PCE), 1,1,1-trichloroethane (TCA), 1,1,2-TCA, trichloroethene (TCE), and vinyl chloride (VC).

During the Off Depot Baseline Sampling event conducted in 2009 prior to startup of the AS/SVE system, groundwater samples were collected from 36 (33 fluvial aquifer/3 intermediate aquifer) performance monitoring wells. A total of 9 VOCs were detected at concentrations above MCLs/TCs at 26 of the fluvial aquifer wells in the vicinity of the AS/SVE system. Except for TCE in MW-159, all these wells currently

have concentrations below the active remediation goal and several are below MCLs. The TCE concentration in MW-159 decreased from 1,280 µg/L in June 2009 to 280 µg/L in June 2010. Since that time TCE concentrations have been relatively stable. CVOC concentrations detected in MW-159 during sampling events conducted from April 2014 through October 2015 are shown on **Figure 5**. Total CVOC concentrations for the Dunn Field/Off Depot area in October 2015 are shown on **Figure 6**.

Problem Definition

CVOCs continue to be detected at concentrations above MCLs and TCs in monitoring well MW-159 which is upgradient of the existing AS/SVE system. Since these CVOCs continue to persist above MCLs/TCs, there is a need to modify the existing treatment system to effectively target the area around MW-159.

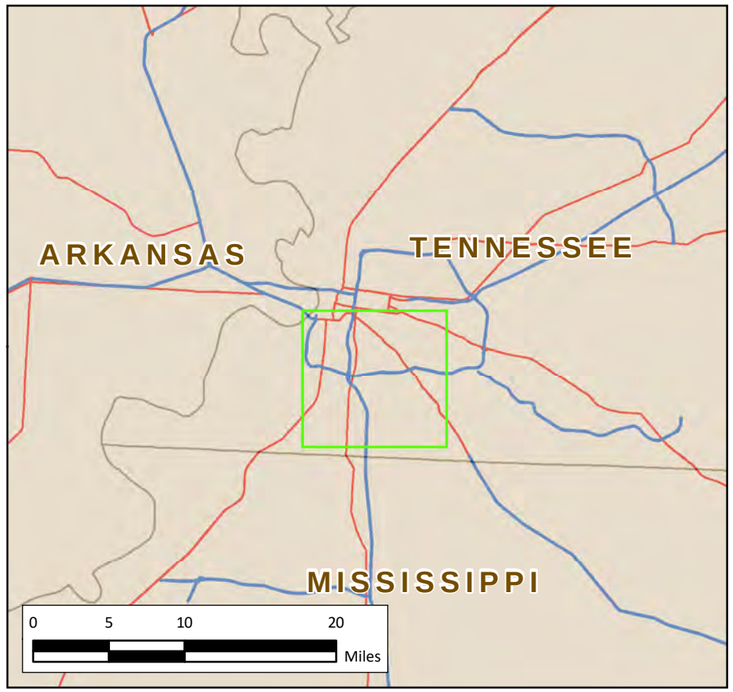
Topography, Geology, and Hydrogeology

The topography of the Off Depot study area drops in elevation from approximately 295 feet above mean sea level along the railroad right of way on the east side to roughly 285 feet above mean sea level near the west boundary (**Figure 7**).

The geologic units of interest at Dunn Field are (from youngest to oldest): loess, including surface soil; fluvial deposits; Jackson Formation/Upper Claiborne Group; and Memphis Sand. The loess consists of wind-blown and deposited brown to reddish-brown, low plasticity clayey silt to silty clay. The loess deposits are unsaturated, about 20 to 30 feet thick, and are continuous throughout the Dunn Field area.

The fluvial (terrace) deposits consist of two general layers. The upper layer is a silty, sandy clay that transitions to a clayey sand and ranges from about 10 to 36 feet thick. The lower layer is composed of interbedded sand, sandy gravel, and gravelly sand, and has an average thickness of approximately 40 feet. The uppermost aquifer is the unconfined fluvial aquifer, consisting of saturated sands and gravelly sands in the lower portion. The saturated thickness of the fluvial aquifer ranges from 3 to 50 feet and is controlled by the configuration of the uppermost clay in the Jackson Formation/Upper Claiborne Group. Groundwater in the fluvial aquifer is not a drinking water source for area residents. A generalized lithologic cross-section of Dunn Field is provided as **Figure 8**.

Groundwater flow direction of the unconfined fluvial aquifer is depicted on **Figure 9**. At Dunn Field, groundwater flow is generally to the west. There is a trough, however, depicted on the figure in the Off Depot area near MW-165, in the vicinity of the AS/SVE system. Groundwater flow in the fluvial aquifer converges on this trough from the east and northwest, and flow from the AS/SVE area diverges to the north and south.



Service Layer Credits: TN Department of Transportation

Trinity Analysis & Development Corp.

Figure 2
Site Location

Dunn Field
Defense Depot Memphis, Tennessee
Memphis, Shelby County, Tennessee

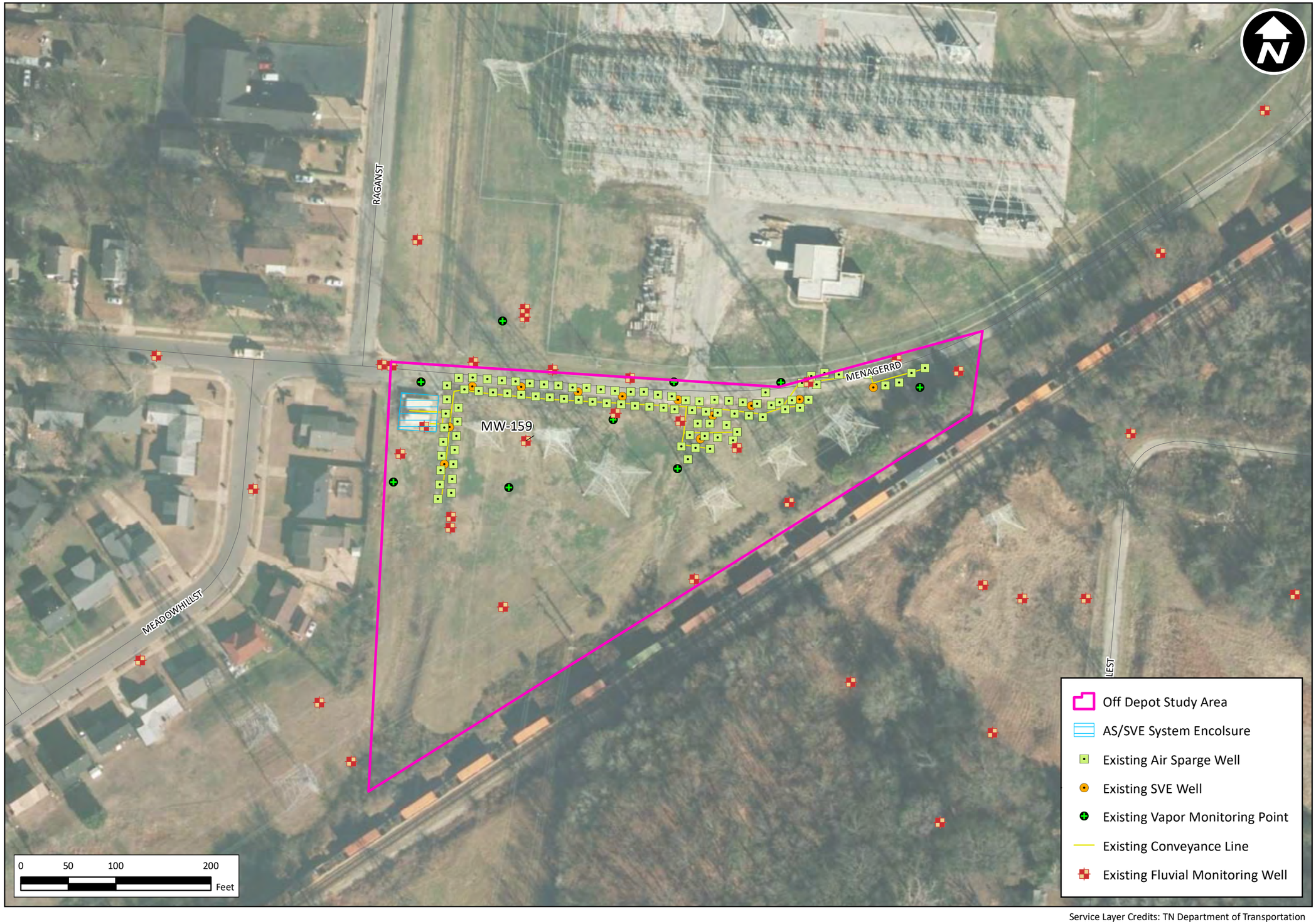
PROJECT NO:	SCALE:	DATE:	DRAWN BY:
W9128F-11-D-0029 CK01	AS SHOWN	10/31/2016	JTC

U.S.ARMY

Figure 3
Site Layout

Dunn Field
Defense Depot Memphis, Tennessee
Memphis, Shelby County, Tennessee

DRAWN BY:	DATE:	SCALE:	PROJECT NO:
JTC	10/31/2016	AS SHOWN	W9128F-11-D-0029 CK01



Service Layer Credits: TN Department of Transportation

Trinity Analysis & Development Corp.

Figure 4
Vapor Zone Monitorng Points
Year 5 Average Vacuum Readings

Ragan

Menager

Rozelle

ODVMP-06A 16.9
ODVMP-06B 17.1
ODVMP-07A 17.4
ODVMP-07B 15.0
ODVMP-05A 16.8
ODVMP-05B 18.9
ODVMP-02A 14.4
ODVMP-02B 14.0
ODVMP-01B 10.2
ODVMP-01A 12.3
ODVMP-09A 19.9
ODVMP-09B 20.0
ODVMP-04A 19.7
ODVMP-04B 19.4
MW-159
ODVMP-03A 14.6
ODVMP-03B 15.0
ODVMP-10A 20.3
ODVMP-10B 21.1
ODVMP-08A 18.7
ODVMP-08B 18.8

Notes:
Vapor Zone Monitoring point vacuum measurements units are in inches of water and reflect negative pressures.
Measurements reflect an average of valid data collected from January 2014 through October 2015.

0 25 50 100
Feet

- Existing Vapor Monitoring Point
- Existing Fluvial Monitoring Well
- Existing Air Sparge Well
- Existing SVE Well
- Existing Conveyance Line
- Off Depot Study Area

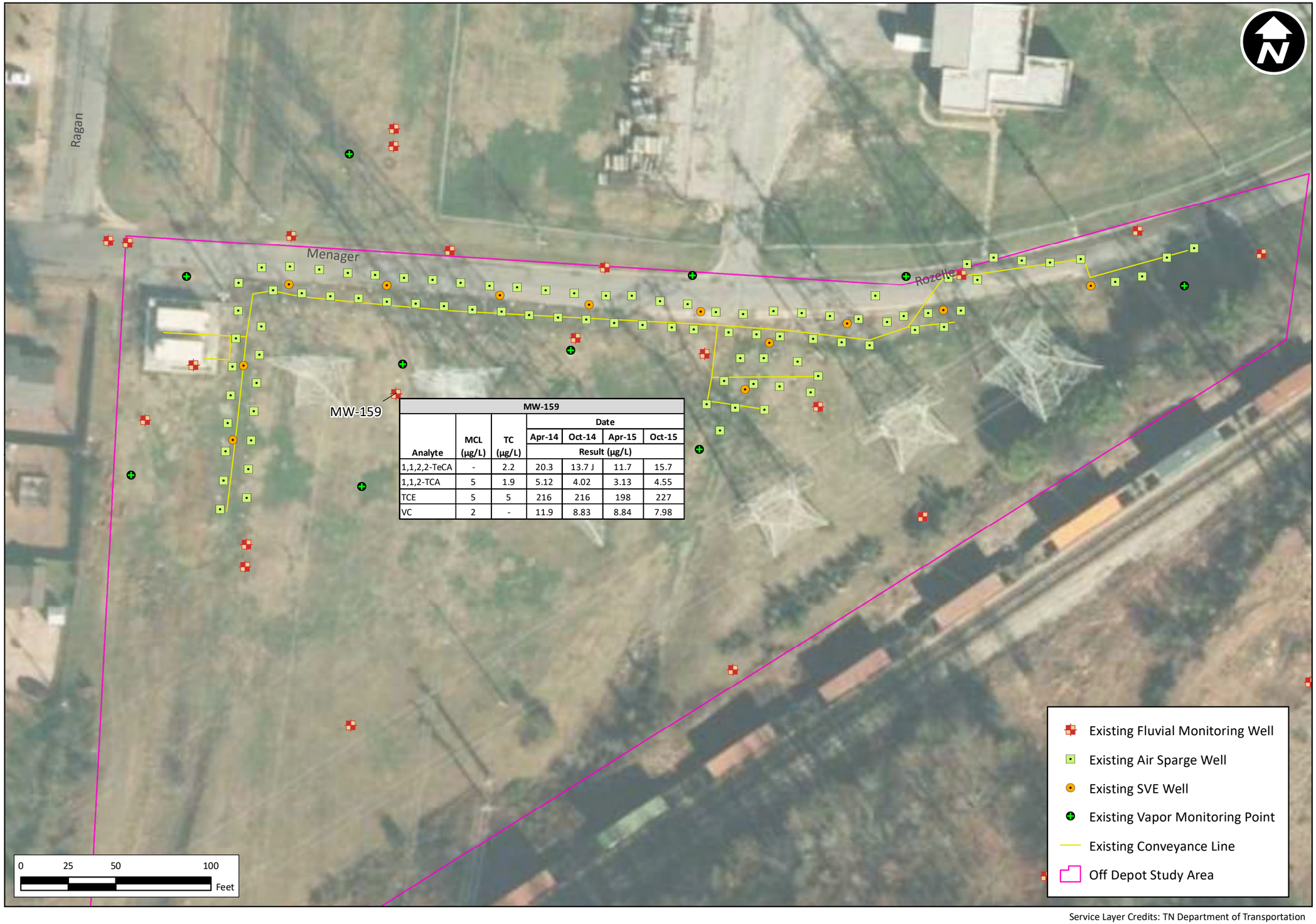
Service Layer Credits: TN Department of Transportation

Trinity Analysis & Development Corp.

Dunn Field
Defense Depot Memphis, Tennessee
Memphis, Shelby County, Tennessee

DRAWN BY: JTC
DATE: 11/21/2016
SCALE: AS SHOWN
PROJECT NO: W9128F-11-D-0029 CK01

U.S.ARMY



MW-159						
			Date			
Analyte	MCL (µg/L)	TC (µg/L)	Apr-14	Oct-14	Apr-15	Oct-15
			Result (µg/L)			
1,1,2,2-TeCA	-	2.2	20.3	13.7 J	11.7	15.7
1,1,2-TCA	5	1.9	5.12	4.02	3.13	4.55
TCE	5	5	216	216	198	227
VC	2	-	11.9	8.83	8.84	7.98

Service Layer Credits: TN Department of Transportation

Trinity Analysis & Development Corp.

Figure 5
MW-159 CVOC Concentrations, 2014 - 2015

Dunn Field
Defense Depot Memphis, Tennessee
Memphis, Shelby County, Tennessee

DRAWN BY: JTC

DATE: 11/21/2016

SCALE: AS SHOWN

PROJECT NO: W9128F-11-D-0029 CK01

U.S.ARMY

Figure 6
Dunn Field Total CVOC Concentrations, October 2015

Dunn Field
Defense Depot Memphis, Tennessee
Memphis, Shelby County, Tennessee

DRAWN BY: JTC
DATE: 10/31/2016
SCALE: AS SHOWN
PROJECT NO: W9128F-11-D-0029 CK01

U.S.ARMY

Off Depot Study Area

Legend

Total TVOC Ranges (µg/L)
- 0 - 10
- 11 - 50
- 51 - 100
- 101 - 500
- Not Sampled

Total CVOC Isopleth (µg/L)
- 10
- 50
- 100
- 200

- Groundwater Flow Direction
- Potentiometric surface of the Fluvial Aquifer 5-ft. contour
- Potentiometric surface of the Fluvial Aquifer 1-ft. contour
- Property Boundary
- Air Sparge Area

Figure 27
Dunn Field Total CVOC Concentrations, October 2015
Annual Long Term Monitoring Report-2015
Defense Depot Memphis, Tennessee

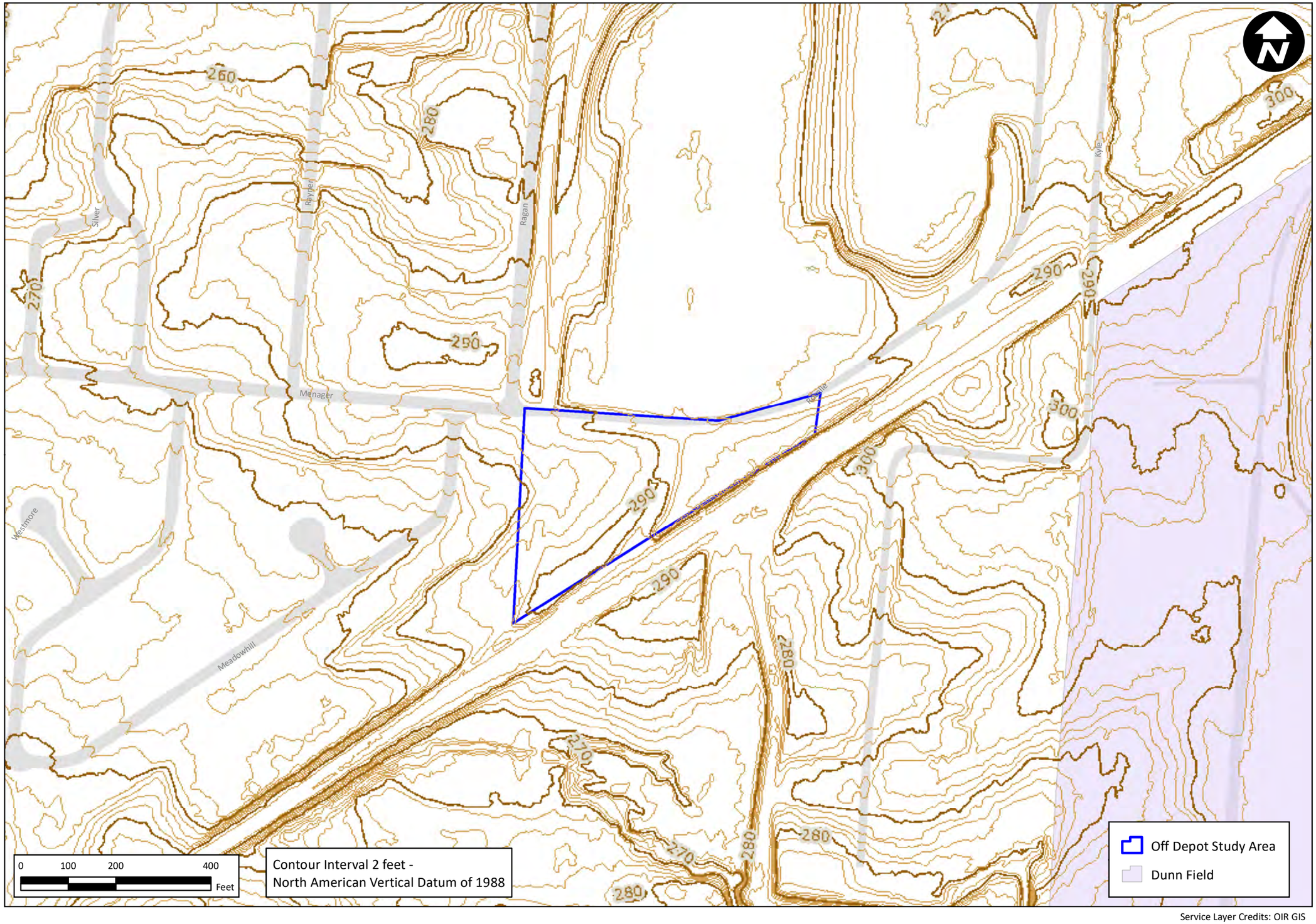
0 100 200
Feet

Notes:
1. Analytical results from the Long Term Monitoring sample event (10/6-8/15).
2. Highest concentration at well pairs used for contour.
3. Results from IAQ and MAQ wells (shown in italics) were not used for isopleths.

Service Layer Credits: HDR, 2016

Trinity Analysis & Development Corp.

Path: W:\Memphis_LTM\7.2_Work_in_Progress\Map_Docs\Draft\27_Figure_27_Dunn_Field_Total_CVOC_Concentrations_October_2015.mxd



Service Layer Credits: OIR GIS

Trinity Analysis & Development Corp.

Figure 7
Site Topography

Dunn Field
Defense Depot Memphis, Tennessee
Memphis, Shelby County, Tennessee

PROJECT NO:	SCALE:	DATE:	DRAWN BY:
W9128F-11-D-0029 CK01	AS SHOWN	10/31/2016	JTC

U.S.ARMY

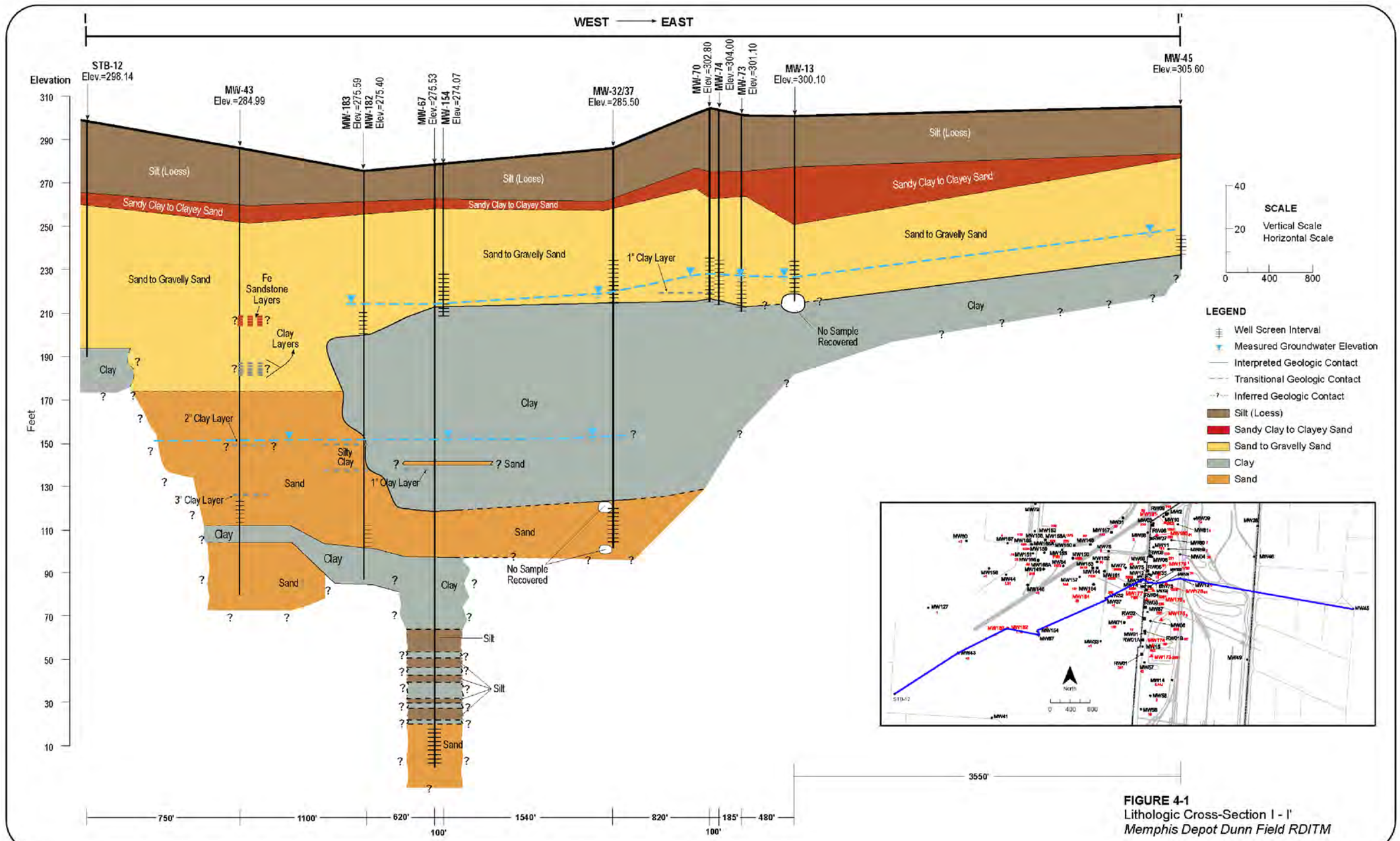


FIGURE 4-1
Lithologic Cross-Section I - I'
Memphis Depot Dunn Field RDITM

CH2MHILL

ES022006012ATL\119

Service Layer Credits: HDR, 2016

Trinity Analysis & Development Corp.

Figure 8
Dunn Field Lithologic Cross-Section

Dunn Field
Defense Depot Memphis, Tennessee
Memphis, Shelby County, Tennessee

DRAWN BY: JTC
DATE: 10/31/2016
SCALE: AS SHOWN
PROJECT NO: W9128F-11-D-0029 CK01

U.S.ARMY

Figure 9
Dunn Field Groundwater Elevations, October 2015

Dunn Field
Defense Depot Memphis, Tennessee
Memphis, Shelby County, Tennessee

DATE: 10/31/2016
DRAWN BY: JTC
SCALE: AS SHOWN
PROJECT NO: W9128F-11-D-0029 CK01

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Off Depot Study Area

Legend

- Monitoring Well Screened in the Fluvial Aquifer
- Monitoring Well Screene in the Transition Zone
- Monitoring Well Screened in the Intermediate Aquifer
- Monitoring Well Screened in the Memphis Aquifer
- Groundwater Flow Direction
- Potentiometric surface of the Fluvial Aquifer 5-ft. contour
- Potentiometric surface of the Fluvial Aquifer 1-ft. contour
- Property Boundary
- Air Sparge Area

MW-03 100.12 Blue: Fluvial Aquifer, used for groundwater contours

MW-107 202.34 Lt Blue: Transition Zone, used for groundwater contours

MW-237 100.15 Orange: Intermediate Aquifer; not contoured

MW-254 156.83 Green: Memphis Aquifer, not contoured

Figure 15
Dunn Field Groundwater Elevations, October 2015

Annual Long Term Monitoring Report-2015

Defense Depot Memphis, Tennessee

0 100 200
Feet

Service Layer Credits: HDR, 2016

Worksheet 11 - Data Quality Objectives

This worksheet is used to develop and document project data quality objectives (DQOs) using the systematic planning process outlined in *Guidance on Systematic Planning Using the Data Quality Objectives Process* (USEPA, 2006). The site-specific DQOs were developed to optimize the existing AS/SVE system, including installation of five additional AS wells, lines, and manifolds using the USEPA seven-step process and are summarized below.

Table 5 Data Quality Objectives

1	Problem Statement	CVOC concentrations in most wells within the AS/SVE system area have been reduced through operation of the system; however, concentrations at MW-159 continue to exceed active treatment objectives.
2	Identify the Goals	Optimize performance of the AS/SVE system to improve CVOC remediation of groundwater through installation of five new AS wells targeting MW-159 with associated new lines and manifolds. Wells will be placed in an east-west line on 15-foot centers near MW-159. New system lines and manifolds will be compatible with existing system and controls.
3	Inputs to the Decision	Data utilized in the decisions regarding installation of the AS/SVE system expansion have been collected through remedial action operations and long-term groundwater monitoring in accordance with Remedial Action Operations and Long Term Monitoring Quality Assurance Project Plan (HDR, 2014). Records for the following will be utilized: system operating hours, air injection and extraction rates, vacuum and photoionization detector readings at SVE wells, system effluent and vapor monitoring points and effluent samples analyzed for VOCs.
4	Study Area Boundaries	The study area is limited to the vicinity of the existing AS/SVE system, located Off Depot, west of Dunn Field and south of Menager Road. More specifically, the work will occur from the AS/SVE Compound to the new AS wells south of MW-159.
5	Analytical Approach	No analytical data other than that for waste characterization will be generated during the AS install activities. SVE effluent and VMP monitoring will continue to be performed in accordance with the previously approved Remedial Action Operations and Long Term Monitoring Quality Assurance Project Plan (HDR, 2014).
6	Acceptable Limits on Decision Error	The performance and acceptance criteria will be those that support the tasks specified above under Identify the Goals and in Worksheets 14 and 17.
7	Develop the Plan	The specific project tasks will be conducted as described in Worksheet 14. This is a stand-alone UFP-QAPP for the installation of five new AS wells and associated lines and manifolds. Routine O&M as well as groundwater monitoring is performed under the Remedial Action Operations and Long Term Monitoring Quality Assurance Project Plan (HDR, 2014).

Worksheet 13 - Secondary Data Criteria and Limitations

Secondary data refer to historical data and background information previously collected at the site. The source(s) of the data, date of collection, planned uses, and limitations of the secondary data are summarized in the following table.

Table 6 Secondary Data Criteria Limitations

Secondary Data Source	Source	Date of Collection	How Data Will Be Used	Limitations on Data Use
Annual Long-Term Monitoring Report – 2015	HDR, 2016	2015	Historical data providing trends and analysis	None
Annual Long-Term Monitoring Report – 2014	HDR, 2015	2014	Historical data providing trends and analysis	None
Dunn Field Off Depot Groundwater Interim Remedial Action Construction Report, Revision 0	HDR, 2011	2009	Existing system details	None

Worksheet 14 - Summary of Project Tasks

This worksheet includes specific tasks and responsible parties. The planned start and end dates for the project tasks are provided in Worksheet 16. The proposed activities are based on the project schedule. A discussion of project activities is presented in the following sections. Field SOPs are included in **Attachment 1** and example field forms are included in **Attachment 2**.

Physical Boundaries for the Area Under Study

The boundaries of the study area are shown in **Figure 10**. Work is limited to the vicinity of the existing AS/SVE system, located off DDMT, west of Dunn Field and south of Menager Road. More specifically, the work will occur from the AS/SVE Compound to the new AS wells south of MW-159.

Pre-Investigation Requirements

Before field activities begin, Trinity will obtain clearance for all subsurface intrusive activities prior to field mobilization. This will include permits from the Shelby County Health Department and approval by Memphis Light Gas and Water Utility. A pre-investigation walk through will be conducted by the FTL to inspect site conditions for equipment access, equipment staging, decontamination area(s), potential site hazards, and emergency evacuation routes. The proposed boring locations will be located and staked by a professional land surveyor (PLS) licensed in the state of Tennessee.

Basis for Placement of new AS wells and Associated lines

Within the existing AS/SVE system area, concentrations of TCE continue to exceed the target concentration for active remediation (50 µg/L) in MW-159. The modifications are proposed to increase the area of influence of the system to target the MW-159 area with the objective to reduce TCE concentrations below the active remediation goal. Individual conveyance piping from each new AS well to the equipment compound provides the greatest operational flexibility and allows adjustment of sparge flow rates from a central location.

Contingencies in the Event Field Conditions Differ from Expected Conditions

The locations of new wells require permits from Shelby County Health Department. New well and line locations require clearance from Memphis Light Gas and Water Utility. In the event the required approvals are not obtained, suitable alternatives will be negotiated with the aforementioned entities. Alternate locations will be as close as possible to the original location at the discretion of the FTL. If a boring location cannot be moved reasonably close to the originally proposed location, the Trinity Project Manager will be consulted by the FTL and will, in turn, communicate the issue to the Army BEC and the CESAM Technical Manager for a solution.

New AS Well Installation

Five new AS wells will be installed in 6-inch diameter soil borings advanced using rotasonic drilling with target depths of 0.5 to 1 foot below the top of clay at the base of the fluvial aquifer at approximate locations identified on **Figure 10**. Continuous soil cores will be collected during the advancement of each boring and logged in the field and screened with a photoionization detector (PID) by the FTL for field screening purposes only. Lithology will be compared to that available from nearby borings to correlate soil types to more accurately identify the clay layer. No soil samples will be collected and submitted for off-site laboratory analysis for contaminants of concern.

Based on information available from soil borings for adjacent monitoring and AS wells, the top of the clay is expected to range from 95 to 100 feet below ground surface (bgs). Specifically, in review of the soil boring log associated with the installation of MW-159, clay was observed at a depth of 96 feet bgs. However, during advancement of the initial boring, communication with the driller will be maintained to note differences in drilling conditions once near the target depth. Once the depth of the clay is identified, it will be used to focus the target depth for the remainder of the AS wells to minimize advancement into the clay.

The AS wells will be constructed of new, unused, decontaminated, 2-inch inside-diameter (I.D.) Schedule 40 polyvinyl chloride (PVC) with internal threaded flush joints and a 30-inch long, 2.5-inch diameter microbubble sparger (Mott Corporation model # 2205401-020). Once the PVC riser is installed in the boring with the bottom of the sparger suspended at the base of the fluvial aquifer (top of clay), the drill casing will be raised so that the annular space fills with natural formation materials to 6 to 12 inches above the top of the sparger. The field geologist will measure the borehole depth using a tag line measuring tape to ensure proper collapse of formation materials has occurred. If the formation materials do not collapse around and above the sparger to the desired height, then conventional filter sand will be used to augment the formation materials.

A seal of hydrated bentonite 3 to 5 feet thick will be installed above the formation materials/filter pack and a cement-bentonite grout will be installed with a tremie pipe to approximately 3 feet bgs. The long seal is to prevent pressurized air short-circuiting along the borehole and forcing air into the saturated treatment zone. Boring logs and construction diagrams will be prepared and included in the AS/SVE Optimization Report.

The AS points will be completed approximately 2 feet bgs with a 2-inch PVC slip tee, a 2-inch to ¾-inch PVC reducing fitting and a ¾-inch diameter pigtail to connect to the high density polyethylene (HDPE) conveyance lines. The slip tee connections will be secured with glue. A 2-inch diameter PVC riser will extend from the slip tee to just bgs and will be capped with a PVC slip cap with threaded plug. A steel manhole set in a 2-foot by 2-foot concrete pad will be installed for access to the AS point.

AS Lines and Manifolds

Individual conveyance piping will be installed from each AS well to the equipment compound to provide operational flexibility and the ability to adjust sparge flow rates from a central location. A single trench will be extended from the farthest AS well location to the existing system compound and lateral trenches will extend off this main trunk line to the individual AS wells. The excavated soil will be stockpiled next to the excavated areas and covered with plastic sheeting for use as backfill. As possible, the sod will be removed and separated from the excavated soil for later use. Excavation will be performed with a mechanical equipment (backhoe, mini-excavator) by an experienced operator.

The trench depth will be set to allow a 2-foot covering of soil after the conveyance lines are installed. In the area of the existing AS/SVE lines, the previously installed locating tape will be used to identify the extent of the existing trench, as possible. Once identified, the sod above the air lines will be removed with the excavator to a depth of no greater than 1 foot and the remainder of the trench manually dug to locate the existing lines to prevent damage. In the event of accidental damage, the lines will be repaired and tested.

The newly installed AS tubing will be labeled at several points as the trench is backfilled. Locating tape will be placed approximately 6 to 12 inches above the tubing. The stockpiled excavated soil will be used

for backfill and compacted using a vibratory device in 1-foot lifts. Any excess soil will be spread in low spots around the area. Excavated areas and bare excess soil will be covered with seed and straw.

AS conveyance piping will be ¾-inch diameter HDPE (DriscoPlex® Pipe Series). Distance from the well farthest from the system compound is approximately 150 feet with the total estimated footage of piping estimated at 600 feet. Piping will be ordered as a continuous roll or in appropriate lengths to eliminate or minimize the need for connections. However, if connections are required, they will be butt-fusion welded by a certified welder. The HDPE pipe will be connected to the ¾-inch transition coupling at each AS well. Once above grade at the equipment compound, the ¾-inch HDPE piping will transition to 3/8-inch flexible PVC hose, which will be installed by the AS/SVE contractor. The lines from the new AS well will be labeled and bound with stainless steel slip connectors. A portable compressor will be used to blow air through the connection at each wellhead to confirm lines are properly labeled.

The AS system will have individual solenoid valves for each manifold leg; DIN rail-mounted solenoids (SMC part # VV5Q2-4-08C-DN-00T (5/16-inch), 2000 Series) will be installed in a dedicated panel, approximately 48-inch (tall) x 36-inch (wide) x 10-inch (deep). Proper operation of the pneumatic control for each solenoid valve must be checked by the contractor prior to shipment to the site. Each cassette-style solenoid will be powered (24V direct current) using #18 wire (3/4-inch conduit inlet, 1.5-meter SMC Corporation). The panel-mounted solenoid valves (Metal Work Multimatch Model M51-3-8-18) for each of the AS wells will be actuated by the programmable logic controller (Micrologix 1400).

Each individual new AS well will have a manifold leg containing the following, or similar, elements (mounted in the order listed, from bottom up):

- 5/16-inch diameter red polyurethane tubing (SMC part #TU0805R-33)
- 5/16-inch diameter tube to 3/8-inch diameter National Pipe Thread (NPT) adaptor (McMaster Carr part #5111K672)
- 3/8-inch speed control valve
- 3/8-inch pressure regulator, modular, backflow (with integrated check valve) (Metal Work MR Bit, 0-170 psi)
- 3/8-inch nickel plated bushing
- ½-inch rotometer (Environmental World Products, Model LZT-10A24G, 2.4-24 scfm)
- Glycerin-filled stainless steel pressure gauge (0-30 psi, ¼-inch center back mount, 2.5-inch face) (McMaster Carr part #4053K18) mounted on ½-inch NPT nickel plated tee
- ½-inch diameter NPT to 3/8-inch tubing adaptor (McMaster Carr #5111K677)
- 3/8-inch diameter red polyurethane tubing (SMC Part #TIUB13R-33)

Following installation of wells and lines, trenches will be filled with the excavated soil, compacted, and the area graded to be uniform with surrounding area and seeded for grass.

As-Built Survey

A PLS licensed in the State of Tennessee will utilize existing horizontal and vertical control for the final as-built locations of AS wells and conveyance piping trench. Vertical coordinates will be based on the North American Datum, 1927 used for all survey data at DDMT. Horizontal coordinates will be provided in the Tennessee State Plane Coordinate System. Accuracy for well locations will be within 0.01 foot for elevations and 0.1 foot for horizontal coordinates. The surveyor's data will be compatible with the 2009 survey data for the existing AS/SVE system.

Investigative Derived Waste Management

Waste generated during AS well and component installation will be classified as either non-investigative waste or investigation derived waste (IDW). Non-investigative waste such as packaging materials, personal protective equipment, and other inert refuse will be collected and placed in a dumpster for disposal as municipal waste. The IDW will consist of decontamination water and excess soil cuttings from the AS well install activities. Decontamination water will be stored in 55-gallon drums or polyethylene totes and excess soil cuttings will be stockpiled on plastic sheeting at designated locations within the Dunn Field fenced boundary. Each medium will be sampled for waste characterization to determine final disposition.

Soil excavated from the airline conveyance trench will be stockpiled on plastic sheeting adjacent to the trench and used for backfill and not considered waste. The soil will be covered with plastic to prevent rainwater infiltration and runoff as necessary.

Documentation and Records

An AS/SVE Optimization Report will be prepared and submitted to document all activities included in this plan. AS well and line locations obtained by the PLS after completion will be included with the final documentation.

Figure 10
Proposed Air Sparge Well and Line Layout

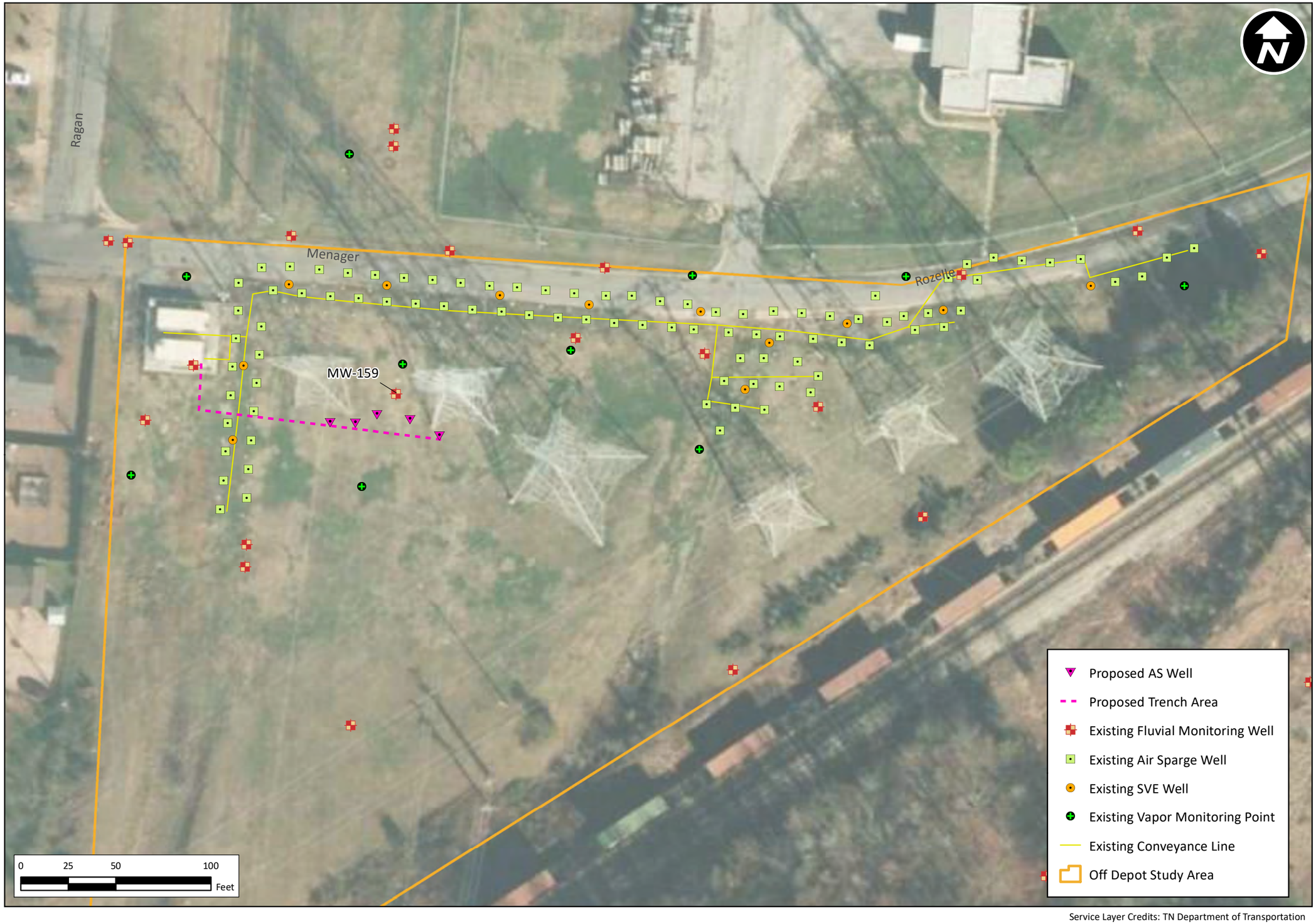
Dunn Field
Defense Depot Memphis, Tennessee
Memphis, Shelby County, Tennessee

DRAWN BY: JTC

DATE: 11/21/2016

SCALE: AS SHOWN

PROJECT NO: W9128F-11-D-0029 CK01



Service Layer Credits: TN Department of Transportation

Trinity Analysis & Development Corp.

Worksheet 16 - Project Schedule/Timeline Table

Table 7 presents the anticipated schedule for this project, which includes the timeframes for the major activities and deliverables, as well as the individual tasks and their interrelationships.

Table 7 Project Schedule

Activity	Organization	Anticipated Date(s) of Initiation	Anticipate Date(s) of Completion	Deliverable	Deliverable Due Date
Work Plan Preparation	Trinity	5/6/2016	12/9/2016	UFP-QAPP Work Plan	12/15/2016
AS Well Installation	Trinity	1/16/2017	1/20/2017	---	---
AS Line/Manifold Installation	Trinity	1/23/2017	1/27/2017	---	---
Report Preparation	Trinity	1/30/2017	6/29/2017	Optimization report	6/29/2017

Worksheet 21 - Project Standard Operating Procedure Reference

The field SOPs associated with AS well and conveyance line installation are listed in the following table. Project specific SOPs were prepared based on guidance from the Quality System and Technical Procedures established by the USEPA Science and Ecosystem Support Division (http://www.epa.gov/region4/sesd/fbqstp/). The referenced field SOPs are provided in **Attachment 1**.

Table 8 Sampling SOP References

Reference Number	Title	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)
SOP 01	Field Records and Documentation	Trinity	Not applicable	N
SOP 02	Drilling and Soil Sampling	Trinity	Not applicable	N
SOP 03	AS Well Installation	Trinity	Not applicable	N
SOP 04	Field Screening	Trinity	Field measurement equipment	N
SOP 05	Equipment Decontamination	Trinity	Not applicable	N
SOP 06	Investigation Derived Waste Management	Trinity	Not applicable	N

Worksheet 22 - Field Equipment Calibration, Maintenance, Testing, and Inspection

This worksheet lists the field equipment and instruments to be used during the field investigation that will require calibration, maintenance, testing, or inspection.

Field equipment and instruments are identified in the table below.

Table 9 Field Equipment and Instruments

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	Field SOP Reference
PID	Before each use per manufacturer's specifications	None	Analyze reference standard as per manufacturer's specifications	Beginning of day (before use)	See manufacturer's specifications	Repeat calibration	Field Personnel	SOP 04

Worksheet 31 - Planned Project Assessments

Periodic assessments will be performed during the course of the project so that the planned project activities are implemented in accordance with this document. The type, frequency, and responsible parties of planned assessment activities to be performed for the project are summarized in the table below.

Table 10 Planned Project Assessments

Assessment Type	Frequency	Report for Documenting Assessment Findings	Person(s)/Organization Responsible for Performing Assessment	Person(s) Responsible for Identifying and Implementing Corrective Actions
Field Document Review	Daily	Findings to be included in Project Reports	Ben Stewart, Trinity FTL	Todd Calhoun, Trinity Project Manager
Field Procedure Assessment	As work progresses	Findings to be included in Project Reports	Ben Stewart, Trinity FTL	Todd Calhoun, Trinity Project Manager
Safety & Health Audit	As needed	Findings to be included in Project Reports	Jeanette Baldwin, Trinity Corporate HSO	Jeanette Baldwin, Trinity Corporate HSO

Worksheet 32 - Assessment Findings and Corrective Action Responses

Periodic assessments will be performed during the course of the project so that the planned project activities are implemented in accordance with this document. The type, frequency, and responsible parties of planned assessment activities to be performed for the project are summarized in the table below.

Table 11 Assessment Findings and Corrective Action Responses

Assessment Type	Frequency	Report for Documenting Assessment Findings	Person(s)/Organization Responsible for Performing Assessment	Person(s) Responsible for Identifying and Implementing Corrective Actions
Field Document Review	Daily	Findings to be included in Project Reports	Ben Stewart, Trinity FTL	Todd Calhoun, Trinity Project Manager

Worksheet 33 - Quality Assurance Management Reports

Periodic assessments will be performed during the course of the project so that the planned project activities are implemented in accordance with this document. The type, frequency, and responsible parties of planned assessment activities to be performed for the project are summarized in the table below.

Table 12 Periodic Assessment Schedule

Type of Report	Frequency	Projected Delivery Date(s)	Person(s)/Organization Responsible for Report Preparation	Report Recipient(s) (title and organizational affiliation)
Field Daily Quality Control Report (DQCR)	Daily during AS well/line/manifold install	Daily	Ben Stewart, Trinity FTL	Todd Calhoun, Trinity Project Manager
Internal Project Report Review	Once per report	To be determined	Robyn Peterson, Trinity Project Engineer	Laura Roebuck, CESAM Technical Manager Joan Hutton, BEC Tom Holmes, HDR Project Manager
External Project Report Review	Once per report	To be determined	Robyn Peterson, Trinity Project Engineer Todd Calhoun, Trinity Project Manager	Diedre Lloyd, USEPA Region 4 Remedial Project Manager Jamie Woods, TDEC Remedial Project Manager Laura Roebuck, CESAM Technical Manager Joan Hutton, BEC Tom Holmes, HDR Project Manager

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Attachments

Attachment 1 Field Standard Operating Procedures

1.0 SOP 01 – FIELD RECORDS AND DOCUMENTATION

This Standard Operating Procedure (SOP) describes the objectives necessary to provide consistent procedures and formats for collecting clear and concise field records and field documentation of field activities conducted at the Defense Depot Memphis, Tennessee (DDMT). This SOP focuses only on the procedures for documenting field activities in the field logbook and Daily Quality Control Reports (DQCRs). Important documents used to develop this SOP are U.S. Environmental Protection Agency (USEPA) Science and Ecosystem Support Division (SESD) Procedure SESDPROC-010-R5, *Logbooks* (USEPA, 2013).

1.1 Procedure

It is the responsibility of the Field Team Leader (FTL) to scribe field activities in the field logbook. However, if necessary, it is acceptable for the FTL to designate field personnel to take this responsibility. Personnel will use only bound field logbooks that have sewn and consecutively numbered pages that meet USEPA guidance for the maintenance of field records (USEPA, 2013).

The following materials will be used for recording field records in the logbook:

- Field logbook
- Pens, containing water-proof ink
- Calculator
- Means to tell time (e.g. wristwatch, cell phone, laptop computer)

Management of the field logbooks will be based on specific conditions and requirements of each project. The Project Manager (PM), however, will ensure that all field notes can be efficiently traced, filed, and retrieved.

1.1.1 Documentation of Field Records

All field data will be recorded in waterproof ink. If errors are made in any field logbook, field form, chain of custody form, or any other field record document, corrections will be made by crossing a single line through the error, entering the correct information, and initialing.

1.1.2 Field Logbook Format

Logbook entries will be made in the following format. Documentation and reporting of events and activities will be made in chronological order. Every page will contain the date, recorded at the top, left-hand corner, followed by the site name and client of the project. At the beginning of each day, the first four entries will be “Personnel/Contractors on Site”, “Weather”, “Anticipated Scope of Work for the Day”, and the “FTL for the project”. The time of every entry will precede the field note, and be listed in columnar form down the left-hand side of each page. Military time will be used (for example, 1300, rather than 1:00 PM.)

All calculations, results, and calibration data (including the calibration media’s lot number and expiration date) for field sampling and serial numbers for field equipment will be recorded in the field logbooks or recorded on approved field forms.

All field analyses, measurements, and samples will be traceable to specific pieces of field equipment, and to the field investigator in the field logbook, or specific field form. Therefore, the reconciliation of later problems can be better resolved.

All samples collected in the field will be recorded in the logbook. Mandatory information regarding the sample are sample time, sample name, matrix, and laboratory analyses. The depth interval relative to a

measuring point for all soil, sediment, and surface water samples shall also be recorded. All QC/QA samples will also be recorded with the same mandatory information. This information must match what is recorded on the COC and the sample label. Additional information about the sample will be recorded as warranted, including unique circumstances or sample characteristics that could affect data evaluation. soil lithology, and detected odors.

Pertinent information on health and safety will also be logged in the field book. This includes time of daily health and safety meeting and safety issues discussed, times and reasons for breaks or stop work (e.g., excessive heat or cold conditions, or other inclement weather scenarios), and any other unanticipated health and safety events or issues. Resolutions to applicable health and safety issues will be recorded.

All personnel on site, visitors' names, association, and time of arrival/departure, etc., will also be recorded in the field logbook.

All phone calls to the project manager, client, etc. will be recorded with issues discussed. Additionally, any important discussions had in the field with property owner, project manager, client, etc. will be recorded.

The personnel will initial at the bottom, right-hand or left-hand corner of each completely filled out page. Additionally, at the end of each day's entry or particular event, the personnel will draw a diagonal line originating from the bottom left corner of the page to the conclusion of the entry and sign along the line indicating the conclusion of the entry of the day's activity.

If an entry is made in a non-dedicated logbook, then the date, project name, and project number will be entered left to right, respectively, along the top of the right page. All other aspects of field record keeping will follow guidelines outlined in the previous paragraphs of this section.

Once completed, these field logbooks become formal records and must be maintained as part of the project files. Periodic audits of field logbooks should be conducted by the PM to ensure compliance with this procedure.

Since field records are the basis for later written reports, the language should be objective, factual, and free of personal feelings or other terminology which might prove inappropriate. However, the personnel should not feel limited to record only the information previously outlined. Any and all information pertaining to the site or project that could affect data interpretation or management decision-making should be recorded.

1.2 Daily Quality Control Report and Format

DQCRs will be completed daily by the FTL. The purpose of the DQCRs is to provide a one-page summary of the daily field activities to applicable stakeholders (for example, client and/or contracting agency).

Different projects/clients may require specific DQCRs, but commonly require the recording of the following information:

- Project number
- Project name and location
- Date
- Temperature range
- Wind conditions
- Personnel on site

- Summary of site activities
- Level of health and safety protection
- Instruments used (including serial numbers)
- Calibrations performed (with lot numbers and expiration of calibration solutions)
- Instrument problems (and corrective actions taken)
- Soil borings/well installation details (with hand-held coordinates, if necessary)
- Samples collected
- Summary of sample collection methods
- Quality control samples collected
- Additional remarks

DQCRs will be completed on a daily basis. These reports will be reproduced and sent to the client or contracting agency, as required per the contract agreement. These records may be submitted in hardcopy or by electronic files sent via email.

1.3 Copying and Filing of Field Records

During field activities, the field logbooks will be copied on a periodic basis. The FTL is responsible for making copies of logbook pages and DQCRs. The PM is responsible for ensuring that copies are maintained as project files.

When an individual logbook is full, it will be submitted to the PM for final cataloging and filing. The logbooks will be stored at Trinity's office.

All non-bound field records (for example, DQCRs, drilling logs, well construction forms, sampling records, and chain of custody copies) will be completed on the same work day, scanned, and turned in to the Project Manager the following work day. The originals will be filed by the PM or, as designated by the PM, the FTL in the project file.

All field data collected using electronic data loggers or computer entry forms will be downloaded, as soon as practical, to the Trinity server.

1.4 References

USEPA, 2013. *Logbooks,* SESDPROC-010-R5. May.

2.0 SOP 02 – DRILLING AND SOIL SAMPLING

This Standard Operating Procedure (SOP) describes the methods and procedural guidelines for drilling and soil sampling operations in support of environmental investigation activities at the Defense Depot Memphis, Tennessee (DDMT). Important documents used to develop this SOP are U.S. Environmental Protection Agency (USEPA) Science and Ecosystem Support Division (SESD) Guidance SESDGUID-101-R1, *Design and Installation of Monitoring Wells* (USEPA, 2013), Procedure SESDPROC-205-R3, *Field Equipment Cleaning and Decontamination* (USEPA, 2015), and SESDPROC-300-R3, *Soil Sampling* (USEPA, 2014).

2.1 Overview

The selected method for the installation of the aquifer air sparge (AS) wells is rotosonic drilling. Rotosonic drilling has proven to be most effective for boring advancement and well installation at DDMT based on geologic and hydrogeologic conditions.

Based on the proposed location of the AS wells being near overhead powerlines and transmission towers, a low profile track mounted drill rig will be utilized. Drilling will be conducted by a Tennessee-licensed subcontractor with experience on similar projects and geology. All necessary permits (as applicable) will be obtained prior to initiation of drilling operations.

2.2 Health and Safety

Specific tasks and general safety requirements are addressed in the *Site Safety and Health Plan* (SSHP), Environmental Restoration Support, Defense Depot Memphis, Tennessee, Final (Trinity, 2016). Each individual supporting the AS well installation activities is required to have read and understood the SSHP. Personal protective equipment (PPE) will be worn at all times during drilling activities and, at a minimum will consist of hard hats, steel toed shoes, safety glasses, hearing protection, and high visibility clothing.

All drilling locations will be cleared for underground and above ground utilities prior to beginning drilling activities with special consideration given to the proper clearance tolerances from transmission towers as required by Memphis Light, Gas and Water (MLGW). Prior to the start of drilling activities, the drilling subcontractor will hand auger each drilling location to a depth of 4-feet below ground surface (bgs) in order to verify that no underground utilities or objects are present.

2.3 Personnel Qualifications and Responsibilities

Field activities will be directed by the Field Team Leader (FTL), a mid- or senior level geologist with experience in the planned drilling activities. Drilling will be performed by a licensed driller and crew familiar with the requirements of this tasks. Additional details are provided in the UFP-QAPP Work Plan and the SSHP.

2.4 Start-Up Activities

After arrival on-site, but prior to beginning drilling activities, the following activities will be performed:

- Complete equipment and supply checklists and verify that required documentation and equipment are on-site and in working order
- Confirm drilling locations are clearly marked and review locations for hazards including overhead and underground utilities
- Calibrate field equipment
- Conduct team safety meeting

2.5 Soil Borings

This section describes the procedures for drilling and sampling of soil borings. Stringent protocols will be followed to ensure that geologic data produced are reliable and of high quality, that contaminant migration has not occurred, and that contaminants are not introduced to the subsurface or to samples obtained. This procedure applies to all Trinity personnel who are responsible, both directly and indirectly, for obtaining and evaluating data obtained from soil borings.

Procedures employed, site-specific conditions, and other pertinent observations that may affect the evaluation and interpretation of data collected will be recorded by the on-site geologist or geotechnical engineer on the boring log (**Attachment 1**), and/or in the field log book, as appropriate. The data sheets will be maintained in the project file.

2.5.1 Field Documentation

Field activities will be documented in a bound logbook for each team as outlined in SOP 01 *Field Record and Documentation*.

2.5.2 Boring Logs

The geologist will log the subsurface conditions encountered in the boring and record the information on the boring log and in the logbook. Additional pertinent information will be recorded on the boring log including the following information:

- Boring identification
- Coordinates/elevation
- Drilling method
- Drilling date(s) including start and completion times
- Weather conditions
- Geologist name
- Driller's name/Drilling subcontractor/Type of drill rig
- Diameter of outer and inner sonic drill casings
- Types of drilling fluids and depths at which they were used
- Penetration length
- Penetration rate
- Soil recovery per penetration
- Visual description of soil consistent with the Uniform Soils Classification System (USCS)
- Total depth of boring
- Final disposition of boring

2.5.3 Soil Description

The USCS will be used for soil identification. The USCS provides useful information about soil gradation and plasticity. However, critical information necessary for site interpretation and evaluation are not included in the USCS. The USCS should therefore be supplemented with additional information.

The descriptive format begins with the USCS group name and symbol, which is discussed in more detail below. A detailed description, based upon ASTM standards, follows the USCS classification. For

consistency, the primary descriptive elements listed below should be included in all soil descriptions, presented in the following standardized order:

- USCS group name and symbol (underlined and capitalized)
- Color (observable and Munsell Chart designation)
- Plasticity (non-plastic, slightly plastic, or plastic)
- Moisture condition (dry, damp, moist, or wet)
- Consistency (very soft, soft, medium stiff, very stiff, or hard for cohesive soils; loose, compact, or dense for non-cohesive soils)
- Gradation (relative percentages of all soil components: 40-50% = numerous, 30%-40% = many, 20%-30% = few, 10%-20% = scattered, 0%-10% = occasional; maximum size; weathering)
- Other descriptors (roots, lenses, seams, etc.)

A description of other pertinent properties should be included, as needed, following the primary descriptive elements listed above.

Following the detailed soil description, the probable geologic origin should be provided (in capital letters as shown). Several typical descriptions are presented below:

POORLY GRADED SAND (SP)
Yellowish brown (10YR 5/4), non-plastic, dry, loose, mostly fine sand with occasional medium sand.

LEAN CLAY (CL)
Olive brown (2.5 YR 4/3), sli-plastic, moist, stiff, occasional rock fragments, rooted.

POORLY GRADED SAND WITH GRAVEL (SP)
Pale yellow (2.5 YR 7/3), non-plastic, wet, compact to dense, subrounded, scattered gravel up to 0.5-inch.

Soil/sediment descriptions should be as comprehensive as possible, without excessive emphasis on insignificant details. Good judgment and common sense based on an understanding of geology, engineering behavior of soils, and project requirements are required.

2.6 Drilling Procedures

Drilling activities will be completed in accordance with the planned activities presented in the project UFP-QAPP Work Plan and the following requirements.

- All borings will be advanced using rotosonic drilling methods in a manner that conforms to Shelby County rules and regulations, Rules of Tennessee Department of Environment and Conservation (TDEC), Division of Water Supply, Chapter 12-4-10.
- All drilling equipment will be decontaminated prior to drilling activities in accordance with SOP 04 *Equipment Decontamination and Investigative Derived Waste Management*.
- All necessary precautions will be taken to prevent leakage of hydraulic fluids of other contaminants into the borehole or onto equipment that is placed in the borehole
- Potable water is the only allowable drilling fluid and will only be used when necessary as approved by the FTL
- Soil cores will be collected continuously in intervals not to exceed 10 feet. The soil cores will be vibrated from the core barrel into plastic bag for visual logging by the Trinity geologist and headspace measurements.

- A representative specimen from each soil core will be kept for preparation of the composite soil sample to be analyzed for waste characterization purposes. The remainder of the soil containerized in accordance with SOP 04 *Equipment Decontamination and Investigative Derived Waste Management*.
- The Trinity geologist will measure and record the depth to groundwater observed during drilling.
- During drilling activities, the driller will notify the Trinity geologist of any changes in drilling conditions which will be noted on the boring log.
- Rotosonic drilling utilizes ultrasonic vibrations to advance a core barrel to the target depth. A continuous soil core is captured in the core barrel and minimal waste is produced outside the borehole.

2.7 Boring Diameter

The boring diameter is based on a minimum of 2-inches of annular space between the outside of the well casing and the borehole wall. The AS wells will be installed in the fluvial aquifer so no surface casing is required. Therefore, the borehole diameter of 6-inches will allow for proper installation of a nominal 2-inch outside diameter well casing.

2.8 Soil Sampling

Soil sampling for contaminant of concern analysis will not be performed as part this investigation. However, a composite samples of the soil cores will be collected for waste characterization purposes.

2.9 Closeout Activities

Prior to departure at the end of each day's drilling activities, the following activities will be performed:

- All equipment shall be decontaminated and checked for damage
- All debris and trash shall be collected and removed from the site
- The FTL will complete all logbook entries and provide to Trinity Project Manager for review
- The crew will ensure the site is secured for the night and/or weekend

2.10 References

Trinity, 2016. *Site Safety and Health Plan*, Final. July.

USEPA, 2013. *Design and Installation of Monitoring Wells*, SESDGUID-101-R1. January.

USEPA, 2014. *Soil Sampling*, SESDPROC-300-R3. August.

USEPA, 2015, *Field Equipment Cleaning and Decontamination* SESDPROC-205-R3. December.

3.0 SOP 03 – AIR SPARGE WELL AND CONVEYANCE LINE INSTALLATION

This Standard Operating Procedure (SOP) describes methods to be used in the installation of Air Sparge (AS) wells and conveyance lines at the Defense Depot Memphis, Tennessee (DDMT). This SOP focuses only on the procedures installation and completion of AS wells. Well installation will occur immediately after drilling and preparations should be made prior to beginning drilling operations which are described in SOP 02 *Drilling and Soil Sampling*. Important documents used to develop this SOP are U.S. Environmental Protection Agency (USEPA) Science and Ecosystem Support Division (SESD) Guidance SESDGUID-101-R1, *Design and Installation of Monitoring Wells* (USEPA, 2013).

3.1 Overview

AS wells will be installed by a Tennessee-licensed subcontractor and supervised by a Trinity geologist. Well installation will occur immediately after drilling and preparations should be made prior to beginning drilling operations, which are described in SOP 02 *Drilling and Soil Sampling*. Note that due to the constructed nature of the AS points, development will not be necessary or performed. Trenching activities will be performed by experienced and trained equipment operators.

3.2 Health and Safety

Specific tasks and general safety requirements are addressed in the *Site Safety and Health Plan* (SSHP), Environmental Restoration Support, Defense Depot Memphis, Tennessee, Final (Trinity, 2016). Each individual supporting the AS well installation and associated activities is required to have read and understood the SSHP. Personal protective equipment (PPE) will be worn at all times during AS well and conveyance line installation activities and, at a minimum will consist of hard hats, steel toed shoes, safety glasses, hearing protection, and high visibility clothing.

3.3 Personnel Qualifications and Responsibilities

Field activities will be directed by the Field Team Leader (FTL), a mid- or senior level geologist with experience in the planned drilling activities. Drilling will be performed by a licensed driller and crew familiar with the requirements of this tasks. Additional details are provided in the UFP-QAPP Work Plan and the SSHP.

3.4 Equipment and Materials List

The required equipment and supplies to complete AS installation are identified in the UFP-QAPP Work Plan and field activities will not begin until all necessary equipment is on-site. Usual equipment/supplies for AS installation will include: tape measure, nitrile gloves, grout mixer, grout pump, sand, bentonite, Portland cement, well construction forms, and camera. Usual equipment/supplies for AS line installation will include: air compressor, utility locating tape, ultrasonic welder, and all necessary connection fittings.

3.5 Start-Up Activities

After arrival on-site, but prior to beginning AS well/line install activities, the following activities will be performed:

- Complete equipment and supply checklists and verify that required documentation and equipment are on-site and in working order
- Confirm drilling locations are complete and trenching areas are clearly marked for hazards including overhead and underground utilities
- Calibrate field equipment
- Conduct team safety meeting

3.6 AS Well Installation

AS well installation will be completed in a manner consistent with the relevant sections of USEPA, 2013, and applicable state/local requirements. With the exception of the well screen type (slotted verse microbubbler sparger) all other installation methods and procedures will apply.

AS well installation will be conducted by a licensed driller and well installation subcontractor under the oversight of a Trinity geologist.

The following information will be collected as part of the field documentation:

- Length of spargers and risers
- Type, manufacturer, and gradation of the filter sand, and the volume used for each well
- Type and manufacturer of the Portland cement and bentonite and the volume used for the bentonite seal and grout at each well
- Record surface completion details including completion type and description of surface completion materials.

Borings for AS wells will be advanced using rotosonic drilling as described in SOP 02 *Drilling and Soil Sampling*. The following procedure will be used to install the well casing and microbubbler sparger:

- If the boring was drilled deeper than the top of the clay at the base of the Fluvial Aquifer, backfill the boring to the top of the clay in accordance with the UFP-QAPP Work Plan, either with bentonite chips or by allowing the formation material to collapse as the casing is raised.
- Remove the new stainless steel microbubbler sparger and polyvinyl chloride (PVC) riser from the manufacturer packaging
- Attach the 30-inch long microbubbler sparger to the PVC riser (10-foot threaded flush joints) and install the string inside the steel drill casing to the bottom depth
- Once the well string has been installed, the casing will be raised to allow collapse of the natural formation materials to 6 to 12-inches above the top of the sparger. If collapse doesn't occur, filter pack materials will be installed by using the gravity method through the annular opening between drill casing and well screen as the drill casing is removed. The steel casing can be vibrated during removal to seat the filter pack as necessary.
- A 3 to 5-foot thick bentonite seal will be placed above the sand formation/filter pack via gravity methods and allowed to hydrate for a minimum of 4 hours prior to grouting
- The remainder of the boring annulus will be grouted to near ground surface with a Portland cement/bentonite mixture
- AS well riser will be completed approximately 2 feet below ground surface (bgs) with a 2-inch diameter PVC slip tee, a 2-inch to ¾-inch PVC reducing fitting, and a ¾-inch diameter pigtail to connect to the AS conveyance lines. The slip tee will be secured with glue and a 2-inch diameter PVC riser will be added to extend from the slip tee to just bgs. The riser will be capped with a PVC slip cap with a threaded plug.
- A steel manhole set in a 2-foot by 2-foot concrete pad will be installed for access to the AS point. Note that this step may be performed after completion of the AS conveyance lines.

3.6.1 Well Construction Materials

Well risers will consist of material durable enough to retain their long-term stability and structurally integrity to allow for low pressure air injections. Well materials will consist of new stainless steel microbubbler spargers (Mott Corporation model # 2205401-020) 30-inches in length and 2.5-inches in

diameter and new commercially fabricated, threaded, flush joint, minimum 2-inch inside diameter (ID) Schedule 40 PVC riser. Materials will be unused and decontaminated prior to installation. Due to the difference in diameter and thread patterns of the sparger and riser, a stainless steel coupler will be required. No glues or solvents will be permitted down-hole.

3.6.2 Well Design

AS wells will be designed and installed in a manner to allow proper delivery of compressed atmospheric air to the aquifer to aid in the removal of volatile organic compounds (VOCs) and to prevent pressurized air from short-circuiting along the borehole.

Well design includes placement of the screen, installation of filter pack (natural collapse or addition by gravity method), bentonite seal, and grout seal. The FTL and Trinity Project Manager will collectively make decisions on well depths. Borings will be advance only 6 to 12-inches into the clay unit at the base of the fluvial aquifer and the sparger will be set immediately above the clay.

Filter Pack

A natural collapse of the formation as a filter pack will be allowed during installation of the AS wells and removal of the drill casing. If natural collapse does not occur, then a filter pack sand size of 20/40 will be added to complete to the 6 to 12-inches above the top of the sparger. The 6-inch steel drill casing will be vibrated during removal to compact any added filter pack materials. If the addition of filter pack sand is required, lifts will not exceed 1-foot.

Bentonite Seal

A 3 to 5-foot thick bentonite seal will be installed above the filter pack in the annular space of the well. Only 100% high yielding sodium bentonite pellets or chips will be used and care will be taken to prevent bridging by frequently measuring the thickness of the bentonite as it is gravity placed. Based on the depth to water, it is anticipated that the bentonite seals will be installed beneath the water table. The bentonite seals will be allowed to hydrate for a minimum of 4 hours prior to grouting.

Grout Seal

A non-shrinking Portland cement/bentonite grout mixture will be placed in the annular space from the top of the bentonite seal to approximately 2.5 feet bgs. Concrete will be added in the remaining annular space during installation of the protective casing and concrete pad.

The cement/bentonite grout mixture will consist of 94 pounds of neat Type I Portland cement, not more than 4 pounds of 100% sodium bentonite powder, and not more than 8 gallons of potable water. the grout will be pumped in a single event using a side discharge tremie pipe from the bottom of the hole and continue until undiluted grout is visible at the surface.

Surface Completion

Surface completions will be flush-mount with a 12-inch steel manhole set in a 2-foot by 2-foot concrete pad.

3.6.3 Well Completions Diagrams

The Trinity geologist will maintain suitable logs for detailing drilling and well construction practices. Well dimensions, amount, type and manufacturer of materials used to construct each well will be recorded in the logbook. Additional information to be recorded in the field for the well completion diagrams will include:

- Well identification

- Coordinates/elevation
- Drilling method
- Installation date(s)
- Geologist name
- Driller's name/Drilling subcontractor
- Diameter of boring
- Total boring depth
- Length and descriptions of the screen and sparger
- Thickness and descriptions of filter pack, bentonite seal, annular grout, and any backfilled material
- Quantities of all well construction materials used

3.7 AS Conveyance Line Installation

Individual conveyance piping will be installed from each AS well to the existing equipment compound. These lines will be installed in a single trench with connecting laterals, where applicable to each of the AS wells. The following procedure will be used to install the AS conveyance lines:

- Excavate a 2-foot wide by 2-foot deep trench from the AS well farthest from the existing equipment compound with a mechanical excavator. Excavated soil will be placed on plastic sheeting next to the trench and used for backfill material.
- In the area of the existing AS/SVE lines, the previously installed locating tape will be used to identify the extents of the existing trench, as possible. Once identified, the sod above the air lines will be removed with the excavator to a depth of no greater than 1 foot and the remainder of the trench manually dug to locate the existing lines to prevent damage. In the event of accidental damage, the lines will be repaired and tested.
- Connect the additional AS wells by lateral trenches to the main trunk line as necessary
- Install continuous runs of ¾-inch HDPE piping from each well head to the equipment compound as possible. if connections are required, they will be butt-fusion welded by a certified welder.
- Securely attach each ¾-inch HDPE pipe to the ¾-inch pigtail installed on the wellhead
- Each AS line will be labeled at several points along the trench
- Use air compressor to blow air through each labeled air line from the equipment compound back to the AS well to verify the labeling and check for leaks
- Backfill trench with previously excavated soil to approximately 12 to 6-inches above the conveyance lines and compact with a vibratory device
- Install utility locating tape above the tubing and complete backfill and compaction to ground surface
- Connect each ¾-inch conveyance line tubing to ⅜-inch flexible PVC hose

3.8 Location Survey

Following completion, each AS well and the AS conveyance piping will be surveyed by a Tennessee-licensed surveyor. The wells will be surveyed for horizontal locations and elevations at top of casing, ground surface, and well pad; the lines will be surveyed for horizontal locations and elevations at ground surface. Vertical coordinates will be based on the North American Datum 1927 used for all survey data at DDMT. Horizontal coordinates will be provided in the Tennessee State Plane coordinate system.

Accuracy for all well locations will be within 0.01 foot for elevations and 0.1 foot for horizontal coordinates.

3.9 Closeout Activities

Prior to departure at the end of each day's activities, the following activities will be performed:

- All debris and trash shall be collected and removed from the site
- The FTL will complete all logbook entries and provide to Trinity Project Manager for review
- The crew will ensure the site is secured for the night and/or weekend

3.10 References

Trinity, 2016. *Site Safety and Health Plan*, Final. July.

USEPA, 2013. *Design and Installation of Monitoring Wells*, SESDGUID-101-R1. January.

4.0 SOP 04 – FIELD SCREENING TECHNIQUES

This Standard Operating Procedure (SOP) describes the methods and procedural guidelines for conducting preliminary field screening of geochemical site conditions. The data provided by these methods are not considered to be of quality sufficient to meet regulatory requirements regarding conceptual site modeling, site characterization, and/or closure; but are to be used for gross delineation, and extent of contamination, in order to make accurate real-time field decisions and gain efficiency in field assessment and remediation activities.

4.1 Overview

Although field screening is often critical to the successful completion of a task, the installation and placement of the aquifer air sparge (AS) wells is not dependent upon the findings. Any significant findings of elevated field screening measurements will be used as part of a larger evaluation of site conditions.

4.2 Health and Safety

Specific tasks and general safety requirements are addressed in the *Site Safety and Health Plan* (SSHP), Environmental Restoration Support, Defense Depot Memphis, Tennessee, Final (Trinity, 2016). Each individual supporting the AS well installation and associated activities is required to have read and understood the SSHP. Personal protective equipment (PPE) will be worn at all times during field screening activities and, at a minimum will consist of hard hats, steel toed shoes, safety glasses, hearing protection, and high visibility clothing.

4.3 Volatile Organic Vapor Screening

The objective of this section is to describe procedures to be employed when screening of volatile organic vapors. Volatile organic vapor screening may be conducted for several reasons, including collecting headspace readings for grossly delineating soil contamination and monitoring the breathing zone air quality within the work area.

4.3.1 Soil Headspace Screening

As described in the UFP-QAPP Work Plan, soil cores will have headspace screening performed and the results recorded. The soil cores will be screened for volatile organic compounds (VOC) in the field at the time of visual logging. Note that no samples will be collected for contaminant of concern analysis at an off-site laboratory. Samples will only be collected for waste characterization determination.

VOC field screening shall utilize a photoionization detector (PID). The ionization potential (IP) of the PID lamp will be 10.6 electron volt (eV).

Personnel will perform field headspace screening in accordance with the following procedures:

- Calibrate field equipment
- Immediately upon opening the soil core bag, a representative portion of the headspace screening soil sample shall be collected and placed in a plastic re-sealable bag
- Allow 5 to 30 minutes (or as the environmental or field conditions dictate) for the sample to adequately volatilize and equilibrate to ambient temperatures (68º to 90° F). During cold weather, the samples may need to be warmed to near room temperature prior to taking the headspace measurement.
- The headspace in the plastic bag is sampled by piercing the bag and inserting the PID probe tip into the sample headspace and the reading recorded

4.3.2 Breathing Zone Monitoring

The monitoring of the breathing zone air quality during site activities requires discernment and skill. It is important to recognize that this monitoring is for health and safety purposes only and is not used to help characterize the site contamination, as is the case with the headspace screening described in Section 4.3.1. Therefore, the specific requirements for the breathing zone monitoring should be captured in the SSHP (Trinity, 2016).

Commonly this activity is performed by holding the PID tip at the approximate height of mouth and nostrils of workers and monitoring the readings accordingly. When working around heavy equipment, such as a drill rig, this activity itself can represent a potential safety hazard. Therefore, care should be taken to let workers know when monitoring personnel are coming in to take a breathing zone reading.

4.4 References

Trinity, 2016. *Site Safety and Health Plan*, Final. July.

5.0 SOP 05 – EQUIPMENT DECONTAMINATION

This Standard Operating Procedure (SOP) describes methods to be used in the decontamination of equipment used in the installation of Air Sparge (AS) wells at the Defense Depot Memphis, Tennessee (DDMT). Important documents used to develop this SOP are U.S. Environmental Protection Agency (USEPA) Science and Ecosystem Support Division (SESD) Procedure SESDPROC-205-R3, *Field Equipment Cleaning and Decontamination* (USEPA, 2015).

5.1 Health and Safety

Specific tasks and general safety requirements are addressed in the *Site Safety and Health Plan* (SSHP), Environmental Restoration Support, Defense Depot Memphis, Tennessee, Final (Trinity, 2016). Each individual supporting the AS well installation and associated activities is required to have read and understood the SSHP. Personal protective equipment (PPE) will be worn at all times during decontamination activities and, at a minimum will consist of hard hats, steel toed shoes, safety glasses, hearing protection, and high visibility clothing.

5.2 Personnel Qualifications and Responsibilities

AS well installation equipment decontamination will be directed by the Field Team Leader (FTL) and performed by a member of the drilling team.

5.3 Equipment and Materials List

The required equipment and supplies to complete decontamination activities will consist of a high pressure steam cleaner, potable water, and a decontamination area.

5.4 Start-Up Activities

After arrival on-site, but prior to beginning AS well/line install activities, the FTL will confirm that decontamination equipment and supplies are on-site and in working order.

5.5 Decontamination

Prior to mobilizing to the site, the drilling rig and all downhole tooling will be decontaminated. Once on site and during drilling operations, all downhole tooling will be decontaminated between borings and after the final location has been completed. The drilling rig will also be decontaminated upon completion of the final location and prior to demobilization.

5.5.1 Decontamination Area

The location of the decontamination area will be determined in consultation with the drilling subcontractor personnel. The decontamination area will include a sump lined with 6-mil polyethylene sheeting to collect the decontamination water. The sump will be constructed by either excavating a small area to create a depression or by elevating the edges of the sheeting. Existing concrete pads with containment areas can be used for large equipment like drill rigs and racked steel casing.

5.5.2 Decontamination Water Source

Tap water from the municipal water treatment system will be used as a rinse in the decontamination procedure. The FTL will be responsible for coordinating with the subcontractor personnel to secure an adequate supply of potable water for decontamination procedures. If large quantities of water are to be used, the subcontractor will rent a water meter from Memphis Light, Gas and Water. For smaller amounts, the shop water hose can be used.

5.5.3 Decontamination Procedures

The required decontamination procedure for large pieces of equipment such as drill rigs and drilling casing is:

1. Wash the external surface of the equipment with high pressure hot water and Alconox or equivalent, and scrub with brushes if necessary until all visible, dirt, grime, grease, oil, loose paint, rust flakes, etc. have been removed from the equipment
2. Air dry
3. Decontamination waste water will be stored at the site and analyzed prior to disposal

5.5.4 Equipment Rinsate Collection

No equipment rinsate samples will be collected as part of the AS well installation activities.

5.6 Closeout Activities

Prior to departure at the end of each day's activities, the following activities will be performed:

- Confirm all equipment is decontaminated and properly store all equipment
- Add decontamination rinse water to the wastewater storage tank
- All debris and trash shall be collected and removed from the site
- The FTL will complete all logbook entries and provide to Trinity Project Manager for review

5.7 References

Trinity, 2016. *Site Safety and Health Plan*, Final. July.

USEPA, 2015. *Field Equipment Cleaning and Decontamination*, SESDPROC-205-R3. December.

6.0 SOP 06 – INVESTIGATION DERIVED WASTE MANAGEMENT

This Standard Operating Procedure (SOP) describes methods to be used in the handling, management, and disposal of investigation derived waste (IDW) generated during the Air Sparge (AS) well installation activities at the Defense Depot Memphis, Tennessee (DDMT). Important documents used to develop this SOP are U.S. Environmental Protection Agency (USEPA) Science and Ecosystem Support Division (SESD) Procedure SESDPROC-202-R3, *Management of Investigation Derived Waste* (USEPA, 2014).

6.1 Health and Safety

Specific tasks and general safety requirements are addressed in the *Site Safety and Health Plan* (SSHP), Environmental Restoration Support, Defense Depot Memphis, Tennessee, Final (Trinity, 2016). Each individual supporting the AS well installation and associated activities is required to have read and understood the SSHP. Personal protective equipment (PPE) will be worn at all times during IDW management activities and, at a minimum will consist of hard hats, steel toed shoes, safety glasses, hearing protection, and high visibility clothing.

6.2 Personnel Qualifications and Responsibilities

AS well installation IDW management will be directed by the Field Team Leader (FTL) and performed by a member of the drilling team.

6.3 Equipment and Materials List

The required equipment and supplies to complete IDW management activities will consist of plastic sheeting, drums, or other bulk containers.

6.4 Start-Up Activities

After arrival on-site, but prior to beginning AS well/line install activities, the FTL will confirm that an IDW staging area has been identified and that all containers are in acceptable condition.

6.5 Types of Investigation Derived Waste

IDW generated during AS well installation activities will consist of the following:

- Soil cuttings
- Decontamination water

6.6 Investigation Derived Waste Handling

Waste generated during AS well and component installation will be classified as either non-investigative waste or IDW. Non-investigative waste such as packaging materials, PPE, plastic soil core bags, and other inert refuse will be collected and placed in a dumpster for disposal as municipal waste. The IDW will consist of decontamination water and excess soil cuttings from the AS well install activities. Decontamination water will be stored in 55-gallon drums or polyethylene totes and excess soil cuttings will be stockpiled on plastic sheeting at designated locations within the Dunn Field fenced boundary. Each medium will be sampled for waste characterization to determine final disposition.

6.7 Investigation Derived Waste Characterization

Composite samples from both the soil and decontamination waste streams will be collected for waste characterization analysis to determine final disposition. Analysis will consist of standard (USEPA Method 8260C) and Toxicity Characteristic Leaching Procedure (TCLP) for volatile organic compounds (VOC).

6.8 Investigation Derived Waste Disposal

Based on the analytical results, a final determination for the disposal of the IDW will be made. If soil results are below remediation goals set forth in the Dunn Field Record of Decision (CH2M Hill, 2004), the soil will be spread on the ground at Dunn Field. If soil VOC concentrations are above remediation goals, off-site disposal will be arranged. Containerized decontamination water will be disposed off-site disposal after receipt and review of waste characterization profile.

6.9 Closeout Activities

Prior to departure at the end of each day's activities, the following activities will be performed:

- Confirm all IDW is properly stored and secured
- Confirm all non-investigative waste is packaged and removed from the site
- The FTL will complete all logbook entries and provide to Trinity Project Manager for review

6.10 References

CH2M Hill, 2004. *Dunn Field Record of Decision*. March.

Trinity, 2016. *Site Safety and Health Plan*, Final. July.

USEPA, 2014. *Management of Investigation Derived Waste*, SESDPROC-202-R3. July.

Attachment 2 Field Forms

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services

CONTRACTOR'S DAILY QUALITY CONTROL REPORT

PROJECT NAME: _____ Date: _____
Location: _____ Weather: _____

PERSONNEL: Name	Company	EQUIPMENT: Description	License Number	FIELD INSTALLATIONS: ID Nos.	Drilled from (ft):	Drilled to (ft):

Brief Description of Work Performed?

Environmental or Geotechnical Samples Collected:

Health and Safety Levels:

Changes from Work Plan:

Remarks:

Signature: _____

HTRW DRILLING LOG

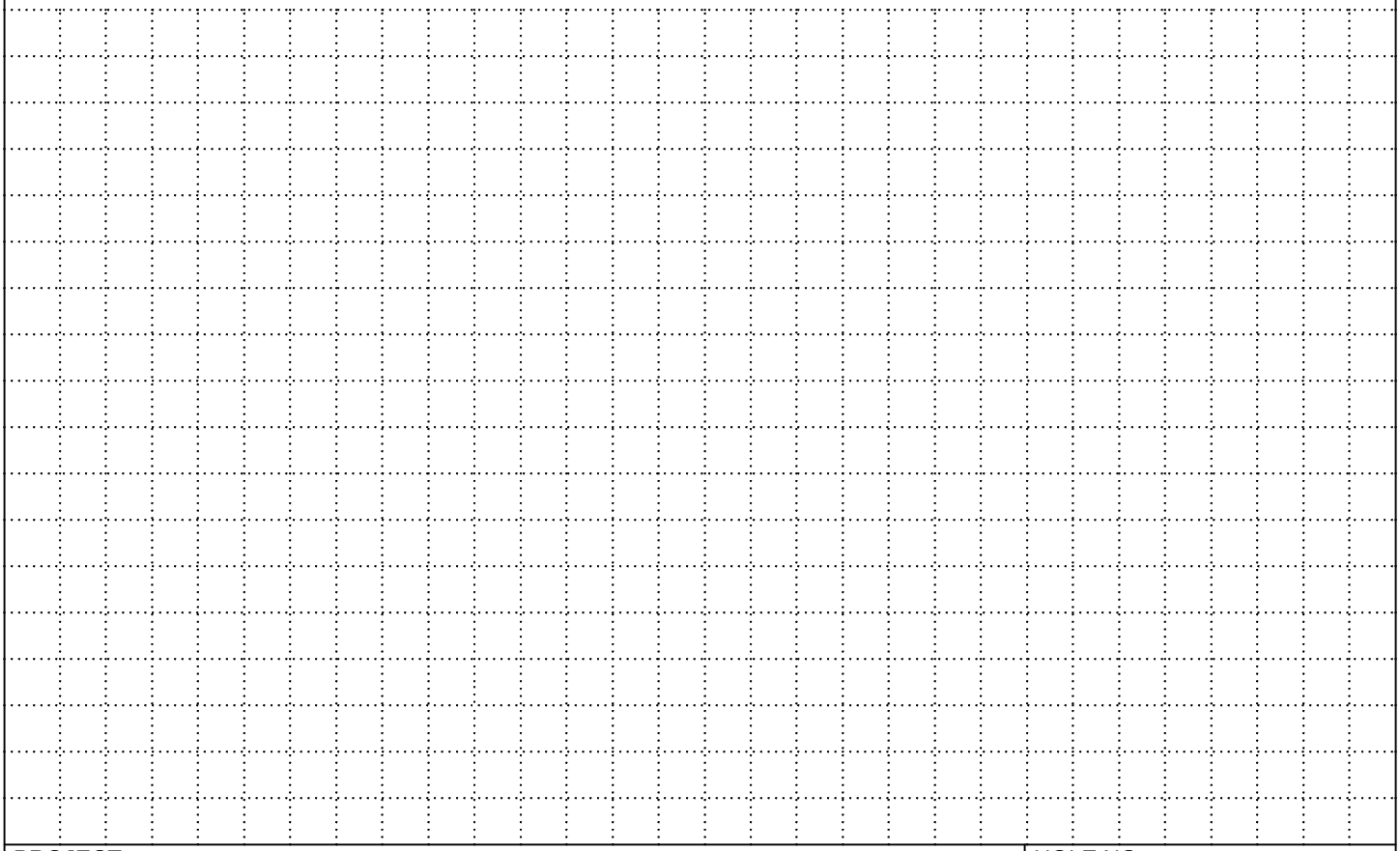
DISTRICT		HOLE NUMBER
1. COMPANY NAME	2. DRILLING CONTRACTOR	SHEET OF SHEETS
3. PROJECT	4. LOCATION	
5. NAME OF DRILLER	6. MANUFACTURER'S DESIGNATION OF DRILL	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	8. HOLE LOCATION	
	9. SURFACE ELEVATION	
	10. DATE STARTED / 11. DATE COMPLETED	
12. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED	
13. DEPTH DRILLED INTO ROCK	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14. TOTAL DEPTH OF HOLE	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR

LOCATION SKETCH/COMMENTS SCALE:



PROJECT	HOLE NO

ENG FORM 5056-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

PROJECT	INSPECTOR	HOLE NUMBER SHEET SHEETS OF

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)

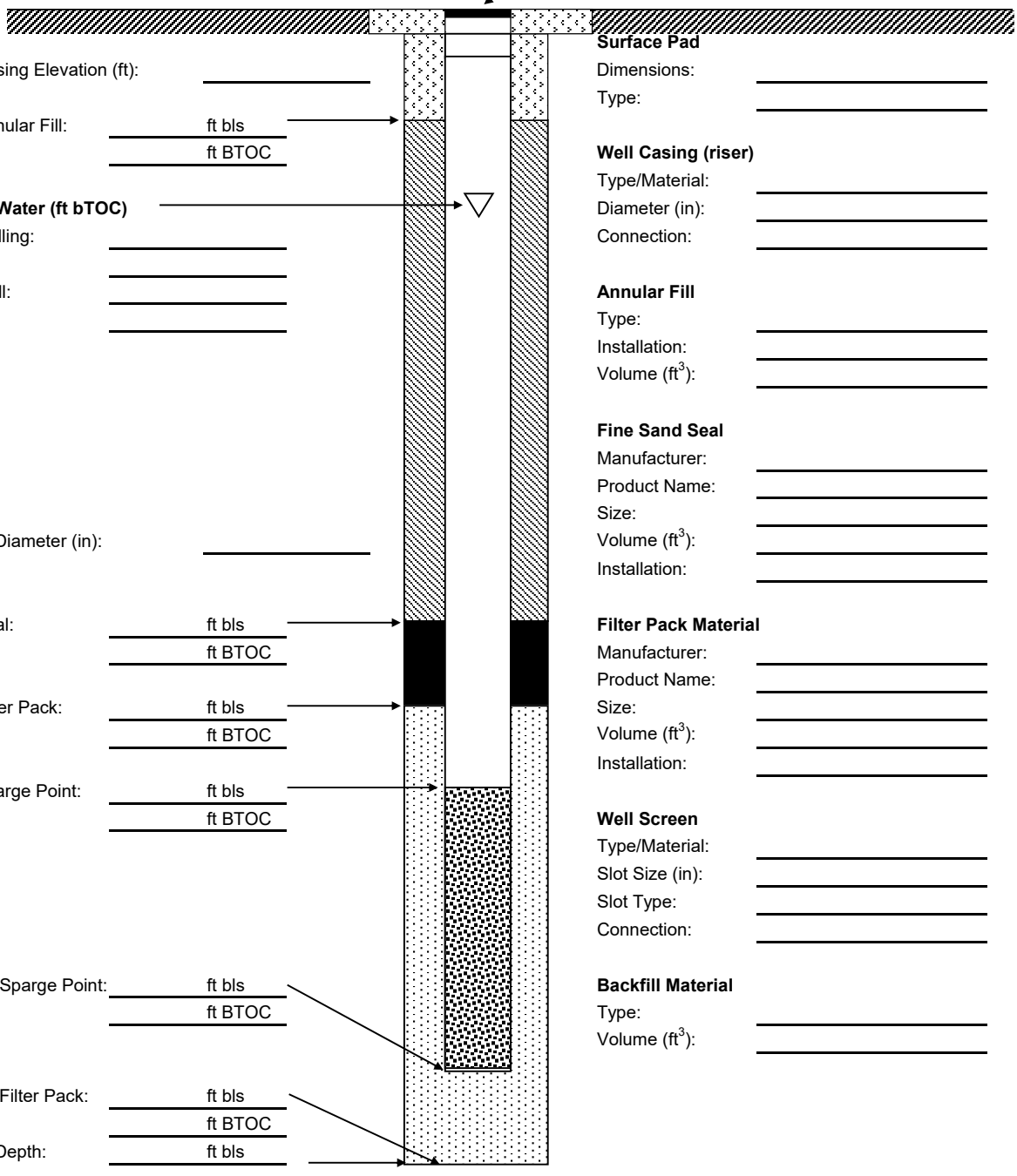
PROJECT	HOLE NO

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

AIR SPARGE WELL CONSTRUCTION DIAGRAM

Project/Phase:		Well/Boring No.:	
Location:		Drilling Method:	
Client:		Date(s):	
Drilling Contractor:		Northing:	
Driller:		Easting:	
Inspector:		Datum:	

NOT TO SCALE



Surface Elevation (ft):

Top of Casing Elevation (ft):

Top of Annular Fill: ft bls / ft BTOC

Depth to Water (ft bTOC)
During Drilling:
Date:
Post-Install:
Date:

Borehole Diameter (in):

Top of Seal: ft bls / ft BTOC

Top of Filter Pack: ft bls / ft BTOC

Top of Sparge Point: ft bls / ft BTOC

Bottom of Sparge Point: ft bls / ft BTOC

Bottom of Filter Pack: ft bls / ft BTOC

Borehole Depth: ft bls

Protective Casing
Type:
Dimensions:
Length:

Surface Pad
Dimensions:
Type:

Well Casing (riser)
Type/Material:
Diameter (in):
Connection:

Annular Fill
Type:
Installation:
Volume (ft^3):

Fine Sand Seal
Manufacturer:
Product Name:
Size:
Volume (ft^3):
Installation:

Filter Pack Material
Manufacturer:
Product Name:
Size:
Volume (ft^3):
Installation:

Well Screen
Type/Material:
Slot Size (in):
Slot Type:
Connection:

Backfill Material
Type:
Volume (ft^3):

Comments: Not to Scale

Notes:

TRINITY ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services

bls	below land surface
BTOC	below Top of Casing

TRINITY
ANALYSIS & DEVELOPMENT CORP.
Environmental & Engineering Services

FIELD DATA SHEET

Site Name:	Sample Date:	Sample Time:	Sample Number:
Sampled By:	Signature(s):	Sampling Method:	Sampling Location:
Client:	Contract Number:	Delivery Order:	Chain of Custody Number:

Solid Sample

Solid Sample Type:

- ☐ Surface Soil
- ☐ Subsurface Soil
- ☐ Sediment
- ☐ Waste
- ☐ Other _____

Sample Collection:

- ☐ Grab
- ☐ Composite
- ☐ Multi-increment
- ☐ Other _____

Sample Description (classification, color, plasticity, moisture content, consistency)

Aqueous Sample

Aqueous Sample Type:

- ☐ Surface Water
- ☐ Groundwater
  - ☐ Monitoring Well
  - ☐ Domestic Well
  - ☐ Other _____
- ☐ Seep
- ☐ Sump
- ☐ Waste
- ☐ Other _____

Well Information

Well Casing Size:
Total Well Depth
Static Water Level:
One Purge Volume:
Start Purge:
End Purge:
Total Purge Time:
Total Purge Volume:
Purge Method:

Analysis

☐ Volatiles ☐ Semivolatiles ☐ Ions ☐ RCRA Metals ☐ TAL Metals ☑ Select Metals (list) _____

☐ Pesticides ☐ Herbicides ☐ PCB ☐ Cyanide ☐ Explosives ☐ Other (list): _____

Purge Data

Time (hrs)	Temperature (ºC)	pH (SU)	Conductance (mS/cm)	D.O. (mg/L)	ORP (mv)	Turbidity (NTU)

Comments:

Weather Conditions: cloudy rainy sunny snowy	Temperature:	Barometer:

Rev. 4/2010

CHAIN OF CUSTODY

Page _____ of _____

Company:
Project Contact:
Telephone:
Project Name:
Project #:
Location:
Sampled By:

CT LABORATORIES

1230 Lange Court, Baraboo, WI 53913
608-356-2760 Fax 608-356-2766
www.ctlaboratories.com

Lab Use Only
Place Header Sticker Here:

Program:
QSM RCRA SDWA NPDES
Solid Waste Other _____

PO #

Report To:
EMAIL:
Company:
Address:

Invoice To:*
EMAIL:
Company:
Address:

**Client Special Instructions*

*Party listed is responsible for payment of invoice as per CT Laboratories' terms and conditions

Matrix:
GW – groundwater **SW** - surface water **WW** - wastewater **DW** - drinking water
S - soil/sediment **SL** - sludge **A** - air **M** - misc/waste

Turnaround Time
Normal RUSH*
Date Needed:
_____
Rush analysis requires prior CT Laboratories' approval
Surcharges:
24 hr 200%
2-3 days 100%
4-9 days 50%

Collection Date	Collection Time	Matrix	Grab/ Comp	Sample ID Description	Filtered? Y/N	ANALYSES REQUESTED	Total # Containers	Designated MS/MSD	CT Lab ID # (Lab use only)
						Fill in Spaces with Bottles per Test			

Relinquished By:	Date/Time	Received By:	Date/Time
Received by:	Date/Time	Received for Laboratory by:	Date/Time

Lab Use Only
Ice Present Yes No
Temperature _____
Cooler # _____

CUSTODY SEALS

Date _____

Signature _____

Attachment 3 Responses to USEPA and TDEC Comments

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
MEMPHIS ENVIRONMENTAL FIELD OFFICE
8383 WOLF LAKE DRIVE
BARTLETT, TN 38133-4119
PHONE (901) 371-3000 STATEWIDE 1-888-891-8332 FAX (901) 371-3170

October 11, 2016

Carolyn Jones
Program Manager
Office of the Chief of Staff for Installation Management
Attn: BRAC Division (DAIM-ODB)
2530 Crystal Drive (Taylor Bldg.), Room 5000
Arlington, VA 22202-3940

Subject: **UFP-QAPP Work Plan - Off Depot Air-Sparge Well Installation, (Rev 0)**
Defense Depot Memphis, Tennessee
TDoR ID # 79-736
EPA ID # TN 4210020570

Ms. Jones,

TDEC-DoR has reviewed the UFP-QAPP Work Plan for the Off Depot Air-Sparge Well Installation (received August 2016), as compiled by Trinity, and approves of the document. If there are questions or concerns, please contact me at (901) 371-3041 or at jamie.woods@tn.gov .

Regards,

Jamie A. Woods, P.G.
Project Manager
Division of Remediation
Memphis Environmental Field Office

cc: Thomas C. Holmes (HDRInc)
Diedre Lloyd (EPA-PM)
Joan Hutton (CALIBRE)
TDoR NCO: file 79-736
TDoR MEFO: file 79-736

Worksheet 4 - Project Personnel Sign-Off Sheet

Table 1 Personnel Sign-Off Sheet

Project Personnel	Project Title	Telephone Number	Signature/Date QAPP Read Email Receipt
ACSIM-ODB			
Carolyn Jones	Program Manager	703-545-2508	
BEC			
Joan Hutton	BRAC Environmental Coordinator	770-317-4323	
CESAM			
Laura Roebuck	CESAM Technical Manager	251-690-3480	
USEPA Region 4			
Diedre Lloyd	USEPA Remedial Project Manager	404-562-8855	
TDEC			
Jamie Woods	TDEC Remedial Project Manager	901-371-3041	JWoods 10/11/2016
Trinity			
Parks Medlock	Program Manager	850-588-0706	
Todd Calhoun	Project Manager	850-588-1001	
Robyn Peterson	Project Engineer	850-613-6800	
Ben Stewart	Project Geologist/Field Team Leader (FTL)/Site Safety and Health Officer (SSHO)	850-312-6576	
Jeanette Baldwin	Corporate Health and Safety Officer (HSO)	850-547-6243	

Responses to:
U.S. Environmental Protection Agency (EPA) Region 4 Comments on:
Uniform Federal Policy-Quality Assurance Project Plan
Off Depot Air Sparge Well Installation Work Plan
Defense Depot Memphis, Tennessee
August 2016 (Revision 0)

EPA Comments:

1. The Uniform Federal Policy – Quality Assurance Project Plan, Off Depot Air Sparge Well Installation Work Plan, Revision 0, dated August 2016 (AS Well Installation WP) does not provide all of the necessary information consistent with EPA guidance within Worksheet #10 (Problem Definition). For example, according to the Uniform Federal Policy for Quality Assurance Project Plans Part 1:UFP-QAPP Manual, EPA-500-B-04-900A, Intergovernmental Data Quality Task Force, Final Version 1, March 2005 (UFP-QAPP Manual), the following list of information is (but not limited to) provided within Worksheet #10 of the Quality Assurance Project Plan (UFP-QAPP):

   - The problem to be addressed by the project.
   - The environmental questions being asked.
   - Observations from any site reconnaissance reports.
   - Synopsis of secondary data or information from all site reports.

   While some of the above information is included in Worksheet #11 (Project Quality Objectives/Systematic Planning Process Statements), Worksheet #10 does not clearly define the problem to be addressed by the project or provide all of the applicable information consistent within the UFP-QAPP Manual for this worksheet. For clarity and completeness, please revise the AS Well Installation WP to address the missing information as it pertains to Worksheet #10.

   Response: Text to support the project definition and the need for modification to the existing AS/SVE system as described in this work plan has been added to Worksheet #10. Two new figures were added as *Figure 4 Vapor Zone Monitoring Points Year 5 Average Vacuum Readings* and *Figure 5 MW-159 CVOC Concentrations, 2014-2015*; Work Plan Rev. 0 figures 4-8 have been renumbered 6-10.

   Summary of the remedial actions for the Off Depot area has been added to the text. The metrics for determining successful operation and performance of the existing SVE system have been added to provide supplemental information to support Comment #2 below.

   Text has been revised to include a subsection for Problem Definition. The problem is the inability of the existing AS system to reduce groundwater CVOC concentrations near MW-159 below target criteria.

2. Figure 8 (Proposed Air Sparge Well Locations) depicts the proposed locations of five air sparge (AS) wells near monitoring well MW-159. However, it is unclear if the five proposed AS wells are within the radius of influence (ROI) of the existing soil vapor extraction (SVE)

wells. For example, as seen in Figure 8 the existing AS and SVE wells are located in close proximity to one another. As such, it is assumed the AS/SVE system was designed so the AS wells would be located within the ROI of the SVE wells.

a. Sufficient information regarding the ROI of the existing SVE wells with respect to the proposed AS wells near MW-159 is needed in order to provide support of this design within the AS Well Installation WP. Please revise the AS Well Installation WP to provide additional information that clearly demonstrates how the target active treatment objectives will be achieved within a reasonable timeframe for MW-159.

Response: The Off Depot Remedial Action Work Plan (e2M, 2009) identifies one of the metrics for determining that the AS/SVE system is operating successfully as "vacuum influence as indicated by negative pressure measurements from the VMPs extends throughout AS/SVE barrier". The document (Work and Test Procedure 16 – Vapor Monitoring Points) also states that "the VMPs will allow pressure readings to be collected to evaluate the radius of influence of the SVE wells…"

Vacuum measurements for Year 5 of the system operation were reviewed and evaluated and negative pressures were observed at all VMP locations. VMP locations VMP08A/B and VMP09A/B are located north and south of the proposed AS well locations and confirm the effectiveness of the SVE system in that area.

Text has been added to Worksheet #10 to identify these metrics and clarify that the SVE system is capable of treating vapors in the area of the proposed AS wells. *Figure 4 Vapor Zone Monitoring Points Year 5 Average Vacuum Readings* has been added to the document.

Note that with the addition of Figures 4 and 5, figure numbers have changed.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

December 9, 2016

UPS NEXT DAY AIR
RETURN RECEIPT REQUESTED

Ms. Carolyn Jones
Assistant Chief of Staff for Installation Management
Base Realignment and Closure Division (ACSIM-ODB)
2530 Crystal Drive (Taylor Building), Room 5000
Arlington, VA 22202-3940

Dear Ms. Jones:

The U.S. Environmental Protection Agency (EPA) has received and reviewed the Department of the Army, Defense Depot of Memphis Depot Uniform Federal Policy-Quality Assurance Project Plan Off Depot Air Sparge Well Installation Work Plan, Revision 1 and the US Army's response to EPA Comments.

EPA approves the above referenced report and the US Army's response to EPA comments. EPA appreciates the US Army's time and effort to address EPA's concerns. If you have any questions, please contact me at (404) 229 -9500.

Sincerely,

Diedre Lloyd

Diedre Lloyd
Remedial Project Manager
Restoration and Sustainability Branch
Superfund Division

cc: Ms. Carolyn Jones, (Signed Original), United Parcel Service, Return Receipt
Mr. Jamie A. Woods, PG, Tennessee, Department of Environment and Conservation, Memphis Environmental Field Office, 8383 Wolf Lake Drive, Bartlett, TN 38133-4119
Ms. Joan Hutton, CALIBRE, 3898 Mountain View Road, Kennesaw, GA 30152
Mr. Thomas Holmes, HDR Environmental, P.O. Box 728, Highlands, NC 28741