

**ARMY DRAFT  
REMEDIAL ACTION COMPLETION REPORT  
LHAAP-35A (58), CHEMICAL LABORATORY  
LONGHORN ARMY AMMUNITION PLANT  
KARNACK, TEXAS**

**Prepared For:**



**US Army Corps of Engineers**

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## Acronyms and Abbreviations

µg/L	micrograms per liter
1,1-DCE	1,1-dichloroethylene
AECOM	AECOM Technical Services, Inc.
ARAR	applicable or relevant and appropriate requirements
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cis-1,2-DCE	cis-1,2-dichloroethylene
cm/s	centimeters per second
COC	contaminant of concern
DHC	<i>Dehalococcoides ethenogenes</i>
DPT	direct push technology
DO	dissolved oxygen
ECP	Environmental Condition of Property
USEPA	(United States) Environmental Protection Agency
ft	feet
ft/ft	feet per foot
ft/yr	feet per year
IWWP	Installation-Wide Work Plan
LHAAP	Longhorn Army Ammunition Plant
LTM	Long-term Monitoring
LUC	Land Use Control
MCL	Maximum Contaminant Level
mg/L	milligrams per liter
MNA	Monitored Natural Attenuation
mV	millivolts
ORP	oxidation reduction potential
PPE	personal protective equipment
QA/QC	Quality Assurance/Quality Control
RA	Remedial Action
RACR	Remedial Action Completion Report

RAO	Remedial Action Objective
ROD	Record of Decision
SDWA	Safe Drinking Water Act
sf	square feet
TAC	Texas Administrative Code
TCE	trichloroethylene
TCEQ	Texas Commission on Environmental Quality
TOC	total organic carbon
trans-1,2-DCE	trans-1,2-dichloroethylene
UUUE	unrestricted use and unlimited exposure
US Army	United States Army Corps of Engineers
VC	vinyl chloride
VFA	volatile fatty acid
VOC	volatile organic compound

## 1 OVERVIEW

Longhorn Army Ammunition Plant (LHAAP) is an inactive, government-owned, formerly contractor-operated and maintained industrial facility located in central-east Texas in the northeastern corner of Harrison County. The facility occupies approximately 1,400 of its former 8,416 acres located between State Highway 43 in Karnack, Texas, and the western shore of Caddo Lake as shown in **Figure 1-1**. LHAAP was listed as a National Priorities List site on August 9, 1990, due to threatened releases of hazardous substances, pollutants, or contaminants. The United States Environmental Protection Agency (USEPA), the Texas Water Commission (now the Texas Commission on Environmental Quality [TCEQ]), and the United States Department of the Army (US Army) signed a Federal Facility Agreement on December 30, 1991.

Remedial activities are required at LHAAP-35A (58) under the Record of Decision (ROD) issued for the site in September 2010 (Shaw, 2010). This Remedial Action Completion Report (RACR) discusses the remedial actions taken to address risks associated with contaminated groundwater at the LHAAP-35A (58) site. This RACR has been developed using the basis of the Remedial Design for the LHAAP-35A (58) site (Shaw, 2011) and the details in the Remedial Action Work Plan (RAWP) for the LHAAP-35A (58) site (AECOM, 2013a).

This work was performed under USACE Huntsville District's Worldwide Environmental Remediation Services Contract No. W912DY-09-D-0059 Task Order No. DS01. The U.S Army Environmental Command provides funding for the environmental remedial activities at LHAAP. The Base Realignment and Closure Division is responsible for all aspects of LHAAP including the environmental program, operations, and land transfer.

### 1.1 Organization of RACR

This RACR is composed of the following sections:

- Section 1: "Overview" summarizes the site background, remedial action objectives (RAOs), constituents of concern (COCs), selected remedy, and the land use assumptions.
- Section 2: "Land Use Control" summarizes the remedial activities with respect to the land use control that were implemented at the site.
- Section 3: "Plume Delineation Activities" summarizes the plume delineation activities implemented at the site, nature and extent of contamination, arsenic monitoring, and site geology and hydrogeology.
- Section 4: "Enhanced In-situ Bioremediation" summarizes the EISB work performed as part of the remedial activities at the site.
- Section 5: "Monitored Natural Attenuation" summarizes the MNA work performed as part of the remedial activities at the site.
- Section 6: "MNA Performance Evaluation and Reporting" outlines activities that were performed in support of MNA performance evaluation and reporting, annual long-term monitoring (LTM) reporting, and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) five-year reviews.

- Section 7: “Schedule” outlines the schedule and timeline of major site activities.
- Section 8: “Community Relations” summarizes public outreach conducted at the site.
- Section 9: “Conclusion” provides a general summary of the remedial action completion report.
- Section 10: “References” provides a list of references cited within the document.

The RACR also includes an Appendix supporting the main text:

- Appendix A: Land Use Control Recordation Document
- Appendix B: Annual Land Use Control Compliance Certification Documentation
- Appendix C: DPT and Monitoring Well Boring Logs, EISB Injection Logs
- Appendix D: Well Construction Logs and Development Forms
- Appendix E: Groundwater Sampling Forms
- Appendix F: Chain of Custody Forms, Data Validation Reports, Analytical Data Tables and Laboratory Reports
- Appendix G: PCE and TCE Concentration Trends in Eastern Plume Shallow Zone Groundwater (EISB Treatment Area)

Activities specified in this RACR were conducted in accordance with the draft Installation-Wide Work Plan (IWWP) (AECOM, 2013b) in place when field work was executed.

## 1.2 LHAAP-35A (58) Background

The LHAAP-35A (58) site, also known as the Shops Area, is located in the north-central portion of LHAAP and currently covers an area of approximately 11 acres (**Figure 1-2**) (Shaw, 2010). The surface features are a mixture of asphalt-paved roads, a parking area, and areas of wooded and grassy vegetation. The topography is relatively flat with the surface drainage flowing into the tributaries of Goose Prairie Creek. Runoff from the site enters Caddo Lake via Goose Prairie Creek.

The Shops Area now designated as LHAAP-35A (58) was established in 1942 as part of the installation’s initial construction (Shaw, 2011). The facility was used to provide plant-operated laundry, automotive, woodworking, metalworking, painting, refrigeration, and electrical services. The site was active throughout LHAAP’s mission and was deactivated along with the rest of the installation in 1996-1997. The LHAAP-35A (58) site boundary has had various configurations. **Figure 1-3** shows the historical site boundary and the current site boundary defined by the U.S. Army Corps of Engineers in November 2006 (Shaw, 2010). Earlier investigations for LHAAP-35A (58) covered additional areas to the south; however, the current boundary encompasses approximately 11 acres. Located within the boundary of LHAAP-35A (58) are additional sites consisting of:

- LHAAP-02, vacuum truck overnight parking;
- LHAAP-03, the Paint Shop Building 722 (waste collection);

- LHAAP-56, a vehicle wash rack & oil/water separator Building 744-A
- LHAAP-59, Storage Building 725
- LHAAP-60, Former Storage Building 714;
- LHAAP-61, Water Treatment Plant
- LHAAP-65, the Flammable Materials Storehouse Building 209
- LHAAP-68, a mobile storage tank parking area; and
- LHAAP-69, service station with underground storage tanks.

Between 1992 and 2008, multiple investigations were conducted in a phased approach to evaluate the nature and extent of contamination at the LHAAP-35A (58) site. The findings from these investigations were that the shallow zone groundwater was impacted with volatile organic compounds (VOCs), while the soil and former sump/waste rack sump areas posed no unacceptable threat to human health or the environment (Shaw, 2011). There have been no previous remedial actions at LHAAP-35A (58). The Feasibility Study completed in 2009 recommended the monitored natural attenuation remedial alternative (Shaw, 2009).

The shallow groundwater at the LHAAP-35A (58) site is impacted with the following constituents of concern (COCs): tetrachloroethene (PCE), trichloroethene (TCE), 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, and vinyl chloride (VC). In addition, there are low levels of 1,1,2-trichloroethane (TCA) and its daughter products 1,1-dichloroethane (DCA) and chloroethane in the site groundwater, but they are not considered COCs.

Although arsenic has not been designated as a COC, it is included in the groundwater monitoring program as discussed in the RAWP (AECOM, 2013a).

### **1.2.1 Remedial Action Objectives**

The remedial action (RA) at LHAAP-35A (58) protects human health and meets applicable or relevant and appropriate requirements (ARARs). There are no ecological risks at the site (USACE, 2010).

The RAOs for LHAAP-35A (58), consistent with the reasonably anticipated future use as a national wildlife refuge, are:

- Protection of human health by preventing human exposure to the contaminated groundwater;
- Protection of human health and the environment by preventing contaminated groundwater from migrating into nearby surface water; and,
- Return of groundwater to its potential beneficial uses as drinking water, wherever practicable.

## 1.2.2 Summary of COCs and the Selected Remedy

The description of the remedy for the LHAAP-35A (58) site is separated into two areas: 1) eastern plume; and 2) western plume.

The COCs in the LHAAP-35A (58) site groundwater are dissolved-phase TCE, PCE, 1,1-DCE, Cis-1,2 DCE, Trans-1,2 DCE, and VC. In addition, there is arsenic, and low levels of 1,1,2-trichloroethane (TCA) and its daughter products 1,1-dichloroethane (DCA) and chloroethane in the site groundwater but they are not considered COCs.

Under the Safe Drinking Water Act (SDWA) the maximum contaminant levels (MCL) will be used as the cleanup levels if established for a COC. For those COCs without a MCL, the groundwater medium-specific concentration (MSC) for industrial use (GW-Ind) will be used as cleanup levels (Shaw, 2011). MSCs are provided under Texas Risk Reduction Rules (30 Texas Administrative Code [TAC] 335.551 through 335.569). **Table 1-1** presents the cleanup levels for the COCs at LHAAP-35A (58).

The remedy for LHAAP-35A (58) protects human health and the environment by preventing human exposure to the contaminated groundwater and preventing contaminated groundwater from migrating into nearby surface water. The approved remedies for the two plume areas are as follows:

- **Eastern Plume Area:** the eastern plume remedy includes land use control (LUC); enhanced in-situ bioremediation (EISB) in the area of highest levels of COCs followed by monitored natural attenuation (MNA) near wells LHSMW05; 35AWW08, and 03WW01; MNA for remainder of the plume beyond the influence of the EISB treatment; and LTM/Five-Year Reviews.
- **Western Plume Area:** The western plume remedy consists of LUC, MNA, and LTM/Five-Year Reviews.

The remedy includes the following components:

- **LUC:** LUC in the impacted area will ensure protection of human health by restricting the use of groundwater exceeding cleanup levels to environmental monitoring and testing only. The LUC will remain in effect until such time as the U.S. Army, USEPA and TCEQ agree that COC concentrations have met cleanup levels.
- **EISB:** EISB technology involves biological degradation of contaminants in groundwater via respiratory or metabolic processes through appropriate microbes. The EISB treatment involves injection of carbon substrates (electron donor), nutrients, and, if needed, microbial cultures, into the subsurface. EISB was implemented in the eastern plume area only, as the COC levels in this area represented highest concentrations in the shallow groundwater zone at the site and warranted active treatment.
- **MNA:** A MNA program is implemented to establish attenuation trends and verify that the VOC plume is stable or shrinking and will not migrate to nearby surface water at levels that may present an unacceptable risk to human health or the environment. Natural attenuation is expected to return groundwater to acceptable quality.

The MNA evaluation will be completed after two years of groundwater monitoring. During these two years, groundwater monitoring data will be collected on a quarterly basis.

- **Long-term Monitoring (LTM)/Five-Year Reviews:** MNA will be evaluated for two years, and after it is verified to be effective, LTM will begin at a semiannual frequency for the following three years (until the first CERCLA Five-Year Review). In subsequent years, LTM will be performed annually until the next CERCLA Five-Year Review. The LTM associated with this remedy will be used to track the continued effectiveness of MNA. The need for continued monitoring and any reductions in the monitoring frequency will be evaluated every five years during the CERCLA Five-Year Review. However, at a minimum, the LTM will continue once every five years until the cleanup levels are achieved.

Based on the previously performed groundwater modeling for the LHAAP-35A (58) western plume area, MCLs are expected to be met through natural attenuation in approximately 200 years (Shaw, 2011). This timeframe will be re-evaluated as part of the MNA evaluation and periodic reviews. A cleanup time has not been estimated for the eastern plume and will be evaluated following EISB implementation and subsequent data collection.

### 1.2.3 Land Use Assumption

Although not a remedy, the land use assumption for LHAAP-35A (58) forms the basis for the remedy. The reasonably anticipated future use of LHAAP-35A (58) as part of the national wildlife refuge is consistent with an industrial risk exposure scenario. Notification of the land use assumption of LHAAP-35A (58) has been made in transfer documentation, and has been recorded in the Harrison County Courthouse in accordance with TAC Title 30, §335.566. The land use assumption language is included in Appendix A – Land Use Control Recordation Document.

### 1.2.4 Bioremediation Treatability Study

A laboratory-scale bioremediation Treatability Study (TS) was performed for LHAAP-35A (58) between February and June 2013. The purpose of the TS was to select an appropriate carbon substrate for EISB treatment in the western plume area. One lactate based carbon substrate (e.g. sodium lactate) and one vegetable oil based carbon substrate (e.g. emulsified vegetable oil [EVO]) were evaluated in the TS.

Compared to the EVO-type substrate evaluated in the TS, the lactate-based carbon substrate was relatively faster substrate in reducing the COCs to below cleanup levels, and was selected for use on that basis. Complete details of the TS were provided in the TS Report included as an appendix to the RAWP (AECOM, 2013a).



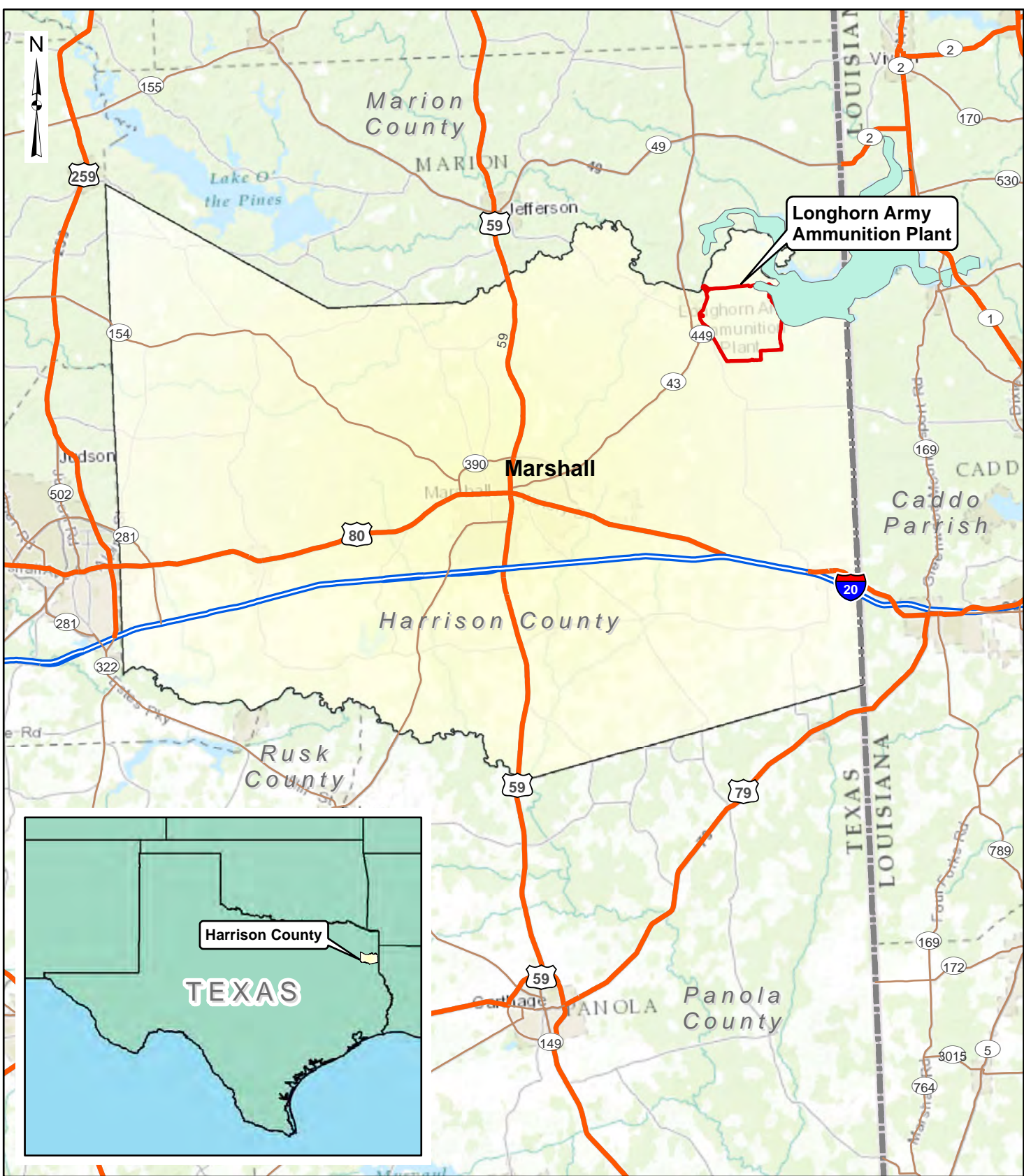
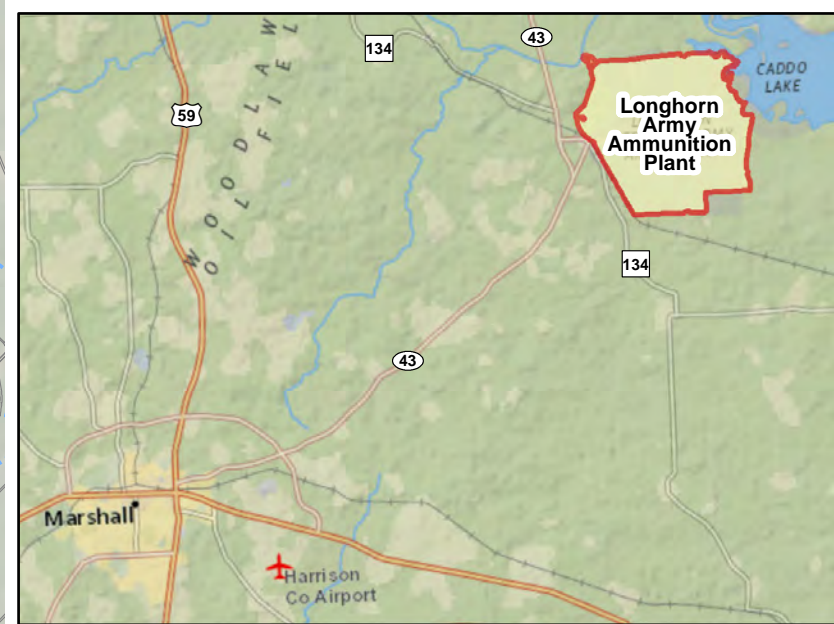
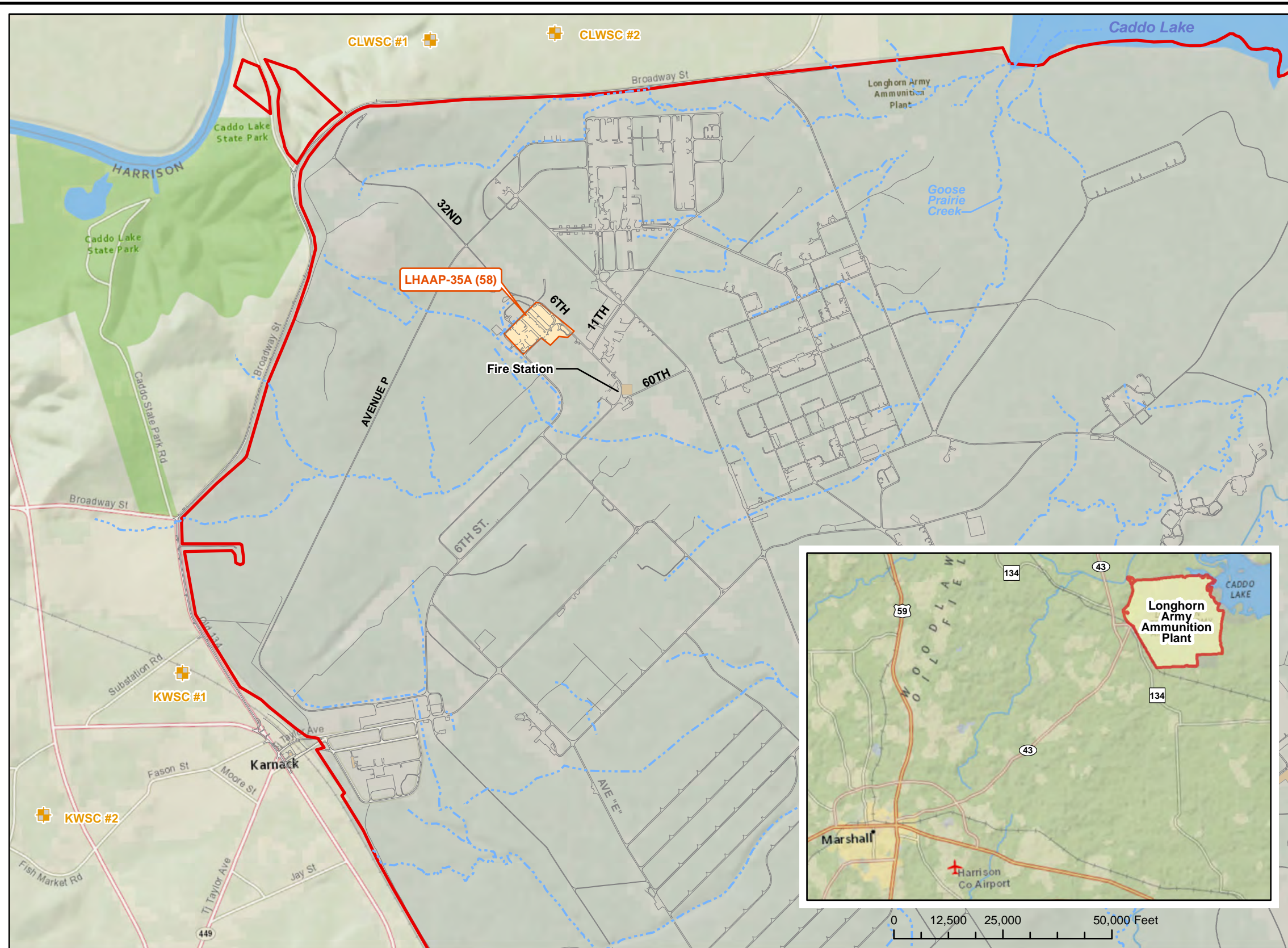


Figure 1-1  
 Site Location Map  
 Remedial Action Completion Report  
 LHAAP-35A(58)  
 Longhorn Army Ammunition Plant  
 Karnack, Texas

60256135

March 2014





- Legend**
- Public Water Supply Well Locations
  - Roads
  - Streams
  - Lake/Pond
  - Site
  - LHAAP Boundary

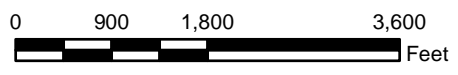
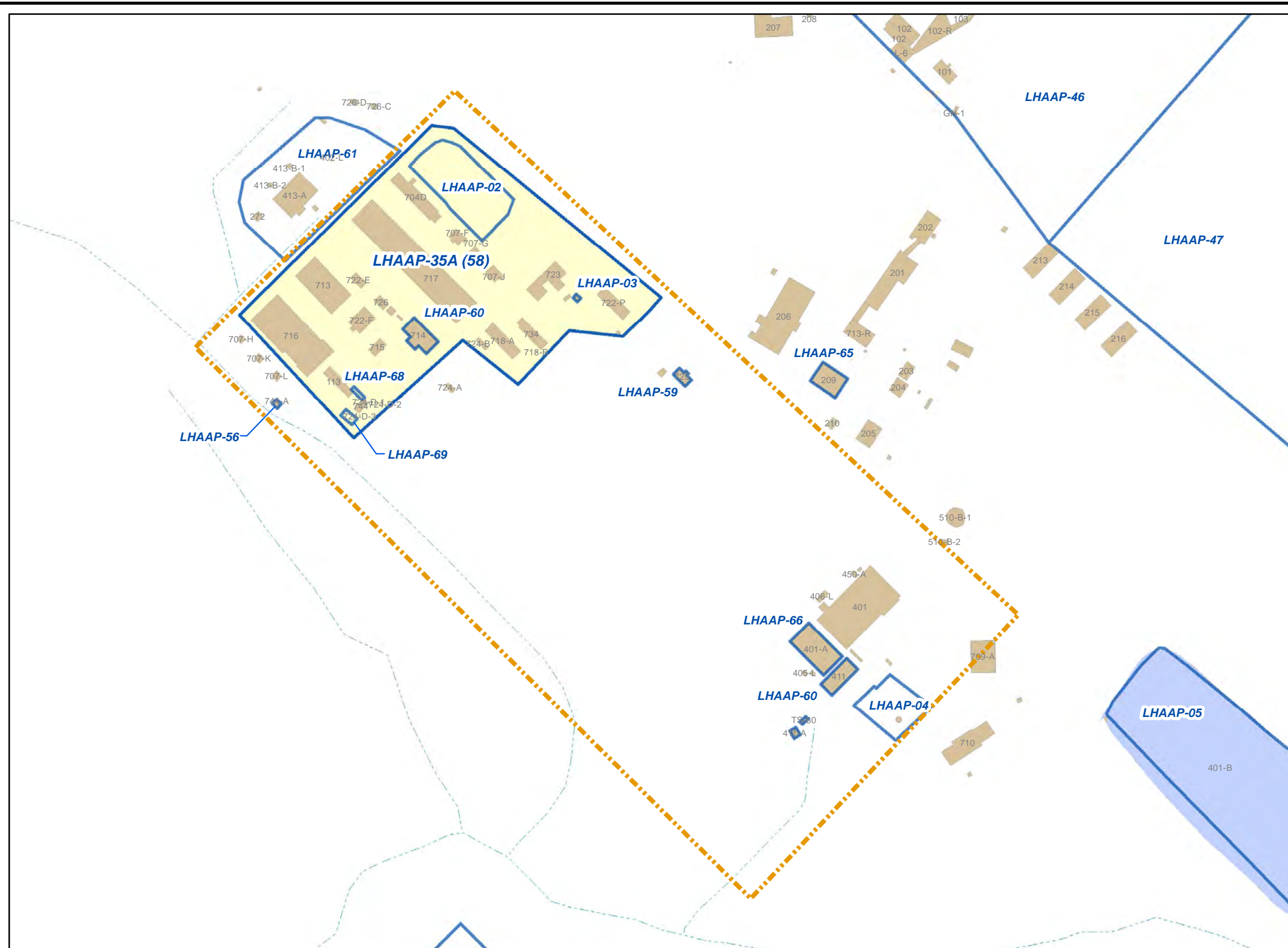


Figure 1-2  
 Site Location Map  
 Remedial Action Completion Report  
 LHAAP-35A(58)  
 Longhorn Army Ammunition Plant  
 Karnack, Texas

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- Legend**
- Streams
  - Roads
  - Former Buildings or Concrete Slab
  - Lake/Pond
  - Other LHAAP Sites
  - LHAAP-58 Site Boundary
  - Historic LHAAP58 Site Boundary

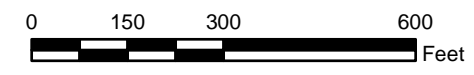


Figure 1-3  
 Site Overview Map  
 Remedial Action Completion Report  
 LHAAP-35A(58)  
 Longhorn Army Ammunition Plant  
 Karnack, Texas

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**Table 1-1: LHAAP-58 Constituents of Concern Cleanup Levels**

<b>Constituent of Concern</b>	<b>Concentration (µg/L)</b>	<b>Basis</b>
1,1-Dichloroethene	7	MCL
cis-1,2-Dichloroethene	70	MCL
Tetrachloroethene	5	MCL
trans-1,2-Dichloroethene	100	MCL
Trichloroethene	5	MCL
Vinyl Chloride	2	MCL

Notes and Abbreviations:

µg/L – micrograms per liter

MCL – United States Environmental Protection Agency Maximum Contaminant Level

## 2 LAND USE CONTROL

The following sections discuss the remedial activities with respect to land use control implemented at LHAAP-35A (58) in accordance with the RAWP (AECOM, 2013a).

### 2.1 Land Use Control Plan

The US Army or its representatives are responsible for LUC implementation and certification, reporting and enforcement. The US Army will address LUC problems within its control that are likely to impact remedy integrity as soon as practicable. The following sections provide details for the LUC component of the RA.

#### 2.1.1 Land Use Control Implementation

The objectives of LUC at LHAAP-35A (58) are to prevent human exposure to groundwater contamination presenting an unacceptable risk to human health and ensure that there is no withdrawal or use of groundwater beneath the site for anything other than environmental monitoring and testing until the cleanup levels are attained. A restriction against residential use of groundwater will remain in effect until COC concentrations in groundwater allow unrestricted use and unlimited exposure (UUUE). Notification of the groundwater use restriction accompanying all transfer documents has been recorded at the Harrison County Courthouse in accordance with the Texas Administrative Code (TAC) Title 30, §335.566.

The LUC addresses the area of LHAAP-35A (58) that contains shallow zone groundwater contamination.

The US Army has completed the following actions to implement the LUC for groundwater restriction for the LHAAP-35A (58) site:

- **Define the Area of the Groundwater Use Restriction**

The groundwater analytical baseline data collected as part of the remedial activities in conjunction with the historic data was used to define the LUC boundary at the LHAAP-35A (58) site. A buffer has been provided to address potential uncertainties in the data.

**Figure 2-1** depicts the LUC boundary for the LHAAP-35A (58) site.

- **Survey the LUC Boundary**

Pursuant to concurrence from the USEPA and TCEQ, the LUC boundary (**Figure 2-1**) was surveyed by a Texas state-licensed surveyor. A legal description of the surveyed LUC area was appended to the existing survey plat for the property.

- **Record the LUC in Harrison County**

The LUC plat, legal description and groundwater use restriction language was recorded in the Harrison County Courthouse in accordance with TAC Title 30, §335.566. The LUC recordation document is included in **Appendix A**.

- **Notify the Texas Department of Licensing and Regulation of the LUC**

The Texas Department of Licensing and Regulation was notified of the groundwater restriction which includes the prohibition of water well installation for any purpose other than environmental monitoring and testing without prior approval from the USEPA and TCEQ. The survey plat, legal boundary, and description of the groundwater restriction, in conjunction with a locator map, have been provided to the Texas Department of Licensing and Regulation in hard and electronic copy.

The US Army and regulators will confer to determine appropriate actions should there be a failure of a LUC objective at the site after it has been transferred.

### **2.1.2 Site Certification and Reporting**

The annual inspections and certifications will be completed in compliance with the LUC objectives. The US Army, or the transferee after transfer, will retain the annual LUC inspection/certification documents (**Appendix A** of this document) in the project files for incorporation into the CERCLA Five-Year Review reports. These reports will be made available to the USEPA and TCEQ upon request. If any violations are found during the annual certification, a separate written explanation will be provided to the USEPA and TCEQ indicating the specific violations found and what efforts or measures have or will be taken to correct the violations. Upon transfer, such responsibilities may shift to the transferee via appropriate provisions placed in the Environmental Condition of Property (ECP) or other environmental transfer document. The need to continue annual certifications will be revisited during CERCLA Five-Year Reviews.

### **2.1.3 Notice of Planned Property Conveyances**

The US Army will provide notice to the USEPA and TCEQ when conveying the LHAAP-35A (58) site acreage. The notice will describe the mechanism by which the LUC will continue to be implemented, maintained, inspected, reported, and enforced. Upon transfer, such responsibilities may shift to the transferee via appropriate provisions placed in the ECP or other environmental document for transfer. The US Army retains the responsibility for remedy integrity and is responsible for addressing substantive violations of the LUC performance objectives that would undermine the CERCLA remedy. The US Army will be responsible for outlining the transferee's LUC obligations into property transfer documents.

### **2.1.4 Opportunity to Review Text of Intended Land Use Control**

The groundwater use restriction notification as recorded in the Harrison County Courthouse is included in **Appendix A**. The US Army will produce an ECP or other environmental document prior to transfer of the LHAAP-35A (58) site and provide a draft to the USEPA and TCEQ.

### **2.1.5 Notification Should Action(s) which Interfere with Land Use Control Effectiveness be Discovered Subsequent to Conveyance**

Should the US Army discover any activity on the property inconsistent with the LUC performance objectives after conveyance of the site, the USEPA and TCEQ will be notified within 72 hours. The US Army, in conjunction with the USEPA, TCEQ, and the transferee,

would correct the problem(s) discovered. This reporting requirement does not preclude the US Army from taking immediate action pursuant to its CERCLA authority to prevent any perceived risks to human health and the environment.

### **2.1.6 Land Use Control Enforcement**

Should the LUC remedy fail, the US Army will coordinate with the USEPA and TCEQ to ensure that appropriate actions are taken to reestablish its protectiveness. The US Army may notify the local agencies with jurisdiction of any LUC violation(s) by future property owners and will work cooperatively with them to restore owner/user compliance with the LUC.

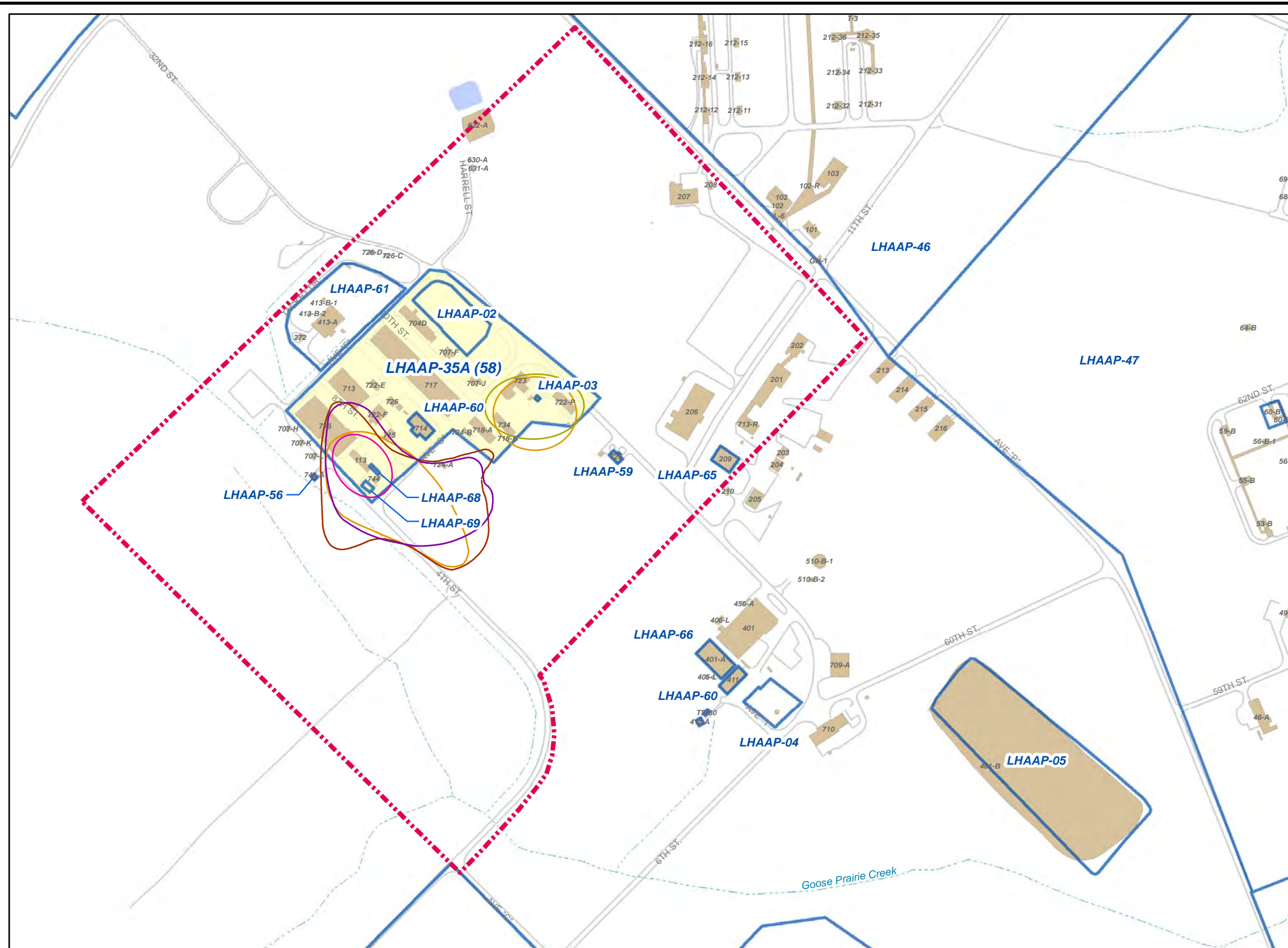
### **2.1.7 Modification or Termination of Land Use Control**

Any significant modification to, or termination of the LUC or a land use change inconsistent with the LUC objectives will be made only with USEPA and TCEQ concurrence, which will be sought prior to commencing actions that may impact remedy integrity.

The LUC will remain in effect until such time as the US Army, USEPA and TCEQ agree that the concentration of COCs have met cleanup levels. When this occurs, the LUC will be terminated consistent with the National Oil and Hazardous Substances Contingency Plan process for post-ROD changes. If the property has been transferred and a determination by the US Army, USEPA and TCEQ has been made to terminate one or more of the LUC objectives, the US Army shall provide to the owner of the property an appropriate release for recordation pertaining to the site and will also advise other local stakeholders of the action in a timely manner.

### **2.1.8 Comprehensive Land Use Control Management Plan**

A copy of the final LUC RA has been included in the Comprehensive LUC Management Plan for LHAAP. The Comprehensive LUC Management Plan figure and table have been updated to reflect the inclusion of LHAAP-35A (58) site.



**Legend**

- cis-1,2-Dichloroethene Concentration Contour (70 µg/L)
- 1,1-Dichloroethene Concentration Contour (7 µg/L)
- Trichloroethene Concentration Contour (5 µg/L)
- Tetrachloroethene Concentration Contour (5 µg/L)
- Vinyl Chloride Concentration Contour (2 µg/L)
- Streams
- Roads
- Former Buildings or Concrete Slab
- Lake/Pond
- Other LHAAP Sites
- LHAAP-58 Site Boundary
- Land Use Control Boundary

µg/L - micrograms per liter  
LHAAP - Longhorn Army Ammunition Plant

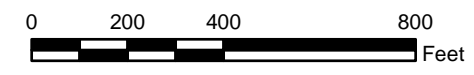


Figure 2-1  
Land Use Control Boundary  
Remedial Action Completion Report  
LHAAP-35A (58)  
Longhorn Army Ammunition Plant  
Karnack, Texas

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### 3 PLUME DELINEATION ACTIVITIES

Plume delineation work was performed as part of the remedial activities between July and September 2013 to refine the extent of contamination in the shallow groundwater zones. The following sections discuss the outcome of this work.

#### 3.1 Direct Push Technology Points Installation and Groundwater Sampling

Direct Push Technology (DPT) points were advanced in both the eastern and western plume areas. If VOC concentrations in a DPT location exceeded cleanup levels, another DPT point was installed as a step-out from the previous DPT point in the down-gradient direction to collect additional VOC data. This procedure was repeated until a DPT location with VOC concentrations less than clean up levels was identified. A total of 20 DPT points, 58DPT10 through 58DPT15, 58DPT15a, and 58DPT15b through 58DPT27 were installed in the shallow groundwater zone to assist in selection of optimal locations for permanent groundwater monitoring wells and delineation of the VOC plumes. The locations of the DPT points are depicted in **Figure 3-1**. The shallow DPT points were advanced to depths between approximately 22.5 to 38 feet (ft) bgs with discrete groundwater samples obtained between 23 and 40 ft bgs. No DPT points were advanced into the intermediate or deep groundwater zones.

Discrete groundwater samples were collected from the DPT points by advancing a stainless steel screen beyond the bottom of the boring and exposing it to the formation. The drilling equipment was decontaminated after each completion of each DPT point to prevent cross-contamination. The groundwater samples from the DPT points were analyzed for VOCs utilizing EPA Method 8260B. Boring logs for the DPT points are included in Appendix C. The VOC data from the DPT points is tabulated in **Table 3-1**.

TCE concentrations observed in the groundwater sample from 58DPT15 location exceeded the MCL, requiring installation of two additional sampling points, 58DPT15a and 58DPT15b (see **Figure 3-1**), prior to finalizing the location of well 35AWW19. Due to equipment availability, however, these two points (58DPT15a and 58DPT15b) were installed with a hollow stem auger drill rig. A 10-foot long 2-inch diameter screen was temporarily placed in the borehole to collect a groundwater sample from each of these points.

#### 3.2 Permanent Groundwater Monitoring Wells Installation and Groundwater Sampling

Fourteen new monitoring wells (35AWW09, 35AWW10, 35AWW11, 35AWW12, 35AWW13, 35AWW14, 35AWW15, 35AWW16, 35AWW17, 35AWW18, 35AWW19, 35AWW20, 35AWW21, and 35AWW22) were installed in the shallow groundwater zone. The locations of these wells were based on the groundwater data from the DPT points, and are generally consistent with the locations proposed in the RAWP, with the exception of 35AWW19 which was moved further to the southeast from its originally proposed location based on the VOC data in groundwater samples obtained from 58DPT15, 58DPT15a and 58DPT15b. **Figure 3-1** depicts the locations of the new monitoring wells. The total depths of the new monitoring wells in the shallow groundwater zone ranged from approximately 29 ft bgs to 40 ft bgs. In addition, monitoring well 35WWW07R was installed as a replacement for well 35AWW07 which had been previously destroyed (see **Figure 3-1**). No wells were installed in the intermediate or deep

groundwater zones. Boring logs for the monitoring wells are included in **Appendix C**. Well construction forms are included in **Appendix D**.

Following well development activities for the new wells, groundwater samples from the wells 35AWW10 (up-gradient), 03WW01 (within source area), 35AWW08 (within source area), and 35AWW09 (downgradient) were collected in August 2013 for analysis of VOCs and key biogeochemical parameters. These wells were sampled prior to EISB treatment to establish baseline conditions as they are located within the eastern plume and provide data useful in evaluation of the EISB treatment. The EISB implementation was performed in September 2013 and is further discussed in Section 4.0. The remaining monitoring wells planned to be part of the MNA remedy were sampled in October 2013. All groundwater samples were analyzed for VOCs to establish baseline conditions. Samples from a subset of monitoring wells were also analyzed for key biogeochemical parameters to assist in evaluation of MNA. Additional discussion on the biogeochemical parameters is provided in **Section 5.0**.

During the baseline groundwater sampling event in October 2013, wells 35AWW04 and 35AWW05 were dry. **Table 3-2** provides a list of wells and analytes for each well collected during the baseline event.

All well installation and sampling activities were performed in accordance with the Draft IWWP (AECOM, 2013b). Groundwater sampling forms are included in Appendix E. Chain of custody forms and the laboratory analytical reports are included in **Appendix F**.

### 3.3 Site Survey

After completion of the well installation activities, the newly installed monitoring wells were surveyed by a state-licensed land surveyor in the Texas State Plane, NAD 1983 coordinate system. The survey data was used to depict the monitoring well locations on the figures for this document.

### 3.4 Nature and Extent of Contamination

#### 3.4.1 Shallow Zone

**Figures 3-1** through **3-5** present the current plumes for PCE, TCE, cis-1,2-DCE, 1,1-DCE, and VC, in the shallow zone, as defined by their respective cleanup levels. The August 2013 data is also presented on these figures to show changes in VOC levels before and immediately after the EISB treatment in the eastern plume area.

The estimated PCE plume configuration is presented in **Figure 3-1**. The PCE plume is roughly centered at the well 35AWW08, and baseline data indicates PCE in wells 03WW01, 35AWW08, and 35AWW09 exceeds the MCL. **Figure 3-1** is different from that shown in the RAWP for the eastern plume due to additional PCE data collected as part of the plume delineation work. The RAWP also identified a small PCE plume in the western plume, centered at monitoring well location 35AWW06; however, the RA baseline results did not identify PCE exceedances in the western area of the site.

**Figure 3-2** presents the two separate TCE plumes (eastern plume and western plume) identified in the shallow zone. The eastern plume is located in the southeast portion of LHAAP-58 (35A) and appears to extend beyond its southern boundary. Wells exceeding the TCE MCL within the

eastern plume were 03WW01, 35AWW08, and 35AWW09. The western plume is located in the southwest portion of LHAAP-35A (58) and extends beyond the southern boundary. Wells exceeding the TCE MCL within the western plume were 35AWW20 and LHSMW07. The configurations of TCE plumes in the shallow groundwater zone shown in **Figure 3-2** appear different than those shown in the RAWP as a result of additional TCE data collected as part of the plume delineation work. The eastern TCE plume remains centered on well 35AWW08; however, it is smaller in areal extent than depicted in the RAWP. Similarly, the western TCE plume is larger in areal extent than depicted in the RAWP, with the highest TCE concentration detected in well 35AWW20, approximately 200 feet north of well LHSMW07 (highest TCE concentration depicted in the RAWP).

The estimated cis-1,2-DCE plume configuration in the shallow zone, as defined by its MCL of 70 µg/L is presented in **Figure 3-3**. A cis-1,2-DCE plume was identified only in the western plume area shallow zone. It is located within the southwest corner of LHAAP-35A (58). Baseline data indicates 35AWW20 is the only well with cis-1,2-DCE concentrations exceeding the MCL. No cis-1,2-DCE plume was identified in the RAWP document.

The highest concentration of 3.77 µg/L trans-1,2-DCE was identified in monitoring well 35AWW20 located at the southwest corner of LHAAP-35A (58). There were no exceedances of the trans-1,2-DCE MCL in any of the wells sampled. Although not identified as a COC for the LHAAP-35A (58) site, 1,1,2-TCA and 1,2-DCA were detected in 35AWW20 at concentrations exceeding their MCL and GW-Ind, respectively.

The estimated 1,1-DCE plume configuration in the western area shallow zone, as defined by its MCL of 7 µg/L, is presented in **Figure 3-4**. This plume is located near the southwest corner of LHAAP-35A (58) and extends beyond its south and southeast boundaries. The 1,1-DCE plume is roughly centered at the 58DPT15 location although the highest 1,1-DCE concentration was identified in well 35AWW20. Baseline data indicates 1,1-DCE levels in wells 35AWW06, 35AWW11, 35AWW20, and LHSMW07 exceed the MCL. The 1,1-DCE plume shown in **Figure 3-4** is different from that shown in the RAWP due to additional 1,1-DCE data from the delineation work. In comparison to the RAWP depiction, the 1,1-DCE plume is located farther southeast. The RAWP also depicted a 1,1-DCE plume in the eastern plume area; however, 1,1-DCE was not observed at concentrations exceeding the MCL in the eastern plume area during the baseline sampling event.

The estimated VC plume configuration in the shallow zone, as defined by its MCL of 2 µg/L, is presented in **Figure 3-5**. Only one VC plume (western plume area) is identified in the shallow zone. The plume is located at the southwest corner of LHAAP-35A (58) and extends beyond its boundary to the south and southeast. The VC plume is roughly centered at the 58DPT15 location although the highest concentration of VC was located at 35AWW20. Evaluation of baseline VOC data indicates VC exceeded the MCL at wells 35AWW20 and LHSMW07. The configuration of the VC western plume in the shallow groundwater zone shown in **Figure 3-5** is different from that shown in the RAWP due to additional VC data gathered as part of the plume delineation work. The VC plume depicted here is larger in areal extent than that depicted in the RAWP, with the plume encompassing the southwestern portion of LHAAP-35A (58) and extending beyond its boundaries to the south and southeast. The RAWP identified a small VC plume in the eastern plume area, centered at the location of temporary monitoring well

1004TWW001. The baseline sampling event did not find VC at concentrations exceeding the MCL in the eastern plume area.

No MCL exceedances of any other VOCs were identified during the baseline sampling event.

The VOC data from the August 2013 and October 2013 events is tabulated in **Table 4-1** and **Table 5-1**, respectively. The associated data validation report is included in **Appendix F**.

### 3.4.2 Intermediate Zone

As discussed in **Section 3.1**, no intermediate groundwater zone DPT points or new monitoring wells were installed as part of the remedial action work. Monitoring well 35AWW01 and 35AWW05 (previously installed by others) are completed in the intermediate groundwater zone. Baseline monitoring event data from these two wells detected no VOCs. The baseline VOC data from the intermediate zone wells is tabulated in **Table 5-1**. The associated data validation report is included in **Appendix F**.

### 3.4.3 Deep Zone

As discussed in **Section 3.1**, no deep groundwater zone DPT points or new monitoring wells were as part of the remedial action work. Monitoring well 35AWW02 (previously installed by others) is completed in the deep groundwater zone. Baseline monitoring event data from this well detected no VOCs. The baseline VOC data from the deep zone well is tabulated in **Table 5-1**. The associated data validation report is included in **Appendix F**.

### 3.4.4 Arsenic Monitoring

Although arsenic has not been designated as a COC, groundwater was monitored for arsenic as described in the RAWP. In November 2008, arsenic was detected in one LHAAP-03 well (03WW01) and five LHAAP-35A (58) wells at concentrations exceeding the 10 µg/L MCL. Detected arsenic concentrations were within the range observed in groundwater during background studies performed in 1995 and 2008 (AECOM, 2012). As indicated in the RAWP, arsenic monitoring was included to provide additional evaluation of arsenic concentration trends after completion of the LHAAP-03 soil excavation and implementation of the EISB remedy at LHAAP-35A (58).

A total of twelve monitoring wells (03WW01, 35AWW01, 35AWW03, 35AWW06, 35AWW07R, 35AWW08, LHSMW03, LHSMW04, LHSMW06, LHSMW07, 1004TWW001, and 1004TWW006) were specified by the RAWP for arsenic sampling. Of these, three wells (35AWW03, LHSMW03, and LHSMW04) were dry and no sample could be collected. Temporary well 1004TWW001 could not be located in the field. Of the eight wells that were sampled, none contained arsenic concentrations exceeding the MCL.

Arsenic monitoring wells are identified on **Figure 3-1**. The arsenic data is provided in **Table 3-3**.

### **3.4.5 Site Geology and Hydrogeology**

#### **3.4.5.1 Geological Description**

The site is underlain by the Wilcox Group, a Tertiary-age geologic unit characterized by the extreme variability and discontinuity of its sediments. The depositional environment at the time these sediments were deposited consisted of a flat coastal flood plain with lakes and swamps that were traversed by shifting streams. This depositional environment resulted in the composition of the Wilcox Group consisting of heterogeneous series of sandy lignitiferous littoral clays, cross-bedded river sands, lacustrine or lagoonal clays, lignite lentils and stratified deltaic silts (Townsend, 1954).

Drilling activities during the remedial action implementation extended to a depth of approximately 40 feet bgs. The soils observed reflect the heterogeneity and discontinuity of a depositional environment consistent with a shifting stream on a coastal flood plain. The soil was generally fine grained consisting of interbedded silt, sand and clay.

A review of soil boring logs for wells 35AWW02 and 35AWW05 previously drilled by others to depths of 75.75 ft and 140 ft bgs, respectively, reveals mostly clay soils with occasional silt and sand layers with depth.

#### **3.4.5.2 Groundwater Occurrence**

##### **3.4.5.2.1 Definition of Water-Bearing Zone**

The lithology and hydrogeology of the study area were reviewed to confirm groundwater occurrence. Historically three groundwater zones (shallow, intermediate, and deep) were reported beneath the LHAAP-35A (58) site. The occurrence of predominantly clay with depth appears to provide aquitards impeding vertical migration of groundwater, and separating the saturated subsurface into multiple groundwater zones, as demonstrated by differences in groundwater elevations between the zones.

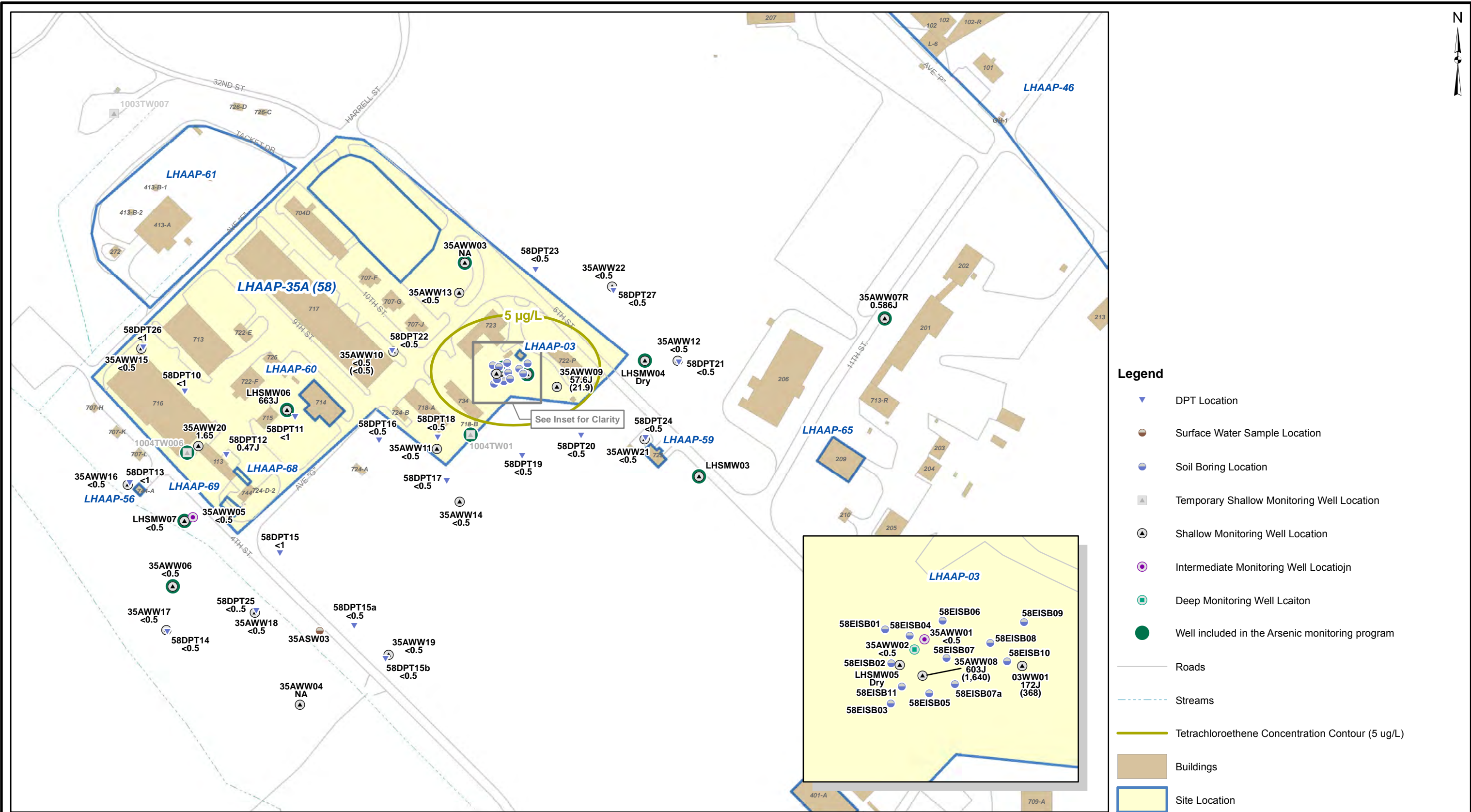
##### **3.4.5.2.2 Groundwater Elevation Data**

The groundwater sampling event conducted in October 2013 included obtaining static water levels from LHAAP-35A (58) monitoring wells. Groundwater (shallow zone) elevations were observed to range from 175.75 feet above mean sea level (msl) to 202.32 feet below msl.

Groundwater elevations were calculated by subtracting the recorded static water levels from the top of casing elevation for each well where a groundwater level reading could be obtained. If the well was dry, the bottom elevation of the well screen was calculated. Groundwater elevation data is tabulated in **Table 3-4**.

Groundwater elevation data was utilized to develop the potentiometric map for the shallow groundwater zone, provided in **Figure 3-6**. The potentiometric map for the shallow groundwater zone indicates groundwater flows in a southeasterly direction. Gradients ranged from approximately 0.005 feet per foot at a potentiometric high located in the northwestern portion of the site to approximately 0.027 feet per foot in the southeast portion of the site.

No groundwater potentiometric maps were developed for the intermediate and deep groundwater zones due to the small number of wells and lack of contaminant impacts. Groundwater ranged from 177.45 feet above msl to 177.71 above msl in the intermediate zone, and was measured at 175.75 feet above msl in the deep zone.



Notes:

- 1 - Estimated results (detected between detection limit and laboratory reporting limit) were considered "non-detect" results for purposes of plume contouring.
- 2 - Concentrations reported in  $\mu\text{g/L}$ .
- 3 - Analytical data from 35AWW01, 35AWW02, and 35AWW05 are from the intermediate or deep zones which were not utilized for mapping purposes.
- 4 - Concentrations from August 2013 sampling event in parentheses.

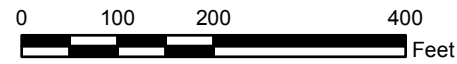


Figure 3-1  
 Shallow Zone PCE Plume  
 October 2013 Event  
 Remedial Action Completion Report  
 LHAAP-35A(58)  
 Longhorn Army Ammunition Plant  
 Karnack, Texas

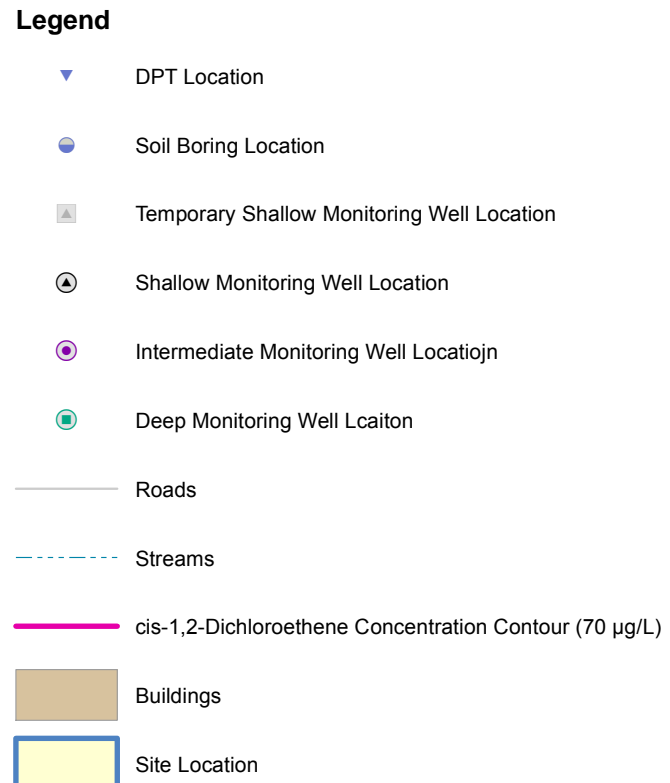
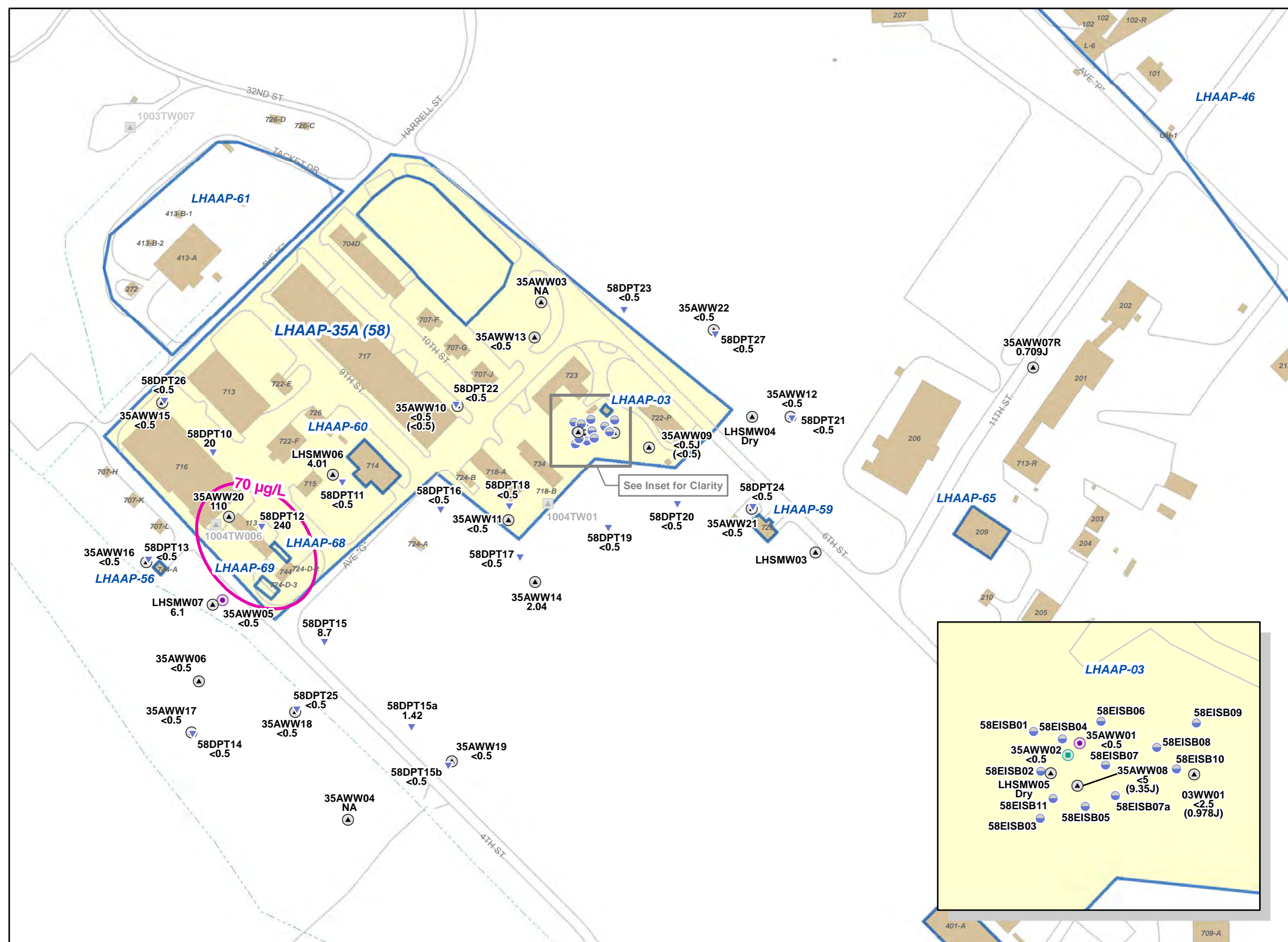
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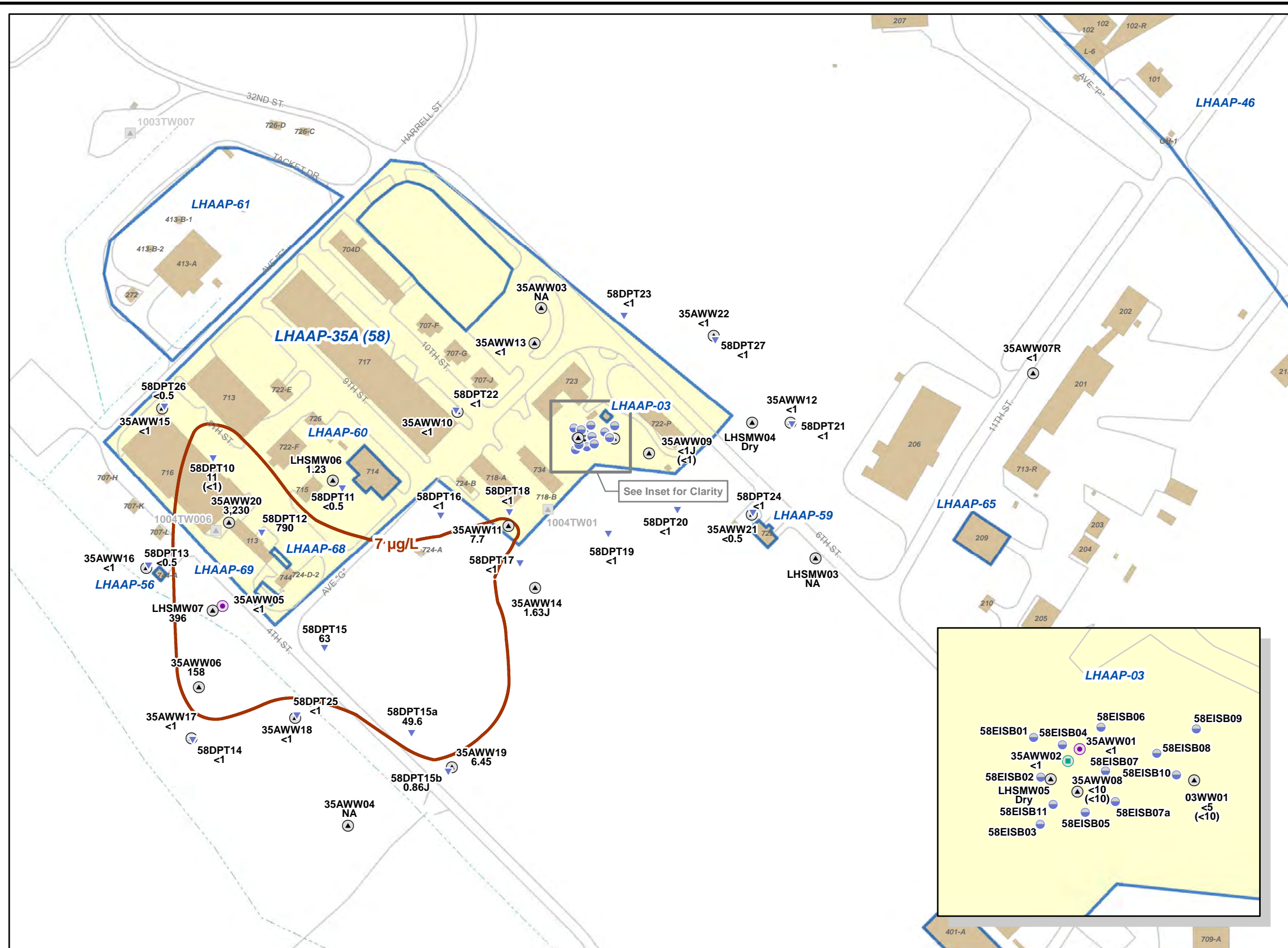
Notes:  
 1 - Estimated results (detected between detection limit and laboratory reporting limit) were considered "non-detect" results for purposes of plume contouring.  
 2 - Concentrations reported in µg/L.  
 3 - Analytical data from 35AWW01, 35AWW02, and 35AWW05 are from the intermediate or deep zones which were not utilized for mapping purposes.  
 4 - Concentrations from August 2013 sampling event in parentheses.



Figure 3-3  
 Shallow Zone Cis-1,2-DCE Plume  
 October 2013 Event  
 Remedial Action Completion Report  
 LHAAP-35A(58)  
 Longhorn Army Ammunition Plant  
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**Legend**

- ▼ DPT Location
- Soil Boring Location
- ▲ Temporary Shallow Monitoring Well Location
- ⊙ Shallow Monitoring Well Location
- ⊙ Intermediate Monitoring Well Location
- ⊙ Deep Monitoring Well Location
- Roads
- - - Streams
- 1,1-Dichloroethene Concentration Contour (7 µg/L)
- Buildings
- Site Location

Notes:  
 1 - Estimated results (detected between detection limit and laboratory reporting limit) were considered "non-detect" results for purposes of plume contouring.  
 2 - Concentrations reported in µg/L.  
 3 - Analytical data from 35AWW01, 35AWW02, and 35AWW05 are from the intermediate or deep zones which were not utilized for mapping purposes.  
 4 - Concentrations from August 2013 sampling event in parentheses.

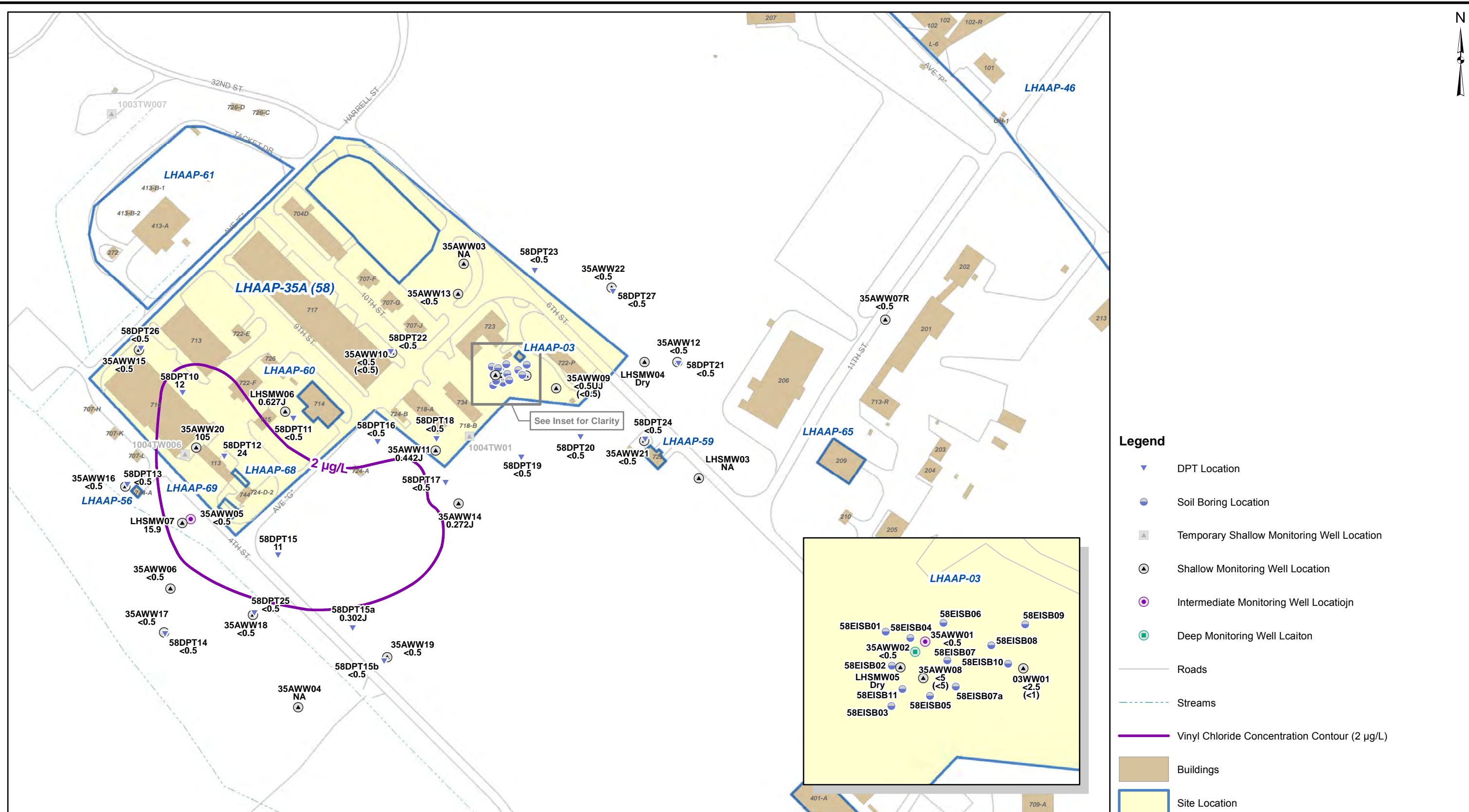


Figure 3-4  
 Shallow Zone 1,1-DCE Plume  
 October 2013 Event  
 Remedial Action Completion Report  
 LHAAP-35A(58)  
 Longhorn Army Ammunition Plant  
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Notes:  
 1 - Estimated results (detected between detection limit and laboratory reporting limit) were considered "non-detect" results for purposes of plume contouring.  
 2 - Concentrations reported in µg/L.  
 3 - Analytical data from 35AWW01, 35AWW02, and 35AWW05 are from the intermediate or deep zones which were not utilized for mapping purposes.  
 4 - Concentrations from August 2013 in parentheses.

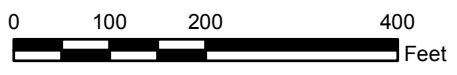
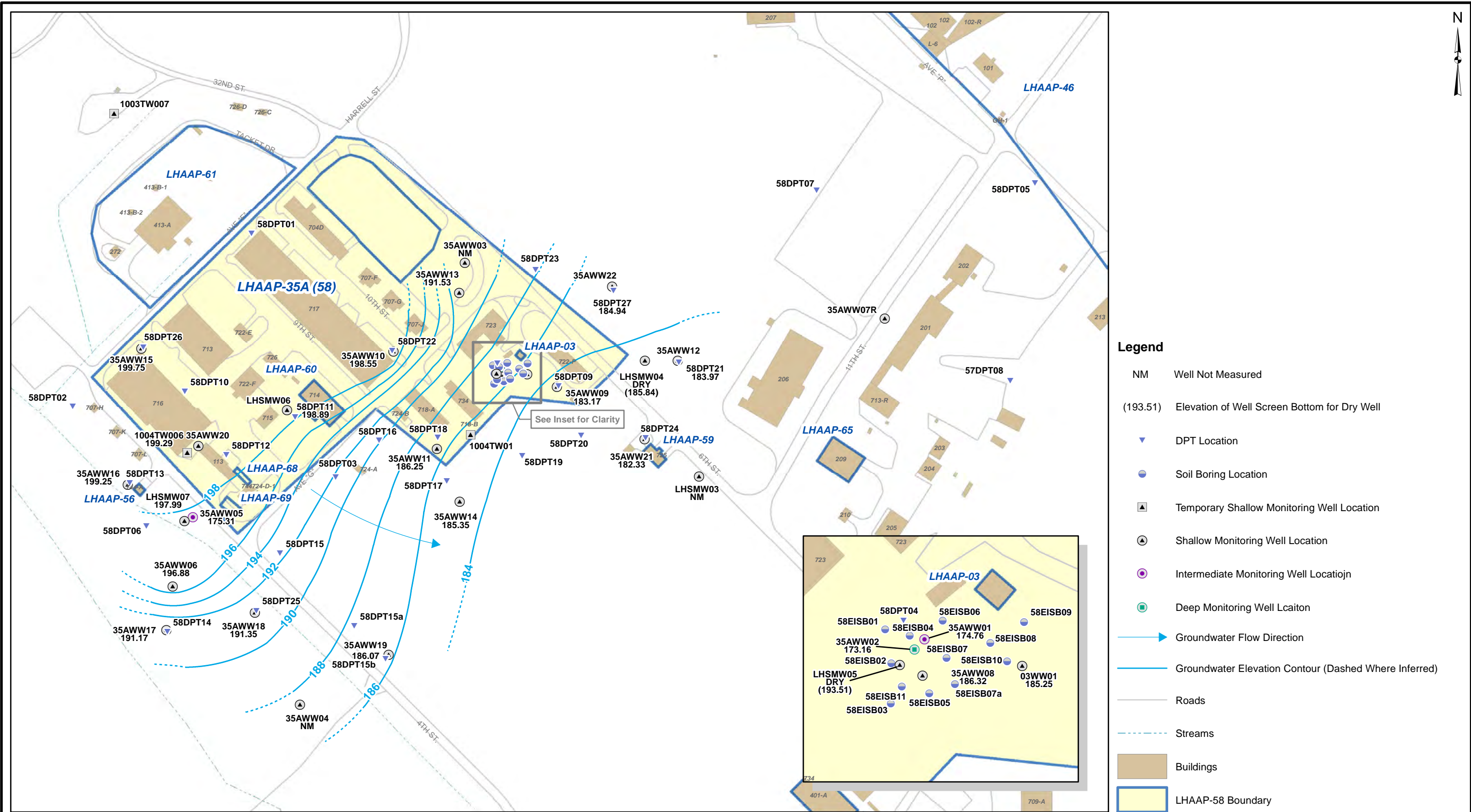


Figure 3-5  
 Shallow Zone Vinyl Chloride Plume  
 October 2013 Event  
 Remedial Action Completion Report  
 LHAAP-35A(58)  
 Longhorn Army Ammunition Plant  
 Karnack, Texas

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- Legend**
- NM Well Not Measured
  - (193.51) Elevation of Well Screen Bottom for Dry Well
  - ▼ DPT Location
  - Soil Boring Location
  - ▲ Temporary Shallow Monitoring Well Location
  - ⊙ Shallow Monitoring Well Location
  - ⊖ Intermediate Monitoring Well Location
  - ⊕ Deep Monitoring Well Location
  - Groundwater Flow Direction
  - Groundwater Elevation Contour (Dashed Where Inferred)
  - Roads
  - - - Streams
  - Buildings
  - LHAAP-58 Boundary

Notes:  
 1 - Groundwater elevations based on measurements conducted October 2013.  
 2 - Groundwater elevations presented are feet mean sea level (ft MSL).  
 3 - Well bottom elevations not utilized for mapping.



Figure 3-6  
 Shallow Zone Potentiometric Map  
 Remedial Action Completion Report  
 LHAAP-35A(58)  
 Longhorn Army Ammunition Plant  
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**Table 3-1: LHAAP-35A (58) Direct Push Technology Borings Volatile Organic Compounds - August/September 2013**

Sample ID:	Units	MCL	58DPT10 (27-31')-200813 8/20/2013	58DPT11 (20-24')-210813 8/21/2013	58DPT12 (23-27')-200813 8/20/2013	58DPT13 (18-22')-220813 8/22/2013	58DPT13 (18-22')-220813D 8/22/2013	58DPT14(33-37)-240813 8/24/2013	58DPT15 (36-40')-220813 8/22/2013	58DPT15A(28-38)060913 9/6/2013	58DPT15B(18-28)170913 9/17/2013	58DPT16(31-35)130813 8/13/2013	58DPT17(36-40)130813 8/13/2013
<b>Volatile Organic Compounds (8260B)</b>													
1,1-Dichloroethene	µg/L	7	NA	NA	NA	NA	NA	<1 U	NA	49.6	0.86 J	<1 U	<1 U
cis-1,2-Dichloroethene	µg/L	70	NA	NA	NA	NA	NA	<0.5 U	NA	1.42	<0.5 U	<0.5 U	<0.5 U
Tetrachloroethene	µg/L	5	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
trans-1,2-Dichloroethene	µg/L	100	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Trichloroethene	µg/L	5	NA	NA	NA	NA	NA	<0.5 U	NA	6.82	<0.5 U	<0.5 U	<0.5 U
Vinyl Chloride	µg/L	2	NA	NA	NA	NA	NA	<0.5 U	NA	0.302 J	<0.5 U	<0.5 U	<0.5 U
<b>Volatile Organic Compounds (8260C)</b>													
1,1-Dichloroethene	µg/L	7	11	<0.5 U	790	<0.5 U	<0.5 U	NA	63	NA	NA	NA	NA
cis-1,2-Dichloroethene	µg/L	70	20	<0.5 U	240	<0.5 U	<0.5 U	NA	8.7	NA	NA	NA	NA
Tetrachloroethene	µg/L	5	<1 U	<1 U	0.47 J	<1 U	<1 U	NA	<1 U	NA	NA	NA	NA
trans-1,2-Dichloroethene	µg/L	100	0.39 J	<0.5 U	5.1	<0.5 U	<0.5 U	NA	0.31 J	NA	NA	NA	NA
Trichloroethene	µg/L	5	<0.5 U	<0.5 U	61	<0.5 U	<0.5 U	NA	6	NA	NA	NA	NA
Vinyl chloride	µg/L	2	12	<0.5 U	24	<0.5 U	<0.5 U	NA	11	NA	NA	NA	NA

Blue Highlighting Indicates Analyte Detected Above Regulatory Limit

J - Estimated value; analyte concentration was less than the limit of quantification

MCL - maximum contaminant level

NA - not analyzed

U - Analyte was not detected. The concentration is below the reported limit of detection.

µg/L - microgram per liter

UJ - The analysis was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. 'UJ' not detects are not definite; the analyte may be present.

**Table 3-1: LHAAP-35A (58) Direct Push Technology Borings Volatile Organic Compounds - August/September 2013**

Sample ID:	Units	MCL	58DPT18(31-35)120813 8/12/2013	58DPT19(31-35)100813 8/10/2013	58DPT20(36-40)050813 8/5/2013	58DPT21(26-30)060813 8/6/2013	58DPT22(26-30)130813 8/13/2013	58DPT23(36-40)060813 8/6/2013	58DPT24(31-35)100813 8/10/2013	58DPT25(36-40)-230813 8/23/2013	58DPT26 (28-32')-210813 8/21/2013	58DPT27(26-30)060813 8/6/2013
<b>Volatile Organic Compounds (8260B)</b>												
1,1-Dichloroethene	µg/L	7	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	NA	<1 U
cis-1,2-Dichloroethene	µg/L	70	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
Tetrachloroethene	µg/L	5	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
trans-1,2-Dichloroethene	µg/L	100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
Trichloroethene	µg/L	5	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
Vinyl Chloride	µg/L	2	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
<b>Volatile Organic Compounds (8260C)</b>												
1,1-Dichloroethene	µg/L	7	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
cis-1,2-Dichloroethene	µg/L	70	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
Tetrachloroethene	µg/L	5	NA	NA	NA	NA	NA	NA	NA	NA	<1 U	NA
trans-1,2-Dichloroethene	µg/L	100	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
Trichloroethene	µg/L	5	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
Vinyl chloride	µg/L	2	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA

Blue Highlighting Indicates Analyte Detected Above Regulatory Limit

J - Estimated value; analyte concentration was less than the limit of quantification

MCL - maximum contaminant level

NA - not analyzed

U - Analyte was not detected. The concentration is below the reported limit of detection.

µg/L - microgram per liter

UJ - The analysis was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. 'UJ' not detects are not definite; the analyte may be present.

**Table 3-2: LHAAP-35A (58) Monitored Natural Attenuation (MNA)  
Monitoring Wells and Analytes**

Monitoring Well ID	VOCs	Field Parameters***	MNA Parameters****
35AWW01 <sup>(2)</sup>	X	X	
35AWW02 <sup>(3)</sup>	X	X	
35AWW05 <sup>(2)</sup>	X	X	
35AWW06	X	X	X
35AWW07R <sup>(4)</sup>	X	X	
35AWW08	X	X	X
35AWW09	X	X	X
35AWW10	X	X	X
35AWW11	X	X	X
35AWW12	X	X	
35AWW13	X	X	
35AWW14	X	X	
35AWW15	X	X	
35AWW16	X	X	
35AWW17	X	X	
35AWW18	X	X	
35AWW19	X	X	
35AWW20	X	X	X
35AWW21	X	X	
35AWW22	X	X	
LHSMW04 <sup>(1)</sup>	X	X	X
LHSMW05 <sup>(1)</sup>	X	X	
LHSMW06	X	X	
LHSMW07	X	X	X
03WW01	X	X	X

Notes:

<sup>(1)</sup> This well was included in the sampling/analysis program; however, due to insufficient groundwater volume (dry) it was not sampled.

<sup>(2)</sup> This well is classified as an intermediate zone well.

<sup>(3)</sup> This well is classified as a deep zone well.

<sup>(4)</sup> This well is a replacement well for 35AWW07.

\*\*\* - Field parameters monitored for all wells: pH, temperature, conductivity, turbidity, ORP, DO

\*\*\*\* - MNA parameters include alkalinity, nitrate, nitrite, sulfate, sulfide, chloride, TOC, dissolved iron and manganese, total phosphorus, carbon dioxide, dissolved gases (methane, ethane, ethene), and total iron. Optional parameters include: hydrogen, volatile fatty acids, and dehalococoides.

X - Well analyzed for that parameter

MNA - monitored natural attenuation

VOCs - volatile organic compounds

**Table 3-3: LHAAP-35A (58) Monitoring Wells Arsenic Data - January 2014**

Sample ID:	Units	Cleanup Level <sup>(1)</sup>	03WW01F-012914	35AWW01F-013114	35AWW06-013014	35AWW07RF-020314	35AWW08F-012914	LHSMW06F-013114	LHSMW07-013014	1004TW006F-013114
Sample Date:			01/29/2014	01/31/2014	01/30/2014	02/03/2014	01/29/2014	01/31/2014	01/30/2014	01/31/2014
<b>Arsenic (6020A)</b>										
Arsenic	µg/L	10	0.0762 J	0.000821 J	<0.100 U	0.00148 J	0.16 J	0.00649	<0.100 U	0.0111

**Note:** Samples were not collected for 35AWW03, LHSMW03, and LHSMW04 as they were dry. 1004TW001 could not be located.

(1) - United States Environmental Protection Agency Maximum Contaminant Level

J - Estimated value; analyte concentration was less than the limit of quantification

U - Analyte was not detected. The concentration is below the reported limit of detection.

µg/L - microgram per liter



**Table 3-4: LHAAP-35A (58) Groundwater Elevations and Monitoring Well Information**

Well	Approximate Well Depth <sup>(a)</sup> (ft from TOC)	Location		Ground Surface Elevation (ft MSL)	Top of Casing Elevation (ft MSL)	Depth to Water (ft from TOC)	Groundwater Elevation (ft MSL)
		Northing	Easting				
35AWW01 <sup>(b)</sup>	72.69	6960171.396	3305092.263	215.34	218.03	40.58	177.45
35AWW02 <sup>(c)</sup>	138.59	6960165.723	3305086.849	215.46	218.05	42.3	175.75
35AWW05 <sup>(b)</sup>	72.41	6959849.641	3304426.136	219.0067	221.4124	43.7	177.7124
35AWW06	29.05	6959701.31	3304382.89	218.38	220.43	21.5	198.93
35AWW07R	31.75	6960277.309	3305913.799	210.26	212.11	27.9	184.21
35AWW08	31.83	6960151.893	3305091.156	215.12	216.95	28.8	188.15
35AWW09	41.99	6960129.516	3305208.701	215.38	217.47	32.21	185.26
35AWW10	32.76	6960205.495	3304857.076	218.7	220.76	20.15	200.61
35AWW11	36.84	6959996.699	3304950.674	217.61	220.15	31.36	188.79
35AWW12	36.77	6960186.155	3305468.392	214.02	215.99	30.05	185.94
35AWW13	39.32	6960332.503	3304998.822	216.6	219.12	25.07	194.05
35AWW14	31.76	6959883.392	3304999.85	216.15	218.41	30.8	187.61
35AWW15	40.37	6960212.192	3304315.448	220.4	222.97	20.65	202.32
35AWW16	36.45	6959920.057	3304286.058	218.83	220.88	19.58	201.3
35AWW17	41.67	6959606.804	3304369.136	219.17	221.44	28	193.44
35AWW18	41.55	6959644.847	3304559.677	219.7	221.75	28.35	193.4
35AWW19	31.39	6959553.806	3304847.027	216.72	219.71	30.65	189.06
35AWW20	35.64	6960002.437	3304438.002	220.41	223.05	21.12	201.93
35AWW21	42.26	6960017.252	3305397.412	216.69	219.05	34.36	184.69
35AWW22	36.77	6960346.102	3305327.622	217.07	219.14	32.13	187.01
LHSMW04	31.11	6960185.99	3305398.12	214.04	216.95	DRY	DRY
LHSMW05	24.08	6960157.585	3305078.933	215.41	217.59	DRY	DRY
LHSMW06	23.32	6960079.99	3304628.53	219.86	223.18	20.97	202.21
LHSMW07	29.73	6959841.17	3304408.12	218.54	221.27	20.55	200.72
03WW01	31.53	6960156.891	3305144.783	214.76	216.29	29.51	186.78

Notes:

Groundwater Elevation Data is from the October 2013 (Baseline) Sampling Event.

Coordinate system is Texas State Plane, NAD 1983

ft bgs - feet below ground surface

ft MSL - feet mean sea level

TOC - top of casing

<sup>a</sup>Approximate Depth is the bottom of the screen interval

<sup>b</sup>Intermediate well

<sup>c</sup>Deep well

Dry - Insufficient or not water in well. No sample collected.

NA = Not Available

## 4 ENHANCED IN-SITU BIOREMEDIATION

This section discusses the details of EISB implementation at the LHAAP-35A (58) site.

EISB treatment was specified to treat COCs in the eastern plume area to enhance their biological degradation and create subsurface conditions favorable for MNA after completion of the EISB treatment. EISB implementation included selection of carbon substrate, mixing and injection procedures, a baseline sampling event, bioaugmentation (injections of microbial culture), post-injection monitoring and analysis of data. Prior to the EISB treatment, an underground injection control substantive requirements notification was submitted to the TCEQ in September 2013, to comply with the substantive requirements for construction, operation, and closure under 30 TAC §331, Subchapters A, C, and H (the Applicable or Relevant and Appropriate Requirements for underground injection control).

The following sub-sections provide details of the EISB treatment.

### 4.1 Substrate Selection

A laboratory-scale TS was performed to assist in selection of appropriate carbon substrate and obtain other design parameter information for EISB application. During the TS, a lactate-based carbon source was able to achieve complete dechlorination of chlorinated VOCs in groundwater from the site at a relatively faster rate than the EVO-based substrate. Thus, a lactate-based carbon substrate was selected for the EISB treatment.

Various formulations of lactate-based carbon sources for groundwater remediation are commercially-available. The specific formulation evaluated in the TS and used for the EISB treatment was Wilclear Plus, manufactured by JRW Bioremediation, LLC. Wilclear Plus is a proprietary blend of neutral pH fatty acids and fermentable substances providing a range of material helping promote growth of an assortment of dechlorinating microbial populations. Wilclear Plus contains approximately 30 – 40% lactates, and 40 – 45% carboxylates, along with other nutrients and metabolites.

### 4.2 Substrate Loading

The mass of Wilclear Plus required for the target treatment area was calculated based on site characteristics (e.g., target area, depth of the shallow zone etc.), TS data, stoichiometric demand exerted by the native (e.g., dissolved oxygen, sulfate, etc.) and anthropogenic electron acceptors. The quantity of Wilclear Plus estimated using stoichiometric calculations was provided in the LHAAP-35A (58) RAWP (AECOM, 2013). The actual quantities of Wilclear Plus solution used during EISB treatment were adjusted based on TS data and to account for unknown conditions during field application. A total of approximately 9,680 pounds (lbs) (880 gallons) of 60 percent (%) sodium lactate solution was injected during the EISB treatment.

### 4.3 Target Treatment Area

The area of elevated COC concentrations in the eastern plume (**Figure 3-1** and **3-2**) was considered the target treatment area for the EISB and was estimated to be approximately 3,600 square feet. The RAWP planned ten injection points (EISB-1 through EISB-10) for injection of the substrate solution into the treatment area. Injection locations EISB-1 through EISB-10 were

first staked in the field using coordinates obtained from the RAWP. During the injection activities at locations EISB-6 and EISB-7, the injected solution came to the surface (daylighted) nearby, likely due to some nearby impervious obstructions (e.g. concrete footing or foundation). Therefore, two additional injection locations (EISB-7A and EISB-11) were used to complete injection of the required volume of substrate solution. The twelve injection points were staked and later surveyed by a Texas licensed surveyor and are shown on **Figure 4-1**.

The injections targeted the depth interval of approximately 23 to 30 feet bgs at each point. The injection flow rates ranged from 4 to 6 gallons per minute (gpm) and the injection pressures were between 25 and 30 pounds per square inch (psi).

#### 4.4 Injection Procedure

As discussed previously, approximately 9,680 lbs of sodium lactate as 2,200 gallons of solution with water (approximately 21% volume/volume [v/v]) was injected via twelve injection points. The sodium lactate solution with water was prepared in the field using a polyvinyl mixing tank, centrifugal pump, and recirculation. Water used to prepare the solution was obtained from the pump house serving the LHAAP Groundwater Treatment Plant.

The injections were performed by a Texas licensed drilling contractor, Best Drilling, LLC (Best) under the supervision of AECOM between September 23, 2013 and September 25, 2013. Injection rates, pressures, and volumes are summarized in the injection logs included as **Appendix C**. Best injected the solution in 180-gallon to 225-gallon batches via direct-push injection rods, generally at depths between 23 and 30 feet (ft) below ground surface (bgs). A “bottom-up” injection technique was used, injecting through bottom of the direct-push rod string. Real time information in the form of injection flow rates and pressures were used to guide the injections into the targeted depths of the subsurface. Injection boreholes were appropriately abandoned after completion of each injection, using bentonite chips and water.

#### 4.5 Baseline Groundwater Sampling

Four monitoring wells; 03WW01, 35AWW08, 35AWW09 and 35AWW10 were sampled and analyzed for VOCs and key biogeochemical parameters in August 2013 to obtain baseline groundwater conditions prior to EISB. Two of these wells (35AWW08 and 03WW01) are in the target treatment area and will be referred to as the “treatment area wells” in the subsequent sections of this report, while well 35AWW10 serves as the well up-gradient of the treatment area, and well 35AWW09 serves as the downgradient well..

In October 2013, the remaining site monitoring wells in the eastern and western plume areas were sampled and analyzed for VOCs. A subset of these wells were also sampled and analyzed for key biogeochemical parameters. The VOC and biogeochemical data collected from site wells in support of the MNA component of the remedy are discussed in **Section 5.0** of the document. The four EISB performance monitoring wells (03WW01, 35AWW08, 35AWW09 and 35AWW10) were also sampled in October 2013 along with the other wells.

##### 4.5.1 EISB Performance Monitoring Results

EISB performance can be evaluated by examination of aquifer conditions that directly indicate or facilitate reductive dechlorination of COCs. These conditions include reductions in VOC

concentrations; reduction/elimination of competing electron acceptors molecular oxygen (O<sub>2</sub>), nitrate (NO<sub>3</sub><sup>-</sup>), manganese (IV) [Mn(IV)], ferrous iron [Fe(III)], and sulfate (SO<sub>4</sub><sup>2-</sup>); the presence of metabolizable organic carbon; and favorable microbial growth conditions (neutral pH, low salinity, warm temperature). For efficient (metabolic) dechlorination to occur, dehalorespiring bacteria and geochemical conditions to support microbial respiration must also be present.

#### 4.5.1.1 Discussion of August 2013 Data

The baseline data indicated PCE and TCE in wells 03WW01, 35AWW08, and 35AWW09 exceeded the MCLs. No other COCs were detected at concentrations exceeding MCLs in these wells. The highest concentrations of PCE (1,640 µg/L) and TCE (544 µg/L) were detected in well 35AWW08. The COCs were not detected in well 35AWW10. The August 2013 VOC data for wells is tabulated in **Table 4-1** and depicted on **Figures 3-1** through **3-5**. The associated data validation report is included in **Appendix F**.

The baseline (August 2013) field parameter data indicate fairly aerobic conditions with high dissolved oxygen (DO) (greater than 9 milligrams per liter [mg/L]) and positive oxidation-reduction potential (ORP) (between 100 and 250 millivolts [mV]) in the treatment area wells (03WW01 and 35AWW08). The groundwater was near neutral pH (between 6 and 7 standard units) and the conductivity was low (between 3 and 9 millisiemens per centimeter [mS/cm]).

Among other electron acceptors, nitrate and nitrite were found at concentrations less than the laboratory reporting limits. The sulfate levels in the four wells ranged between 209 mg/L (well 35AWW10) and 1,480 mg/L (well 35AWW08). Iron, manganese, and sulfide levels were relatively low in all four wells.

The total organic carbon (TOC) levels in the wells were also low (ranging from 3.84 mg/L to 16.5 mg/L) indicating limited supply of metabolizable organic carbon before the EISB treatment. Carbon dioxide levels ranged from 61,000 µg/L (well 35AWW10) to 143,000 µg/L (well 03WW01 and 35AWW08). The other dissolved gases (methane, ethane, and ethene) were mostly less than the laboratory reporting limits during the baseline event.

The August 2013 field parameter and biogeochemical data for wells is tabulated in **Table 4-2**. The associated data validation report is included in **Appendix F**.

#### 4.5.1.2 Discussion of October 2013 Data

The October 2013 VOC data indicates significant reductions in PCE and TCE in the treatment area wells after the EISB treatment, with the PCE concentration being 603 µg/L (J-flagged estimated value) and TCE being 149 µg/L (J-flagged estimated value) in well 35AWW08. Similarly, PCE (172 µg/L) and TCE (42.1 µg/L) (both J-flagged, estimated values) in well 03WW01; were significantly lower than the baseline concentrations. Any detections of other COCs in these wells remained at concentrations less than laboratory reporting limits. COC concentrations in well 35AWW10 were also less than laboratory reporting limits. The October 2013 groundwater VOC data is tabulated in **Table 5-1** and depicted on **Figures 3-1** through **3-5**. The associated data validation report is included in **Appendix F**.

The October 2013 data indicate reductive dechlorination of chlorinated VOCs is occurring in the EISB treatment area. The ORP readings in well 03WW01 (-235 mV) and well 35AWW08 (-100

mV) indicate strong reducing conditions were established in the treatment area. The DO levels in these wells still indicated high readings (greater than 9 mg/L), but may be reflecting a faulty DO probe. The pH remained near neutral, and the conductivity (39.2 mS/cm to 47.7 mS/cm) in the two treatment area wells increased slightly compared to the baseline (August 2013) conditions.

Among the other electron acceptors, nitrate and nitrite levels were mostly at concentrations less than laboratory reporting limits. Sulfate levels in well 03WW01 reduced from a baseline of 534 mg/L in August 2013 to 487 mg/L in October 2013; and in well 35AWW08 reduced from a baseline of 1,480 mg/L in August 2013 to 703 mg/L. Manganese and iron levels remained relatively low in the treatment area wells.

TOC concentrations increased in wells 03WW01 (to 49,200 mg/L) and 35AWW08 (to 66,400 mg/L). These levels are significantly higher than the baseline conditions due to carbon substrate injections and were increased to sufficiently high levels to support microbial activity. The increased levels of lactic acid observed in the treatment area wells is another indicator that the injected sodium lactate substrate is present within the treatment area of the aquifer and has not yet been consumed or migrated down-gradient. Phosphorus levels also increased in the treatment area wells after the substrate injections compared to the baseline data, important because phosphorus is an essential nutrient supporting microbial activity. Most of the dissolved gases remained at very low concentrations or at less than the laboratory reporting limits.

The October 2013 field parameter and biogeochemical data for wells is tabulated in **Table 5-2**. The associated data validation report is included in **Appendix F**.

In summary, the initial EISB performance monitoring data indicates that aquifer conditions in the eastern plume treatment area provide are conducive to degradation of COCs, and this is supported by reduced concentrations of PCE and TCE in the treatment area wells. Data from subsequent monitoring events will further document the progress of the EISB treatment.

#### **4.6 Bioaugmentation Injections**

The TS indicated that augmenting the treatment microcosms with KB-1® Plus accelerated the biodegradation rate of target VOCs in the microcosms. KB-1® Plus is a proprietary microbial culture comprised of a mix of Dehalococcoides ethenogens (DHC) (bacteria well-known for degradation of PCE/TCE, cis-1,2-DCE, and VC) and Dehalobacter (DHB) (bacteria well-known for degradation of TCA and DCA).

During the August 2013 baseline event, the groundwater samples from the four EISB performance monitoring wells (03WW01, 35AWW08, 35AWW09, and 35AWW10) were analyzed to quantify DHC and DHB population along with the functional genes. The population count of both DHC and DHB in the samples ranged from low ( $31.1 \times 10^3$  cells equivalent per liter [CEQ/L]) to less than the laboratory reporting limit. Typically, DHC concentrations greater than  $1 \times 10^7$  CEQ/L are required for sufficiently high rates of EISB and ethene production (Lu, 2006). The baseline conditions indicated that native DHC and DHB population in the subsurface environment in the treatment area are several orders of magnitude lower than concentrations necessary to sustain complete biological reductive dechlorination.

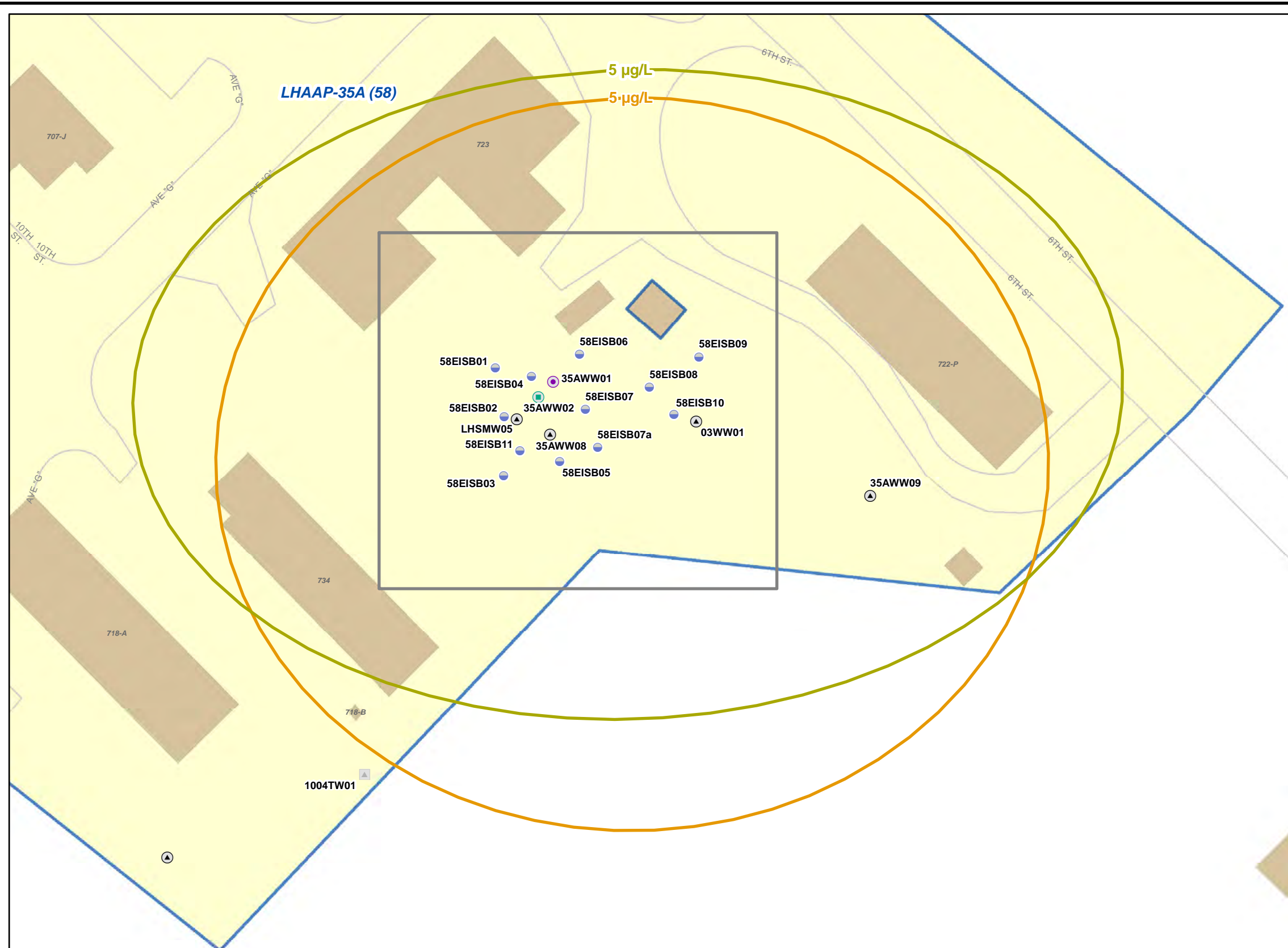
To address this condition, bioaugmentation was performed in the eastern plume target area as provided for in the RAWP. As the microbial culture will persist only in an anaerobic

environment (redox conditions of -75 mV or lower), the bioaugmentation injections were performed after anaerobic conditions were established in the aquifer. The bioaugmentation event was performed in November 2013, approximately six weeks after the EISB carbon substrate injections.












Based on experience with field bioaugmentation for similar EISB remedies with similar lithologies, and using technical recommendations provided by the microbial culture manufacturer (Sirem), a quantity of approximately three liters of KB-1® Plus culture was injected per injection point in the target treatment area. The KB-1® Plus culture was procured from the manufacturer and was delivered to the site in the form of a liquid solution pressurized under a compressed gas (argon or nitrogen).

Bioaugmentation involved injecting the microbial culture (KB-1® Plus) via the direct push points within the target treatment area. The DPT injection points for the KB-1® Plus culture were located generally adjacent to the EISB DPT injection points. At each location, the injection tubing was advanced into the drive point at the desired injection depth and purged with nitrogen gas to displace oxygen from the column. The culture was then injected into the drive point via compressed gas in the same target depth interval (23 ft bgs to 30 ft bgs) as the carbon substrate solution.

Field and analytical data collected in subsequent monitoring events will be used to assist in evaluation of bioaugmentation.



**Legend**

-  Direct Push Technology Injection Point
-  Temporary Shallow Monitoring Well Location
-  Shallow Monitoring Well Location
-  Intermediate Monitoring Well Location
-  Deep Monitoring Well Location
-  Roads
-  Streams
-  Tetrachloroethene Concentration Contour (5 µg/L)
-  Trichloroethene Concentration Contour (5 µg/L)
-  Buildings
-  Site Location

EISB - Enhanced In-situ Bioremediation

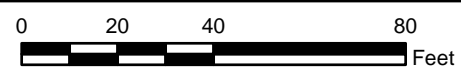


Figure 4-1  
EISB Treatment Area  
Remedial Action Completion Report  
LHAAP-35A(58)  
Longhorn Army Ammunition Plant  
Karnack, Texas

60256135

March 2014

**Table 4-1: LHAAP-35A (58) Monitoring Well Volatile Organic Compound Data - August 2013**

Sample ID:	Units	MCL	03WW01-082013 8/20/2013	35AWW08-082013 8/20/2013	35AWW09-082913 8/29/2013	35AWW10-082913 8/29/2013
Sample Date:						
<b>Volatile Organic Compounds (8260B)</b>						
1,1-Dichloroethene	ug/L	7	<2 U	<10 U	<1 U	<1 U
cis-1,2-Dichloroethene	ug/L	70	0.978 J	9.35 J	<0.5 U	<0.5 U
Tetrachloroethene	ug/L	5	368	1640	21.9	<0.5 U
trans-1,2-Dichloroethene	ug/L	100	<1 U	<5 U	<0.5 U	<0.5 U
Trichloroethene	ug/L	5	94.8	544	11.9	<0.5 U
Vinyl Chloride	ug/L	2	<1 U	<5 U	<0.5 U	<0.5 U

Blue Highlighting Indicates Analyte Detected Above Regulatory Limit

J - Estimated value; analyte concentration was less than the limit of quantification

MCL - maximum contaminant level

NA - not analyzed

U - Analyte was not detected. The concentration is below the reported limit of detection.

UJ - The analysis was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. 'UJ' not detects are not definite; the analyte may be present.



Table 4-2: LHAAP-35A (58) Field Parameters and Biogeochemical Data - August 2013

Sample ID:	Units	03WW01-082013	35AWW08-082013	35AWW09-082913	35AWW09F-082913	35AWW10-082913	35AWW10F-082913
Sample Date:		8/20/2013	8/20/2013	8/29/2013	8/29/2013	8/29/2013	8/29/2013
<b>Water Quality Parameters</b>							
Temperature	°C	26.19	23.44	27.7	NA	26.77	NA
pH	pH Units	6.18	6.05	6.32	NA	6.92	NA
Conductivity	mS/cm	3.64	8.23	7.2	NA	1.39	NA
Dissolved Oxygen	mg/L	9.11	9.84	1.62	NA	5.69	NA
Turbidity	NTU	33	26.9	20.8	NA	1.3	NA
Oxidation Reduction Potential	mV	240	112	108	NA	96	NA
Ferrous Iron, Field	mg/L	0.78	0.52	NA	NA	NA	NA
<b>Alkalinity (310.2)</b>							
Alkalinity, Total	mg/L	142	174	250	NA	379	NA
<b>Nitrogen (353.2)</b>							
Nitrogen, Nitrate-Nitrite	mg/L	NA	NA	0.201	NA	0.455	NA
<b>Phosphorus (365.4)</b>							
Phosphorus	mg/L	<0.2 U	0.178 J	0.351 J	NA	0.412	NA
<b>Sulfide (376.1)</b>							
Sulfide	mg/L	<1 U	1.2 J	1.75 J	NA	<1 U	NA
<b>Total Organic Carbon (415.1)</b>							
Total Organic Carbon (TOC)	mg/L	10.5	16.5	5.77	NA	3.84	NA
<b>Metals (6010C)</b>							
Iron	mg/L	<0.1 U	4.2	<0.1 U	NA	<0.1 U	NA
<b>Dissolved Metals (6010C)</b>							
Iron	mg/L	<0.1 U	4.75	NA	<0.1 U	NA	<0.1 U
<b>Metals (6020A)</b>							
Manganese	mg/L	0.0589	5.67	0.361	NA	0.0814	NA
<b>Dissolved Metals (6020A)</b>							
Manganese	mg/L	0.0561	5.71	NA	0.341	NA	0.0739
<b>Volatile Fatty Acids (830-MBA)</b>							
Acetic Acid	mg/L	<1 U	<1 U	<1 U	NA	<1 U	NA
Butyric Acid	mg/L	<1 U	<1 U	<1 U	NA	<1 U	NA
Lactic Acid	mg/L	<1 U	<1 U	<1 U	NA	<1 U	NA
Propionic Acid	mg/L	<10 U	<10 U	<10 U	NA	<10 U	NA
Pyruvic Acid	mg/L	<0.1 U	<0.1 U	<0.1 U	NA	<0.1 U	NA

**Table 4-2: LHAAP-35A (58) Field Parameters and Biogeochemical Data - August 2013**

Sample ID: Sample Date:	Units	03WW01- 082013 8/20/2013	35AWW08- 082013 8/20/2013	35AWW09- 082913 8/29/2013	35AWW09F- 082913 8/29/2013	35AWW10- 082913 8/29/2013	35AWW10F- 082913 8/29/2013
<b>Anions (9056)</b>							
Chloride	mg/L	892	2510	1970	NA	135	NA
Nitrate	mg/L	<1 U	<4 U	<1 U	NA	<1 U	NA
Nitrite	mg/L	<1 U	<4 U	<1 U	NA	<1 U	NA
Sulfate	mg/L	534	1480	1070	NA	209	NA
<b>Dechlorinating Bacteria</b>							
Dehalococcoides	CEQ/mL	1.2	<0.9	10.4	NA	31.1	NA
tceA Reductase	CEQ/mL	<0.5	<0.9	<0.5	NA	<0.5	NA
BAV1 Vinyl Chloride Reductase	CEQ/mL	<0.5	<0.9	<0.5	NA	<0.5	NA
Vinyl Chloride Reductase	CEQ/mL	<0.5	<0.9	<0.5	NA	0.2 J	NA
Dehalobacter spp.	CEQ/mL	0.4 J	<5.3	0.3 J	NA	1.8 J	NA
<b>Dissolved Gases (RSK-175)</b>							
Carbon Dioxide	ug/L	143000	143000	150000	NA	61000	NA
Ethane	ug/L	<2 U	<2 U	<2 U	NA	<2 U	NA
Ethene	ug/L	<2 U	<2 U	<2 U	NA	<2 U	NA
Methane	ug/L	<2 U	<2 U	31.5	NA	<2 U	NA
<b>Ferrous Iron (SM3500FE)</b>							
Ferrous Iron	mg/L	<0.04 U	<0.04 U	<0.04 U	NA	<0.04 U	NA

**Note:** Samples were not collected for LHSMW04 as it was dry.

°C - degrees celsius

CEQ/ml - cells equivalent per milliliter

J - Estimated value; analyte concentration was less than the limit of quantification

mg/L - milligram per liter

mS/cm - millisiemens per centimeter

mV - millivolt

NA - not analyzed

NTU - Nephelometric turbidity unit

U - Analyte was not detected. The concentration is below the reported limit of detection.

µg/L - microgram per liter

## 5 MONITORED NATURAL ATTENUATION

This section discusses the implementation details of the MNA program under the RA.

The nature and extent of shallow zone groundwater contamination at the LHAAP-35A (58) site is discussed in **Section 3.4**.

MNA in the western plume and portions of the eastern plume of the LHAAP-35A (58) site has been implemented to monitor COCs and ensure protection of human health and the environment. Performance monitoring to evaluate remedy effectiveness includes groundwater and surface water monitoring. The groundwater monitoring program is designed to evaluate and monitor natural attenuation of COCs in shallow zone groundwater. The surface water monitoring program is designed to evaluate potential migration of groundwater to surface water.

The combined monitoring program shall meet the following objectives (USEPA, 1999):

- Demonstrate that natural attenuation is occurring according to expectations;
- Detect changes in environmental conditions (e.g. geochemical, hydrogeological, etc.) that may reduce the efficacy of any of the natural attenuation processes;
- Identify potentially toxic and/or mobile transformation products;
- Verify that the plumes are not expanding;
- Verify no unacceptable impact to down-gradient receptors;
- Detect new releases of contaminants to the environment that could impact effectiveness of the natural attenuation remedy; and,
- Verify attainment of the remediation objectives.

### 5.1 MNA Groundwater Monitoring Program

Groundwater monitoring is essential to demonstrate effectiveness of the MNA remedy at the LHAAP-35A (58) site. Eighteen monitoring wells (in addition to the four wells included in the EISB treatment performance monitoring program) are included in the MNA monitoring program for collection and analysis of VOCs. These wells are depicted on **Figure 5-1** and **Table 3-2**. Two of these wells are screened in the intermediate groundwater zone. These wells have been selected for their placement relative to the VOC plumes to monitor effectiveness of remedial actions at the LHAAP-35A (58) site. After completion of the EISB performance monitoring (six quarters of monitoring are anticipated after the EISB treatment), two EISB performance monitoring wells (35AWW08 and 35AWW10) will be added to the MNA performance monitoring program.

Current and historical groundwater data indicate monitoring wells 35AWW20 and LHSMW07 in the western plume, and wells 35AWW08 and 35AWW09 in the eastern plume will be the primary focus of trend analysis as they contain relatively highest COC concentrations. The presence of cis-1,2-DCE, 1,1-DCE, and VC in wells in the western plume area indicates that natural attenuation is occurring in the western plume. VOC and biogeochemical data from these wells will continue to facilitate evaluation of the MNA remedy.

### 5.1.1 Water Quality and Biogeochemical Parameter Data

Groundwater quality and biogeochemical parameters (cumulatively, MNA parameters) are used in evaluating natural attenuation at the site. MNA parameter data will be collected and analyzed over time for trends that may be used to demonstrate whether MNA is effective. This evaluation includes determination of whether or not the groundwater environment is aerobic or anaerobic (reducing). Reducing conditions are favorable for reductive dechlorination of chlorinated VOCs and are typically characterized by low DO and low to negative ORP values. Depending on the phase of anaerobic respiration, absence of nitrate and presence of nitrite, ferrous (dissolved) iron, dissolved manganese, sulfide, and methane are indicative of progressively greater reducing conditions. Typically, aerobic conditions are indicated by high DO (greater than 2 milligrams per liter [mg/L]), high ORP (greater than 50 to 100 millivolts [mV]), nitrate, ferric iron, manganese, and sulfate. The following section provides a brief discussion of the constituents of interest and biogeochemical environment in the groundwater underlying the site.

Prior to collecting groundwater samples during the October 2013 baseline event, each well was purged and general water quality parameters (temperature, pH, specific conductivity, DO, ORP, and turbidity) were collected to ensure samples collected were representative of groundwater in the formation. The field water quality parameter and natural attenuation parameter data are tabulated in **Table 5-2**. The discussion below excludes the four EISB performance monitoring wells discussed in the summary of the EISB treatment. The following is a summary of the field water quality parameter data:

- The DO values in wells in both areas (western and eastern plumes) ranged widely (0.67 mg/L to 9.72 mg/L), but generally indicated aerobic conditions.
- Similar to the DO, the ORP values also ranged widely (-99 mV to 441 mV) in the shallow zone wells in both plumes.
- Mean temperature values in the wells ranged from 18 degrees Celsius (°C) to 26°C.
- pH values for most of the wells were between 6 and 7 standard units (su), indicating near neutral groundwater.
- Conductivity values were also relatively low (less than 40 mS/cm) in all the measured wells at the site.

Groundwater samples collected from shallow zone monitoring wells 35AWW11, LHSMW04, 35AWW06, 35AWW20, and LHSMW07 were analyzed for the following natural attenuation parameters as discussed in the RAWP: alkalinity, common anions (chloride, sulfate, nitrate, nitrite), sulfide, TOC, dissolved iron and manganese, total phosphorus, carbon dioxide, dissolved gases (methane, ethane, and ethene), and total iron. The natural attenuation parameters are tabulated in **Table 5-2**. The following is the summary of the MNA parameter data for wells excluding 03WW01, 35AWW08, 35AWW09, and 35AWW10 (which are discussed separately in Section 4.5.1.1):

- Alkalinity – There is a positive correlation between zones of microbial activity and increased alkalinity (USEPA, 1998). Alkalinity levels in the shallow zone groundwater at the site ranged between 392 mg/L (35AWW11) and 786 mg/L (35AWW20). The evidence of highest alkalinity levels in well 35AWW20 (western plume) suggests

presence of microbial activity in the western plume area. This observation is also supported by other data (e.g. presence of degradation products) in the western plume area.

- Chloride – During biodegradation of chlorinated hydrocarbons in groundwater, chloride is released in groundwater. This results in higher chloride concentrations in the contaminant plume as compared to background levels or down-gradient wells (USEPA, 1998). Chloride levels in the shallow zone ranged between 1,120 mg/L (well 35AWW06) and 2,670 mg/L (well LHSMW07). Relatively high level of chloride in well LHSMW07 in the western plume supports biodegradation (biological activity) in this area. Well 35AWW20, also in the western plume, also depicted relatively high chloride level (2,360 µg/L).
- Nitrate and Nitrite – After dissolved oxygen has been depleted in the zone of microbiological activity, nitrate may be used as an electron acceptor for anaerobic biodegradation of organic carbon via denitrification. In order for reductive dechlorination to occur, nitrate concentrations in the contaminated portion of the aquifer must be less than 1.0 mg/L (USEPA, 1998). Nitrite is generated when nitrate is reduced during anaerobic dechlorination. In the shallow zone wells, nitrate and nitrite levels were generally less than the laboratory reporting limits, indicating nitrate levels are not currently inhibiting reductive dechlorination.
- Sulfate – After dissolved oxygen and nitrate, sulfate may be used as an electron acceptor for anaerobic biodegradation. This process is termed as ‘sulfate reduction’ and results in production of sulfide (USEPA, 1998). Concentrations of sulfate greater than 20 mg/L may cause competitive exclusion of dechlorination (USEPA, 1998). . However, in many plumes, reductive dechlorination has been observed despite high sulfate concentrations (USEPA, 1998). Sulfate concentrations in the shallow zone groundwater ranged between 1,360 mg/L (35AWW11) and 2,630 mg/L (LHSMW07). These relatively high levels can exert additional demand on the substrate and potentially slow down MNA progress.
- Sulfide – Sulfide is generated when sulfate is reduced during reductive dechlorination. Sulfide levels were less than the laboratory reporting limit in the sampled wells. Indicating the current conditions in the aquifer are not sulfate reducing.
- Phosphorus – Phosphorus in groundwater is a nutrient available to microbes for their metabolic processes during reductive dechlorination. Phosphorus levels in the sampled wells were generally detected at low levels or were less than the laboratory reporting limit indicating that groundwater does not have naturally available phosphorus for biological degradation.
- TOC measurements in the shallow zone wells were very low (not greater than 17 mg/L) indicating a limited supply of organic carbon. TOC levels are used to estimate microbial abundance for biological degradation of chlorinated VOCs. TOC levels are used to estimate conditions for biological degradation of chlorinated VOCs. Limited organic carbon can indicate that conditions for biological activity are not optimal in the aquifer.

Organic substrate (monitored in terms of TOC) can stimulate microbial growth, creating an anaerobic environment for reduction of COCs.

- Dissolved gases – Methanogenesis occurs in highly reducing conditions with ethane, and ethene being the end products of reductive dechlorination of chlorinated VOCs. Concentrations of dissolved gases (ethane and ethene) were generally less than laboratory reporting limits or detected at low concentrations in the sampled wells, indicating limited biological activity in the sampled wells. The absence of ethane and ethene suggests complete dechlorination is not occurring in the groundwater at this time. Methane was detected in the western plume wells 35AWW20 and LHSMW07 at concentrations of 118 µg/L and 204 µg/L indicating some level of methanogenic conditions.

Data on the above MNA parameters, collected over several quarterly sampling events, are expected to allow trend analysis for evaluation of MNA effectiveness.

### 5.1.2 Surface Water Sampling

As per the RAWP, one surface water sample was collected from the ditch that runs parallel to 4<sup>th</sup> Street, at a location near well 35AWW18. The location of surface water sample 35ASW03 is presented on **Figure 3-1**. For the baseline event, surface water sample 35ASW03 was collected in October 2013 and analyzed for VOCs using USEPA Method 8260B. The VOC data for the surface water sample is included in **Table 5-1**. COCs were not detected in the surface water sample at concentrations exceeding laboratory reporting limits.

### 5.1.3 Long-term Monitoring

The data from the first two years of quarterly groundwater monitoring will be used to perform an MNA evaluation at the site. If the evaluation determines MNA is effective, and will likely lead to the achievement of RAOs, the LTM will begin at a semiannual frequency for the following three years (until the first CERCLA Five-Year Review). The suite of analyses performed will also be limited to VOCs for ongoing confirmation of declining concentration trends. In subsequent years, LTM will be performed annually until the next CERCLA Five-Year Review. The LTM associated with this remedy will be used to track the continued effectiveness of MNA. The need for continued monitoring and any reductions in the monitoring frequency will be evaluated every five years during the CERCLA Five-Year Review. However, at a minimum, the LTM will continue once every five years until the cleanup levels are achieved.

### 5.1.4 Site Health and Safety Plan/Procedures

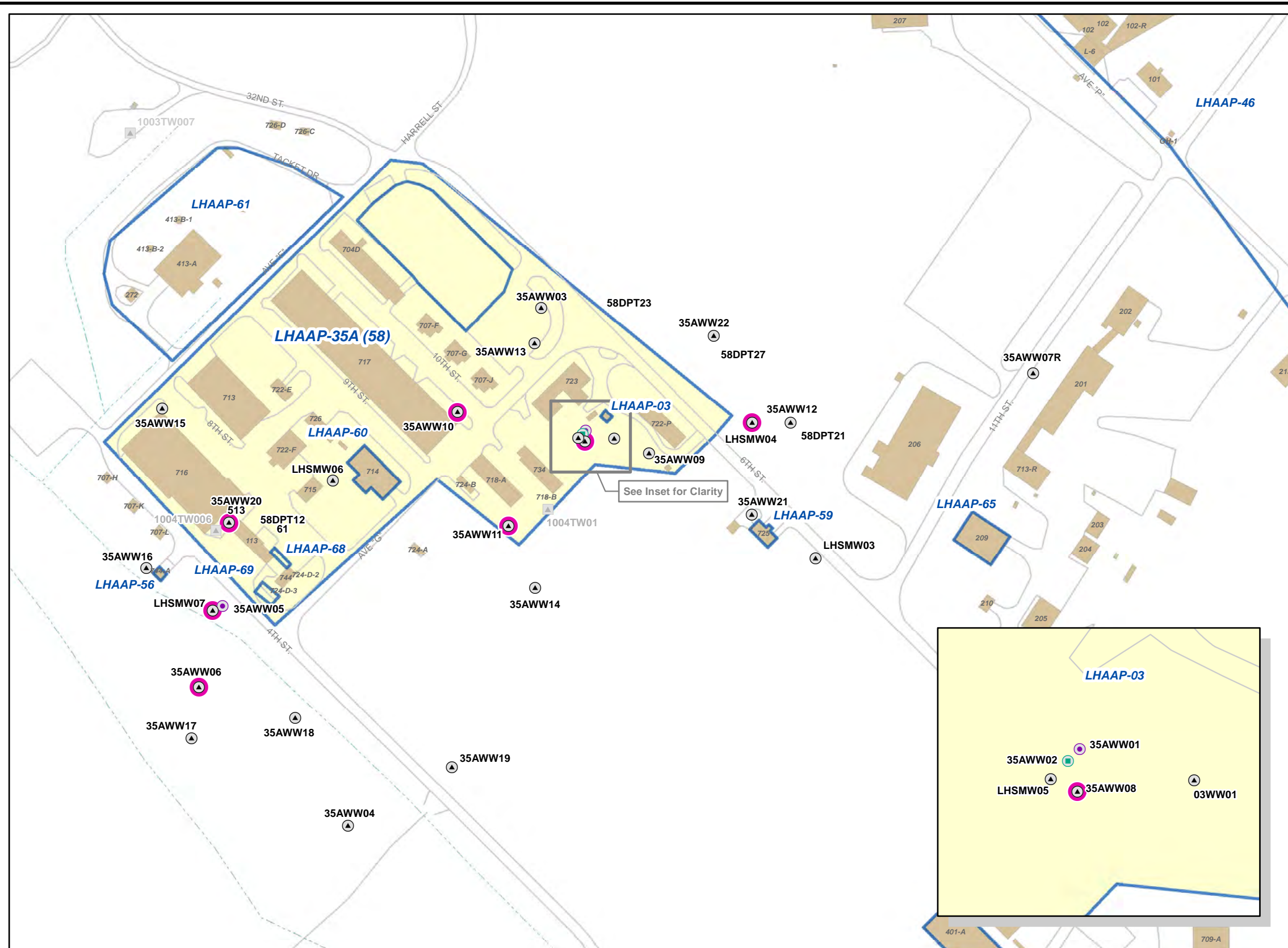
Field work was conducted in compliance with the health and safety procedures described in the LHAAP HASP and draft IWWP (AECOM, 2013b). The field work was performed in modified Level D personal protective equipment (PPE) that included a hard hat, safety glasses, steel-toed boots, and nitrile gloves. Additional PPE utilized depending on the location and type of field activities included bug spray, Tyvek® suits, poison ivy/oak block, and reflective safety vests.

### 5.1.5 Quality Assurance/Quality Control (QA/QC)

All work was performed in accordance with the IWWP in place at the time field work was conducted. The IWWP provides information on QA/QC procedures for this project, identifies

personnel, procedures, controls, instructions, tests, verifications, documents, and forms to be used and the types of records to be maintained. The IWWP also addresses quality control requirements specific to each major feature of work.





- Legend**
- Temporary Shallow Monitoring Well Location
  - Shallow Monitoring Well Location
  - Intermediate Monitoring Well Location
  - Deep Monitoring Well Location
  - Well to be analyzed for biogeochemical parameters for MNA evaluation
  - Roads
  - Streams
  - Buildings
  - Site Location

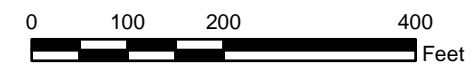


Figure 5-1  
 MNA Performance Wells  
 Remedial Action Completion Report  
 LHAAP-35A(58)  
 Longhorn Army Ammunition Plant  
 Karnack, Texas

60256135

March 2014

**Table 5-1: LHAAP-35A (58) Monitoring Well Volatile Organic Compound Data - October 2013**

Sample ID:	Units	MCL	03WW01-101013 10/10/2013	35ASW03-101713 10/17/2013	35AWW01-101113 10/11/2013	35AWW02-102213 10/22/2013	35AWW05-101613 10/16/2013	35AWW06-101513 10/15/2013	35AWW07R-101613 10/16/2013	35AWW08-101013 10/10/2013	35AWW09-101013 10/10/2013	35AWW10-101013 10/10/2013	35AWW11-101513 10/15/2013
Sample Date:													
<b>Volatile Organic Compounds (8260B)</b>													
1,1-Dichloroethene	ug/L	7	<5 U	<1 U	<1 U	<1 U	<1 U	15.8	<1 U	<10 U	<1 UJ	<1 U	7.7
cis-1,2-Dichloroethene	ug/L	70	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.709 J	<5 U	<0.5 UJ	<0.5 U	<0.5 U
Tetrachloroethene	ug/L	5	172 J	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.586 J	603 J	57.6 J	<0.5 U	<0.5 U
trans-1,2-Dichloroethene	ug/L	100	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
Trichloroethene	ug/L	5	42.1 J	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.03	149 J	8.97 J	<0.5 U	<0.5 U
Vinyl Chloride	ug/L	2	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	0.442 J

**Note:** Samples were not collected for LHSMW04 and LHSMW05 as they were dry. 35ASW03-101713 is a surface water sample.

Blue Highlighting Indicates Analyte Detected Above Regulatory Limit

FD - field duplicate

J - Estimated value; analyte concentration was less than the limit of quantification

MCL - maximum contaminant level

NA - not analyzed

U - Analyte was not detected. The concentration is below the reported limit of detection.

µg/L - microgram per liter

UJ - The analysis was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. 'UJ' not detects are not definite; the analyte may be present.

**Table 5-1: LHAAP-35A (58) Monitoring Well Volatile Organic Compound Data - October 2013**

Sample ID:	Units	MCL	35AWW12-101813 10/18/2013	35AWW12FD-101813 10/18/2013	35AWW13-101113 10/11/2013	35AWW13FD-101113 10/11/2013	35AWW14-101813 10/18/2013	35AWW15-101613 10/16/2013	35AWW15FD-101613 10/16/2013	35AWW16-102213 10/22/2013	35AWW17-101813 10/18/2013	35AWW18-101813 10/18/2013	35AWW19-102213 10/22/2013
<b>Volatile Organic Compounds (8260B)</b>													
1,1-Dichloroethene	ug/L	7	<1 U	<1 U	<1 U	<1 U	1.63 J	<1 U	<1 U	<1 U	<1 U	<1 U	6.45
cis-1,2-Dichloroethene	ug/L	70	<0.5 U	<0.5 U	<0.5 U	<0.5 U	2.04	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Tetrachloroethene	ug/L	5	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
trans-1,2-Dichloroethene	ug/L	100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Trichloroethene	ug/L	5	<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.663 J	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.379 J
Vinyl Chloride	ug/L	2	<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.272 J	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U

**Note:** Samples were not collected for LHSMW04 and LHSMW05 as they were dry. 35ASW03-101713 is a surface water sample.

Blue Highlighting Indicates Analyte Detected Above Regulatory Limit

FD - field duplicate

J - Estimated value; analyte concentration was less than the limit of quantification

MCL - maximum contaminant level

NA - not analyzed

U - Analyte was not detected. The concentration is below the reported limit of detection.

µg/L - microgram per liter

UJ - The analysis was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. 'UJ' not detects are not definite; the analyte may be present.

**Table 5-1: LHAAP-35A (58) Monitoring Well Volatile Organic Compound Data - October 2013**

Sample ID:	Units	MCL	35AWW20-101513 10/15/2013	35AWW21-101613 10/16/2013	35AWW22-102213 10/22/2013	LHSMW06-101713 10/17/2013	LHSMW07-101513 10/15/2013
<b>Volatile Organic Compounds (8260B)</b>							
1,1-Dichloroethene	ug/L	7	3230	<1 U	<1 U	1.23 J	396
cis-1,2-Dichloroethene	ug/L	70	110	<0.5 U	<0.5 U	4.01	6.1
Tetrachloroethene	ug/L	5	1.65	<0.5 U	<0.5 U	0.663 J	<0.5 U
trans-1,2-Dichloroethene	ug/L	100	3.77	<0.5 U	<0.5 U	<0.5 U	0.282 J
Trichloroethene	ug/L	5	513	<0.5 U	<0.5 U	1.87	23.9
Vinyl Chloride	ug/L	2	105	<0.5 U	<0.5 U	0.627 J	15.9

**Note:** Samples were not collected for LHSMW04 and LHSMW05 as they were dry. 35ASW03-101713 is a surface water sample.

Blue Highlighting Indicates Analyte Detected Above Regulatory Limit

FD - field duplicate

J - Estimated value; analyte concentration was less than the limit of quantification

MCL - maximum contaminant level

NA - not analyzed

U - Analyte was not detected. The concentration is below the reported limit of detection.

µg/L - microgram per liter

UJ - The analysis was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. 'UJ' not detects are not definite; the analyte may be present.

Table 5-2: LHAAP-35A (58) Monitoring Well Field Parameters and Biogeochemical Data - October 2013

Sample ID:	Units	03WW01-101013	03WW01F-101013	35AWW01-101113	35AWW02-102213	35AWW05-101613	35AWW06-101513	35AWW06F-101513	35AWW07R-101613	35AWW08-101013	35AWW08F-101013	35AWW09-101013	35AWW09F-101013
Sample Date:		10/10/2013	10/10/2013	10/11/2013	10/22/2013	10/16/2013	10/15/2013	10/15/2013	10/16/2013	10/10/2013	10/10/2013	10/10/2013	10/10/2013
<b>Water Quality Parameters</b>													
Temperature	°C	17.4	NA	25.58	22.72	21.05	21.39	NA	20.83	16.82	NA	19.67	NA
pH	pH Units	6.55	NA	7.08	8.12	6.95	6.56	NA	7.54	6.7	NA	5.43	NA
Conductivity	mS/cm	39.2	NA	0.576	0.875	3.05	6.73	NA	0.205	47.7	NA	7.68	NA
Dissolved Oxygen	mg/L	9.72	NA	0.85	1.3	0.67	1.05	NA	8.86	9.57	NA	1.53	NA
Turbidity	NTU	10	NA	131	7.3	16.9	0	NA	197	4.1	NA	40.5	NA
Oxidation Reduction Potential	mV	-235	NA	23	98	-141	96	NA	108	-100	NA	182	NA
<b>Alkalinity (310.2)</b>													
Alkalinity, Total	mg/L	39700	NA	NA	NA	NA	592	NA	NA	35600	NA	235	NA
<b>Nitrogen (353.2)</b>													
Nitrogen, Nitrate-Nitrite	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<b>Phosphorus (365.4)</b>													
Phosphorus	mg/L	243	NA	NA	NA	NA	<0.2 U	NA	NA	361	NA	<0.2 U	NA
<b>Sulfide (376.1)</b>													
Sulfide	mg/L	<1 U	NA	NA	NA	NA	<1 U	NA	NA	<1 U	NA	<1 U	NA
<b>Total Organic Carbon (415.1)</b>													
Total Organic Carbon (TOC)	mg/L	49200	NA	NA	NA	NA	6.33	NA	NA	66400	NA	9.83	NA
<b>Metals (6010C)</b>													
Iron	mg/L	36.6	NA	NA	NA	NA	0.159 J	NA	NA	29.7	NA	NA	<0.1 U
<b>Dissolved Metals (6010C)</b>													
Iron	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<b>Metals (6020A)</b>													
Manganese	mg/L	60.4	NA	NA	NA	NA	0.278	NA	NA	45.8	NA	NA	0.23
<b>Dissolved Metals (6020A)</b>													
Manganese	mg/L	NA	65.2	NA	NA	NA	NA	0.191	NA	NA	40.7	NA	0.234
<b>Volatile Fatty Acids (830-MBA)</b>													
Acetic Acid	mg/L	946	NA	NA	NA	NA	NA	NA	NA	776	NA	<1 U	NA
Butyric Acid	mg/L	<100 U	NA	NA	NA	NA	NA	NA	NA	<100 U	NA	<1 U	NA
Lactic Acid	mg/L	97100	NA	NA	NA	NA	NA	NA	NA	89700	NA	<1 U	NA
Propionic Acid	mg/L	<1000 U	NA	NA	NA	NA	NA	NA	NA	<1000 U	NA	<10 U	NA
Pyruvic Acid	mg/L	61.5	NA	NA	NA	NA	NA	NA	NA	61.7	NA	<0.1 U	NA
<b>Anions (9056)</b>													
Chloride	mg/L	398	NA	NA	NA	NA	1120	NA	NA	905	NA	1730	NA
Nitrate	mg/L	<20 U	NA	NA	NA	NA	<4 U	NA	NA	12.3 J	NA	<2 U	NA
Nitrite	mg/L	<20 U	NA	NA	NA	NA	<4 U	NA	NA	<20 U	NA	<2 U	NA
Sulfate	mg/L	487	NA	NA	NA	NA	1660	NA	NA	703	NA	1170	NA

**Table 5-2: LHAAP-35A (58) Monitoring Well Field Parameters and Biogeochemical Data - October 2013**

Sample ID:	Units	03WW01-101013	03WW01F-101013	35AWW01-101113	35AWW02-102213	35AWW05-101613	35AWW06-101513	35AWW06F-101513	35AWW07R-101613	35AWW08-101013	35AWW08F-101013	35AWW09-101013	35AWW09F-101013
Sample Date:		10/10/2013	10/10/2013	10/11/2013	10/22/2013	10/16/2013	10/15/2013	10/15/2013	10/16/2013	10/10/2013	10/10/2013	10/10/2013	10/10/2013
<b>Dechlorinating Bacteria</b>													
Dehalococcoides	CEQ/mL	<2.1	NA	NA	NA	NA	NA	NA	NA	3.6	NA	4	NA
tceA Reductase	CEQ/mL	<2.1	NA	NA	NA	NA	NA	NA	NA	2.65	NA	0.3 J	NA
BAV1 Vinyl Chloride Reductase	CEQ/mL	<2.1	NA	NA	NA	NA	NA	NA	NA	<2.2	NA	<0.5	NA
Vinyl Chloride Reductase	CEQ/mL	<2.1	NA	NA	NA	NA	NA	NA	NA	<2.2	NA	<0.5	NA
Dehalobacter spp.	CEQ/mL	15.7 J	NA	NA	NA	NA	NA	NA	NA	1300	NA	<4.7	NA
<b>Dissolved Gases (RSK-175)</b>													
Carbon Dioxide	ug/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethane	ug/L	<2 U	NA	NA	NA	NA	<2 U	NA	NA	<2 U	NA	<2 U	NA
Ethene	ug/L	<2 U	NA	NA	NA	NA	<2 U	NA	NA	<2 U	NA	<2 U	NA
Methane	ug/L	<2 U	NA	NA	NA	NA	<2 UJ	NA	NA	<2 UJ	NA	<2 U	NA
<b>Ferrous Iron (SM3500FE)</b>													
Ferrous Iron	mg/L	35.4 J	NA	NA	NA	NA	<0.04 U	NA	NA	52.4 J	NA	<0.04 U	NA

**Note:** Samples were not collected for LHSMW04 and LHSMW05 as they were dry.

°C - degrees celsius

CEQ/ml - cells equivalent per milliliter

J - Estimated value; analyte concentration was less than the limit of quantification

mg/L - milligram per liter

mS/cm - millisiemens per centimeter

mV - millivolt

NA - not analyzed

NTU - Nephelometric turbidity unit

U - Analyte was not detected. The concentration is below the reported limit of detection.

µg/L - microgram per liter

UJ - The analysis was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. 'UJ' not detects are not definite; the analyte may be present.



Table 5-2: LHAAP-35A (58) Monitoring Well Field Parameters and Biogeochemical Data - October 2013

Sample ID:	Units	35AWW10-101013	35AWW10F-101013	35AWW11-101513	35AWW11F-101513	35AWW12-101813	35AWW13-101113	35AWW14-101813	35AWW15-101613	35AWW16-102213	35AWW17-101813
Sample Date:		10/10/2013	10/10/2013	10/15/2013	10/15/2013	10/18/2013	10/11/2013	10/18/2013	10/16/2013	10/22/2013	10/18/2013
<b>Water Quality Parameters</b>											
Temperature	°C	25.41	NA	21.17	NA	20.93	22.45	19.37	21.88	19.32	17.69
pH	pH Units	6.1	NA	6.12	NA	6.05	6.5	6.89	6.39	6.39	6.64
Conductivity	mS/cm	0.322	NA	9.75	NA	2.6	1.66	6.73	14.9	10.7	10.4
Dissolved Oxygen	mg/L	5.36	NA	4.24	NA	1.29	0.96	10.5	0.65	5	1.72
Turbidity	NTU	5.1	NA	25.8	NA	17.3	22.5	6	19	37.1	12.1
Oxidation Reduction Potential	mV	420	NA	125	NA	153	-68	1	-99	58	74
<b>Alkalinity (310.2)</b>											
Alkalinity, Total	mg/L	128	NA	392	NA	NA	NA	NA	NA	NA	NA
<b>Nitrogen (353.2)</b>											
Nitrogen, Nitrate-Nitrite	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<b>Phosphorus (365.4)</b>											
Phosphorus	mg/L	<0.2 U	NA	0.22 J	NA	NA	NA	NA	NA	NA	NA
<b>Sulfide (376.1)</b>											
Sulfide	mg/L	<1 U	NA	<1 U	NA	NA	NA	NA	NA	NA	NA
<b>Total Organic Carbon (415.1)</b>											
Total Organic Carbon (TOC)	mg/L	5.42	NA	17	NA	NA	NA	NA	NA	NA	NA
<b>Metals (6010C)</b>											
Iron	mg/L	0.155 J	NA	NA	1.16	NA	NA	NA	NA	NA	NA
<b>Dissolved Metals (6010C)</b>											
Iron	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<b>Metals (6020A)</b>											
Manganese	mg/L	0.0811	NA	NA	1.07	NA	NA	NA	NA	NA	NA
<b>Dissolved Metals (6020A)</b>											
Manganese	mg/L	NA	0.0681	NA	1.01	NA	NA	NA	NA	NA	NA
<b>Volatile Fatty Acids (830-MBA)</b>											
Acetic Acid	mg/L	<1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Butyric Acid	mg/L	<1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lactic Acid	mg/L	<1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Propionic Acid	mg/L	<10 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyruvic Acid	mg/L	<0.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
<b>Anions (9056)</b>											
Chloride	mg/L	16.5	NA	2350	NA	NA	NA	NA	NA	NA	NA
Nitrate	mg/L	0.11 J	NA	<4 UJ	NA	NA	NA	NA	NA	NA	NA
Nitrite	mg/L	<0.2 U	NA	<4 UJ	NA	NA	NA	NA	NA	NA	NA
Sulfate	mg/L	66.2	NA	1360	NA	NA	NA	NA	NA	NA	NA

**Table 5-2: LHAAP-35A (58) Monitoring Well Field Parameters and Biogeochemical Data - October 2013**

Sample ID:	Units	35AWW10-101013	35AWW10F-101013	35AWW11-101513	35AWW11F-101513	35AWW12-101813	35AWW13-101113	35AWW14-101813	35AWW15-101613	35AWW16-102213	35AWW17-101813
Sample Date:		10/10/2013	10/10/2013	10/15/2013	10/15/2013	10/18/2013	10/11/2013	10/18/2013	10/16/2013	10/22/2013	10/18/2013
<b>Dechlorinating Bacteria</b>											
Dehalococcoides	CEQ/mL	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
tceA Reductase	CEQ/mL	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAV1 Vinyl Chloride Reductase	CEQ/mL	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride Reductase	CEQ/mL	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dehalobacter spp.	CEQ/mL	3.4 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
<b>Dissolved Gases (RSK-175)</b>											
Carbon Dioxide	ug/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethane	ug/L	<2 U	NA	<2 U	NA	NA	NA	NA	NA	NA	NA
Ethene	ug/L	<2 U	NA	<2 U	NA	NA	NA	NA	NA	NA	NA
Methane	ug/L	<2 U	NA	<2 UJ	NA	NA	NA	NA	NA	NA	NA
<b>Ferrous Iron (SM350FE)</b>											
Ferrous Iron	mg/L	<0.04 U	NA	<0.04 U	NA	NA	NA	NA	NA	NA	NA

**Note:** Samples were not collected for LHSMW04 and LHSMW05 as they were dry.

°C - degrees celsius

CEQ/ml - cells equivalent per milliliter

J - Estimated value; analyte concentration was less than the limit of quantification

mg/L - milligram per liter

mS/cm - millisiemens per centimeter

mV - millivolt

NA - not analyzed

NTU - Nephelometric turbidity unit

U - Analyte was not detected. The concentration is below the reported limit of detection.

µg/L - microgram per liter

UJ - The analysis was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. 'UJ' not detects are not definite; the analyte may be present.

Table 5-2: LHAAP-35A (58) Monitoring Well Field Parameters and Biogeochemical Data - October 2013

Sample ID:	Units	35AWW18-101813	35AWW19-102213	35AWW20-101513	35AWW21-101613	35AWW22-102213	LHSMW06-101713	LHSMW07-101513	LHSMW07F-101513
Sample Date:		10/18/2013	10/22/2013	10/15/2013	10/16/2013	10/22/2013	10/17/2013	10/15/2013	10/15/2013
<b>Water Quality Parameters</b>									
Temperature	°C	18.7	18.75	26.17	20.7	18.67	20.46	23.04	NA
pH	pH Units	6.67	6.44	6.55	5.72	6.2	6.82	6.48	NA
Conductivity	mS/cm	10.1	6.95	11.4	1.05	9.85	3.65	12.5	NA
Dissolved Oxygen	mg/L	1.4	9.67	1.55	1.44	9.67	10	0.75	NA
Turbidity	NTU	22.9	475	6.7	21.3	25	1	1.8	NA
Oxidation Reduction Potential	mV	104	106	441	213	170	157	79	NA
<b>Alkalinity (310.2)</b>									
Alkalinity, Total	mg/L	NA	NA	786	NA	NA	NA	597	NA
<b>Nitrogen (353.2)</b>									
Nitrogen, Nitrate-Nitrite	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
<b>Phosphorus (365.4)</b>									
Phosphorus	mg/L	NA	NA	<0.2 U	NA	NA	NA	<0.2 U	NA
<b>Sulfide (376.1)</b>									
Sulfide	mg/L	NA	NA	<1 U	NA	NA	NA	<1 U	NA
<b>Total Organic Carbon (415.1)</b>									
Total Organic Carbon (TOC)	mg/L	NA	NA	13.1	NA	NA	NA	9.22	NA
<b>Metals (6010C)</b>									
Iron	mg/L	NA	NA	0.339	NA	NA	NA	1.55	NA
<b>Dissolved Metals (6010C)</b>									
Iron	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
<b>Metals (6020A)</b>									
Manganese	mg/L	NA	NA	2.8	NA	NA	NA	0.101	NA
<b>Dissolved Metals (6020A)</b>									
Manganese	mg/L	NA	NA	2.54	NA	NA	NA	NA	0.0961
<b>Volatile Fatty Acids (830-MBA)</b>									
Acetic Acid	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Butyric Acid	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Lactic Acid	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Propionic Acid	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Pyruvic Acid	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
<b>Anions (9056)</b>									
Chloride	mg/L	NA	NA	2360	NA	NA	NA	2670	NA
Nitrate	mg/L	NA	NA	<4 U	NA	NA	NA	<4 UJ	NA
Nitrite	mg/L	NA	NA	<4 U	NA	NA	NA	<4 UJ	NA
Sulfate	mg/L	NA	NA	2290	NA	NA	NA	2630	NA

**Table 5-2: LHAAP-35A (58) Monitoring Well Field Parameters and Biogeochemical Data - October 2013**

Sample ID:	Units	35AWW18-101813	35AWW19-102213	35AWW20-101513	35AWW21-101613	35AWW22-102213	LHSMW06-101713	LHSMW07-101513	LHSMW07F-101513
Sample Date:		10/18/2013	10/22/2013	10/15/2013	10/16/2013	10/22/2013	10/17/2013	10/15/2013	10/15/2013
<b>Dechlorinating Bacteria</b>									
Dehalococcoides	CEQ/mL	NA	NA	NA	NA	NA	NA	NA	NA
tceA Reductase	CEQ/mL	NA	NA	NA	NA	NA	NA	NA	NA
BAV1 Vinyl Chloride Reductase	CEQ/mL	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride Reductase	CEQ/mL	NA	NA	NA	NA	NA	NA	NA	NA
Dehalobacter spp.	CEQ/mL	NA	NA	NA	NA	NA	NA	NA	NA
<b>Dissolved Gases (RSK-175)</b>									
Carbon Dioxide	ug/L	NA	NA	NA	NA	NA	NA	NA	NA
Ethane	ug/L	NA	NA	1.19 J	NA	NA	NA	<2 U	NA
Ethene	ug/L	NA	NA	<2 U	NA	NA	NA	<2 U	NA
Methane	ug/L	NA	NA	118	NA	NA	NA	204	NA
<b>Ferrous Iron (SM3500FE)</b>									
Ferrous Iron	mg/L	NA	NA	<0.04 U	NA	NA	NA	<0.04 U	NA

**Note:** Samples were not collected for LHSMW04 and LHSMW05 as they were dry.

°C - degrees celsius

CEQ/ml - cells equivalent per milliliter

J - Estimated value; analyte concentration was less than the limit of quantification

mg/L - milligram per liter

mS/cm - millisiemens per centimeter

mV - millivolt

NA - not analyzed

NTU - Nephelometric turbidity unit

U - Analyte was not detected. The concentration is below the reported limit of detection.

µg/L - microgram per liter

UJ - The analysis was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. 'UJ' not detects are not definite; the analyte may be present.

## 6 MNA PERFORMANCE EVALUATION AND REPORTING

Typical natural attenuation processes include adsorption, dispersion, dilution, volatilization and biodegradation. Adsorption, dispersion, and dilution are controlled by the physical characteristics of the aquifer (e.g., particle grain size, groundwater flow velocity, recharge, etc.). Volatilization of the compound of concern is generally controlled by compound chemistry and aquifer characteristics (i.e., temperature, pH, etc.). Biodegradation can be estimated indirectly by monitoring the daughter products and other MNA parameters discussed in the previous section.

The available data indicates that the aquifer outside of the eastern plume EISB treatment area is moderately aerobic. The presence of cis-1,2-DCE, 1,1-DCE, and VC in wells in the western plume area indicates that biological degradation is occurring, albeit limited. In the eastern plume, outside of the EISB treatment area, current data does not indicate biological degradation. However, over time, the effect of the EISB treatment is expected to be observed down-gradient from the treatment area. The baseline data does not provide sufficient information to properly assess MNA effectiveness at the site. Additional data collected during subsequent monitoring events, along with baseline data, will be used to evaluate progress of the remedy. Annual reports will be completed at the end of each calendar year and a formal technical evaluation of MNA effectiveness will be performed after the first eight quarters (two years) of groundwater monitoring. After the first two years, LTM will be continued and CERCLA Five-Year Reviews will be conducted until clean up goals are achieved.

### 6.1 MNA Reporting Plan

The MNA performance criteria listed in **Table 6-1** and discussed below will be used during formal evaluation of MNA as the remedy. The MNA Evaluation Report will include:

- Figures of the site, wells, and groundwater elevation contours;
- Groundwater and surface water analytical results;
- Plume extent and concentrations over time;
- Consideration of the first and second lines of evidence for MNA (see **Section 6.1.2** and **Section 6.1.3**); and,
- An evaluation of the effectiveness of MNA at the site.

#### 6.1.1 Migration/Expansion

The MNA evaluation should demonstrate a stable or decreasing plume size if the MNA remedy is to be considered effective at the LHAAP-35A (58) site. A groundwater plume is stable when the pollutant concentrations and plume footprint are relatively unchanged over time. A stable plume shows that pollutant migration in groundwater is under control. A decreasing plume is decreasing in contaminant concentrations and/or its footprint is not migrating or expanding. This situation occurs when the attenuation rate of dissolved-phase pollutants exceeds their generation rate from all sources.

Monitoring must occur over a period of time sufficient to demonstrate plume stability or decrease under natural conditions. This may take up to several years, depending on site-specific

conditions such as monitoring data trend analysis, potential threats to beneficial uses, and other uncertainties. The non-parametric Mann-Kendall statistic will be used to evaluate solute plume stability. If monitoring data do not indicate plume stability or decrease, additional plume remediation activities may be necessary.

### **6.1.2 First Line of Evidence**

The first line of evidence relies upon comparison of current and historical groundwater data from appropriate monitoring or sampling points that demonstrates a trend of stable or decreasing contaminant mass and/or COC concentrations over time or with distance traveled from the source. Decreasing concentrations should not be solely the result of plume migration, so performance wells will be evaluated to determine if the plume is migrating. COC concentrations in individual wells can be evaluated to calculate a time-based attenuation rate or across multiple wells through the centerline of a plume to calculate distance-based attenuation rate. These calculations will be performed using the methods contained in the *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater* (USEPA, 1998).

The trends of PCE and TCE for wells in the EISB treatment area (03WW01, 35AWW08, 35AWW09, and 35AWW10) are depicted in Appendix G. The other wells in the shallow zone have limited VOC data exceeding their cleanup levels, and hence, no trend graphs were created for this document.

Time-based attenuation rates will be calculated for any monitoring well that shows consistent COC concentrations exceeding cleanup levels. Distance-based attenuation rates will be calculated using wells with the highest concentrations parallel to the direction of groundwater flow. According to October 2013 sampling data, monitoring wells 35AWW20 and LHSMW07 (western plume area) and wells 03WW01 and 35AWW08 (eastern plume area) are expected to be the primary focus of analysis at the LHAAP-35A (58) site, as they contain the greatest COC concentrations.

### **6.1.3 Second Line of Evidence**

The second line of evidence uses chemical analytical data in mass balance to show that decreases in contaminant and electron acceptor/donor concentrations can be directly correlated to increases in metabolic end products or daughter compounds. The evidence can be used to show groundwater conditions are sufficiently favorable to natural attenuation so that degradation of chlorinated solvent contaminants can occur. The second line of evidence also evaluates biogeochemical parameters such as nitrates, sulfates, chloride, TOC, etc. The results of these analyses will continue to be interpreted using the *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater* (USEPA 1998) to determine whether conditions are favorable for continued MNA.

### **6.1.4 Third Line of Evidence**

If the first two lines of evidence for MNA are deemed inadequate or inconclusive and/or if the need for a contingency remedy is evaluated, data from field or additional microcosm studies will be necessary to establish the third line of evidence for MNA. The need for any additional studies will be deferred until the initial two-year groundwater monitoring program is concluded.



The third line of evidence, if necessary, consists of predictive modeling studies and other laboratory/field studies that demonstrate an understanding of the natural attenuation processes occurring at the site and their effectiveness in controlling plume migration and decreasing COC concentrations. For the MNA evaluation, the presence of microorganisms in the groundwater capable of degrading the COCs will be considered the favorable condition supporting continued MNA. Additional analyses (e.g. DHC, hydrogen, VHA) related to general laboratory and microcosm studies will be deferred until such time as the initial two-year groundwater monitoring program is concluded and such a study is found necessary.

### **6.1.5 MNA Performance Evaluation Report**

The MNA Performance Evaluation Report will review data for the initial eight quarters of monitoring to determine whether MNA is functioning as intended and will continue to be the remedial action applied at the LHAAP-35A (58) site.

The first and second lines of evidence will be evaluated for decreasing COC concentrations and suitable geochemical conditions to demonstrate MNA. The MNA Performance Evaluation Report will also include recommendations for future LTM and well abandonments.

## **6.2 Long-term Monitoring Annual Reports**

An annual report will be prepared at the end of each year of LTM with the following information:

- Present groundwater monitoring results, a description of field activities, and to document other relevant information that may be considered useful for the CERCLA Five-Year Review;
- Evaluation of perimeter well data for plume migration and data from wells within the plume areas for evaluation of MNA performance;
- Present monitoring well conditions and maintenance required, if any; and
- Recommendations, if possible, for reducing the number of monitoring wells to be included in the monitoring program and/or frequency of monitoring events.

## **6.3 CERCLA Five-Year Review Reports**

CERCLA Five-Year Reviews will be performed for the LHAAP-35A (58) site. The Five-Year Review report will present summaries of information from the annual reports, information from the five-year sampling event, and recommend the future course of action. The progress towards cleanup levels will be evaluated in the Five-Year Review report.

**Table 6-1: LHAAP-35A (58) MNA Evaluation Performance Criteria**

<b>Performance Criteria</b>	<b>Type</b>	<b>Expected Performance</b>	<b>Commentary</b>
Migration/Expansion	Qualitative	Stable or decreasing plume footprint, stable footprint position	An expanding or migrating plume footprint indicates MNA should not be continued.
Concentrations	Quantitative	Declining concentrations or total CVOC mass in a majority of performance monitoring wells	First Line of Evidence
Aquifer Conditions	Quantitative	Conditions favorable for natural attenuation	Second Line of Evidence
Microcosm Studies or Modeling (if necessary)	Quantitative	Detectable presence of appropriate microorganisms	Third Line of Evidence (if necessary)

## **7 SCHEDULE**

Periodic sampling events for the MNA remedy will be continued for the first two years of remedy implementation. Reporting will consist of formal annual reports, supplemented by the sharing of validated data as it becomes available to shorten the time between sampling and data receipt by the regulators. An initial MNA evaluation report will be completed after the first two years of sampling are complete. Annual LTM reports containing annual MNA evaluations will be prepared at the end of each calendar year thereafter. The CERCLA Five-Year Reviews will be conducted and reports prepared until clean up levels are achieved.

## **8 COMMUNITY RELATIONS**

The overall goal of the community involvement program is to promote two-way communication between local residents and other stakeholders, and to provide opportunities for meaningful and active involvement by the community in the cleanup process. Periodic public meetings provide updates about the ongoing remedial activities and progress toward clean up, and the public's concerns, if any, are addressed.

## 9 CONCLUSION

In accordance with the RAWP, remedial activities were implemented at LHAAP-35A (58) to mitigate risks to human health from groundwater impacted with VOCs. The LUC boundary for the site, upon concurrence from USEPA and TCEQ, was surveyed and the formal survey plat and LUC recordation document was recorded with the Harrison County Courthouse.

Remedial action activities conducted in accordance with the RAWP included installation of temporary DPT points and permanent groundwater monitoring wells to refine the extent of shallow zone groundwater contamination in the eastern and western plume areas. Groundwater monitoring indicates contamination is restricted to shallow groundwater zone.

Groundwater monitoring was performed to establish baseline conditions. Groundwater COCs (PCE, TCE, cis-1,2-DCE, 1,1-DCE, and VC) were detected in shallow zone wells at concentrations exceeding cleanup levels. Bioaugmentation was performed in the eastern plume area in November 2013, approximately six weeks after the EISB treatment.

Key findings from the RA include the following:

- Presence of two separate shallow zone plumes (eastern plume area and western plume area) was confirmed, as previously described in the RAWP;
- The eastern plume extent appears smaller in areal extent than depicted in the RAWP;
- The western plume appears to extend farther southeasterly direction than depicted in the RAWP document;
- It was confirmed that the intermediate and deep groundwater zones are not impacted with COCs;
- The EISB treatment performance monitoring in the eastern plume area demonstrated that reductive conditions have been established in the treatment zone, further supported by reduced concentrations of PCE and TCE in treatment area wells after EISB treatment.
- The presence of cis-1,2-DCE, 1,1-DCE, and VC in wells in the western plume area indicates that natural attenuation is occurring in the western plume. Data from the eastern plume area outside of the EISB treatment is limited and currently indicates aerobic conditions not conducive to MNA.

The current data set is limited in effective assessment of MNA. Additional data will be collected over the next two years with cumulative data used to monitor progress of the MNA remedy. An annual report will be prepared in 2014 summarizing the sampling data collected over the first year and will provide a limited evaluation of MNA.

## 10 REFERENCES

- AECOM, 2013a. *Final Remedial Action Work Plan, LHAAP-35A (58), Chemical Laboratory, Longhorn Army Ammunition Plant, Karnack, Texas, August.*
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- Jacobs Engineering Group, Inc. (Jacobs), 2002, *Final Remedial Investigation Report for the Group 4 sites, Sites 35A, 35B, 35C, 46, 47, 48, 50, and 60, and Goose Prairie Creek, Longhorn Army Ammunition Plant, Karnack, Texas, Oak Ridge, TN, January.*
- Lu, Xiaoxia, Wilson, J.T., Kampbell, D. H., 2006, *Relationship between Dehalococoides DNA in groundwater and rates of reductive dechlorination at field scale*, Water Research 40 (2006) 3131-3140, August 2006
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- Shaw, 2011, *Final Remedial Design, LHAAP-35A (58), Shop Area, Group 4, Longhorn Army Ammunition Plant, Karnack, Texas, September.*
- Townsend Jr., John V, 1954, *The generalized geology of the Wilcox Group of northeast Texas. Gulf Coast Association of Geological Societies Transactions*, Vol. 4, Pages 69-74.
- United States Army Corps of Engineers (USACE), 1998, *Technical Protocol for Evaluating natural Attenuation of Chlorinated Solvents in Groundwater*, EPA/600/R-98/128, September.
- USACE, 1999, *Use of monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites*, Directive 9200.4-17P, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC.



**APPENDIX A: Land Use Control Recordation Document**

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STATE OF TEXAS HARRISON COUNTY

INDUSTRIAL SOLID WASTE  
NOTICE OF LAND USE CONTROL AT LHAAP-35A (58)

KNOW ALL MEN BY THESE PRESENTS THAT:

Pursuant to the Rules of the Texas Commission on Environmental Quality (TCEQ) pertaining to Industrial Solid Waste Management, this document is hereby filed in the Public Records of Harrison County, Texas in compliance with the recordation requirements of said rules:

I

The U.S. Army, Department of Defense, has performed remedial activities at the land described herein. The remediation site is in a former industrial area, located on the Former Longhorn Army Ammunition Plant (LHAAP) and is designated as LHAAP-35A (58) (Shops Area). LHAAP was placed on the National Priorities List (NPL) during August 1990. After its listing on the NPL, the U.S. Army, United States Environmental Protection Agency (USEPA), and TCEQ (formerly known as the Texas Water Commission) entered into an agreement under the Comprehensive Environmental Response Compensation, and Liability Act (CERCLA) Section 120 for remedial activities. The CERCLA Section 120 Agreement, referred to as the Federal Facility Agreement (FFA), became effective on December 30, 1991. Remedial activities at LHAAP-35A (58) were performed in accordance with the FFA requirements.

The Shops Area now designated as LHAAP-35A(58) was established in 1942 as part of the installation's initial construction (Shaw, 2011). The facility was used to provide plant-operated laundry, automotive, woodworking, metalworking, painting, refrigeration, and electrical services. The site was active throughout LHAAP's mission and was deactivated along with the rest of the installation in 1996-1997. A Record of Decision (ROD) for LHAAP-35A (58) was signed by the USEPA in 2010 establishing the final remedy which is separated into two areas: 1) eastern plume; and 2) western plume. The eastern plume remedy includes land use control (LUC); enhanced in-situ bioremediation (EISB) in the area of highest levels of constituents of concern (COCs) followed by monitored natural attenuation (MNA). The western plume remedy consists of LUC and MNA.

The site was not remediated to levels suitable for unrestricted use. The LUC at

LHAAP-35A (58) is required to prevent human exposure to contaminated groundwater. MNA will be implemented to establish confidence in attenuation trends and verify that the COCs are stable or shrinking and will not migrate to nearby surface water at levels that may present an unacceptable risk to human health or the environment. Further information may be found by examination of the Notice of Registration No. 30990 files, which are available for inspection upon request at TCEQ, Central File Room Customer Service Center, Building E, 12100 Park 35 Circle, Austin, Texas, 78753, (512) 239-2900, Monday through Friday 8:00 a.m. to 5:00 p.m. or the Administrative Record available at the Marshall Public Library, 300 S. Alamo Blvd, Marshall, Texas 75670, (903) 935-4465, Monday through Thursday 10:00 a.m. to 8 p.m., Friday and Saturday 10:00 a.m. to 5:30 p.m.

The TCEQ requires certain persons to provide recordation in the real property records to notify the public of the conditions of the land and/or the occurrence of remediation. This notification is not a representation or warranty by the TCEQ of the suitability of this land for any purpose.

## II

The LHAAP-35A (58) parcel is a 11-acre tract, more or less, located in Harrison County, Texas, near the town of Karnack, being more particularly described with survey plat and metes and bounds established in Exhibit A. Associated with the LHAAP-35A (58) parcel is designated a LUC boundary which is a X-acre tract, more or less, as described in Exhibit A. The LUC boundary is also presented in the attached Figure 1. .

Future use of the parcel is intended as a national wildlife refuge consistent with non-residential use. For purposes of this certification, residential use includes, but is not limited to, single family or multifamily residences; child care facilities; and nursing home or assisted living facilities; and any type of educational purpose for children/young adults in grades kindergarten through 12. The United States Department of the Army has undertaken careful environmental study of the LHAAP-35A (58) site and concluded that the LUC set forth below is required to ensure protection of human health and the environment.

- (1) Groundwater Restriction. The groundwater use restriction boundary consists of the X acre tract, more or less. Groundwater underlying this land is contaminated with tetrachloroethene (PCE), trichloroethene (TCE), 1,1-dichloroethene (1,1-DCE), cis-1,2-DCE), trans-1,2-DCE, and vinyl chloride (VC) and shall not be accessed or used for any purpose without the prior written approval of the U.S. Army, the USEPA, and the TCEQ. A LUC restricting the use of groundwater has been established for the protection of human health. The U.S. Army has notified the Texas Department of Licensing and Regulation of the groundwater restriction which includes prohibition of water well installation for any purpose other than environmental monitoring and testing without prior approval by the U.S. Army, the USEPA, and the TCEQ. The LUC will remain in place until applicable or relevant and appropriate requirements (ARARs) as established in accordance with the National Oil and Hazardous Substance Pollution Contingency Plan (40 Code of Federal Regulation 300) are met. Due to the potential for groundwater

contaminated with the COCs to migrate, monitored natural attenuation will be implemented to assure that contaminated groundwater will not migrate to nearby surface water at levels that may present an unacceptable risk to human health and the environment. The monitoring and reporting associated with this remedy will continue until ARARs are achieved.

III

The owner of the site is the Department of the Army, and its address where more specific information may be obtained is as follows:

ATTN: DAIM-ODB-LO (R. Zeiler)  
Post Office Box 220  
Ratcliff, AR 72951

or

Assistant Chief of Staff for Installation Management  
ATTN: DAIM-BDO (T. Lederle)  
600 Army Pentagon  
Washington D.C. 20310-0600

---

Rose M. Zeiler  
Longhorn AAP Site Manager

EXECUTED this the \_\_\_\_th day of \_\_\_\_\_, 2014.

BEFORE ME, on this the \_\_\_\_th day of \_\_\_\_\_, personally appeared Rose M. Zeiler, of United States Army, United States Department of Defense, known to me to be the person and agent of said agency whose name is subscribed to the foregoing instrument, and she acknowledged to me that she executed the same for the purposes and in the capacity therein expressed.

GIVEN UNDER MY HAND AND SEAL OF OFFICE, this the \_\_\_\_day of \_\_\_\_\_, 2014.

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Notary Public in and for the State of Texas,  
County of Harrison

**EXHIBIT A**  
**LEGAL SURVEY PLAT TO BE ADDED**

**APPENDIX B: Annual Land Use Control Compliance Certification Documentation**

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## Annual Land Use Control Compliance Certification Documentation

In accordance with the Remedial Action Work Plan dated August 2013 for LHAAP-35A (58) a certification of site was conducted by \_\_\_\_\_ [indicate transferee] on \_\_\_\_\_.

A summary of land use control mechanisms is as follows:

- No residential use or residential development of the property.
- Groundwater restriction - restriction of the use of groundwater to environmental monitoring and testing until cleanup levels are met. The restriction against residential use of groundwater will remain in effect until the levels of the COCs in groundwater allow unrestricted use and unlimited exposure (UUUE). [Indicate whether groundwater restrictions are still required at LHAAP-35A (58)]

A summary of compliance with land use and restriction covenants is as follows:

- No residential use or residential development of the property.
- No use of groundwater, installation of new groundwater wells, or tampering with existing wells at LHAAP-35A (58).

I, the undersigned, do document that the certification was performed as indicated above, and that the above information is true and correct to the best of my knowledge, information, and belief.

Date: \_\_\_\_\_

Name/Title: \_\_\_\_\_

Signature: \_\_\_\_\_

Annual compliance certification forms shall be completed no later than March 1 of each year for the previous calendar year.



**APPENDIX C: Direct Push Technology/Monitoring Well Boring Logs and EISB Injection  
Logs**

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Client:		BORING ID: 58 DPT 10
Project Number: 60256135		
Site Location: 58 DPT 10		Sheet 1 of 2
Coordinates:	Elevation	Monitoring Well Installed:
Drilling Method: Direct Push		Screened Interval: 27-31
Sample Type(s): G.W	Boring Diameter: 2"	Depth of Boring: 28

Weather: Sunny 80'S	Logged By: RL	Date/Time Started: 8/20/13	Water Level:
Drilling Contractor: Furgo	Ground Elevation:	Date/Time Finished: 8/20/13	

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
1							0-6" brown clayey sand, fine grained, poorly graded, mica present		
2				60"	2		6"-4' gray sandy clay, very fine grained, poorly graded, sands little brown mottling, mica present med. plasticity, dry		
3							4'-5' dark grey, silty clay, dry hard, trace mica, plastic		
4							5-7' dark gray clay, clay, hard, trace mica, med plastic		
5							7-10' Same as above, light gray and light brown mottling, lignite present 9.5 to 10'		
6				10"			10-11' same as above		
7							11'-11'10" same as above, no mottling		
8							8" clayey sand lens, poorly graded, fine grain, mica present, plastic		
9							11-11.6" light gray clay, light brown mottling trace sand, dry, med. plasticity		
10							14-15' brown clayey sand, fine grain, poorly graded, medium, dry trace mica		
11							15'-15'6" brown clayey sand, poorly graded, fine grained low plasticity, trace mica		
12							15'6"-20' light gray sandy clay, light brown mottling, very fine grain sands, trace lignite in last foot 19'-20'.		
13									
14									
15									
16									
17									
18									
19									

TES:

Date	Time	Depth to groundwater while drilling

Date:



Client:		BORING ID:	
Project Number: 60256135		58DPT10	
Site Location: 58DPT10		Sheet 2 of 2	
Coordinates:	Elevation	Monitoring Well Installed:	
Drilling Method: Direct Push		Screened Interval: 27-31	
Sample Type(s): G.W.	Boring Diameter: 2"	Depth of Boring: 28	
Weather: Sunny 40's	Logged By: ZL	Date/Time Started: 8/20/13	Water Level:
Drilling Contractor: Furgo	Ground Elevation:	Date/Time Finished: 8/20/13	

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21							20'-25' core barrel sleeve stuck		
22							Sample became extremely compacted trying to remove sample. about 1' recovered of compacted sample appears to be same as above. some increased		
23							Sand noted.		
24									
25							24'-25.6" dark gray sandy clay, very fine grained poorly graded sands, hard, dry, mica present		
26							25.6"-26' silty brown sandy sand, trace clay, fine grained poorly graded, moist, mica present		
27		Screen 27'					26'-27' dark gray clay, hard, Dry, medium plasticity mica present		
28		to 31'					27'-28' brown sandy silt very fine to fine grain <del>coarse</del> , Dry, mica present.		
29							end of boring @ 28'		
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									

NOTES:	Date	Time	Depth to groundwater while drilling
Checked by:	Date:		



Client:		BORING ID: 58 DPT/1
Project Number: 60256135		
Site Location: 58 DPT/1 LHAAP Site 58		Sheet 1 of 2
Coordinates:	Elevation	
Drilling Method: Direct Push		Monitoring Well Installed: NO
Sample Type(s): G.W.	Boring Diameter: 2"	Screened Interval: 24-28

Weather: Sunny 90°S	Logged By: RL	Date/Time Started: 8/24/13 1630	Depth of Boring: 25
Drilling Contractor: Fugo	Ground Elevation:	Date/Time Finished:	Water Level:

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
1						0-2'	reddish brown silt, trace clay, dry, loose very fine grain <del>med. plasticity</del> RL		
2				60"			2-5' light gray, silty clay, very fine grain, dry loose, med. plasticity		
3				60"			5'-6'6" dark brown clay few silts gray mottling, trace organics, trace lignite, dry, hard, very fine grained, <del>med. plasticity</del> med. plasticity		
4							7'-10' light gray clay, <del>trace sand</del> trace sand, brown mottling, hard, dry, very fine grained poorly graded; med. plasticity.		
5							Stuck in core <del>10'-15'</del> 10'-15'		
6							Can not get out,		
7							15'-16'6" light brown sandy clay, very fine to fine grain clay mottling, medium, moist, med plasticity		
8				60"			16'6" - 17'6" brown clayey sand, very fine to fine grain, poorly graded, low plasticity, medium		
9							17'6" - 20' light brown to gray silty clay, medium moist, med plasticity, fine grain		
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

NOTES:	Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_



Client:		BORING ID: 58DPT11	
Project Number: 60256135			
Site Location: 58DPT11 LAMP SITE 58			
Coordinates:	Elevation	Sheet 2 of 2	
Drilling Method: Direct Push		Monitoring Well Installed: NO	
Sample Type(s): G.W.	Boring Diameter: 21"	Screened Interval: 24-28'	
Weather: Sunny 90S	Logged By: RL	Date/Time Started: 8/20/13 1630	Depth of Boring: 25'
Drilling Contractor: Fugro	Ground Elevation:	Date/Time Finished:	Water Level:

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21							20'-21'6" light brown silty clay, <del>very fine grain, high plasticity, mottled, moist</del> RL		
22							21'6"-22'6" light gray clay, trace silt, moist		
23					60"		hard, <del>very</del> mottled, high plasticity		
24		Screen 24'					22'-6"-25' transition from mottled gray to dark gray clay, maroon iron staining		
25		to 28'					hard, moist, highly plastic		
26							end of boring @ 25'		
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									

NOTES:	Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_



Client:  
 Project Number: 60256135  
 Site Location: 58 DPT 12  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: Direct Push  
 Sample Type(s): G.W

BORING ID:  
 58 DPT 12  
 Sheet 1 of 2  
 Monitoring Well Installed:  
 Screened Interval: 23-27  
 Depth of Boring: 24  
 Water Level: \_\_\_\_\_

Weather: Sunny  
 Logged By: RL  
 Date/Time Started: 8/10/13 822  
 Drilling Contractor: Fuyo  
 Ground Elevation: \_\_\_\_\_  
 Date/Time Finished: \_\_\_\_\_

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
1				0-5'			0-30" brown clay, mottled tan/gay, med. plastic		
2				38"					
3							30"-36" brown silt, dry, loose		
4							gray clay, moist, increasing trace sand + brown mottling from 72"-78" mica present plastic		
5									
6									
7				60"			78"-84" same as above increased mottling increased <del>sand</del> trace sand, decrease moisture		
8							light gray, sandy clay, light brown mottling, slightly moist, plastic mica present		
9									
10									
11									
12									
13				60"			13' 4" dark gray, silty sand, very fine to fine grained, moist, non-cohesive, mica present		
14							13' 4" - 14' gray sandy clay, fine grain, mottled plastic, mica present		
15							14'-15' clayey sand, light brown, gray mottling fine grain mica present		
16				45"			15'-16.5" dark gray, clay, trace sand, fine grain, med plastic, mica present		
17							16' 6" - 17' brown, clayey sand, very fine grain, mica present		
18							17'-20' gray silty clay, with inter-dispersed sand lenses, brown mottling dry, mica present.		
19									
20									

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_



Client: \_\_\_\_\_  
 Project Number: 60256135  
 Site Location: 58DPT12  
 Coordinates: \_\_\_\_\_ Elevation: \_\_\_\_\_  
 Drilling Method: Direct Push  
 Sample Type(s): G.W. Boring Diameter: \_\_\_\_\_  
**BORING ID: 58DPT12**  
 Sheet 2 of 2  
 Monitoring Well Installed:  
 Screened Interval: 23-27

Weather: Sunny Logged By: RL Date/Time Started: \_\_\_\_\_ Depth of Boring: 24  
 Drilling Contractor: Fuyo Ground Elevation: \_\_\_\_\_ Date/Time Finished: \_\_\_\_\_ Water Level: \_\_\_\_\_

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21							20'-21' brown, clayey sand, fine grain slight low plasticity, mod. mica present		
22						40	21'-22' light gray, sandy clay, very fine to fine grain plastic, little moisture, mica present		
23		screen 23'					22'-24' brown sandy clay, very fine to fine grain plastic, wet, mica present.		
24		to				X	Water present @ 22'		
25							end of boring 24'		
26		27'							
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									

**NOTES:**

Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_

Date: \_\_\_\_\_





Client:  
 Project Number: 60256135  
 Site Location: LHAAP Site S8  
 Coordinates: Elevation  
 Drilling Method: Direct Push  
 Sample Type(s): Groundwater

BORING ID: 58DPT13

Sheet 1 of 2  
 Monitoring Well Installed: 10  
 Screened Interval: 24-28

Weather: Sunny 90s  
 Logged By: R.L.  
 Date/Time Started: 8/21/13 1340  
 Depth of Boring: 22.5  
 Drilling Contractor: FUGRO  
 Ground Elevation:  
 Date/Time Finished:  
 Water Level:

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Runs - Blows per 6"	% Recovery (finest)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
1	RL	1.8'	1	100		CL	<del>CL</del> Silty Clay (0-1.8') loose, dry, brown, grey mottling, med to high plasticity, trace sands very fine grain, trace mica, trace organics, lignite nodules present		
2						CL	Sandy Clay (1.8'-5') stiff, moist, brown transitioning to red w. in depth; grey mottling, trace organics, trace mica, med to high plasticity		
3		5'					Same as above (5-6')		
4		6'					Same as above (6-8') color change to gray with light brown mottling		
5		8'	2	100		CL	Same as above (8-10') dry		
6		10'							
7		11.8'	3	100		CL	Silty Clay (10-11.8) medium, moist, gray light brown mottling, medium plasticity.		
8						CL	Sandy Clay (11.8-15) medium, moist, gray, light brown mottling, fractures in clay colored gray. evaporite salt @ 14'. medium plasticity		
9									
10									
11						CL	Clayey Sand (15-17.5') medium, moist, brown fine grain, poorly graded, low plasticity		
12			4	100					
13									
14			5	100		CL	Same as above w/ med plasticity		
15									
16									
17									
18									
19									
20									

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_



Client: \_\_\_\_\_  
 Project Number: 60256135  
 Site Location: LHAAP site 88  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: Direct Push  
 Sample Type(s): G.W. Boring Diameter: 2"

**BORING ID: 58 DPT 13**  
 Sheet 2 of 2  
 Monitoring Well Installed: NO  
 Screened Interval: 24-28'

Weather: Sunny 90'S Logged By: R.L Date/Time Started: 8/1/13 1340 Depth of Boring: 22.5  
 Drilling Contractor: FUGRO Ground Elevation: \_\_\_\_\_ Date/Time Finished: 8/2/13 1450 Water Level: \_\_\_\_\_

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21		<u>20.5'</u>	<u>6</u>	<u>100</u>		<u>SP</u>	<u>sand (20-20.5') loose, wet sand, brown fine grain, poorly graded,</u>		
22		<u>22.5'</u>				<u>CL</u>	<u>silty clay (20.5-22) sat, moist, brown, high plasticity</u>		
23							<u>end of boring @ 22.5'</u>		
24		<u>screen</u>							
25		<u>24'</u>							
26		<u>to</u>							
27		<u>28'</u>							
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									

NOTES:	Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_



Client: **USACE**  
 Project Number: **60256135**  
 Site Location: **LHAAP Site 58**  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: **Direct Push**  
 Sample Type(s): **G.W.** Boring Diameter: **2" 1710**  
 Weather: **Sunny 90s** Logged By: **R.L** Date/Time Started: **8/22/13 1000**  
 Drilling Contractor: **FUGRO** Ground Elevation: \_\_\_\_\_ Date/Time Finished: **8/23/13 1015**

**BORING ID: 58DPT14**  
 Sheet 1 of **2**  
 Monitoring Well Installed:  
 Screened Interval:  
 Depth of Boring:  
 Water Level:

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Runs Blows per 6"	% Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
1									
2		2.5	1	100		ML	Sandy silt with clay (0-2.5) loose, dry light tan, brown mottling, trace organics, trace mica, low plasticity		
3									
4		4				CL	sandy clay (2.5-4.0) loose, dry, brown with gray mottling, trace mica, med plasticity		
5		5				ML	sandy silt (4-5) stiff, moist, reddish brown, fractures		
6							with gray <del>clay</del> clay (claration, few clays, brown + gray mottling trace mica, <del>to</del> med. plasticity		
7			2	100		CL-ML	Silty clay w/sand (5-10') @ stiff, moist, brown mottling, root @ 12.9', iron nodules @ 13.5', medium plasticity		
8									
9									
10		10.5				CL-ML	Same as above (10-10.5)		
11			3	100			Silty sand loose, dry, brown to gray, very fine to fine grains, poorly graded, trace mica, low plasticity (10.5-14.5)		
12									
13									
14		14.5				CL-ML	Silty clay with sand (14.5-15) med moist, brown, med plasticity, trace mica		
15		15							
16		16				CL-ML	Silty clay (15-16) med. moist, brown, reddish brown and gray mottling, nonstaining? med plasticity		
17			4	100					
18						ML	Sandy silt with clay medium, moist, gray w/ brown mottling, <del>fractures</del> with anoxic <del>fractures</del> , mica present		
19									
20		20							

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_



Client: **USACE**  
 Project Number: **60256135**  
 Site Location: **LHAAP SIX 58**  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: **Direct Push**  
 Sample Type(s): **G.W.** Boring Diameter: **2"**

**BORING ID: 58DPT14**  
 Sheet 2 of **2**  
 Monitoring Well Installed:  
 Screened Interval: **36-40**

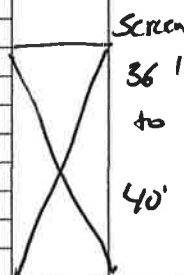
Weather: **Sunny 80s** Logged By: **2L** Date/Time Started: **8/22 1710** Depth of Boring: **32.5**  
 Drilling Contractor: **FUGRO** Ground Elevation: \_\_\_\_\_ Date/Time Finished: **8/23 1015** Water Level: \_\_\_\_\_

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	RuAs Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21						<b>ML</b>	<b>Silt</b> trace sand and clay, stiff, moist, dark brown, <sup>to</sup> few sand lenses, fine grained and poorly graded, trace mica,		
22									
23			<b>5</b>	<b>100</b>			<b>Sandy Silt</b> (24.5-25) stiff, moist dark brown, fine grained, poorly graded, thinly laminated sands, trace mica, trace lignite, low to med plasticity, brown mottling		
24		<b>24.5</b>							
25		<b>25.0</b>				<b>ML</b>			
26			<b>6</b>	<b>100</b>			Same as above (25-27.5) Some anoxic fractures		
27									
28		<b>27.5</b>							
29		<b>29</b>	<b>7</b>	<b>100</b>		<b>CL</b>	clay with thinly laminated silts and sands (27.5-29) stiff, moist, dark brown, medium plasticity, mica present		
30		<b>30</b>				<b>ML</b>	<b>Sandy Silt</b> (29-30) thinly laminated clays, medium moist, fine grained, poorly graded, med plasticity, mica		
31			<b>8</b>				Stuck in core, driller hand auger some cuttings out of macrocorr. Cuttings from bottom are (same as above).		
32		<b>32.5</b>							
33							end of boring @ 32.5		
34									
35									
36									
37									
38									
39									
40									

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_





Client: <b>USACE</b>		BORING ID: <b>58DPT15</b>
Project Number: <b>60256135</b>		
Site Location: <b>LHAAP Site 58</b>		Sheet 1 of 2
Coordinates:	Elevation	
Drilling Method:		Monitoring Well Installed:
Sample Type(s):		Screened Interval: <b>36-40</b>
Weather: <b>Sunny 90's</b>		Date/Time Started: <b>8/11/13 1750</b>
Logged By: <b>RL</b>		Depth of Boring: <b>37</b>
Drilling Contractor: <b>FUGRO</b>		Date/Time Finished: <b>8/21/13 1000</b>
Ground Elevation:		Water Level:

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	2000 Blows per 6"	% Recovery (min)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
1							Sandy clay w/ silt, loose, dry, brown with reddish brown mottling, trace organics, trace mica, med plasticity  moist from 4-5'		
2						CL			
3				100					
4		5'							
5									
6		6'					sandy clay (5-6') moist, medium, gray w/ red + brown mottling, trace organics, trace mica, med plasticity		
7		6.5'	2	100		CL			
8						SC	clayey sand (6'-6.5') medium, moist, reddish brown, fine grained, poorly graded, trace mica, red + gray mottling		
9									
10		10'				CL	same as (5-6')		
11							sandy clay (10-15) <del>base med</del> med, moist, light gray, light brown mottling, trace mica, trace organics, medium plasticity		
12						CL			
13			3						
14							silty clay (15-20') medium, moist, gray clay, with trace sands, light brown mottling. black staining possibly from VOCs. high plasticity		
15		15'							
16						CL			
17			4						
18							VOC <sup>s</sup> smells		
19									
20		20'							

NOTES:	Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_



Client: **USACE**  
 Project Number: **60256135**  
 Site Location: **LHAAP Site 58**  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: **Direct Push**  
 Sample Type(s): **G.W.** Boring Diameter: \_\_\_\_\_

**BORING ID: 58DPT15**

Sheet 2 of 2

Monitoring Well Installed:

Screened Interval: **36-40**

Weather: **Sunny 90's**

Logged By: **RL**

Date/Time Started: **8/21/15 1750**

Depth of Boring: **37'**

Drilling Contractor: **FUGRO**

Ground Elevation: \_\_\_\_\_

Date/Time Finished: **8/22/15 0600**

Water Level: \_\_\_\_\_

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	ECUS Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21							Sandy clay (20-22.5) medium, moist, brown with fractures (an over, light gray) gray mottling, trace lignite. medium plasticity		
22		22.5	5	100		CL			
23		23.5					Same as above (no lignite)		
24		25	6	100		CL			
25							<del>clay</del> (23.5-25) medium, moist <del>some</del> some silty gray, few mottles, med-high plasticity		
26		27.5	7	100		CL			
27							Same as above (25-27.5) staining present sand lens from 26.3'-26.5' with staining below		
28		28.5	8	100		CL			
29							Same as above (27.5-28.5)		
30		30	8	100		CL			
31							Sandy clay (28.5-30) medium, moist, brown, very fine grain, partly graded sands, med to high plasticity, mica present		
32		33	9	100		CL			
33							Same as above (30-33) with decreasing sand content with depth		
34		35	10	100		CL			
35							Silty clay (33-35) medium, moist, brown, med-to-high plasticity, mica present.		
36		36.5	11	100		CL			
37		37					Same as above (35-36.5) - dark clay lens @ 35.5 - stiff, moist, med to high plasticity → brown clay (36.5-37) stiff, moist, with very thin sand lamination, med-to-high plasticity dark brown		
38								end of boring @ 37'	
39									
40									

NOTES:

Date Time Depth to groundwater while drilling

Checked by:

Date:









Client: **USACE**  
 Project Number: **60256135**  
 Site Location: **58**  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: **HSA**  
 Sample Type(s): **Core Parcel** Boring Diameter: **4"**

**BORING ID:**  
**58DPT15A**  
 Sheet 2 of \_\_\_\_\_  
 Monitoring Well Installed:  
 Screened Interval:

Weather: **98° Sunny** Logged By: **R. O. [unclear]** Date/Time Started: **9/5/13 14:00**  
 Drilling Contractor: **Fugro** Ground Elevation: \_\_\_\_\_ Date/Time Finished: \_\_\_\_\_ Water Level: \_\_\_\_\_

Depth (ft)	Time Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21	1452		5	100%		SP	Same as above - slight coarsening with depth. becomes medium grained at 22.8'		
22							moist at 25'		
23									
24									
25									
26	1503		6	70%	26.5	CL	clay with 10-20% very fine sand - moist non plastic, stiff yellowish brown with red mottling		
27									
28									
29									
30									
31	1517		7	100%	30	CL-MC	Silty clay - moist - gray and brownish yellow - stiff - non plastic some mica present beginning at 30'		
32									
33									
34									
35									
36	1531		8	100%	35	CL	clay - laminated with silt (10-20%) moist stiff - low plasticity - very dark brown and brownish gray one 1/2" sand lens @ 35.5' TD @ 38'		
37									
38									
39									
40									

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_

Date: \_\_\_\_\_



Client: USACE  
 Project Number: 60256135  
 Site Location: Site 58  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: HSA  
 Sample Type(s): \_\_\_\_\_ Boring Diameter: ~ 5"  
 BORING ID: 58DPT15B  
 Sheet 1 of 2  
 Monitoring Well Installed:  
 Screened Interval:

Weather: Sunny Logged By: M. Low Date/Time Started: 9/16/12 859 Depth of Boring:  
 Drilling Contractor: Fargo Ground Elevation: \_\_\_\_\_ Date/Time Finished: 9/16/12 1027 Water Level:

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Pen # Blows per ft	Recovery (Inches %)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
1		1'				ML	<u>SILT (ML)</u> Soft, Dry, Pale Brown, mostly silt, few very fine sand, non-plastic		
2				~75%		CL			
3							<u>LEAN CLAY (CL)</u> Stiff to very stiff, Dry, light pale yellow, with yellowish red and brown mottles, mostly clay, few fine sand, trace silt, low plasticity.  - increasing sand content - light gray with reddish brown mottles grading to yellowish brown.		
4									
5							<u>POORLY GRANNED SAND WITH SILT (SP)</u> Dense to loose, Dry, pale yellow with brownish yellow in clays. mostly fine sand, little silt, few clay, slightly plasticity to non-plastic, trace roots.  <u>SAME AS ABOVE</u> loose, Dry, light yellowish brown grading to brownish yellow, mostly fine sand, little silt, trace mica below 12' Bgs where color changes. no clay either		
6		7'	2	~100%		SP			
7							<u>LEAN CLAY WITH SILT (CL)</u> Dry, Soft, light yellow brown, with light gray mottles, mostly clay, little silt, few to trace fine sand. low plasticity, silts are laminated thinly, trace mica.		
8									
9							<u>POORLY GRANNED SAND WITH SILT (SP)</u> loose, moist, light gray, mostly fine sand, little silt, non-plastic.		
10		12'	3	~100%		SP			
11							<u>LEAN CLAY WITH SILT (CL)</u> Dry, Soft, light yellow brown, with light gray mottles, mostly clay, little silt, few to trace fine sand. low plasticity, silts are laminated thinly, trace mica.		
12		14'							
13							<u>POORLY GRANNED SAND WITH SILT (SP)</u> loose, moist, light gray, mostly fine sand, little silt, non-plastic.		
14									
15							<u>LEAN CLAY WITH SILT (CL)</u> Dry, Soft, light yellow brown, with light gray mottles, mostly clay, little silt, few to trace fine sand. low plasticity, silts are laminated thinly, trace mica.		
16		15'	4	~100%		CL			
17							<u>POORLY GRANNED SAND WITH SILT (SP)</u> loose, moist, light gray, mostly fine sand, little silt, non-plastic.		
18									
19							<u>LEAN CLAY WITH SILT (CL)</u> Dry, Soft, light yellow brown, with light gray mottles, mostly clay, little silt, few to trace fine sand. low plasticity, silts are laminated thinly, trace mica.		
20			5	~100%		SP			

NOTES:

temporary swell screen set @ 18'-28' Bgs  
 Back-filled Boring to 30' with Bentonite chips.

Date	Time	Depth to groundwater while drilling

Checked by:

Date:



Client: \_\_\_\_\_  
 Project Number: 60256135  
 Site Location: Site 58  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: \_\_\_\_\_  
 Sample Type(s): \_\_\_\_\_ Boring Diameter: \_\_\_\_\_

BORING ID: S8DPT15B  
 Sheet 2 of 2  
 Monitoring Well Installed:  
 Screened Interval:  
 Depth of Boring:  
 Water Level:

Weather: \_\_\_\_\_ Logged By: M. Law Date/Time Started: \_\_\_\_\_  
 Drilling Contractor: Fugro Ground Elevation: \_\_\_\_\_ Date/Time Finished: \_\_\_\_\_

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21			5	~101%		(SP)	POORLY GRANNED SAND WITH SILT (SP) loose, moist, light gray, mostly fine sand, little silt, non-plastic.		
22									
23		23'							
24						CL	LEAN CLAY WITH SAND (CL) soft, moist, light gray with light brown mottles, mostly clay, few to little fine sand, low to medium plasticity.		
25									
26				~900%					
27									
28		27.5'	6			SP	POORLY GRANNED SAND WITH CLAY (SP) moist, moist, light gray, mostly fine sand, little clay, slightly plastic, trace mica.		
29		29'							
30						CL	LEAN CLAY (CL) medium stiff, dry, brown, mostly clay, few fine sand, few silt, trace mica in sands, low plasticity, clays are thinly laminated (2-5mm) with very thin fine sand in places, sand is light gray. (1 mm thick).		
31				~100%					
32									
33			7						
34									
35						CL	SAME AS ABOVE very dark brown, trace lignite @ 35' Bgs		
36			8	~100%					
37									
38							End of Boring @ 38' Bgs		
39									
40									

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_

Date: \_\_\_\_\_







Client: **USACE**  
 Project Number: **60256135**  
 Site Location: **LHWAF Site 58**  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: **DPT**  
 Sample Type(s): **Macrocore**

**BORING ID:**  
**58DPT16**  
 Sheet 2 of 2  
 Monitoring Well Installed: **no**  
 Screened Interval: **31-35**

Weather: **1000, Light, sunny** Logged By: **D. Black** Date/Time Started: **8/12/13 16:15**  
 Drilling Contractor: **Zygo** Ground Elevation: \_\_\_\_\_ Date/Time Finished: **8/12/13 18:15**

Depth of Boring: **70'**  
 Water Level: \_\_\_\_\_

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21				20-24		NR	CL? (top and bottom of core looked to be sandy clay) → sandy silt w/ clay (ML)		
22				Core stuck in sample					
23									
24							24-27, medium dense to dense, brown to dark gray, moist, very low plasticity, laminated, fine sand → occasional 1" clay lenses, med plasticity		
25				<del>100%</del>	0.0	ML			
26									
27							27-28 1/2 - very soft to soft, dark brown to brown, silty clay (CL), medium plasticity, moist to saturated, little silt		
28				100%					
29							28 1/2 - 30 - hard, dark brown to light gray, silty clay (CL), clay, medium plasticity, little silt laminated w/ occasional fine sand lenses < 1/8"		
30									
31							End of boring		
32									
33									
34									
35									
36									
37									
38									
39									
40									

58DPT16 (31-35) 130813  
 0805  
 volts

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_



Client: USACE

Project Number: 60256135

Site Location: LAAP Sfc 58

Coordinates:

Elevation

Drilling Method: DPT

Sample Type(s): Mudstone

Boring Diameter: 2"

BORING ID: 00

SBDPT # 17

Sheet 1 of

Monitoring Well Installed: No

Screened Interval: 31'-35'

Weather: 100% humid

Logged By: VBlack

Date/Time Started: 8/13/07

Depth of Boring: 20'

Drilling Contractor: Fugro

Ground Elevation:

Date/Time Finished: 8/13/07

Water Level:

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
1							0-5 - loose to very loose, dark to light brown, sandy silt (SP), dry to damp, mottled, fine sand		
2				70%	0.0	SP			
3							5-9 - stiff to very stiff, light to dark gray, sandy clay (CL), damp, medium plasticity, mottled, hematite concretions, fine sand		
4									
5							9-10 - loose to dense, light gray to light brown, silty sand (SP), damp, mottled, fine sand		
6									
7				100%	0.0	CL	10-11 1/2 - medium, light gray, sandy clay (CL), low to med plasticity, damp, mottled, fine sand		
8									
9							11 1/2 - 15 - loose to medium dense, light gray, silty sand (SP), damp, laminated, mottled, fine sand		
10									
11							16-19 - AS ABOVE (SP)		
12				80%	0.0	SP			
13							19-20, medium, light gray to light brown, sandy clay (CL), moist, low plasticity, high fine sand content		
14									
15									
16				67%	0.0	CL			
17									
18									
19									
20									

NOTES:	Date	Time	Depth to groundwater while drilling

Checked by:

Date:



Client: <b>USACE</b>		BORING ID: <b>DB 58 DPT-17</b>
Project Number: <b>60256135</b>		
Site Location: <b>LHAAP Site 58</b>		Sheet 2 of 2
Coordinates:	Elevation	Monitoring Well Installed: <b>No</b>
Drilling Method: <b>DPT</b>		Screened Interval: <b>31'-35'</b>
Sample Type(s): <b>macrocore</b>	Boring Diameter: <b>2"</b>	Depth of Boring: <b>32'</b>
Weather: <b>~75° Sunny</b>	Logged By: <b>DBlack</b>	Date/Time Started: <b>8/10/13 15:20</b>
Drilling Contractor: <b>Zugo</b>	Ground Elevation:	Date/Time Finished: <b>8/14/13 09:25</b>
		Water Level:

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21							20-24 - medium dense, light gray, sandy silt (ML), moist, mottled, very little fine sand		
22				60%	0.0	ML			
23									
24						CL	24-25 - medium, light gray, silty clay (CL), moist, mottled, high silt content, low plasticity		
25									
26						SP	25-28 1/2 - medium dense to dense, light gray, silty sand (SP), moist, mottled, fine sand		
27				60%	0.0	SP			
28									
29						CL	28 1/2 - 30 - very stiff to hard, light gray, sandy clay (CL), damp to moist, med to high plasticity, mottled, fine sand, 1" sand lens @ ~ 29 1/2'		
30									
31							End of boring		
32									
33									
34									
35									
36									
37									
38									
39									
40									

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by:

Date:



Client: <u>USACE</u>		BORING ID: <u>58DPT18</u>
Project Number: <u>62256130</u>		
Site Location: <u>LHAAP Site 58</u>		Sheet 2 of <u>2</u>
Coordinates:	Elevation	Monitoring Well Installed: <u>N/A</u>
Drilling Method: <u>DPT</u>		Screened Interval: <u>31-35</u>
Sample Type(s): <u>Macrocore</u>	Boring Diameter: <u>2"</u>	Depth of Boring: <u>30</u>
Weather: <u>85° humid</u>	Logged By:	Date/Time Started: <u>8/1/17</u>
Drilling Contractor: <u>Ango</u>	Ground Elevation:	Date/Time Finished:
		Water Level:

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21							20-25 - AS ABOVE. laminated, very fine sand below 2 1/8", brown, damp to moist		
22									
23				62%	0.0	CL			
24									
25									
26							clay (CL) only could view ends		
27							of core		
28				NR		CL?			
29									
30									
31							End of Boring		
32									
33									
34									
35									
36									
37									
38									
39									
40									

58 DPT 18 (31-35)  
08412-13  
0805

NOTES:	Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_





Client: USACE  
 Project Number: 60256135  
 Site Location: LHAAP Site SP  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: DPT  
 Sample Type(s): Macrocore

**BORING ID:**  
58DPT18  
 Sheet 1 of 2  
 Monitoring Well Installed ✓  
 Screened Interval: 3'-5'  
 Depth of Boring: 30'  
 Water Level: \_\_\_\_\_

Weather: 65°, humid  
 Logged By: DR/ack  
 Date/Time Started: 8/11/17  
 Drilling Contractor: Fugro  
 Ground Elevation: \_\_\_\_\_ Date/Time Finished: \_\_\_\_\_

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
1						SP	0-2 1/2 - loose to medium dense, light brown to gray, silty sand (SP), damp, mottled, fine sand, sandy clay lens 2" e ~ 1 1/2"		
2				80%	0.0				
3							2 1/2 - 5 - medium to stiff, gray to light gray, sandy clay (CL), dry, damp, medium plasticity, fine sand		
4									
5							5-10 - As ABOVE, very stiff, trace gravel, ↑ fine sand w/ depth		
6									
7						CL			
8									
9									
10							10-12 - Dense, light gray, silty sand w/ clay (SP), damp, very low plasticity, mottled, fine sand		
11						SP			
12							12-15 - very stiff, light blue-gray, sandy clay (CL), medium to high plasticity, mottled, fine sand, 2" silty sand lens e ~ 17'		
13				90%	0.0				
14									
15							15-20 - As above, <sup>SP</sup> w/out, occasional very fine sand lenses 2 1/2"		
16						CL			
17									
18									
19									
20									

**NOTES:**

Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_



Client: <u>USACE</u>		BORING ID: <del>58077</del> <u>58077 19</u>
Project Number: <u>60256135</u>		
Site Location: <u>LMAAP Site 5F</u>		Sheet 1 of <u>2</u>
Coordinates:	Elevation	Monitoring Well Installed: <u>No</u>
Drilling Method: <u>DPT</u>	Boring Diameter:	Screened Interval: <u>26'-30'</u>
Sample Type(s): <u>Macrocors</u>	Date/Time Started: <u>8/10/13 1040</u>	Depth of Boring: <u>20'</u>
Weather: <u>270°, hazy</u>	Logged By: <u>DBlack</u>	Water Level:
Drilling Contractor: <u>Fogco</u>	Ground Elevation:	Date/Time Finished: <u>8/10/13 1145</u>

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
1							0-2 1/2 - soft to very soft, light gray to gray, sandy clay (CL), dry, low plasticity, mottled, fine sand		
2				85%	0.0		2 1/2 - 5 - Hard, dark gray, silty clay, dry, high plasticity, trace fine sand, mottled (CL)		
3						CL	6-7 1/2 - AS ABOVE (CL)		
4									
5									
6									
7				95%	0.0		7 1/2 - 10 - stiff to very stiff, light gray, sandy clay (CL), dry, medium plasticity, mottled, fine sand		
8									
9									
10									
11							10-15 - loose to medium dense, light gray, silty sand (SP), damp, mottled, fine sand, occasional (2) 1" clay lenses		
12				80%	0.0	SP			
13									
14									
15									
16							15-20 - AS ABOVE, hematite concretions from 18 1/2 - 20, no clay lenses, thinly bedded (SP)		
17				60%	0.0				
18									
19									
20									

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by:

Date:



Client: USACE  
 Project Number: 60256135  
 Site Location: LHAAP Site 58  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: DPT  
 Sample Type(s): Macrocore Boring Diameter: 2"

**BORING ID:**  
58DPT19  
 Sheet 2 of 2  
 Monitoring Well Installed: 116  
 Screened Interval: 26'-20'

Weather: 90°, Humid Logged By: D.B. Lach Date/Time Started: 8/10/13 1040 Depth of Boring: 25'  
 Drilling Contractor: \_\_\_\_\_ Ground Elevation: \_\_\_\_\_ Date/Time Finished: 8/10/13 1145 Water Level: \_\_\_\_\_

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21						SP	20-23% AS ABOVE, mottled, damp (SP)		
22				50%	0.0				
23						CL	23 1/2 - 24% - medium, light gray, sandy clay (CL) damp, medium plasticity, very fine sand, mottled hematite concretions		
24						SP	24% - 25 - dense, light gray, silty sand (SP), moist, laminated, no mottling, fine sand		
25							End of boring		
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									

58DPT 19 081013  
 1415  
 (31-35)  
 VOL 3

**NOTES:**

Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_

Date: \_\_\_\_\_



Client: LSACE  
 Project Number:  
 Site Location: LHAAP Site 58  
 Coordinates: Elevation:  
 Drilling Method: DPT  
 Sample Type(s): MUD CONE Boring Diameter: 2 in

BORING ID:  
58DPT20  
 Sheet: 1 of 2  
 Monitoring Well Installed:  
 Screened Interval:

Weather: SUNNY 95 Logged By: MH Date/Time Started: 10/15 Depth of Boring:  
 Drilling Contractor: Fugro Ground Elevation: Date/Time Finished: Water Level:

Depth (ft)	Geologic sample ID	Sample Depth (ft)	Blows per 6" Push	Recovery (inches)	Headspace (ppm)	U.S.C.S	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (If Known)	Lab Sample ID	Lab Sample Depth (Ft.)
1						SM	SILTY FINE SAND, Gray, DRY 0-0.5'		
2						CL	0.5-4' SILTY CLAY, gray with less reddish brown, mottling, damp, cohesive dull to slightly shiny smear. very stiff.		
3			1	60"		CL	4'-7' SILTY CLAY WITH SAND, dry, gray, very stiff		
4						CL	7'-11' SILTY CLAY, light gray with reddish brown mottling, moist.		
5							9.5-10 manganese mottling staining.		
6						SM	11-14.5 FINE SILTY SAND, reddish brown with gray mottling, moist -		
7						SP	14.5-15 POORLY GRADED FINE SAND.		
8						CL	light gray, moist SILTY CLAY SANDY SILTY CLAY reddish brown fine gray mottled, moist		
9							iron oxide		
10							horizontal concretions 18-18.2		
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_





Client: USACE  
 Project Number:  
 Site Location: LHARP S-6 58  
 Coordinates: Elevation:  
 Drilling Method: DPT  
 Sample Type(s): MACRO COR Boring Diameter: 2 IN

BORING ID:  
58DPT20  
 Sheet: 1 of 2  
 Monitoring Well Installed: NA  
 Screened Interval:  
 Depth of Boring:

Weather:  
 Drilling Contractor:  
 Logged By: M Hartford Date/Time Started: 16.5  
 Ground Elevation: Date/Time Finished: Water Level:

Depth (ft)	Geologic sample ID	Sample Depth (ft)	Blows per 6" <i>Pest</i>	Recovery (inches)	Headspace (ppm)	U.S.C.S	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (If Known)	Lab Sample ID	Lab Sample Depth (Ft.)
2.1							21.7		
2.2						SM	21.5-21.7 cemented sand. Dark Red, silty fine sand, light gray and reddish brown, moist		
2.3			5	42"					
2.4									
2.5					0	SP	POORLY GRADED SAND, light brown moist 24.5-25'		
2.6									
2.7						CL	SILTY CLAY with zones of iron oxide "gravel size". Dark Red - moist, trace free water		
2.8			6	48"			28-5 - some concretions		
2.9							SILTY CLAY, light gray with silty sand seam 29-29.2 - wet moist		
2.10					0				
2.11									
2.12						CL	SILTY CLAY with fine sand laminations and occasional 1/2 in fine sand seams, light gray, (31-33 reddish brown), moist, possible wet in some sand seams - No obvious		
2.13			7	60"					
2.14									
2.15					0				
2.16							Water producing zones detected in soil samples		
2.17									
2.18							Pest SP-16 Groundwater sampler 36'-40'		
2.19									
2.20							Total Depth 40'		

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by

Date:



Client: USACE  
 Project Number: 60256135  
 Site Location: LHAAD Site SP  
 Coordinates: \_\_\_\_\_ Elevation: \_\_\_\_\_  
 Drilling Method: DPT  
 Sample Type(s): Macro core Boring Diameter: 2"

BORING ID:  
JB DPT 21  
 Sheet: 1 of 1  
 Monitoring Well Installed: No  
 Screened Interval: 26-30

Weather: 101° Sunny, humid Logged By: DBlack Date/Time Started: 8/6/13 1450 Depth of Boring: 25'  
 Drilling Contractor: Fugro Ground Elevation: \_\_\_\_\_ Date/Time Finished: 8/6/13 1600 Water Level: \_\_\_\_\_

Depth (ft)	Geologic sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches) %	Headspace (ppm)	U.S.C.S	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (If Known)	Lab Sample ID	Lab Sample Depth (ft.)
1						ML	0-2 - medium dense, light brown, sandy silt (ML), dry, fine grained sand.		
2				75%	0.0		2-5 - medium, light brown to light gray, sandy clay, <sup>(CC)</sup> dry low plasticity, fine sand		
3									
4									
5							5-10 - very stiff to hard, light brown to light gray, sandy clay, dry, medium plasticity, fine sand, ↑ hardness & sand w/depth, mottled		
6									
7				100%	0.0	CL	↳ 4" fine sand of loose @ ~ 8 1/2 ft. dry,		
8									
9									
10							10-12 1/2 - stiff to medium, light gray, sandy clay (CC)		
11							dry, low plasticity (high sand content) mottled		
12				95%	0.0		12 1/2 - 15 - medium dense to loose, light gray, silty sand (SP), dry, fine sand, little silt, mottled		
13						SP			
14									
15							15-16 1/2 - Hard, dark brown to light gray sandy clay (CL), dry, medium plasticity, fine sand, mottled		
16						CL			
17				75%	0.0		16 1/2 - 20 - loose to medium dense, sandy silt (ML), damp, fine sand, mottled		
18						ML			
19									
20									

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by \_\_\_\_\_ Date: \_\_\_\_\_



Client: USACE

Project Number: 60256135

Site Location: LHAAP Site 5B

Coordinates:

Elevation:

Drilling Method: DPT

Sample Type(s): Macro core

Boring Diameter: 2"

BORING ID:

58DPT21

Sheet: 2 of 1

Monitoring Well Installed: No

Screened Interval: 26-30

Weather: 17° Sunny

Logged By: DBeck

Date/Time Started: 8/10/13

Depth of Boring: 25'

Drilling Contractor: Fugro

Ground Elevation:

Date/Time Finished: 8/13/13 1600

Water Level:

Depth (ft)	Geologic sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (If Known)	Lab Sample ID	Lab Sample Depth (Ft.)
20									
21									
22				50%	0.0	ML	20-23 1/2 medium dense, light gray, sandy silt w/ clay (ML), moist, very low plasticity mottled		
23									
24						SP	23 1/2-24 1/2 very loose, light brown, silty sand, moist, mottled, little silt		
25						CL	24 1/2-25 - hard, gray, clay w/ sand, damp, high plasticity, mottled		
26		58DPT21					End of boring		
27		1708							
28		(26-30)							
29		8/6/13							
30		LOC's							
31									
32									
33									
34									
35									
16									
17									
18									
19									
20									

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by

Date:





Client: **USACE**  
 Project Number: **6025L135**  
 Site Location: **LHAAP Site 58**  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: **DPT**  
 Sample Type(s): **Macrocore** Boring Diameter: **2"**

**BORING ID:**  
**68 DPT 22**  
 Sheet 1 of 2  
 Monitoring Well Installed: **Y**  
 Screened Interval: **26-30**

Weather: **91° humid, cloudy**  
 Drilling Contractor: **Fugro**

Logged By: **RJL/CL**  
 Ground Elevation: \_\_\_\_\_  
 Date/Time Started: **8/17/15 10:25**  
 Date/Time Finished: **8/17/15**

Depth of Boring: **29**  
 Water Level: \_\_\_\_\_

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
1						SP	0-1 1/2 - very loose, light brown, silty sand (SP), dry, fine sand, trace gravel		
2				75%	0.0		1 1/2 - 4 1/2 - soft, light gray to light brown, sandy clay (CL), dry, low plasticity, fine sand, mottled		
3							4 1/2 - 5 - as above, moist, & sand content, hematite		
4							5 - 9 - medium to soft dark to light gray, sandy clay (CL), moist to damp, med to high plasticity, mottled w/ hematite		
5						CL			
6									
7				100%	0.0				
8									
9							9-10 dense to medium dense, light gray, silty sand w/ clay (SP), damp, very low plasticity, mottled, fine sand		
10						CL	10-12, medium, blue gray, sandy clay (CL), damp, low plasticity, mottled, fine sand		
11									
12						SP	12-13, medium dense, gray, silty sand (SP), moist to saturated, mottled, little silt		
13				65%	0.6				
14							13-15, stiff to medium, blue-gray to light gray, sandy clay (CL), damp, low to med plasticity, mottled, fine sand		
15						CL	15-17, AS ABOVE, w/ hematite (CL)		
16									
17						SP	17-17 1/2 medium dense, light gray to light brown, silty sand, moist, mottled, fine sand (SP)		
18				86%	0.0				
19						CL	17 1/2 - 20 medium to stiff, blue gray to light brown, sandy clay (CL), damp, med plasticity, fine sand, mottled		
20									

NOTES:	Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_







Client: USACE  
 Project Number: 60256135  
 Site Location: LHAAP Site 5B  
 Coordinates: \_\_\_\_\_ Elevation: \_\_\_\_\_  
 Drilling Method: DPT  
 Sample Type(s): Macro core Boring Diameter: 8"

BORING ID:  
58DPT23  
 Sheet: 1 of 2  
 Monitoring Well Installed: No  
 Screened Interval: 36-40

Weather: ~80° humid, sunny Logged By: P. Black Date/Time Started: 5/6/13 0857 Depth of Boring: 35'  
 Drilling Contractor: Fugro Ground Elevation: \_\_\_\_\_ Date/Time Finished: 5/6/13 1030 Water Level: \_\_\_\_\_

Depth (ft)	Geologic sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches) %	Headspace (ppm)	U.S.C.S	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (If Known)	Lab Sample ID	Lab Sample Depth (ft.)
1						ML	0-1/2 - very loose, tan, sandy silt (ML), fine sand, dry		
2				95%	0.0		1/2-5 - very stiff, dark to light brown, sandy clay (CL), fine sand, medium to high plasticity, orange mottling, dry		
3									
4									
5						CL	5-8 1/2 Hard, light gray, sandy clay (CL) ↑ fine sand content, dry, medium plasticity, mottled, concretions @ - 6'		
6									
7				106%	0.0				
8						SP	8 1/2-10 Medium dense, light gray, silty sand (SP), fine sand, damp, mottled		
9									
10						CL	10-11, Hard, dark brown, sandy clay (CL), fine sand, dry, medium plasticity		
11							11-14, Medium dense, silty sand (SP), damp to moist mottled, very uniform (little silt), denser w/depth		
12				80%	0.0				
13						SP	14-15 Denser, light gray, silty sand w clay (little), (SP), damp, very low plasticity, mottled w/ concretions		
14							15-16 - As above w/out sand concretions, mottled		
15									
16						CL	16-20 - Stiff to medium, light gray, sandy clay (CL) damp to moist, medium to high plasticity, mottled, sand ↑ plasticity ↓ w/depth		
17				90%	0.0				
18									
19									
20									

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_



Client: USACE

Project Number: 60256135

Site Location: LHAAD Site SR

Coordinates:

Elevation:

Drilling Method: DPI

Sample Type(s): Macro core

Boring Diameter: 2"

BORING ID:

SRDPT23

Sheet: 2 of 2

Monitoring Well Installed: No

Screened Interval: 36-40

Weather: ~85° Sunny

Logged By: DBlack

Date/Time Started: 8/6/13 0845

Depth of Boring: 35'

Drilling Contractor: Fugro

Ground Elevation:

Date/Time Finished: 8/6/13 0930

Water Level:

Depth (ft)	Geologic sample ID	Sample Depth (ft)	Blows per 6"	Recovery (meshes) %	Headspace (ppm)	U.S.C.S	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (If Known)	Lab Sample ID	Lab Sample Depth (Ft.)
20							20-23 - As above, fine sand, med plasticity		
21									
22				65%	0.0	CL			
23							23-24 - medium dense, silt w/ clay (ML), moist, very low plasticity mottled		
24						ML			
25						CL	24-25 - stiff, light gray to gray, sandy clay (CL), fine sand, moist, low plasticity, mottled, occasional fine sand lenses (1/8")		
26						ML	25-26 - medium dense, light gray, sandy silt, (ML), fine sand, moist, mottled, little sand		
27				75%	0.0		26-27 - stiff to very stiff, light gray, sandy clay (CL), moist, fine sand mixed to high plasticity		
28							27-30 - As above, hard, dry, high plast		
29									
30						CL			
31							As above, no recovery, very hard, dry clay (CL), stuck in sampler		
32				NR	0.0				
33									
34									
35									
36							End of boring 35'		
37									
38									
39									
40									

SRDPT23  
1130  
8/6/13  
VOC's  
(36-40)

DB

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by

Date:





Client: USACE  
 Project Number: 60256135  
 Site Location: SP LARAP Site 58  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: DPT  
 Sample Type(s): macrocore Boring Diameter: 2"

BORING ID: SPDPT24  
 Sheet 1 of 2  
 Monitoring Well Installed: N  
 Screened Interval: 26'-30'

Weather: ~80° humid Logged By: PBlack Date/Time Started: 8/10/13 0948 Depth of Boring: 25'  
 Drilling Contractor: Inge Ground Elevation: \_\_\_\_\_ Date/Time Finished: 8/10/13 Water Level: \_\_\_\_\_

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
1							0-3/4' - <del>to</del> very loose to medium dense tan to dark gray, sandy silt w/clay, (ML) dry to moist, very low plasticity, fine sand, little clay, mottled, 1" gravel lens @ 2"		
2				94%	0.0	(ML)			
3							3/4'-5' - medium, dark brown to dark gray, (CC) sandy clay, damp, low plasticity, high fine sand content, mottled		
4							5-9' - As above, w/hematite concretions, light gray, mottled		
5									
6				75%	0.0	CL			
7									
8							8-10" gravel lens		
9							9'-10' - medium to stiff, light gray to brown, sandy clay (CC), damp, low plasticity, mottled, fine to medium grained sand, trace gravel		
10						SP			
11						SP	10-11 1/2' - medium dense, tan, silty sand, dry, mottled, trace gravel, fine sand		
12				75%	0.0	CL	11 1/2' - 15' - very stiff, light gray, sandy clay, (CC) damp, medium to high plasticity, mottled, low fine sand content		
13									
14									
15									
16							15-20' - loose to medium dense, light brown to light gray, silty sand (SP), moist to damp, thin bedded, mottled		
17				60%	0.0	SP			
18									
19									
20									

NOTES:	Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_



Client: **USACE**

Project Number: **60256/35**

Site Location: **LHAAP Site 58**

Coordinates:

Elevation

Drilling Method: **DPT**

Sample Type(s): **Macrocores**

Boring Diameter: **2"**

**BORING ID:**

**58DPT24**

Sheet 2 of 2

Monitoring Well Installed: **No**

Screened Interval: **26'-30'**

Weather: **~90°, humid**

Logged By:

Date/Time Started: **8/10/13 0845**

Depth of Boring: **25'**

Drilling Contractor: **Engro**

Ground Elevation:

Date/Time Finished: **8/10/13 0948**

Water Level:

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21							20'-25' - As above (SP), moist, w/ occasional ~1/4" clay beds (light grey, high plastic) mottled		
22				60%	0.0	SP			
23									
24									
25									
26							End of boring		
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									

58DPT24 08/10/13  
(27'-35') Vols  
1525

DRY

**NOTES:**

Date	Time	Depth to groundwater while drilling

Checked by:

Date:



Client: **USACE**  
 Project Number: **60256135**  
 Site Location: **LHAAP Site 58**  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: **Direct Push**  
 Sample Type(s): **G.W.** Boring Diameter: **2"** Screened Interval: **36-40"**

**BORING ID: 58DPT25**  
 Sheet 1 of 2  
 Monitoring Well Installed:  
 Depth of Boring: **32.5'**  
 Water Level:

Weather: **Sunny 80's** Logged By: **R.L.**  
 Drilling Contractor: **FUGRO** Ground Elevation: \_\_\_\_\_ Date/Time Finished: **8/22/15**

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Ruys Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
1							Silt (0-4') loose, dry, tan, some clays, low-plasticity, trace mica		
2		4'	1	100	ML				
3									
4		5'				CL	Silty clay w/sand (4-5') stiff, moist, gray brown + red mottling, trace organics, trace mica		
5									
6		6.3'				CL			
7			2	100		ML	Silt (6.3-10) very stiff, slightly moist, gray, with brown mottling, trace mica, low plasticity		
8									
9									
10		10.5'				CL	Silty clay (10-10.5') loose, slightly moist, gravel, orange iron cemented sands, med plasticity		
11									
12		13'	3	100		CL			
13							Silty clay (10.5-15') med, moist, gray with brown mottling, staining at 11', med plasticity		
14									
15							Sand (13-15') loose, dry, brown, very fine to fine grain, poorly graded, some clay, low plasticity		
16									
17			4	100		Silty Sandy Clay	Silty clay (10-20') medium, moist gray, with brown mottling, some staining from 15'-15.5'. med plasticity.		
18						CL			
19									
20									

NOTES:

Date	Time	Depth to groundwater while drilling

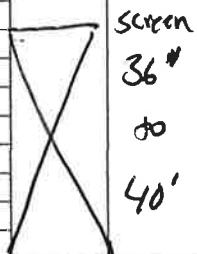
Checked by: \_\_\_\_\_ Date: \_\_\_\_\_



Client: USACE  
 Project Number: 60256135  
 Site Location: LHMAR Site 58  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: Direct Push  
 Sample Type(s): G.W. Boring Diameter: 2"  
 Weather: Sunny 90° Logged By: RL Date/Time Started: 8/22/13 1115  
 Drilling Contractor: FUGRO Ground Elevation: \_\_\_\_\_ Date/Time Finished: 8/22 1530

BORING ID: 58DPT25  
 Sheet 2 of 2  
 Monitoring Well Installed:  
 Screened Interval: 36-40  
 Depth of Boring: 32.5  
 Water Level: \_\_\_\_\_

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Runs Blows per 6"	% Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21		21.5	5	100		CL	Same as above (20-21.5')		
22						CL	silty clay (21.5-22.5) stiff, moist, gray med- to-high plasticity		
23		24	6	100		CL	Same as above (22.5-24.0) little dark staining.		
24		24.1				CL	iron cemented sand (24.0-24.1')		
25		25				CL	Sandy clay (24.1-25.) medium, moist brown, trace mica med- to-high plasticity.		
26			7	100		CL	Silty clay (25-27) stiff, moist, gray med- to-high plasticity, trace mica		
27		27					SANDY CLAY (27-27.5) stiff, moist, brown, very-fine grain, poorly graded sands, med plasticity, mica present		
28						CL	Same as above (27-30')		
29		30'	8	100					
30							Core stuck in barrel; what came out was		
31							Same as above		
32							End of boring @ 32.5'		
33									
34									
35									
36									
37									
38									
39									
40									



NOTES:

Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_





Client: USACE  
 Project Number: 60256135  
 Site Location: LHAAP Site 55  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: Direct Push  
 Sample Type(s): Groundwater Boring Diameter: 2"

58DPT21  
 BORING ID: ~~BPT5526~~  
 Sheet 1 of 2  
 Monitoring Well Installed: NO  
 Screened Interval: 28-32

Weather: Sunny 80's Logged By: RL Date/Time Started: 8/1/09 0920 Depth of Boring: 27.5  
 Drilling Contractor: Fugro Ground Elevation: \_\_\_\_\_ Date/Time Finished: \_\_\_\_\_ Water Level: \_\_\_\_\_

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Pen-Blows per 6"	Recovery (inches) %	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
1		<del>1'</del>				CL	Silty Clay (0-1.5') brown, loose, dry, medium plasticity		
2		<del>2'</del>				CL	Silty clay (1.5-2') loose, dry, light gray, mottling to brown mottling, medium plasticity		
3			1	100%		CL	Clay (2-5') stiff, <del>dry</del> dark brown, dark red staining, med-high plasticity moist		
4		5'							
5									
6						CL	Clay (5'-15') medium, <del>dry</del> <sup>moist</sup> light gray, light brown mottling, medium to high plasticity - trace mica present, trace lignite present starting at 8' until ~10' as well as 14'-15'.		
7			2	100					
8									
9									
10									
11									
12			3	100		CL			
13									
14		15'							
15									
16		16'				CL	Same as above mica present		
17		16.2'					Clay (16-16.2) stiff, <del>dry</del> dark gray, med to high plasticity moist, mica present		
18		17.0'	4	45			Sandy clay (16.2-17) stiff, moist, light gray with light brown mottling, med to high plasticity, mica present.		
19		<del>18'</del>							
20		NR 20'							

NOTES: No recovery ~17'-20'

Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_





Client: USACE  
 Project Number: 60256135  
 Site Location: LHAAP site 58  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: Direct Push  
 Sample Type(s): Groundwater Boring Diameter: 2" Screened Interval: 28-32'  
 Weather: Sunny 80's Logged By: P.L. Date/Time Started: 9/21/15 920 Depth of Boring: 27.5'  
 Drilling Contractor: FUGRO Ground Elevation: \_\_\_\_\_ Date/Time Finished: \_\_\_\_\_ Water Level: \_\_\_\_\_

BORING ID: DPT 26

Sheet 2 of 2

Monitoring Well Installed: NO

Screened Interval: 28-32'

Depth of Boring: 27.5'

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Runs Blows per 6"	% Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21									
22		22.5'	5	100%		CL	Sandy Clay (20-22.5') very fine grain sands, brown with light gray sand clay lenses, medium, moist, med to high plasticity, mica present		
23							Same as above		
24		24		100		CL	Clay (24-25') med gray clay, reddish brown mottling, trace fine grain sands, medium, moist, med to high plasticity, trace mica		
25		25							
26	2L	NR				CL	No recovery		
27	<del>2L</del>	<del>27</del>		20		CL	<del>Clay</del> Sandy clay (27-27.5') dark gray clay, med, moist, med to high plasticity; thin lignite deposits present		
28		27.5'					end of boring @ 27.5'		
29		6 screen							
30		28'							
31		30							
32		32'							
33									
34									
35									
36									
37									
38									
39									
40									

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_



Client: USACE

Project Number: 60256135

Site Location: LHAP Site SR

Coordinates:

Elevation:

Drilling Method: DPT

Sample Type(s): Macro core

Boring Diameter: 2"

BORING ID:

SP DPT 27

Sheet: 1 of 2

Monitoring Well Installed: No

Screened Interval: 26-30

Weather: 95° Sunny humid

Logged By: DBlack

Date/Time Started: 8/6/13 1115

Depth of Boring: 25'

Drilling Contractor: Fugro

Ground Elevation:

Date/Time Finished: 8/6/13 1210

Water Level:

Depth (ft)	Geologic sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (If Known)	Lab Sample ID	Lab Sample Depth (ft.)
1							0-4, loose to medium dense, sandy silt (ML), light brown to brown, dry to damp, mottled		
2				70%	0.0	ML			
3									
4						CL	4-5, very stiff, gray, sandy clay (CL), dry, low plasticity, fine sand, mottled		
5						SP	5-6, very dense, light gray to light brown, silty sand (SP), dry, fine sand, mottled		
6							6-10 - very stiff to stiff, light gray, sandy clay (CL), dry, low to med. plasticity, mottled w/ hematite, ↳ occasional (3) 1/4" fine sand lenses, dry, mottled		
7				96%	0.0	CL			
8									
9									
10							10-15 - very dense to medium dense, silty sand (SP), dry to damp, mottled ↳ occasional (2) 1"-1 1/2" clay lenses, very stiff mod. plasticity		
11									
12				100%	0.0				
13									
14						SP	15-20 As above, medium dense to loose, moist, ↳ one 1" clay lense @ ~14', hard, med plast		
15									
16									
17				80%	0.0				
18									
19									
20									

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by

Date:



Client: **USACE**

Project Number: **60256135**

Site Location: **LHAP Site SB**

Coordinates:

Elevation:

Drilling Method: **DPT**

Sample Type(s): **Macro core**

Boring Diameter: **2"**

BORING ID:

**SDPT 27**

Sheet: **2 of 2**

Monitoring Well Installed: **NO**

Screened Interval: **26-30**

Weather: **75°F Sunny, humid**

Logged By: **DDK**

Date/Time Started: **8/6/13 11:5**

Depth of Boring: **25'**

Drilling Contractor: **Fugro**

Ground Elevation:

Date/Time Finished: **8/6/13 12:0**

Water Level:

Depth (ft)	Geologic sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (If Known)	Lab Sample ID	Lab Sample Depth (Ft.)
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									

20-24 - loose to medium dense, light gray, silty sand (SP), high silt content, moist, mottled

75% 0.0 SP

24-25 - very stiff, light gray, sandy clay (CL) moist to damp, low plasticity, fine sand, mottled w/ hematite concretions

End of boring

SDPT 27  
1455  
(26-30)  
8/6/13  
voc's

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by

Date:



Client: **USACE**  
 Project Number: **60256135**  
 Site Location: **S.O 58**  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: **HSA**  
 Sample Type(s): **Split Spoon** Boring Diameter: **8**  
 Weather: **Clouds Humid 78°F** Logged By: **M. Hartford** Date/Time Started: **8/14/13 8:15**  
 Drilling Contractor: \_\_\_\_\_ Ground Elevation: \_\_\_\_\_ Date/Time Finished: \_\_\_\_\_  
**BORING ID: 35AWW09**  
 Sheet 1 of **2**  
 Monitoring Well Installed: \_\_\_\_\_  
 Screened Interval: \_\_\_\_\_  
 Depth of Boring: **40.5**  
 Water Level: **30.75**

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
1			2						
2			26			SP	POORLY GRADED FINE SAND, moist, dark yellowish brown to brownish yellow, damp, trace silt, medium dense		
3			9						
4			10	48					
5			9		0.0	CL	4-9.5 SILTY CLAY, reddish brown, gray, yellow mottled moist, medium plasticity, very stiff		
6			13						
7			17			CL	SILTY CLAY with FINE SAND, reddish brown to olive yellow, moist, stiff to hard, gradual increasing fine sand content w depth		
8			4	41					
9			6						
10			7		0.1	SP	9.5 FINE SAND, moist, pale yellow, trace silt, very dense		
11			14						
12			22						
13			21	48		SP	13 FINE SAND, moist, dark yellowish brown to brownish yellow, dense, trace silt		
14			22						
15			31		0.1		14.5-18.5 FINE to COARSE SAND w iron oxide nodules		
16			33				18.5 - FINE SAND		
17			40			SP/SW	Alternating every 3-6 inches FINE SAND and FINE to COARSE SAND with iron oxide nodules		
18			7				moist, dark yellowish brown to olive yellow		
19			13	50					
20			10		0.7	SP	FINE SAND, moist, olive yellow, trace silt		
			12				HARD.		
			15						
			15						
			16						

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_





Client: USACE  
 Project Number: 60256135  
 Site Location: S.U 58  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: HSA  
 Sample Type(s): SPLIT SPUR Boring Diameter: 8

BORING ID: 35AWW09

Sheet 2 of 2

Monitoring Well Installed:

Screened Interval:

Weather: \_\_\_\_\_ Logged By: Hartford Date/Time Started: \_\_\_\_\_ Depth of Boring: 40.5

Drilling Contractor: \_\_\_\_\_ Ground Elevation: \_\_\_\_\_ Date/Time Finished: \_\_\_\_\_ Water Level: \_\_\_\_\_

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21		9-16					Alternating every 4-8 inches Fine sand and fine to coarse sand with iron oxide nodules, moist dark yellowish brown to pale yellow, dense		
22		16-21	55			SP			
23		15-18				SW			
24		20-26							
25		25-26			0.2	CL	24-24.2 well graded sand 24.2-24.7 SILTY CLAY 24.7-27.5 yellowish brown to olive yellow. Hard - Tag Range after 15 min - DRY		
26		9-16	60				27.5-27.7 SILTY SAND, olive yellow, moist 27.7-28.3 SILTY CLAY with sand, grey, moist, HARD		
27		15-16				SM			
28		16-19				CL			
29		21-24	31		0.1	CL	28.5-28.8 SILTY SAND 28.8-30.1 SILTY CLAY with sand, yellowish brown and grey, moist, HARD		
30		24-26							
31		26-31							
32		5-9	54				Laminated SILTY CLAY with sand with 1 in silty sand seams at 33 and 34' moist, yellowish brown and grey, HARD		
33		10-17				CL			
34		16-22							
35		25-30	32		0.2		Laminated SILTY CLAY, SILT with SILTY sand seam 1/4 in to 0.5 in thick - sand seam are saturated, HARD, DENSE		
36		30-32							
37		4-11				CL			
38		13-19	60				with SM seam		
39		25-31							
40		39-47				0.6			
40		75-83	83						

NOTES: Stop at 25, 15 min - DRY -  
 Water at 33.7  
 TD 40 - sampling - Aug 40.5 to set well

Date	Time	Depth to groundwater while drilling
8-14	11:50	33.7
8-14	13:20	30.75

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_

Neighb  
 well → 35AWW08 4/29/13 TO 33.7 SW 28.78 B10L  
 8/14/13 26.20 DTW 87.5



Client: USACE  
 Project Number: 60256135  
 Site Location: S. 6 58  
 Coordinates: \_\_\_\_\_ Elevation: \_\_\_\_\_  
 Drilling Method: HSA  
 Sample Type(s): NON<sup>a</sup> Boring Diameter: \_\_\_\_\_

BORING ID: 35AWW10  
 Sheet: 1 of 1  
 Monitoring Well Installed: \_\_\_\_\_  
 Screened Interval: \_\_\_\_\_  
 Depth of Boring: \_\_\_\_\_  
 Water Level: \_\_\_\_\_

Weather: Cloudy 77°F  
 Drilling Contractor: FAGRU

Logged By: HANIFAR Date/Time Started: \_\_\_\_\_  
 Ground Elevation: \_\_\_\_\_ Date/Time Finished: \_\_\_\_\_

Depth (ft)	Geologic sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (If Known)	Lab Sample ID	Lab Sample Depth (ft.)
1							<p>See log for 58DPT22 completed 8/13/13.</p> <p>HSA - G - <u>31.5</u></p>		
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by \_\_\_\_\_ Date: \_\_\_\_\_



Client: USACE  
 Project Number: 60256135  
 Site Location: S.G 58  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: HSR  
 Sample Type(s): CME CONTINUOUS Boring Diameter: 8"

**BORING ID:** 35AWW11  
 Sheet 1 of 7  
 Monitoring Well Installed:  
 Screened Interval:

Weather: \_\_\_\_\_ Logged By: M. Hartford Date/Time Started: 8-23-13 10:10  
 Drilling Contractor: FUGRO Ground Elevation: \_\_\_\_\_ Date/Time Finished: 8-23-13 15:10

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
1						SM	0-5 SILTY FINE SAND, olive brown, dry, trace subrounded gravel near surface		
4			30		2.2	CL-MI SM	5-8 Silty clay, gray & reddish brown and SILTY FINE SAND, olive brown 3-in beds		
6						SC SM	CLAYEY/SILTY SAND, mottled, reddish brown and gray; moist, blocky,		
8			60			SC SC	8-10 CLAYEY FINE SAND, brownish yellow, moist		
10					0.4	ML CL-ML	10-10.5 SANDY SILT, yellowish red, moist		
11						ML	SANDY SILTY CLAY, gray & brownish yellow, moist	10.5-11.5	
12						ML	SANDY SILT, yellowish brown, moist	11.5-12.5	
13			60			MI	ELASTIC SILT, gray, moist, medium plasticity	12.5-13	
14					0.0 0.3	CL	SANDY CLAY, olive yellow and gray, moist Blocky 13-14 (more sandy)	13-13.5	
15						ML			
16						CL-MI SM	SILTY CLAY with very thin silty sand lenses, olive yellow, moist	15.5-16.5	
17						SM	16.5 FINE SILTY SAND, olive brown, moist. Cool	Possible water at 17ft	
18									
19			60		0.6				
20									

**NOTES:**

Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_



Client: USACE  
 Project Number: 60256135  
 Site Location: Sta 58  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: HSA  
 Sample Type(s): CME Continuous Boring Diameter: 8" / 8

**BORING ID:** 35A WW11  
 Sheet 2 of 2  
 Monitoring Well Installed: yes  
 Screened Interval: 19.7-34.7

Weather: \_\_\_\_\_ Logged By: M. Hartford Date/Time Started: 4-23-13 10:15  
 Drilling Contractor: FUGRO Ground Elevation: \_\_\_\_\_ Date/Time Finished: 8-23-13 15:15

Depth of Boring: 35.3  
 Water Level: \_\_\_\_\_

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21						ML / SM / CL-ML	Fine Sandy SILT and silty sand, olive brown, moist, cool to touch, thinly laminated with grey silty clay		
22									
23				60					
24					0.5				
25						ML	25-27 Elastic SILT, greyish brown to olive brown, moist/cool, blocky		
26									
27									
28									
29				60					
30					0.0		29-31 Same as above except more cohesive, not blocky		
31						ML	31-34 SILT, very dark greyish brown wet 32-32.5 - Olive brown to		
32									
33				60			very dark greyish brown, wet		
34					0.0		34-35 Lignite, Black, Blocky, wet to dry		
35		35.3				CL-ML	35 SILTY CLAY, dark grey, dry Total Depth 35.3		
36									
37									
38									
39									
40									

NOTES:	Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_





Client: USACE  
 Project Number: 60256135  
 Site Location: SIG 58  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: HSA  
 Sample Type(s): CME CONTINUOUS Boring Diameter: 8" - 12"

**BORING ID:**  
35AWW12  
 Sheet 1 of 2  
 Monitoring Well Installed: Y  
 Screened Interval: 20.2-34.8

Weather: \_\_\_\_\_ Logged By: HANFORD Date/Time Started: 9/22/13 7:55  
 Drilling Contractor: FUGRO Ground Elevation: \_\_\_\_\_ Date/Time Finished: 9/27/13 9:34 Water Level: \_\_\_\_\_

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
1						ML	<u>fine 0-2.5</u> Sandy SILT, light olive brown, moist dry		
2			<u>24</u>	<del>18</del>		CL-ML	2.5-9 Sandy silty clay, yellowish brown to gray, moist, soft, mottled, blocky, possible fill		
3					<u>0.0</u>				
4									
5									
6							Same as above, blocky, crumbles easily Sandy		
7									
8									
9			<u>60</u>			CL-ML	9-11 SILTY CLAY, mottled brownish yellow to gray, moist, hard, not blocky		
10					<u>0.0</u>				
11									
12							11-12 SANDY SILTY CLAY, mottled brownish yellow to gray, blocky fine		
13			<u>48</u>			SM	12-20 SILTY SAND, moist, brownish yellow to gray, moist		
14					<u>0.0</u>				
15									
16						SM	SILTY FINE SAND, yellowish brown to gray, moist		
17									
18			<u>42</u>						
19									
20					<u>0.0</u>				

**NOTES:**

Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_



Client:	USACE	BORING ID: 35AWW12	
Project Number:	60256175		
Site Location:	S.G. 58		
Coordinates:		Elevation	Sheet 2 of 2
Drilling Method:		Monitoring Well Installed:	
Sample Type(s):		Boring Diameter:	Screened Interval:

Weather:	Logged By:	Date/Time Started:	Depth of Boring:
Drilling Contractor:	Ground Elevation:	Date/Time Finished:	Water Level:

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21									
22				54		SP	21.5-22.5 FINE SAND, yellow, moist		
23						CL-ML	SILTY sandy clay, light grayish brown & olive yellow, moist, blocky, medium plasticity		
24					0.0		24.5-25 not blocky, Firm		
25						ML	25- FINE SILTY SANDY SILT, grayish brown, moist, cool to touch, may indicate water		
26							low plasticity		
27							28.5 FINE SILTY SAND and FINE SANDY SILT, thinly laminated, grayish brown to yellow, wet, soft		
28				60		SM/ML	30.5-31 yellowish brown SILTY SAND		
29					0.1		Remains thinly laminated and cool to touch		
30									
31									
32									
33						SM/ML			
34					0.0				
35									
36									
37									
38									
39									
40									

Total depth 35.5

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by:

Date:



Client: USACE  
 Project Number: 60256135  
 Site Location: S. G 58  
 Coordinates: \_\_\_\_\_ Elevation: \_\_\_\_\_  
 Drilling Method: HSA  
 Sample Type(s): \_\_\_\_\_ Boring Diameter: \_\_\_\_\_

BORING ID:  
35AWW13

Sheet: 1 of 2

Monitoring Well Installed:

Screened Interval:

Weather: Clear 95 Logged By: HARRISON Date/Time Started: 8/20/19 140  
 Drilling Contractor: FUGRO Ground Elevation: \_\_\_\_\_ Date/Time Finished: \_\_\_\_\_

Depth of Boring:

Water Level:

Depth (ft)	Geologic sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (If Known)	Lab Sample ID	Lab Sample Depth (ft.)
1						CL-ML	Silty Clay with Fine Sand, grey and yellowish brown, soft, moist low to med plasticity		
2									
3			42						
4					0	-SC	4-4.2 CLAYEY SAND, olive brown, wet, soft		
5						CL-ML	4.2-5.5 SILTY CLAY with FINE SAND, mottled grey and dark red, moist, soft		
6						CL-ML	5.5- SILTY CLAY, mottled grey and dark red - moist		
7						CL-ML	firm.		
8			56			SC	-8.1-8.2 clayey sand - wet		
9					0.3	CL-ML	8.2-9.5 SILTY CLAY, mottled grey and yellowish brown, moist, hard		
10						CL-ML	9.5-17 SILTY CLAY with FINE SAND, grey with yellowish brown staining, moist, hard; low to med plasticity		
11						CL-ML			
12			42						
13					0				
14									
15									
16									
17						SP	17-18 FINE SAND, brownish grey, moist, soft		
18			48			SC	18-20.5 CLAYEY FINE SAND, brownish yellow, moist, soft		
19					0				
20									

NOTES: Ground reference is 8 in below Pavement. Pavement & base have been cleaned. Survey ground will be 8 in -1 ft higher.

Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_



Client: <u>USA CE</u>		BORING ID: <u>35AWW13</u>
Project Number: <u>60256135</u>		
Site Location: <u>SIG 58</u>		Sheet 2 of <u>2</u>
Coordinates:	Elevation	Monitoring Well Installed:
Drilling Method: <u>HSA</u>	Boring Diameter:	Screened Interval:
Sample Type(s): <u>CONTINUOUS</u>	Date/Time Started:	Depth of Boring:
Weather: <u>Clean</u>	Logged By: <u>HARTFORD</u>	Water Level:
Drilling Contractor: <u>FUGRO</u>	Ground Elevation:	Date/Time Finished:

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21						SC	20.5-21.5		
22						SM	SILTY FINE SAND, olive yellow, moist		
23			60			SC	21.5-23.5 CLAYEY SAND, yellowish brown and grey mottled, moist		
24					0.5		Iron oxide concentration 23.5-24 moist		
25						CLML	24.5-25 SILTY CLAY, yellowish brown, moist trace fine sand firm		
26						ML and CLML	25-28 SILT with silty clay, grey and olive yellow, moist, low plasticity, soft		
27									
28			60			CLML	28.0-30 SILTY CLAY, grey and olive yellow, moist firm, low plasticity		
29					0.0				
30						ML	30-32 SILT, light olive brown, moist, crumbly, low plasticity		
31									
32						CLML	32-36 SILTY CLAY, grey and yellowish brown, moist,		
33			60		0.0				
34									
35									
36						CL-ML SM	36-37.0 SILTY CLAY with silty sand seams, wet, black -		
37									
38			41			1 -	Lignite - Dry - light		
39						7 -	weight. - Powder dry		
40					0.0	1 -			
							Total Depth 40'		

NOTES: <u>While drilling at 35 - Water at 34.8</u> <u>Hard at 35-36'</u>	Date	Time	Depth to groundwater while drilling
		1555	Tagged 30' dry

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_





Client: <u>USACE</u>	BORING ID: <u>14</u> <u>35AWW#</u>	
Project Number: <u>60256135</u>		
Site Location: <u>Sig 58</u>		
Coordinates:	Elevation	Sheet 1 of
Drilling Method: <u>HSA</u>	Monitoring Well Installed: <u>yes</u>	
Sample Type(s): <u>CME Continuous</u>	Boring Diameter: <u>8-in</u>	Screened Interval: <u>H. 8-27.5</u>
Weather:	Logged By: <u>HARIFURD</u>	Date/Time Started: <u>8-24-13 9:30</u>
Drilling Contractor: <u>FUGRO</u>	Ground Elevation:	Date/Time Finished: <u>10-20</u>
		Water Level:

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
1						SM	0-4.5 FINE SILTY SAND, light olive brown, dry		
2									
3									
4									
5			36		13.7	CL	4.5-6 SANDY CLAY, mottled grayish to reddish brown, dry, hard		
6									
7						SC	6-9 CLAYEY SAND, mottled yellowish red to gray, moist, blocky		
8									
9									
10			42		0.0	SM	9-12 SILTY FINE SAND, brownish yellow to gray, hard dense		
11									
12						SP	12-13 FINE SAND, pale yellow, moist		
13									
14						SM	13-17 SILTY FINE SAND, yellowish brown to gray, moist		
15			60		0.1				
16									
17						SM	17-18 WELL GRADED SAND with silt and gravel grains		
18						SM	COARSE GRAINED on iron oxide, trace petrified wood strong brown, moist		
19			48		0.0	SM	18-19.5 SILTY FINE SAND, yellowish brown to gray, moist		
20						SC			

NOTES: Core Bored HARD Drilling 0 to 20

Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_







Client: <u>USACE</u>		BORING ID: <u>35AWW15</u>
Project Number: <u>60256135</u>		
Site Location: <u>3ITE 58</u>		Sheet 1 of 2
Coordinates:	Elevation	Monitoring Well Installed: <u>YES</u>
Drilling Method: <u>HSA CME 75</u>	Boring Diameter: <u>8.25</u>	Screened Interval: <u>37.8-23.1</u>
Sample Type(s):	Date/Time Started: <u>8/25/13 9:39</u>	Depth of Boring: <u>38.3</u>

Weather:	Logged By: <u>KAW</u>	Date/Time Finished: <u>8/25/13 16:44</u>	Water Level: <u>30'</u>
Drilling Contractor:	Ground Elevation:		

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
1							See 58 DPT 26 For lithology from $\phi$ to 27.5'		
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

<b>NOTES:</b>	Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_



Client: USACE  
 Project Number: 60256135  
 Site Location: SITE 58  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: HSA CME 75  
 Sample Type(s): \_\_\_\_\_ Boring Diameter: 8.25

**BORING ID:**  
35A WW 15  
 Sheet 2 of 2  
 Monitoring Well Installed: Yes  
 Screened Interval: 37.8-23.1  
 Depth of Boring: 38.3  
 Water Level: 30'

Weather: \_\_\_\_\_ Logged By: KAW Date/Time Started: 8/25/13 9:59  
 Drilling Contractor: \_\_\_\_\_ Ground Elevation: \_\_\_\_\_ Date/Time Finished: 8/25/13 16:44

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21							SEE 58 DPT 26 For Lithology from $\phi$ -27.5'		
22									
23									
24									
25									
26									
27									
28				100%		Lignite	Lignite, black, dry		
29						CL	clay, dark grayish brown, fissile, w/ laminae of yellowish brown silty zones		
30				90%		SM	silty <sup>vs</sup> sand, grayish brown, moist-wet		
31									
32									
33						SS	Sandstone - silty-fn grained, hard, lt gray		
34						CL	Clay - silty, light gray		
35						SM	Silty-vf sand, moist, grayish brown		
36				100%		CL	Clay lt gray, silty w/ thin silty sand laminae		
37						SM	silty-fn Sand moist		
38						CL/SM	Silty-fn sand and Clay interbedded moist		
39						CL	clay, gray to dark gray, very stiff, dry		
40			TD	38.3					

**NOTES:** water gauged in hole at 32'  
 Hit hard spot at 32.5-33.0 feet, had to drill through ~~with~~ without samples recovered hard spot in next sample (sandstone)

Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_

58DPT13



Client: <u>USACE</u>		BORING ID: <u>35AUM116</u>
Project Number: <u>60256135</u>		
Site Location: <u>S. to 58</u>		
Coordinates:	Elevation	Sheet 1 of
Drilling Method: <u>HSF</u>		Monitoring Well Installed: <u>yes.</u>
Sample Type(s): <u>CME CONTINUOUS</u>	Boring Diameter: <u>8</u>	Screened Interval: <u>19.7-34.4</u>

Weather: <u>Clear 76-95</u>	Logged By: <u>HARIFORO</u>	Date/Time Started: <u>8-26-13</u>	Depth of Boring: <u>35</u>
Drilling Contractor: <u>FUGRO</u>	Ground Elevation:	Date/Time Finished: <u>8-26-13</u>	Water Level:

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
1							<p>For 0-20 lithology see 58DPT13</p>		
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

NOTES:	Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_



Client: <u>USACE</u>		BORING ID: <u>35AWW16</u>
Project Number: <u>60256135</u>		
Site Location: <u>Site 58</u>		Sheet 2 of <u>2</u>
Coordinates:	Elevation	Monitoring Well Installed: <u>yes</u>
Drilling Method: <u>HSR</u>	Boring Diameter: <u>8</u>	Screened Interval: <u>19.7-34.4</u>
Sample Type(s): <u>CME CONTINUOUS</u>	Date/Time Started: <u>8-26-13 9:10</u>	Depth of Boring: <u>35</u>
Weather: <u>Clear 76-95</u>	Logged By: <u>HARTMAN?</u>	Water Level:
Drilling Contractor: <u>FUGRO</u>	Ground Elevation:	

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	1045 MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21						SM	SILTY FINE SAND, olive yellow, moist to wet		
22						CL-MC	21.5-23.4 SILTY CLAY, olive yellow, wet, medium plasticity		
23			60			OH	Lignite, Black, 23.4-23.8 med plastic		
24					0.0	CL-MC	SILTY CLAY, very dark grayish brown, moist, medium plasticity		
25							same except grayish brown		
26							27.5-28 SILTY CLAY w/ SAND, olive yellow, wet		
27							28-28.2 lignite		
28						SM	SILTY FINE SAND and SILTY CLAY, olive yellow to gray laminated, moist to wet		
29			60		0.0	CL-MC			
30									
31						SM	SILTY FINE SAND, olive brown, wet		
32									
33									
34			60		0.0	CL-MC	SILTY FINE SAND, and silty clay, dark gray, moist		
35						SM			
36									
37									
38									
39									
40									

Total Depth 35'

NOTES: Retrieved geoprubal point in cone at 28 ft

Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_



Client: <b>USACE</b>		BORING ID: <b>35AWW17</b>
Project Number: <b>60256135</b>		
Site Location: <b>S. to 58</b>		Sheet 1 of 2
Coordinates:	Elevation	Monitoring Well Installed: <b>Y</b>
Drilling Method: <b>HSA</b>	Boring Diameter: <b>8</b>	Screened Interval:
Sample Type(s): <b>CME CONTINUOUS</b>	Date/Time Started: <b>8-25-13 1330</b>	Depth of Boring: <b>40</b>
Weather: <b>93</b>	Logged By: <b>FLARFORD</b>	Water Level:
Drilling Contractor: <b>FUGRO</b>	Ground Elevation:	Date/Time Finished:

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
1							<p>For 0-30 lithology see 58DPT14 completed 8-22-13</p> <p>Cuttings balling up.</p>		
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

<b>NOTES:</b> Tag geoprobe hole prior to drilling - 21' deep - DRY - Geoprobe water sample collected 33-37	Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_

58DPT14



Client: <u>USACE</u>		BORING ID: <u>35AWW17</u>
Project Number: <u>60256135</u>		
Site Location: <u>Site 58</u>		Sheet 2 of 2
Coordinates:	Elevation	Monitoring Well Installed: <u>Y02</u>
Drilling Method: <u>HSA</u>		Screened Interval: <u>24.7-<del>37.4</del> 39.4</u>
Sample Type(s):	Boring Diameter: <u>8</u>	Depth of Boring: <u>40</u>
Weather: <u>Partly cldy 97</u>	Logged By: <u>Hartford</u>	Date/Time Started: <u>8-25-13</u>
Drilling Contractor: <u>FLURO</u>	Ground Elevation:	Date/Time Finished:
		Water Level:

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21							<p>For 0-30 lithology see 58 DPT14</p> <p>SILT, Elastic SILT, SILT w/ Fine sand olive brown to gray, moist, thinly laminated low plasticity - Turns gray at 34' blocky/crumblz 30-33</p> <p>Same as above</p> <p>TD 40.0</p>		
22									
23									
24									
25									
26									
27									
28									
29									
30									
31						ML/MH			
32									
33									
34			60		0.0				
35									
36									
37									
38									
39			60		0.0				
40									

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by:

Date:







Client: USACE  
 Project Number: 60356135  
 Site Location: Site 58  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: HSA  
 Sample Type(s): CME CONTAMINATOR Boring Diameter: 8

BORING ID: 35A11W18  
 Sheet 2 of 2  
 Monitoring Well Installed:  
 Screened Interval:  
 Depth of Boring:  
 Water Level:

Weather: Partly Cloudy 85 Logged By: Hartford Date/Time Started: 8-24-13  
 Drilling Contractor: FUGRO Ground Elevation: \_\_\_\_\_ Date/Time Finished: 8-27-13

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21							<p>8/25/13</p> <p>For 0-30 Lithology see 58 DPT 25 completed 8-22-13</p> <p>cuttings ball up during drilling possibly indicating water.</p>		
22									
23									
24									
25									
26									
27									
28									
29									
30									
31						ML	<p>Fine 30-32' Sandy silt and <del>fine</del> silty fine sand olive brown, thinly laminated, moist</p>		
32	<u>32</u>					SM	<p>32' - 1/2 in cemented sand</p>		
33									
34			60						
35					0.0		<p>some laminations <sup>100%</sup> silt, Elastic silt or silty clay</p>		
36						ML	<p>Same as above more silt than sand. No apparent water zone</p>		
37						SM			
38							<p>Color change to gray at 38-40</p>		
39			60				<p>Total depth 40'</p>		
40					0.0				

NOTES: Dry at 35 during drilling  
8/24/13 Stop at 35 with Tag Water in the AM  
The silt in the 30-40 zone and elsewhere on site has low to med. plasticity but crumbles when moist or dry. Behaves more like a silt than a clay

Date	Time	Depth to groundwater while drilling
8-24	1015	24 @ 35
8-25	750	32

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_



35ANW19



Client:		BORING ID: S8DPT15B
Project Number: 60256135		
Site Location: Site 58		Sheet 2 of 2
Coordinates:	Elevation	Monitoring Well Installed:
Drilling Method:	Boring Diameter:	Screened Interval:
Sample Type(s):	Date/Time Started:	Depth of Boring:

Weather:	Logged By: M. Law	Date/Time Finished:	Water Level:
Drilling Contractor: Fugro	Ground Elevation:		

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21						(SP)	POORLY GRANNED SAND WITH SILT (SP) loose, moist, light gray, mostly fine sand, little silt, non-plastic.		
22			5	~101%					
23		23'				CL	LEAN CLAY WITH SAND (CL) soft, moist, light gray with light brown mottles, mostly clay, few to little fine sand, low to medium plasticity.		
24									
25									
26				~900%					
27									
28		27.5'	6			SP	POORLY GRANNED SAND WITH CLAY (SP) loose, moist, light gray, mostly fine sand, little clay, slightly plastic, trace mica.		
29		29'				CL	LEAN CLAY (CL) medium stiff, dry, brown, mostly clay, few fine sand, few silt, trace mica in sands, clay low plasticity, clays are thinly laminated (2-5mm) with very thin fine sand in places, sand is light gray. (1 mm thick).		
30				~100%					
31			7						
32									
33									
34									
35						CL	SAME AS ABOVE very dark brown, trace lignite @ 35' Bgs		
36			8	~100%					
37									
38							End of Boring @ 36' Bgs		
39									
40									

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by:

Date:



Client: USACE  
 Project Number: 60256135  
 Site Location: SITE 58  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: HSA CME 75  
 Sample Type(s): \_\_\_\_\_ Boring Diameter: 8.25  
 BORING ID: 3SAww 20  
 Sheet 1 of 2  
 Monitoring Well Installed:  
 Screened Interval: 33.0-18.3

Weather: \_\_\_\_\_ Logged By: KAW Date/Time Started: 8/24/13 8:27 Depth of Boring: 33.8  
 Drilling Contractor: \_\_\_\_\_ Ground Elevation: \_\_\_\_\_ Date/Time Finished: 8/26/13 Water Level: 22.5

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches) %	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
1				100		<del>SM</del> CL	clayey silt v. pale brown w/ yellowish brown inclusions + black inclusions, roots		
2									
3						CL	clay silty light brownish gray, w/ black inclusions + yellowish brown inclusions, roots		
4									
5						<del>SM</del>	clay silty from brownish gray silty sand, yellowish red		
6				100					
7									
8					4.1	CL	clay silty lt gray, w/ yellowish brown mottling, yellowish brown in silty to v. silty sand		
9									
10									
11				100	5.3	<del>SM</del> SP	moist - wet sand, silt - v. s, lt gray + yellowish brown		
12									
13						CL	clay, lt gray w/ yellowish brown mottling occ. black inclusion, plastic		
14									
15						CL	clay, pale brown + light gray inter bedded silty - to v. silty w/ some v. fine sand		
16				100					
17									
18						<del>SM</del> CL	silty - v. s sand lt yellowish brown, moist clay, pale brown + light gray, interbedded		
19									
20						<del>SM/SC</del>	silt-clayey v. s sand yellowish brown ← 2 1/2" dark brown concretion, in yellowish brown sand		

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_



Client: *USACE*

Project Number: *60256135*

Site Location: *Site 58*

Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_

Drilling Method: *HSA CME 75*

Sample Type(s): \_\_\_\_\_ Boring Diameter: *8.25*

BORING ID:

*35A W W 20*

Sheet 2 of 2

Monitoring Well Installed:

Screened Interval: *33.0-18.3*

Weather: \_\_\_\_\_

Logged By: *KAW*

Date/Time Started: *8/26/13 8:27*

Depth of Boring: *33.8*

Drilling Contractor: \_\_\_\_\_

Ground Elevation: \_\_\_\_\_

Date/Time Finished: *8/26/13 13:25*

Water Level: *22.5*

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21						CL	SM - silt-vf sand, lt gray, moist		
22				100%		CL	silty-vf gravel sand, lt grayish brown wet at 22.5'		
23						SM			
24				100%		SP	Sand, vf-fn grained, lt brown		
25				Drilled w/o sampler		CL	Clay, dark grayish brown		
26						Limestone	Limestone - gray, hard		
27				NR		No Returns			
29						CL	Clay, silty to vf sandy, lt yellowish brown		
30						CL	Clay, dark gray, w/ silty laminations of lt gray sand silty-vf, lt brown, moist		
31				100%		SM	Clay, dark gray, blocky - fissile texture		
32						CL			
34									
35				TD 33.8					

NOTES: *hard spot at 25' drilled through w/o a sampler*

Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_

Date: \_\_\_\_\_





Client: USAFC  
 Project Number: 6025635  
 Site Location: S. 654  
 Coordinates: \_\_\_\_\_ Elevation \_\_\_\_\_  
 Drilling Method: HSA  
 Sample Type(s): CME Continuous Boring Diameter: 8-1/2"  
 Weather: Clear 94 Logged By: Hartford Date/Time Started: 8-22-13 1330  
 Drilling Contractor: FUGRO Ground Elevation: \_\_\_\_\_ Date/Time Finished: 8-22-13 1550

**BORING ID:** 35AWWZ1  
 Sheet 1 of 2  
 Monitoring Well Installed: 4/20  
 Screened Interval: 25.2-39.9  
 Depth of Boring: 40.3  
 Water Level: \_\_\_\_\_

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
0-3.5						SM	SILTY SAND, brownish yellow, to pale brown, moist		
3.5-5.5			48			ML	CLAYEY SILT with fine sand, mottled yellowish brown & grayish brown, moist, blocky with IRON concretions		
5.5-7						SC	CLAYEY SAND, mottled, yellowish brown & gray, moist. 7-9 Clayey to fine to medium sand, brown		
7-9			60			CL-ML	SILTY CLAY, mottled brownish yellow & gray, hard, moist		
9-10						SC	CLAYEY SAND, brownish yellow & gray, moist		
10-11						CL-ML	SILTY CLAY with sand, mottled brownish yellow & gray, moist, blocky		
11-14			60			SC	CLAYEY SAND, mottled brownish yellow & gray, moist		
14-17						SM	SILTY SAND, brownish yellow, moist		
17-17.5			48			SM	CLAYEY SAND, brownish yellow		
17.5-18						SM	SILTY SAND, brownish yellow, moist		
18-20						SP	FINE SAND, light yellowish brown, moist		

NOTES: \_\_\_\_\_

Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_



Client: <u>USACE</u>		BORING ID: <u>35AWW21</u>
Project Number: <u>60256135</u>		
Site Location: <u>S. 58</u>		
Coordinates:	Elevation:	Sheet 2 of 2
Drilling Method: <u>HSA</u>		Monitoring Well Installed:
Sample Type(s): <u>CME Continuum</u>		Screened Interval:
Weather: <u>Clear 94</u>	Logged By: <u>HANSEUNG</u>	Date/Time Started: <u>8-22-13 1400</u>
Drilling Contractor: <u>89 FUGRO</u>	Ground Elevation:	Date/Time Finished:
		Depth of Boring:
		Water Level:

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21									
22			36			SP	Fine sand, yellow, moist, several iron oxide <sup>nodules</sup> zones		
23							1/2 in thick. • 23.5 on 24.5		
24					0.5		1/2 silty clay slams		
25							25-26		
26						SW	Iron oxide sand to gravel sized nodules - well graded sand with gravel		
27						SM	dark brown, moist		
28						CL-ML	26-26.5 silty sand, brown, moist		
29			60				26.5 silty sandy clay; olive brown, moist, blocky		
30					0.2				
31						GM	31-32 fine silty sand, brownish yellow, moist		
32									
33						SM/ML	silty sand and sandy silt, brownish yellow and olive brown, moist to wet		
34			60		0.5		thinly laminated.		
35									
36									
37						SM/ML	same as above except laminated sand slams up to 1/4 in thick		
38			60						
39									
40					0.1				
							Total Depth 40.5 ft		

NOTES:	Date	Time	Depth to groundwater while drilling

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_



Client: USACE  
 Project Number: 60256135  
 Site Location: S. to 58  
 Coordinates: \_\_\_\_\_ Elevation: \_\_\_\_\_  
 Drilling Method: HSA  
 Sample Type(s): CME CONTINUUM Boring Diameter: 8

BORING ID: 35AWW22  
 Sheet: 1 of 2  
 Monitoring Well Installed: \_\_\_\_\_  
 Screened Interval: 20.2 - 34.7  
 Depth of Boring: 35.5

Weather: Clean 88° Logged By: ALAN GUNO Date/Time Started: 8/24/13  
 Drilling Contractor: FUGRO Ground Elevation: \_\_\_\_\_ Date/Time Finished: \_\_\_\_\_

Depth (ft)	Geologic sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (If Known)	Lab Sample ID	Lab Sample Depth (ft.)
1						SM	SILTY FINE SAND, pale yellow, dry		
2									
3				42					
4									
5					0.0				
6									
7						CLM	6.5-9.5 FINE SILTY CLAY WITH SAND & IRON oxide concretions, mottled, yellowish red, yellowish brown & grey, moist, Firm		
8			60						
9									
10				1.3		SM	9.5-11 SILTY clayey fine sand, moist, hard m. Hb yellowish brown & grey		
11						SM	11-15 FINE SILTY SAND, yellowish brown & greyish brown, moist, thin clayey sand zones between		
12						SM	12 & 13		
13			60						
14									
15					0.0		15-20 FINE SILTY SAND, yellowish brown to pale yellow, moist		
16						SM	Few iron concretions at 17 ft		
17									
18									
19			60						
20					0.0				

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by \_\_\_\_\_

Date: \_\_\_\_\_



Client:	USACE		BORING ID: 35AWW 22
Project Number:	60256135		
Site Location:	S. to 58		
Coordinates:	Elevation	Sheet 2 of 2	
Drilling Method:	HSA		Monitoring Well Installed:
Sample Type(s):	CME CONTINUUM	Boring Diameter:	8
Weather:	Clear 92	Logged By:	Hart Fu.
Drilling Contractor:	Fugro	Ground Elevation:	Date/Time Finished:
			Water Level:

Depth (ft)	Geologic Sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (if known)	Lab Sample ID	Lab Sample Depth (ft)
21						SP	20-22 Fine Sand, pale yellow moist		
22						SM	22 SILTY FINE SAND, olive yellow, moist		
23			54			CL-M			
24					0.0				
25						CL-M	SILTY CLAY WITH FINE SAND, olive yellow & grayish brown, moist		
26									
27			60				SILTY CLAY WITH FINE SAND, olive yellow & grayish brown, moist		
28									
29					0.0				
30						CL-M	SANDY CLAY, olive yellow & grayish brown - with silty fine sand seams, moist		
31									
32						MH			
33			60			CL-M	SILTY CLAY TO CLAY SILT, olive yellow & grayish brown, moist, blocky		
34									
35					0.0	SM	SILTY SAND, olive yellow, moist		
36									
37									
38									
39									
40									

Total Depth - 35.5

NOTES:

Date	Time	Depth to groundwater while drilling

Checked by:

Date:

**Field Injection Logs  
(Wilclear Plus Injections)  
LHAAP-35A(58) Site, Shops Area  
Karnack, TX**

<b>Injection Point</b>	<b>Date</b>	<b>Start Time</b>	<b>End Time</b>	<b>Depth Interval (ft.)</b>	<b>Approximate Flow Rate (gpm)</b>	<b>Approximate Injection Pressure (psig)</b>	<b>Amount Injected (gal.)</b>	<b>Comments</b>
EISB-1 24' - 30'	9/23/2013	10:48/11:04	11:36	24-30	5.0	25	185	used approximately 1.5 drum of sodium lactate
				30-28			60	Grouted hole with bentonite/water slurry
				28-26			60	used one bag of 50-lb bentonite
				26-24			60	pellets to grout
EISB-2 23' - 30'	9/23/2013	1:30/1:58	2:14	23-30	6.0	25	180	used approximately 1.5 drum of sodium lactate
				30-28			~60	
				28-25			~60	used one bag of 50-lb bentonite
				25-23			~60	pellets to grout
EISB-4 23' - 30'	9/23/2013	3:23/3:53	4:20	23-50	5.0	25	180	Drill rig stopped working due to
				30-28				short on kill switch
				28-25				
				25-23				used approximately 0.75 bag of 50-lb of bentonite pellets to grout
EISB-3 30' - 23'	9/24/2013	8:39/9:00	9:27	30-23	4.0	25	225	1.5 drums of sodium lactate
				30-28				Increased the amount of water
				28-25				
				25-23				used one bag of 50-lb bentonite
EISB-5 30' - 23'	9/24/2013	10:30/11:00	11:27	30-23	4.0	25	225	1.5 drums of sodium lactate
				30-28				Increased the amount of water
				28-25				
				25-22				used one bag of 50-lb bentonite
EISB-6 30' - 22'	9/24/2013	1:00/1:15	1:40	30-22	5.0	25	80	some daylighting of solution at 1:25pm
								started at 180 gal, stopped at 100 gallons
								Moved the rig to EISB-7 location used approximately 0.75 bag of 50-lb of bentonite pellets to grout



**Field Injection Logs  
(Wilclear Plus Injections)  
LHAAP-35A(58) Site, Shops Area  
Karnack, TX**

Injection Point	Date	Start Time	End Time	Depth Interval (ft.)	Approximate Flow Rate (gpm)	Approximate Injection Pressure (psig)	Amount Injected (gal.)	Comments
EISB-7 33' - 26'	9/24/2013	2:00/2:25	2:45	33-26	5.0	25	120	injected 100 gallons remaining from EISB-6
				33-31				daylighting of solution; stopped at 2:45pm
				31-29				restarted at 3:15pm
				29-27				
				27-26				
								Moved to EISB-7A location
								used one bag of 50-lb bentonite
EISB-7A 33' - 26'	9/24/2013	4:00/4:15	4:45	33-26	5.0	25	180	Injected 180 gallons solution
				33-31				EISB-7A at 10 feet from EISB-7
				31-29				No daylighting.
				29-27				
			27-26					used one bag of 50-lb bentonite
EISB-8 33' - 26'	9/25/2013	8:50/9:06	9:54	33-26	5.5	25	200	Injected 200 gallons of solution
								no daylighting, no leaks
								used 1 - 50 lb bag for grouting
EISB-9 33' - 26'	9/25/2013	10:32/10:45	11:02	33-26	5.5	20	200	injected 200 gal. 33-26'
								no daylighting, no leaks
								used one bag of 50-lb bentonite
EISB-10 33' - 26'	9/25/2013	1:18/1:36	2:05	33-26	5.5	30	225	injected 225 gal 33-26'
								no daylighting, no leaks
								used one bag of 50-lb bentonite
EISB-11 33' - 26-	9/25/2013	2:50/3:05	4:00	33-26	5.5	30	125	EISB-11 at 10' upgradient of 35AWW08
								used one drum of sodium lactate solution
								used one bag of 50-lb bentonite

Notes:

EISB - Enhanced In-situ Bioremediation

ft - feet

gal - gallons

psig - pounds per square inch gauge

lb - pounds

gpm - gallons per minute



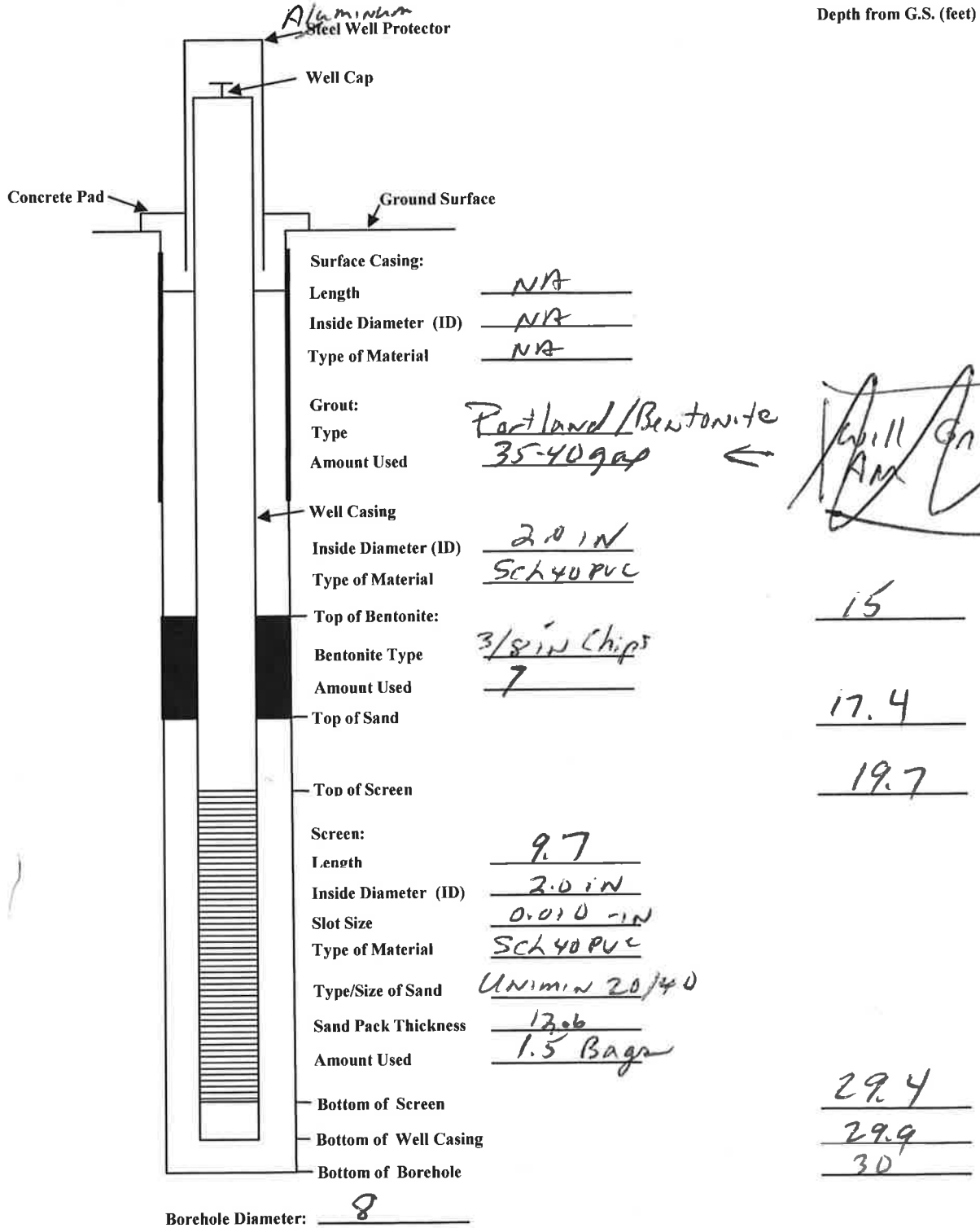
**APPENDIX D: Monitoring Well Construction Logs and Development Forms**

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**AECOM**

Client: <u>USACE</u>	WELL ID: <u>Replacement</u>
Project Number: <u>60256135</u>	<u>35AWW07R</u>
Site Location: <u>Site 58</u>	Date Installed: <u>8-26-13</u>
Well Location: _____	Coords: _____
Method: <u>HSA</u>	Borehole Diameter: <u>8</u>
	Contractor: <u>FUGRO</u>

**MONITORING WELL CONSTRUCTION DETAIL**



Comments: Replacement well  
Not logged. Originally logged 11/14/08

Installation Observed By: Mittal

## STATE OF TEXAS WELL REPORT for Tracking #352602

Owner:	Longhorn AAP - USACE	Owner Well #:	35AWW07R
Address:	Highway 43 Karnack , TX 75661	Grid #:	35-23-6
Well Location:	Highway 43 Karnack , TX 75661	Latitude:	32° 41' 10" N
Well County:	Harrison	Longitude:	094° 09' 06" W
Elevation:	211 ft.	GPS Brand Used:	No Data
<hr/>			
Type of Work:	Replacement Well	Proposed Use:	Monitor

Drilling Date: Started: **8/26/2013**  
Completed: **8/26/2013**

Diameter of Hole: Diameter: **8 in From Surface To 30 ft**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: Gravel Packed From: **30 ft to 17.4 ft**  
Gravel Pack Size: **20 / 40**

Annular Seal Data: 1st Interval: **From 30 ft to 17.4 ft with 7.5 (#sacks and material)**  
2nd Interval: **From 17.4 ft to 15 ft with 1 (#sacks and material)**  
3rd Interval: **From 15 ft to 0 ft with 3 (#sacks and material)**  
Method Used: **Tremie**  
Cemented By: **Donald Edwards**  
Distance to Septic Field or other Concentrated Contamination: **No Data**  
Distance to Property Line: **No Data**  
Method of Verification: **No Data**  
Approved by Variance: **No Data**

Surface Completion: **Surface Slab Installed**

Water Level: Static level: **No Data**  
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**  
Depth of Strata: **No Data**  
Chemical Analysis Made: **No Data**  
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **Fugro**  
**6105 Rookin St.**  
**Houston , TX 77074**

Driller License Number: **56013**

Licensed Well Driller Signature: **Donald Edwards**

Registered Driller Apprentice Signature: **No Data**


Apprentice Registration Number: **No Data**

Comments: **No Data**

**IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY**

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Please include the report's Tracking number (Tracking #**352602**) on your written request.

**Texas Department of Licensing & Regulation**  
**P.O. Box 12157**  
**Austin, TX 78711**  
**(512) 463-7880** 

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description  
**Gray / Brown clay with sand layers**

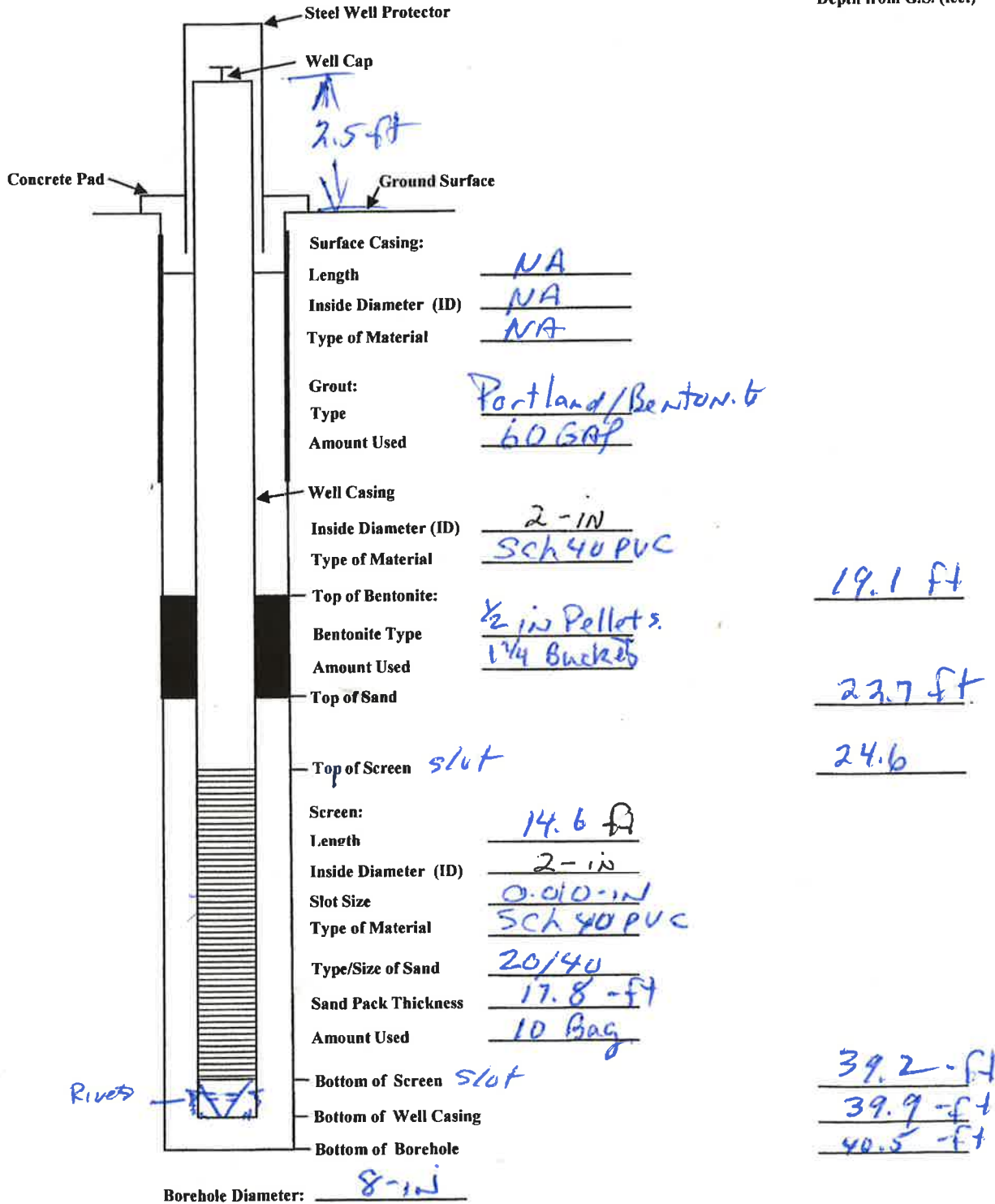
CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
2in	new	pvc screen	30ft to 19.7ft .010 slot
2in	new	pvc casing	19.7ft to 0

<b>AECOM</b>	Client: <u>USACE</u>	WELL ID: <u>3581110 35ANW09</u>
	Project Number: <u>60256135</u>	Date Installed: <u>8-14-13</u>
	Site Location: <u><del>SITE 57</del> SITE 58</u>	Borehole Diameter: <u>8-IN</u>
	Well Location: _____ Coords: _____	Contractor: <u>FUGRO</u>
	Method: <u>HSA</u>	

**MONITORING WELL CONSTRUCTION DETAIL**

Depth from G.S. (feet)



Comments: Measurement Type may not go past Plastic Rivets inside end point 0.1' above

Installation Observed By: Mark Hertford

## STATE OF TEXAS WELL REPORT for Tracking #352597

Owner: <b>Longhorn AAP - USACE</b>	Owner Well #: <b>35AWW09</b>
Address: <b>Highway 43 Karnack , TX 75661</b>	Grid #: <b>35-23-6</b>
Well Location: <b>Highway 43 Karnack , TX 75661</b>	Latitude: <b>32° 41' 09" N</b>
Well County: <b>Harrison</b>	Longitude: <b>094° 09' 06" W</b>
Elevation: <b>215 ft.</b>	GPS Brand Used: <b>No Data</b>
<hr/>	
Type of Work: <b>New Well</b>	Proposed Use: <b>Monitor</b>

Drilling Date: Started: **8/14/2013**  
Completed: **8/14/2013**

Diameter of Hole: Diameter: **8 in From Surface To 40.5 ft**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: Gravel Packed From: **40.5 ft to 22.7 ft**  
Gravel Pack Size: **20/40**

Annular Seal Data: 1st Interval: **From 40.5 ft to 22.7 ft with 10 (#sacks and material)**  
2nd Interval: **From 22.7 ft to 19.1 ft with 1.75 (#sacks and material)**  
3rd Interval: **From 19.1 ft to 0 ft with 3 (#sacks and material)**  
Method Used: **tremie**  
Cemented By: **Donald Edwards**  
Distance to Septic Field or other Concentrated Contamination: **No Data**  
Distance to Property Line: **No Data**  
Method of Verification: **No Data**  
Approved by Variance: **No Data**

Surface Completion: **Surface Slab Installed**

Water Level: Static level: **26.20 ft. below land surface on 8/14/2013**  
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**  
Depth of Strata: **No Data**  
Chemical Analysis Made: **No Data**  
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **Fugro**  
**6105 Rookin St.**  
**Houston , TX 77074**

Driller License Number: **56013**



Licensed Well Driller Signature: **Donald Edwards**

Registered Driller Apprentice Signature: **No Data**

Apprentice Registration Number: **No Data**


Comments: **No Data**

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Please include the report's Tracking number (Tracking #352597) on your written request.

**Texas Department of Licensing & Regulation**  
**P.O. Box 12157**  
**Austin, TX 78711**  
**(512) 463-7880** 

---

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description  
**Gray / Brown clay with layers of sand**

---

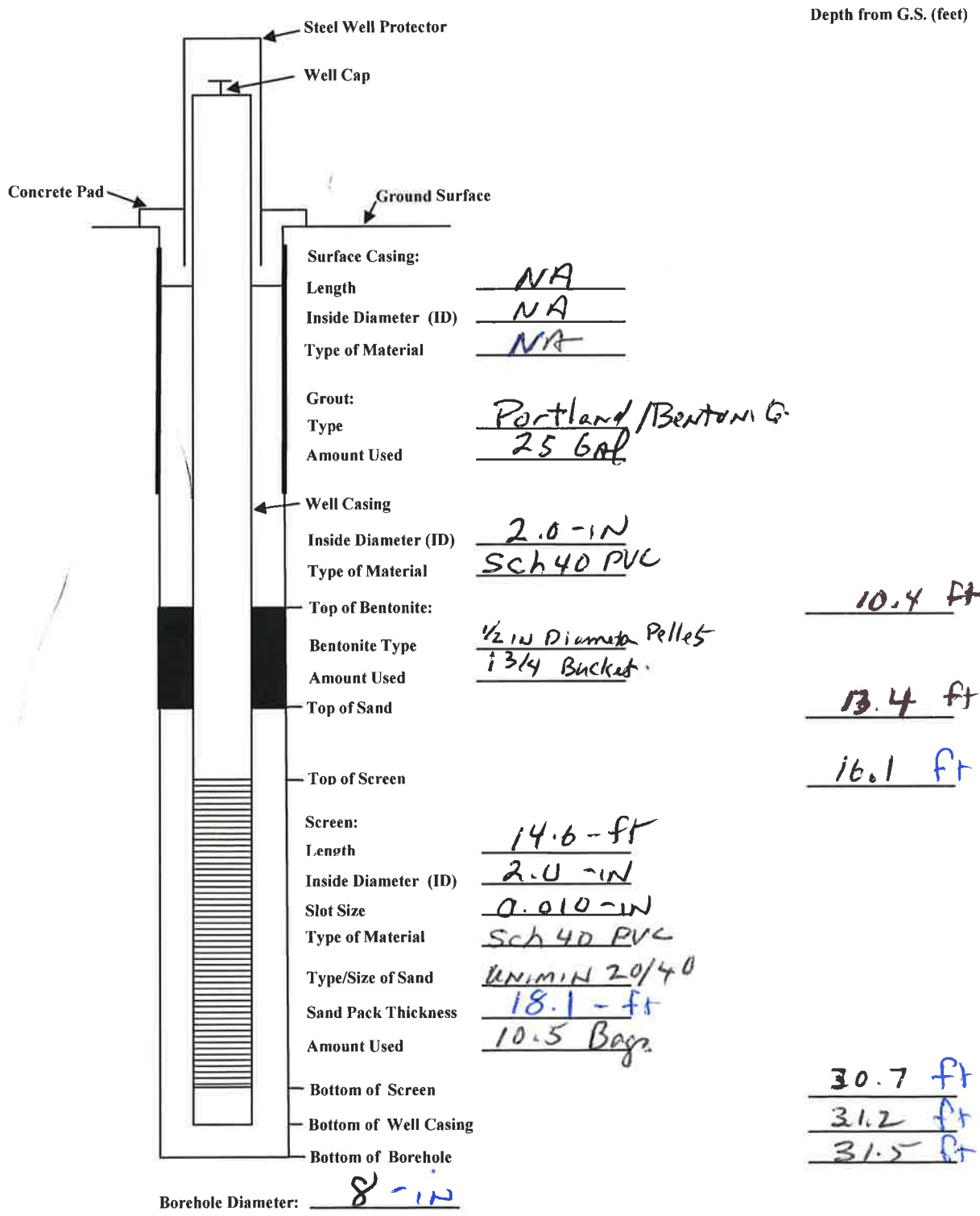
CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
2in	new	pvc screen	39.9ft to 24.6ft .010 slot
2in	new	pvc casing	24.6 to 0

**AECOM**

Client: <u>USACE</u>	WELL ID: <u>35AWW10</u>
Project Number: <u>60256135</u>	Date Installed: <u>8-20-13</u>
Site Location: <u>S.G. 58</u>	Borehole Diameter: <u>8 - IN</u>
Well Location: _____	Coords: _____
Method: <u>HSA</u>	Contractor: <u>FUGRO</u>

**MONITORING WELL CONSTRUCTION DETAIL**



Borehole Diameter: 8 - IN

Comments: See Boring Log for S&DP122

Installation Observed By: HARTFORD

## STATE OF TEXAS WELL REPORT for Tracking #352614

Owner:	<b>Longhorn AAP-USACE</b>	Owner Well #:	<b>35AWW10</b>
Address:	<b>Highway 43 Karnack , TX 75661</b>	Grid #:	<b>35-23-6</b>
Well Location:	<b>Highway 43 Karnack , TX 75661</b>	Latitude:	<b>32° 41' 10" N</b>
Well County:	<b>Harrison</b>	Longitude:	<b>094° 09' 18" W</b>
Elevation:	<b>218 ft.</b>	GPS Brand Used:	<b>No Data</b>
<hr/>			
Type of Work:	<b>New Well</b>	Proposed Use:	<b>Monitor</b>

Drilling Date:      Started: **8/20/2013**  
                          Completed: **8/20/2013**

Diameter of Hole:    Diameter: **8 in From Surface To 31.5 ft**

Drilling Method:    **Hollow Stem Auger**

Borehole  
Completion:          Gravel Packed From: **31.5 ft to 13.4 ft**  
                                  Gravel Pack Size: **20 / 40**

Annular Seal Data:    1st Interval: **From 31.5 ft to 13.4 ft with 10.5 sand (#sacks and material)**  
                                  2nd Interval: **From 13.4 ft to 10.4 ft with 1.75 bentonite (#sacks and material)**  
                                  3rd Interval: **From 10.4 ft to 0 ft with 2 Portland (#sacks and material)**  
                                  Method Used: **Tremie**  
                                  Cemented By: **Donald Edwards**  
                                  Distance to Septic Field or other Concentrated Contamination: **No Data**  
                                  Distance to Property Line: **No Data**  
                                  Method of Verification: **No Data**  
                                  Approved by Variance: **No Data**

Surface  
Completion:          **Surface Slab Installed**

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Water Level:          Static level: **No Data**  
                                  Artesian flow: **No Data**

Packers:              **No Data**

Plugging Info:        Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump:        **No Data**

Well Tests:            **No Data**

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Water Quality:        Type of Water: **No Data**  
                                  Depth of Strata: **No Data**  
                                  Chemical Analysis Made: **No Data**  
                                  Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**

Certification Data:    The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company  
Information:            **Fugro**  
                                  **6105 Rookin St**  
                                  **Houston , TX 77074**

Driller License  
Number:                **56013**

Licensed Well Driller Signature: **Donald Edwards**

Registered Driller Apprentice Signature: **No Data**

Apprentice Registration Number: **No Data**


Comments: **No Data**

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**Austin, TX 78711**  
**(512) 463-7880** 

---

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description  
**Gray / Brown clay with layers of sand**

---

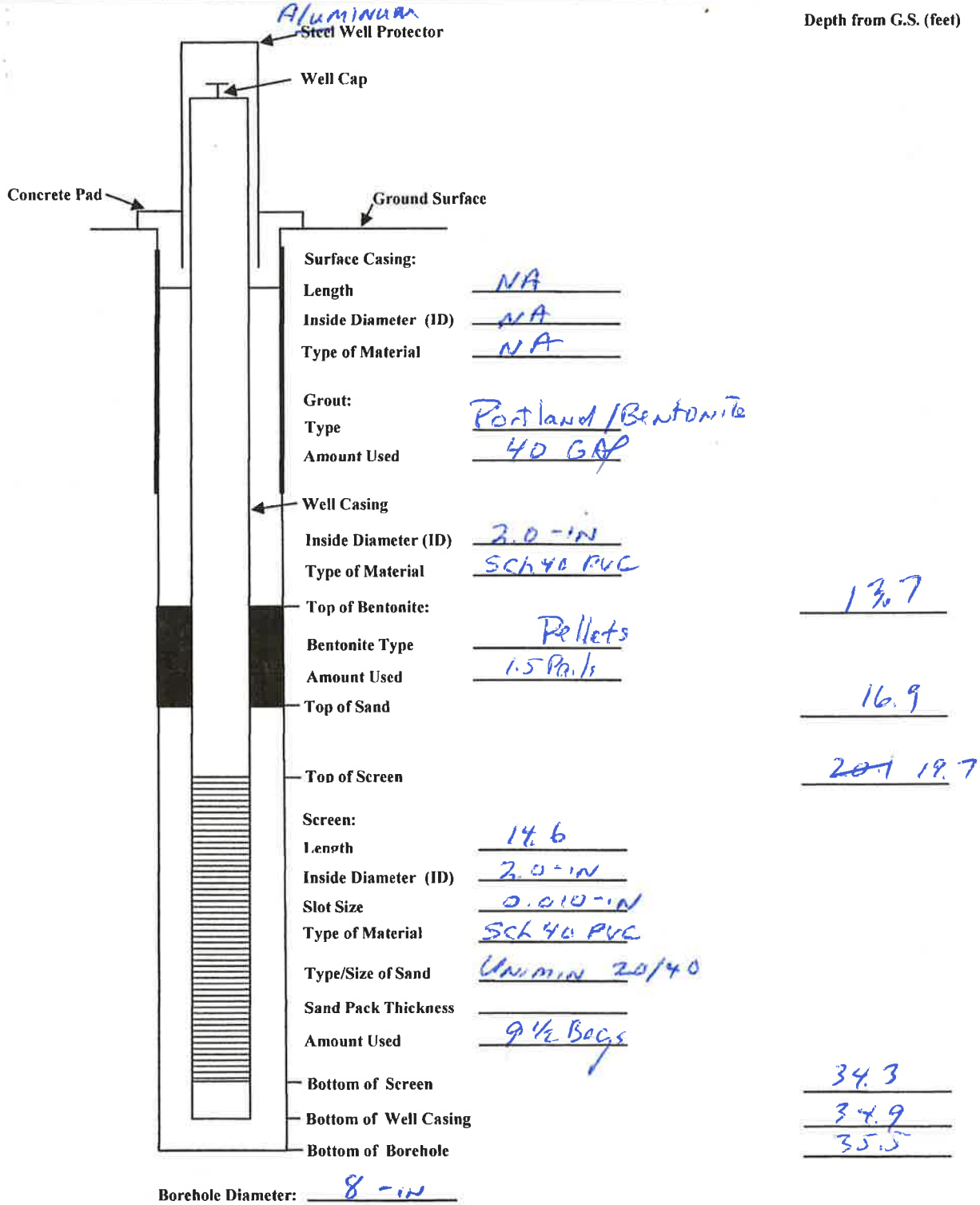
CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To  
**2in new pvc screen 30.7ft to 16.1ft .010 slot**  
**2in new pvc casing 16.1ft to o**

**AZCOM**

Client:	USAGE	WELL ID:	35AWW11
Project Number:	60256135	Date Installed:	8-23-13
Site Location:	Site 58	Borehole Diameter:	8-in
Well Location:		Coords:	
Method:	HSA	Contractor:	FUGRO

**MONITORING WELL CONSTRUCTION DETAIL**



Comments:

Installation Observed By: M. Hartford

## STATE OF TEXAS WELL REPORT for Tracking #352610

Owner:	Longhorn AAP- USACE	Owner Well #:	35AWW11
Address:	Highway 43 Karnack , TX 75661	Grid #:	35-23-6
Well Location:	Highway 43 Karnack , TX 75661	Latitude:	32° 41' 08" N
Well County:	Harrison	Longitude:	094° 09' 17" W
Elevation:	218 ft.	GPS Brand Used:	No Data
<hr/>			
Type of Work:	New Well	Proposed Use:	Monitor

Drilling Date: Started: **8/23/2013**  
Completed: **8/23/2013**

Diameter of Hole: Diameter: **8 in From Surface To 35.5 ft**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: Gravel Packed From: **35.5 ft to 16.9 ft**  
Gravel Pack Size: **20 / 40**

Annular Seal Data: 1st Interval: **From 35.5 ft to 16.9 ft with 9.5 (#sacks and material)**  
2nd Interval: **From 16.9 ft to 13.7 ft with 1.5 (#sacks and material)**  
3rd Interval: **From 13.7 ft to 0 ft with 2 Portland (#sacks and material)**  
Method Used: **Tremie**  
Cemented By: **Donald Edwards**  
Distance to Septic Field or other Concentrated Contamination: **No Data**  
Distance to Property Line: **No Data**  
Method of Verification: **No Data**  
Approved by Variance: **No Data**

Surface Completion: **Surface Slab Installed**

---

Water Level: Static level: **No Data**  
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

---

Water Quality: Type of Water: **No Data**  
Depth of Strata: **No Data**  
Chemical Analysis Made: **No Data**  
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **Fugro**  
**6105 Rookin St**  
**Houston , TX 77074**

Driller License Number: **56013**



Licensed Well Driller Signature: **Donald Edwards**

Registered Driller Apprentice Signature: **No Data**

Apprentice Registration Number: **No Data**


Comments: **No Data**

---

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**Austin, TX 78711**  
**(512) 463-7880** 

---

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description  
**Gray / Brown clay with layers of sand**

---

CASING, BLANK PIPE & WELL SCREEN DATA

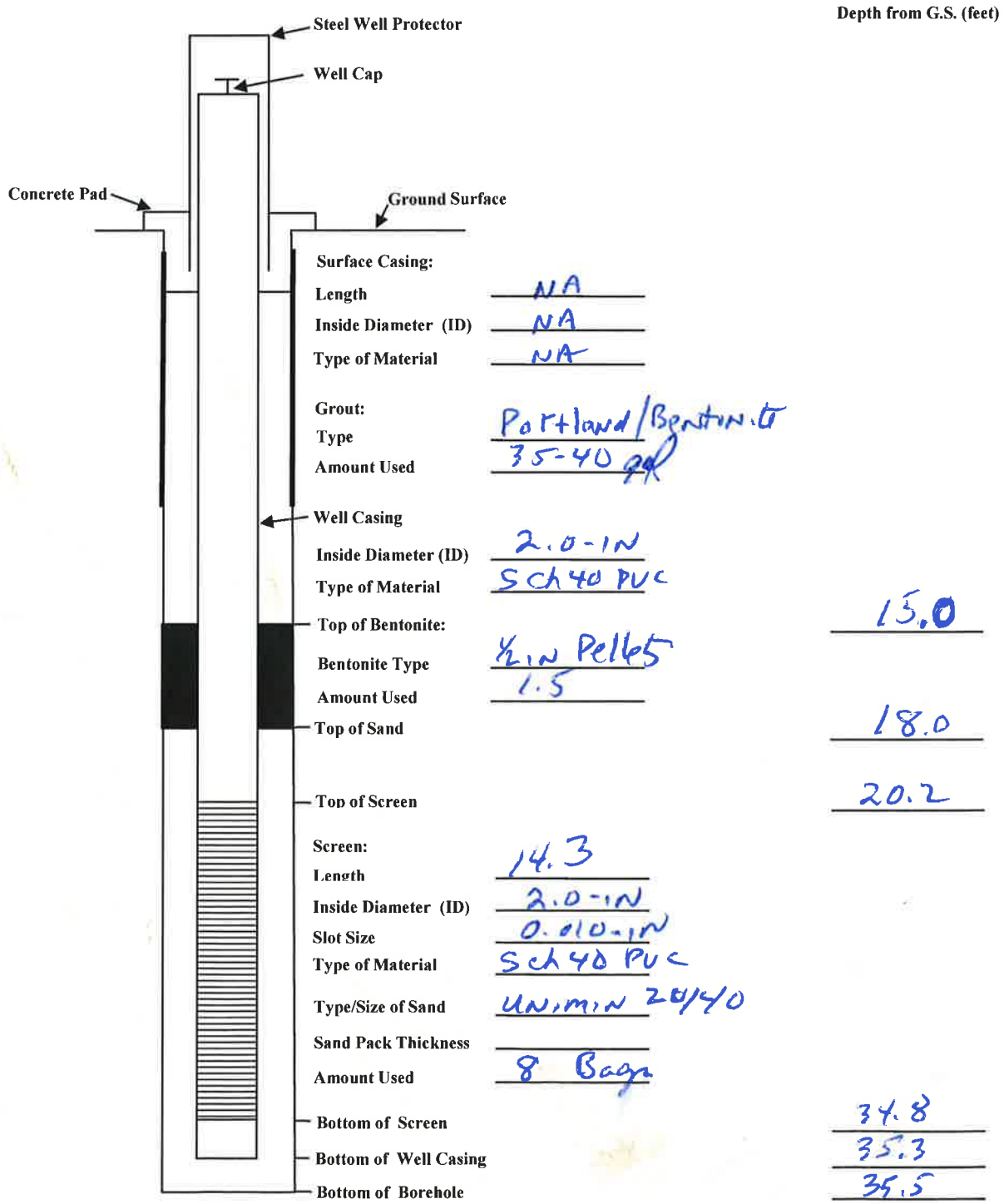
Dia.	New/Used	Type	Setting From/To
<b>2in</b>	<b>new</b>	<b>pvc screen</b>	<b>34.9ft to 19.7ft .010 slot</b>
<b>2in</b>	<b>new</b>	<b>pvc casing</b>	<b>19.7ft to 0</b>

**AECOM**

Client: USACE  
Project Number: 60256135  
Site Location: S.G 58  
Well Location: \_\_\_\_\_ Coords: \_\_\_\_\_  
Method: HSA

WELL ID: 35AWW12  
Date Installed: 8-22-13  
Borehole Diameter: 8-in  
Contractor: FUGRU

**MONITORING WELL CONSTRUCTION DETAIL**



Borehole Diameter: 8-IN

Comments: used

Installation Observed By: M. Hartford

## STATE OF TEXAS WELL REPORT for Tracking #352620

Owner:	Longhorn AAP- USACE	Owner Well #:	35AWW12
Address:	Highway 43 Karnack , TX 75661	Grid #:	35-23-6
Well Location:	Highway 43 Karnack , TX 75661	Latitude:	32° 41' 10" N
Well County:	Harrison	Longitude:	094° 09' 11" W
Elevation:	214 ft.	GPS Brand Used:	No Data
<hr/>			
Type of Work:	New Well	Proposed Use:	Monitor

Drilling Date: Started: **8/22/2013**  
Completed: **8/22/2013**

Diameter of Hole: Diameter: **8 in From Surface To 35.5 ft**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: Gravel Packed From: **35.5 ft to 18 ft**  
Gravel Pack Size: **20 / 40**

Annular Seal Data: 1st Interval: **From 35.5 ft to 18.0 ft with 8 20/40 sand (#sacks and material)**  
2nd Interval: **From 18.0 ft to 15.0 ft with 1.5 bentonite (#sacks and material)**  
3rd Interval: **From 15 ft to 0 ft with 3 Portland (#sacks and material)**  
Method Used: **Tremie**  
Cemented By: **Donald Edwards**  
Distance to Septic Field or other Concentrated Contamination: **No Data**  
Distance to Property Line: **No Data**  
Method of Verification: **No Data**  
Approved by Variance: **No Data**

Surface Completion: **No Data**

Water Level: Static level: **No Data**  
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**  
Depth of Strata: **No Data**  
Chemical Analysis Made: **No Data**  
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **Fugro**  
**6105 Rookin St**  
**Houston , TX 77074**

Driller License Number: **56013**

Licensed Well Driller Signature: **Donald Edwards**

Registered Driller Apprentice Signature: **No Data**

Apprentice Registration Number: **No Data**


Comments: **No Data**

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**IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY**

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Please include the report's Tracking number (Tracking #**352620**) on your written request.

**Texas Department of Licensing & Regulation**  
**P.O. Box 12157**  
**Austin, TX 78711**  
**(512) 463-7880** 

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DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description  
**Gray / Brown clay with layers of sand**

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CASING, BLANK PIPE & WELL SCREEN DATA

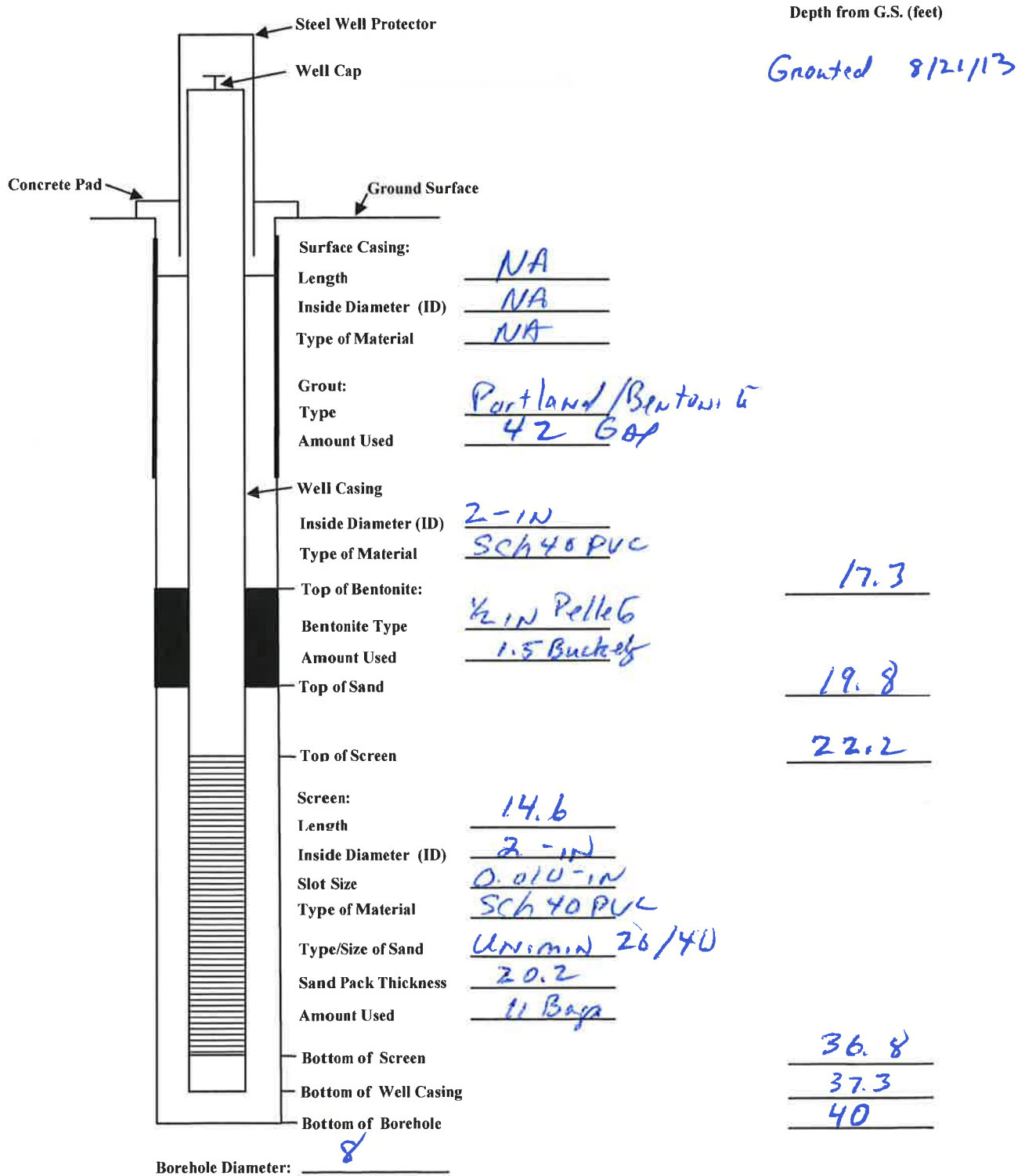
Dia.	New/Used	Type	Setting From/To
2in	new	pvc screen	34.8ft to 20.2ft .010 slot
2in	new	pvc casing	20.2ft to 0

**AECOM**

Client: USACE  
Project Number: 60256135  
Site Location: S: G 58  
Well Location: \_\_\_\_\_ Coords: \_\_\_\_\_  
Method: HSA

WELL ID: 35AWW13  
Date Installed: 8-20-13  
Borehole Diameter: 8 IN  
Contractor: FUGRU

**MONITORING WELL CONSTRUCTION DETAIL**



Comments: Well Install & Lithology log ground surface reference is at Base of Pavement and subgrade gravel.  
Approx 8-IN Below asphalt surface

Installation Observed By: MID

## STATE OF TEXAS WELL REPORT for Tracking #352625

Owner: <b>Longhorn AAP-USACE</b>	Owner Well #: <b>35AWW13</b>
Address: <b>Highway 43 Karnack , TX 75661</b>	Grid #: <b>35-23-6</b>
Well Location: <b>Highway 43 Karnack , TX 75661</b>	Latitude: <b>32° 41' 10" N</b>
Well County: <b>Harrison</b>	Longitude: <b>094° 09' 11" W</b>
Elevation: <b>217 ft.</b>	GPS Brand Used: <b>No Data</b>
<hr/>	
Type of Work: <b>New Well</b>	Proposed Use: <b>Monitor</b>

Drilling Date: Started: **8/20/2013**  
Completed: **8/20/2013**

Diameter of Hole: Diameter: **8 in From Surface To 40 ft**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: Gravel Packed From: **40 ft to 19.8 ft**  
Gravel Pack Size: **20 /40**

Annular Seal Data: 1st Interval: **From 40 ft to 19.8 ft with 11 20/40 sand (#sacks and material)**  
2nd Interval: **From 19.8 ft to 17.3 ft with 1.5 Bentonite (#sacks and material)**  
3rd Interval: **From 17.3 ft to 0 ft with 3 Portland (#sacks and material)**  
Method Used: **Tremie**  
Cemented By: **Donald Edwards**  
Distance to Septic Field or other Concentrated Contamination: **No Data**  
Distance to Property Line: **No Data**  
Method of Verification: **No Data**  
Approved by Variance: **No Data**

Surface Completion: **Surface Slab Installed**

---

Water Level: Static level: **34.8 ft. below land surface on 8/20/2013**  
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

---

Water Quality: Type of Water: **No Data**  
Depth of Strata: **No Data**  
Chemical Analysis Made: **No Data**  
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **Fugro  
6105 Rookin St  
Houston , TX 77074**

Driller License Number: **56013**



Licensed Well Driller Signature: **Donald Edwards**

Registered Driller Apprentice Signature: **No Data**

Apprentice Registration Number: **No Data**


Comments: **No Data**

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**Texas Department of Licensing & Regulation**  
**P.O. Box 12157**  
**Austin, TX 78711**  
**(512) 463-7880** 

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DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description  
**Gray / Brown clay with layers of sand**

---

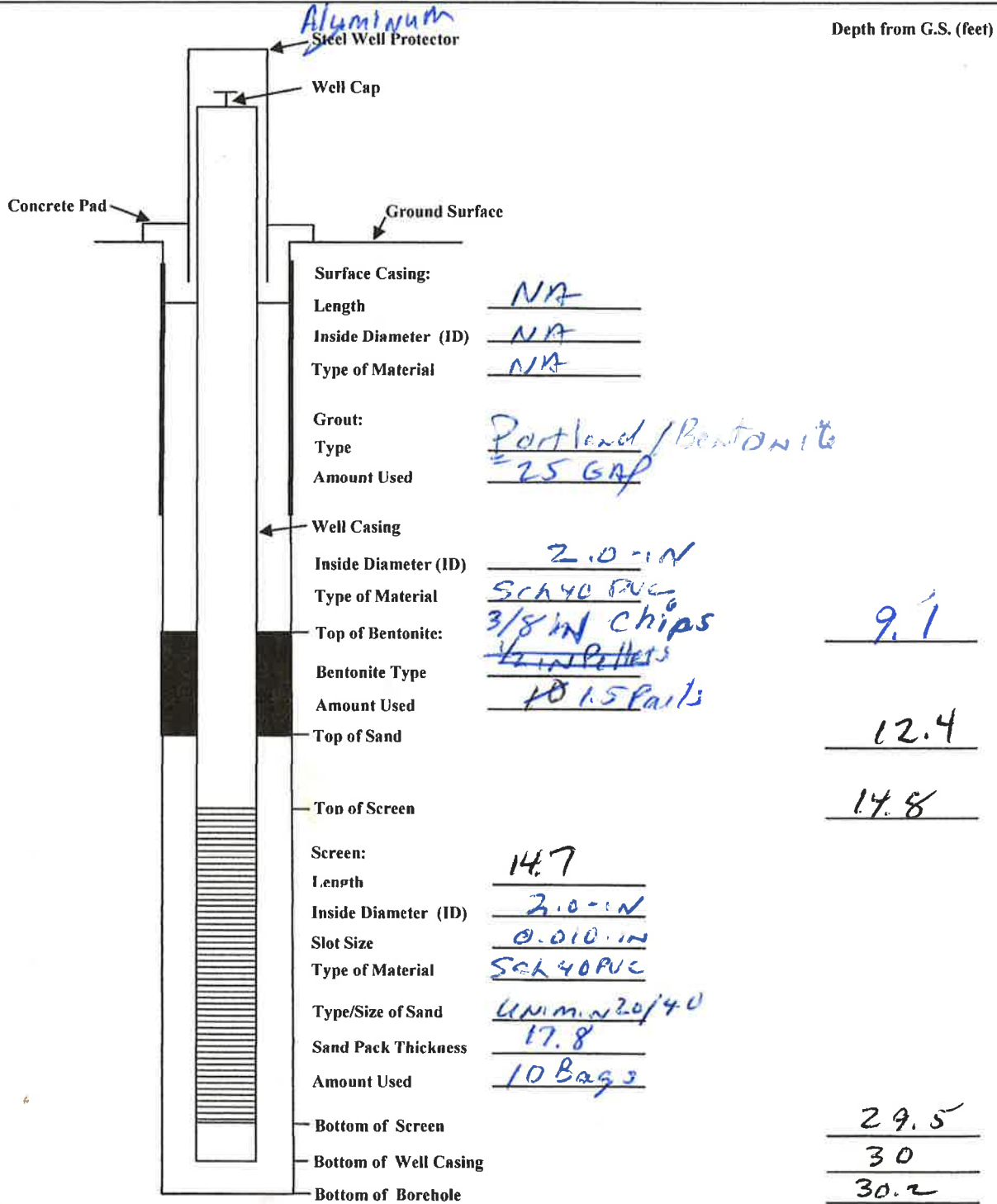
CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
<b>2in</b>	<b>new</b>	<b>pvc screen</b>	<b>40ft to 22.2ft .010 slot</b>
<b>2in</b>	<b>new</b>	<b>pvc riser</b>	<b>22.2 to 0</b>

**AECOM**

Client: <u>USACE</u>	WELL ID: <u>35AWW14</u>
Project Number: <u>60256135</u>	Date Installed: <u>8-24-13</u>
Site Location: <u>SIG 58</u>	Borehole Diameter: <u>8</u>
Well Location: _____ Coords: _____	Contractor: <u>FUGRO</u>
Method: <u>HSA</u>	

**MONITORING WELL CONSTRUCTION DETAIL**



Borehole Diameter: 8-IN

Comments: 30-35 Interval was dug  
IN 58 DPT 17

Installation Observed By: HARTFORD

## STATE OF TEXAS WELL REPORT for Tracking #352630

Owner:	Longhorn AAP- USACE	Owner Well #:	35AWW14
Address:	Highway 43 Karnack , TX 75661	Grid #:	35-23-6
Well Location:	Highway 43 Karnavck , TX 75661	Latitude:	32° 41' 07" N
Well County:	Harrison	Longitude:	094° 09' 18" W
Elevation:	216 ft.	GPS Brand Used:	No Data
<hr/>			
Type of Work:	New Well	Proposed Use:	Monitor

Drilling Date: Started: **8/24/2013**  
Completed: **8/24/2013**

Diameter of Hole: Diameter: **8 in From Surface To 30.2 ft**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: Gravel Packed From: **30.2 ft to 12.4 ft**  
Gravel Pack Size: **20/40**

Annular Seal Data: 1st Interval: **From 30.2 ft to 12.4 ft with 10 20/40 sand (#sacks and material)**  
2nd Interval: **From 12.4 ft to 9.1 ft with 1.5 Bentonite (#sacks and material)**  
3rd Interval: **From 9.1 ft to 0 ft with 2 Portland (#sacks and material)**  
Method Used: **Tremie**  
Cemented By: **Donald Edwards**  
Distance to Septic Field or other Concentrated Contamination: **No Data**  
Distance to Property Line: **No Data**  
Method of Verification: **No Data**  
Approved by Variance: **No Data**

Surface Completion: **Surface Slab Installed**

Water Level: Static level: **No Data**  
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**  
Depth of Strata: **No Data**  
Chemical Analysis Made: **No Data**  
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **Fugro**  
**6105 Rookin St**  
**Houston , TX 77074**

Driller License Number: **56013**

Licensed Well Driller Signature: **Donald Edwards**

Registered Driller Apprentice Signature: **No Data**


Apprentice Registration Number: **No Data**

Comments: **No Data**

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Please include the report's Tracking number (Tracking #352630) on your written request.

**Texas Department of Licensing & Regulation**  
**P.O. Box 12157**  
**Austin, TX 78711**  
**(512) 463-7880** 

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description  
**Gray /Brown clay with layers of sand**

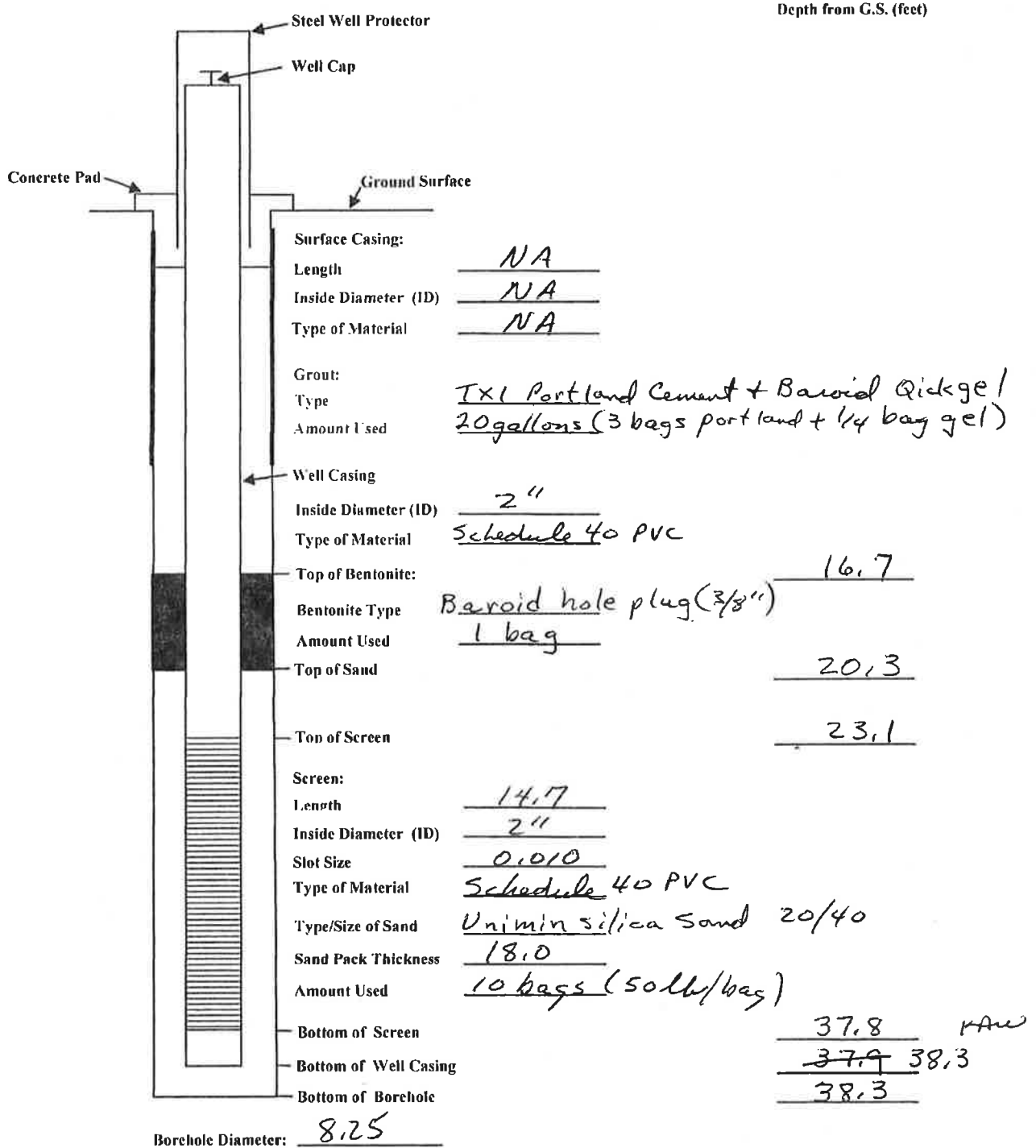
CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To  
**2in new pvc screen 30ft to 14.8ft .010 slot**  
**2in new pvc casing 14.8ft to 0**

**AZCOM**

Client: <u>USACE</u>	WELL ID: <u>35A WW15</u>
Project Number: <u>60256135</u>	Date Installed: <u>8/25/13</u>
Site Location: <u>SITE 58</u>	Borehole Diameter: <u>8.25</u>
Well Location: _____ Coords: _____	Contractor: <u>Fugro</u>
Method: <u>HSA CME 75</u>	

**MONITORING WELL CONSTRUCTION DETAIL**



Comments: \_\_\_\_\_

Installation Observed By: KAW

## STATE OF TEXAS WELL REPORT for Tracking #352631

Owner:	<b>Longhorn AAP-USACE</b>	Owner Well #:	<b>35AWW15</b>
Address:	<b>Highway 43 Karnack , TX 75661</b>	Grid #:	<b>35-23-6</b>
Well Location:	<b>Highway 43 Karnack , TX 75661</b>	Latitude:	<b>32° 41' 06" N</b>
Well County:	<b>Harrison</b>	Longitude:	<b>094° 09' 17" W</b>
Elevation:	<b>218 ft.</b>	GPS Brand Used:	<b>No Data</b>
<hr/>			
Type of Work:	<b>New Well</b>	Proposed Use:	<b>Monitor</b>

Drilling Date:      Started: **8/25/2013**  
                          Completed: **8/25/2013**

Diameter of Hole:    Diameter: **8 in From Surface To 38.3 ft**

Drilling Method:    **Hollow Stem Auger**

Borehole  
Completion:          Gravel Packed From: **38.3 ft to 20.3 ft**  
                                  Gravel Pack Size: **20/40**

Annular Seal Data:    1st Interval: **From 38.3 ft to 20.3 ft with 10 sand (#sacks and material)**  
                                  2nd Interval: **From 20.3 ft to 16.7 ft with 1 bentonite (#sacks and material)**  
                                  3rd Interval: **From 16.7 ft to 0 ft with 3 Portland (#sacks and material)**  
                                  Method Used: **Tremie**  
                                  Cemented By: **Donald Edwards**  
                                  Distance to Septic Field or other Concentrated Contamination: **No Data**  
                                  Distance to Property Line: **No Data**  
                                  Method of Verification: **No Data**  
                                  Approved by Variance: **No Data**

Surface  
Completion:          **Surface Slab Installed**

---

Water Level:          Static level: **30 ft. below land surface on 8/25/2013**  
                                  Artesian flow: **No Data**

Packers:              **No Data**

Plugging Info:        Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump:        **No Data**

Well Tests:            **No Data**

---

Water Quality:        Type of Water: **No Data**  
                                  Depth of Strata: **No Data**  
                                  Chemical Analysis Made: **No Data**  
                                  Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**

Certification Data:    The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company  
Information:            **Fugro**  
                                  **6105 Rookin St**  
                                  **Houston , TX 77074**

Driller License  
Number:                **56013**



Licensed Well Driller Signature: **Donald Edwards**

Registered Driller Apprentice Signature: **No Data**

Apprentice Registration Number: **No Data**


Comments: **No Data**

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**Texas Department of Licensing & Regulation**  
**P.O. Box 12157**  
**Austin, TX 78711**  
**(512) 463-7880** 

---

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description  
**Gray / Brown clay with layers of sand**

---

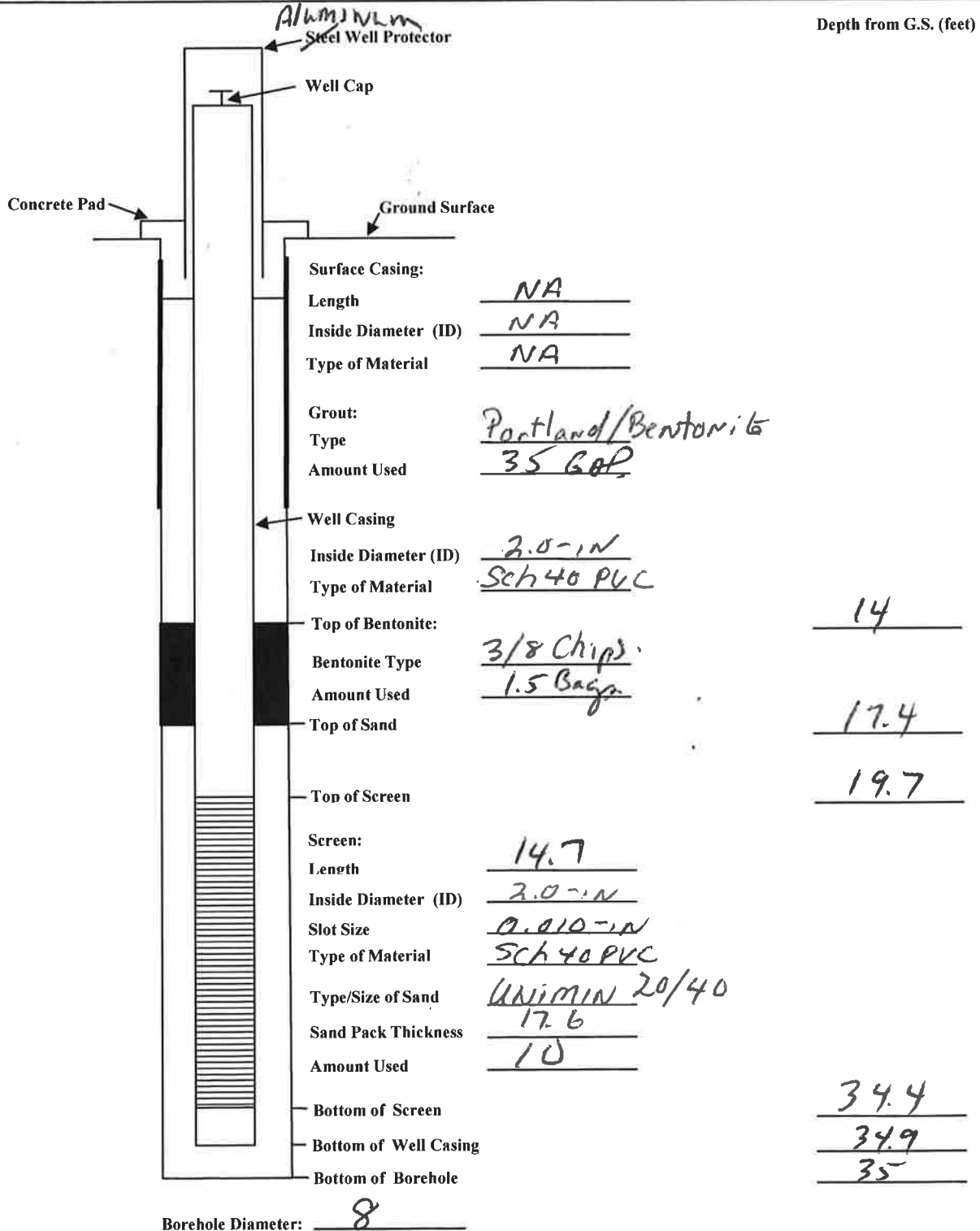
CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
2in	new	pvc screen	37.8ft to 23.1ft .010 slot
2in	new	pvc casing	23.1ft to 0

**AECOM**

Client: <u>USACE</u>	WELL ID: <u>35AWW16</u>
Project Number: <u>60256135</u>	Date Installed: <u>8-26-13</u>
Site Location: <u>Site 58</u>	Borehole Diameter: <u>8</u>
Well Location: _____ Coords: _____	Contractor: <u>FUGRO</u>
Method: <u>HSA</u>	

**MONITORING WELL CONSTRUCTION DETAIL**



Comments: \_\_\_\_\_

Installation Observed By: HARTFORD

## STATE OF TEXAS WELL REPORT for Tracking #352638

Owner:	<b>Longhorn AAP-USACE</b>	Owner Well #:	<b>35AWW16</b>
Address:	<b>Highway 43 Karnack , TX 75661</b>	Grid #:	<b>35-23-6</b>
Well Location:	<b>Highway 43 Karnack , TX 75661</b>	Latitude:	<b>32° 41' 08" N</b>
Well County:	<b>Harrison</b>	Longitude:	<b>094° 09' 25" W</b>
Elevation:	<b>219 ft.</b>	GPS Brand Used:	<b>No Data</b>
<hr/>			
Type of Work:	<b>New Well</b>	Proposed Use:	<b>Monitor</b>

Drilling Date:      Started: **8/26/2013**  
                          Completed: **8/26/2013**

Diameter of Hole:    Diameter: **8 in From Surface To 35 ft**

Drilling Method:    **Hollow Stem Auger**

Borehole  
 Completion:        Gravel Packed From: **35 ft to 17.4 ft**  
                          Gravel Pack Size: **20/40**

Annular Seal Data:   1st Interval: **From 35 ft to 17.4 ft with 10 sand (#sacks and material)**  
                          2nd Interval: **From 17.4 ft to 14 ft with 1.5 bentonite (#sacks and material)**  
                          3rd Interval: **From 14 ft to 0 ft with 3 Portland (#sacks and material)**  
                          Method Used: **Tremie**  
                          Cemented By: **Donlad EDwards**  
                          Distance to Septic Field or other Concentrated Contamination: **No Data**  
                          Distance to Property Line: **No Data**  
                          Method of Verification: **No Data**  
                          Approved by Variance: **No Data**

Surface  
 Completion:        **Surface Slab Installed**

---

Water Level:        Static level: **No Data**  
                          Artesian flow: **No Data**

Packers:            **No Data**

Plugging Info:     Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump:     **No Data**

Well Tests:         **No Data**

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Water Quality:     Type of Water: **No Data**  
                          Depth of Strata: **No Data**  
                          Chemical Analysis Made: **No Data**  
                          Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**

Certification Data:   The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company  
 Information:        **Fugro**  
                          **6105 Rookin St**  
                          **Houston , TX 77074**

Driller License  
 Number:            **56013**

Licensed Well Driller Signature: **Donald Edwards**

Registered Driller Apprentice Signature: **No Data**


Apprentice Registration Number: **No Data**

Comments: **No Data**

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**Texas Department of Licensing & Regulation**  
**P.O. Box 12157**  
**Austin, TX 78711**  
**(512) 463-7880** 

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description  
**Gray / Brown clay with layers of sand**

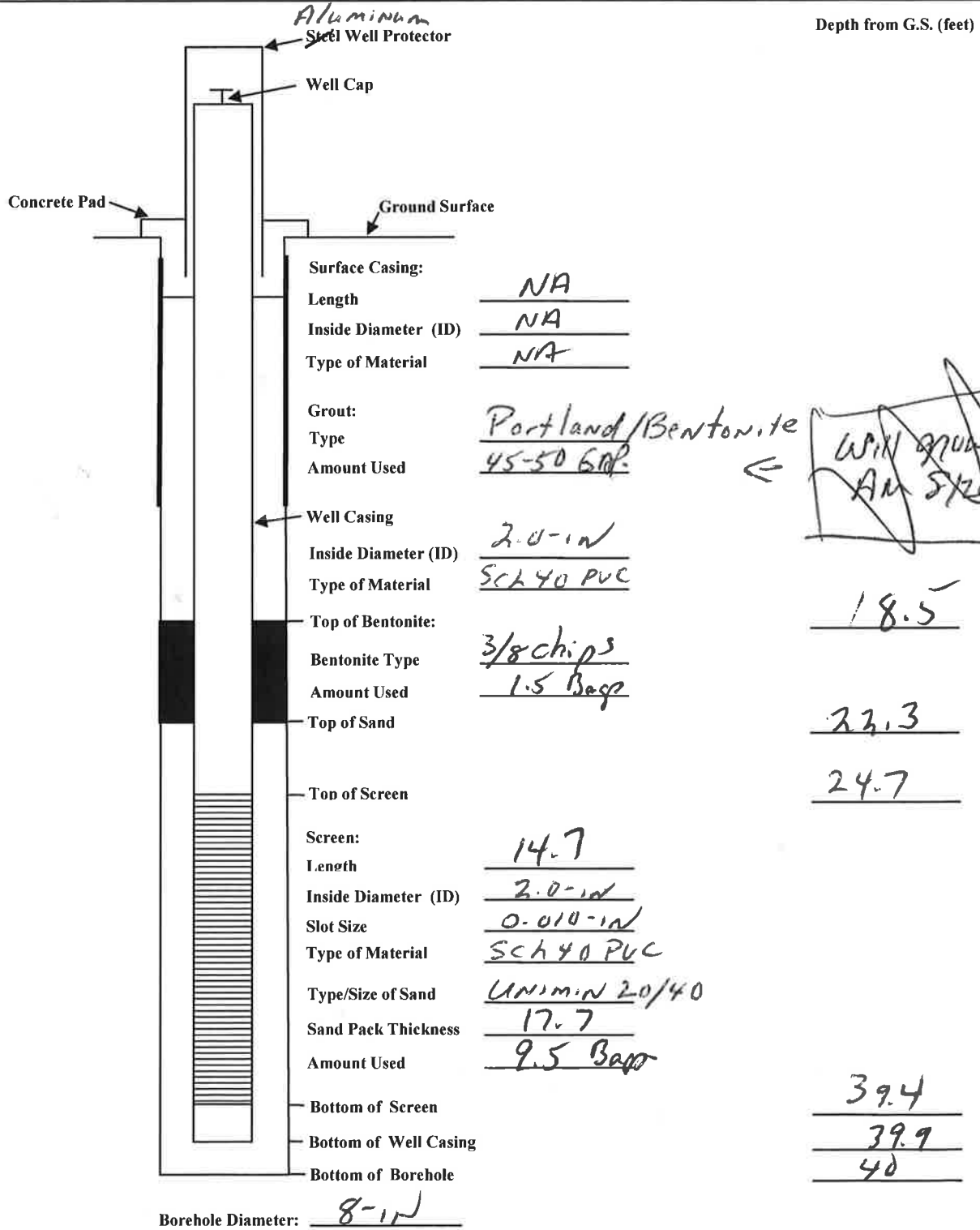
CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
2in	new	pvc screen	34.9ft to 19.7ft .010 slot
2in	new	pvc casing	19.7ft to 0

58DPT14

<b>AECOM</b>	Client: <u>USACE</u>	WELL ID: <u>35AWW17</u>
	Project Number: <u>60256135</u>	Date Installed: <u>8/25/13</u>
	Site Location: <u>Site 58</u>	Borehole Diameter: <u>8-in</u>
	Well Location: _____ Coords: _____	Contractor: <u>FUGRU</u>
	Method: <u>HSN</u>	

**MONITORING WELL CONSTRUCTION DETAIL**



WIN QUANT W  
AM 5/25/13

Comments: \_\_\_\_\_

Installation Observed By: HARTFORD

## STATE OF TEXAS WELL REPORT for Tracking #352642

Owner: <b>Longhorn AAP-USACE</b>	Owner Well #: <b>35AWW17</b>
Address: <b>Highway 43 Karnack , TX 75661</b>	Grid #: <b>35-23-6</b>
Well Location: <b>Highway 43 Karnack , TX 75661</b>	Latitude: <b>32° 41' 04" N</b>
Well County: <b>Harrison</b>	Longitude: <b>094° 09' 24" W</b>
Elevation: <b>219 ft.</b>	GPS Brand Used: <b>No Data</b>
<hr/>	
Type of Work: <b>New Well</b>	Proposed Use: <b>Monitor</b>

Drilling Date: Started: **8/25/2013**  
Completed: **8/25/2013**

Diameter of Hole: Diameter: **8 in From Surface To 40 ft**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: Gravel Packed From: **40 ft to 22.3 ft**  
Gravel Pack Size: **20/40**

Annular Seal Data: 1st Interval: **From 40 ft to 22.3 ft with 9.5 sand (#sacks and material)**  
2nd Interval: **From 22.3 ft to 18.5 ft with 1.5 bentonite (#sacks and material)**  
3rd Interval: **From 18.5 ft to 0 ft with 3 Portland (#sacks and material)**  
Method Used: **Tremie**  
Cemented By: **Donald Edwards**  
Distance to Septic Field or other Concentrated Contamination: **No Data**  
Distance to Property Line: **No Data**  
Method of Verification: **No Data**  
Approved by Variance: **No Data**

Surface Completion: **Surface Slab Installed**

Water Level: Static level: **No Data**  
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**  
Depth of Strata: **No Data**  
Chemical Analysis Made: **No Data**  
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **Fugro**  
**6105 Rookin St**  
**Houston , TX 77407**

Driller License Number: **56013**



Licensed Well Driller Signature: **Donald Edwards**

Registered Driller Apprentice Signature: **No Data**

Apprentice Registration Number: **No Data**


Comments: **No Data**

---

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**Texas Department of Licensing & Regulation**  
**P.O. Box 12157**  
**Austin, TX 78711**  
**(512) 463-7880** 

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DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description  
**Gray / Brown clay with layers of sand**

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CASING, BLANK PIPE & WELL SCREEN DATA

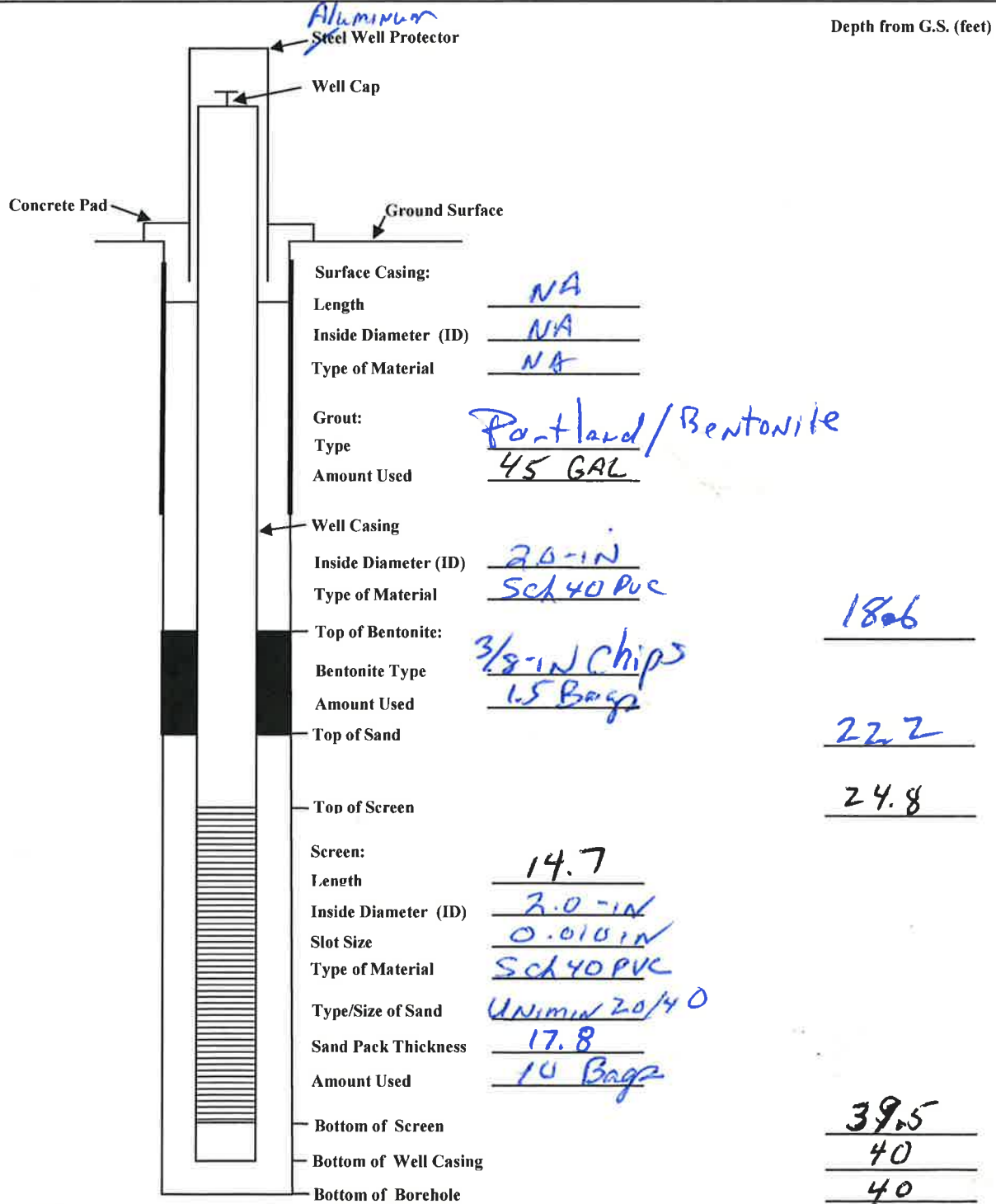
Dia.	New/Used	Type	Setting From/To
<b>2in</b>	<b>new</b>	<b>pvc screen</b>	<b>39.9ft to 24.7ft .010 slot</b>
<b>2in</b>	<b>new</b>	<b>pvc casing</b>	<b>24.7 to 0</b>

58DPT25

**AECOM**

Client: <u>USACE</u>	WELL ID: <u>35AWW18</u>
Project Number: <u>60256135</u>	Date Installed: <u>8-24-13 8-25-13</u>
Site Location: <u>S. 4-58</u>	Borehole Diameter: <u>8-IN</u>
Well Location: _____	Coords: _____
Method: <u>HSA</u>	Contractor: <u>FUGRO</u>

**MONITORING WELL CONSTRUCTION DETAIL**



Borehole Diameter: 8-IN

Comments: \_\_\_\_\_

Installation Observed By: M. Hartford

## STATE OF TEXAS WELL REPORT for Tracking #352646

Owner: <b>Longhorn AAP-USACE</b>	Owner Well #: <b>35AWW18</b>
Address: <b>Highway 43 Karnack , TX 75661</b>	Grid #: <b>35-23-6</b>
Well Location: <b>Highway 43 Karnack , TX 75661</b>	Latitude: <b>32° 41' 05" N</b>
Well County: <b>Harrison</b>	Longitude: <b>094° 09' 22" W</b>
Elevation: <b>220 ft.</b>	GPS Brand Used: <b>No Data</b>
<hr/>	
Type of Work: <b>New Well</b>	Proposed Use: <b>Monitor</b>

Drilling Date: Started: **8/24/2013**  
Completed: **8/25/2013**

Diameter of Hole: Diameter: **8 in From Surface To 40 ft**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: Gravel Packed From: **40 ft to 22.2 ft**  
Gravel Pack Size: **20/40**

Annular Seal Data: 1st Interval: **From 40 ft to 22.2 ft with 10 sand (#sacks and material)**  
2nd Interval: **From 22.2 ft to 18.6 ft with 1.5 bentonite (#sacks and material)**  
3rd Interval: **From 18.6 ft to 0 ft with 3 Portland (#sacks and material)**  
Method Used: **Tremie**  
Cemented By: **Donald Edwards**  
Distance to Septic Field or other Concentrated Contamination: **No Data**  
Distance to Property Line: **No Data**  
Method of Verification: **No Data**  
Approved by Variance: **No Data**

Surface Completion: **Surface Slab Installed**

---

Water Level: Static level: **32 ft. below land surface on 8/24/2013**  
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

---

Water Quality: Type of Water: **No Data**  
Depth of Strata: **No Data**  
Chemical Analysis Made: **No Data**  
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **Fugro**  
**6105 Rookin St**  
**Houston , TX 75661**

Driller License Number: **56013**

Licensed Well Driller Signature: **Donald Edwards**

Registered Driller Apprentice Signature: **No Data**


Apprentice Registration Number: **No Data**

Comments: **No Data**

**IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY**

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Please include the report's Tracking number (Tracking #**352646**) on your written request.

**Texas Department of Licensing & Regulation**  
**P.O. Box 12157**  
**Austin, TX 78711**  
**(512) 463-7880** 

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description  
**Gray / Brown clay with layers of sand**

CASING, BLANK PIPE & WELL SCREEN DATA

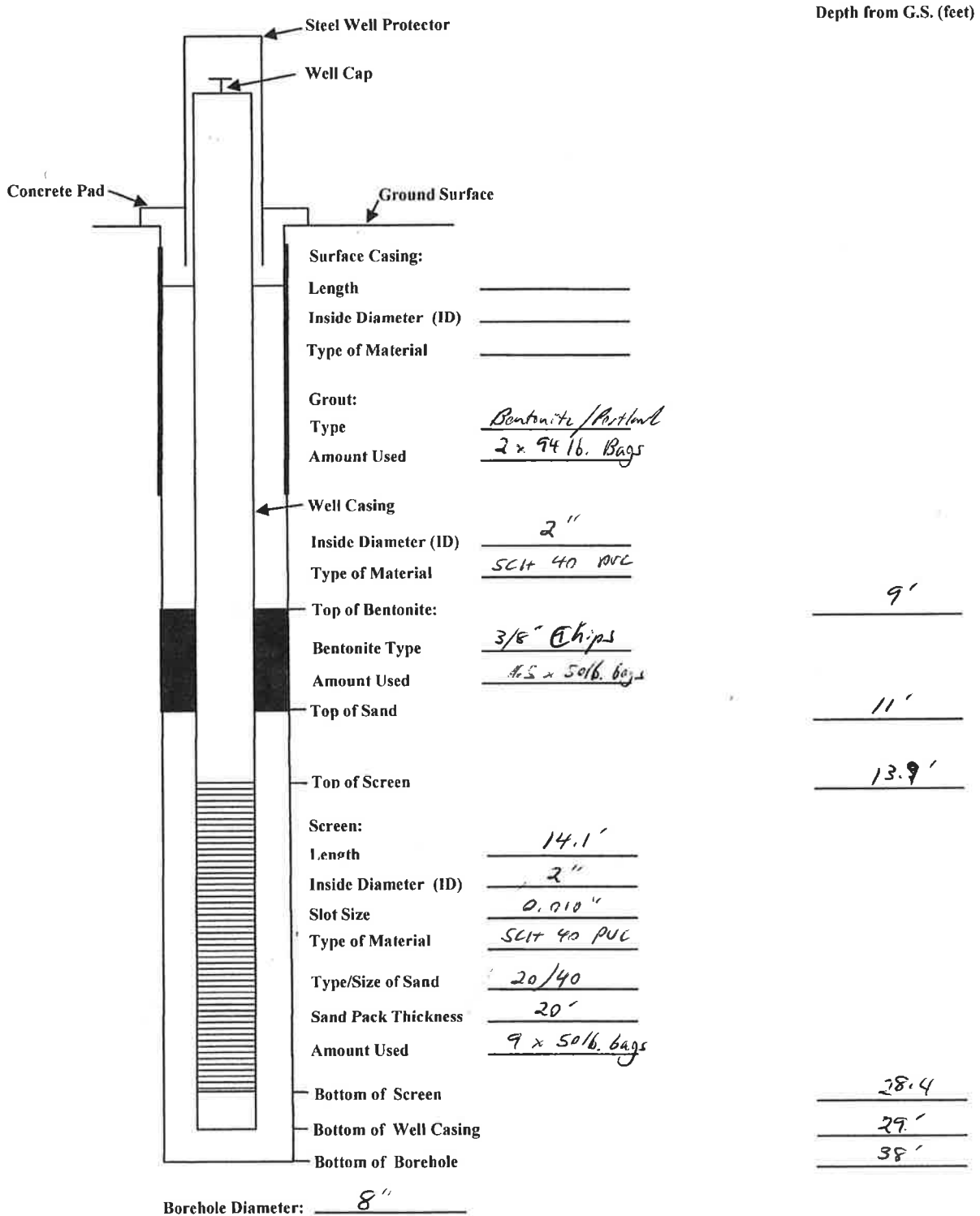
Dia.	New/Used	Type	Setting From/To
2in	new	pvc screen	39.5ft to 24.8ft .010 slot
2in	new	pvc casing	24.8ft to 0

**AZCOM**

Client: USACE  
 Project Number: 60258135  
 Site Location: Site 58  
 Well Location: \_\_\_\_\_ Coords: \_\_\_\_\_  
 Method: HSA

WELL ID: 90 3SAWW19  
 Date Installed: 9/19/13  
 Borehole Diameter: 8"  
 Contractor: Fygro

**MONITORING WELL CONSTRUCTION DETAIL**



Comments:

Back-filled w/ Bentonite chips from 28' to 31' Bgs  
Filter sand from 31' to 11' Bgs

Installation Observed By:

Mr. Law

## STATE OF TEXAS WELL REPORT for Tracking #352655

Owner: <b>Longhorn AAP-USACE</b>	Owner Well #: <b>35AWW19</b>
Address: <b>Highway 43 Houston , TX 75661</b>	Grid #: <b>35-23-6</b>
Well Location: <b>Highway 43 Karnack , TX 75661</b>	Latitude: <b>32° 41' 04" N</b>
Well County: <b>Harrison</b>	Longitude: <b>094° 09' 18" W</b>
Elevation: <b>217 ft.</b>	GPS Brand Used: <b>No Data</b>
<hr/>	
Type of Work: <b>New Well</b>	Proposed Use: <b>Monitor</b>

Drilling Date: Started: **9/19/2013**  
Completed: **9/19/2013**

Diameter of Hole: Diameter: **8 in From Surface To 38 ft**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: Gravel Packed From: **38 ft to 11 ft**  
Gravel Pack Size: **20/40**

Annular Seal Data: 1st Interval: **From 38 ft to 11 ft with 9 sand (#sacks and material)**  
2nd Interval: **From 11 ft to 9 ft with 1 bentonite (#sacks and material)**  
3rd Interval: **From 9 ft to 0 ft with 2 Portland (#sacks and material)**  
Method Used: **Tremie**  
Cemented By: **Donald Edwards**  
Distance to Septic Field or other Concentrated Contamination: **No Data**  
Distance to Property Line: **No Data**  
Method of Verification: **No Data**  
Approved by Variance: **No Data**

Surface Completion: **Surface Slab Installed**

---

Water Level: Static level: **No Data**  
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

---

Water Quality: Type of Water: **No Data**  
Depth of Strata: **No Data**  
Chemical Analysis Made: **No Data**  
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **Fugro  
6105 Rookin St  
Houston , TX 77074**

Driller License Number: **56013**



Licensed Well Driller Signature: **Donald Edwards**

Registered Driller Apprentice Signature: **No Data**


Apprentice Registration Number: **No Data**

Comments: **No Data**

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**Texas Department of Licensing & Regulation**  
**P.O. Box 12157**  
**Austin, TX 78711**  
**(512) 463-7880** 

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description  
**0 to 38ft Gray / Brown clay with layers of sand**

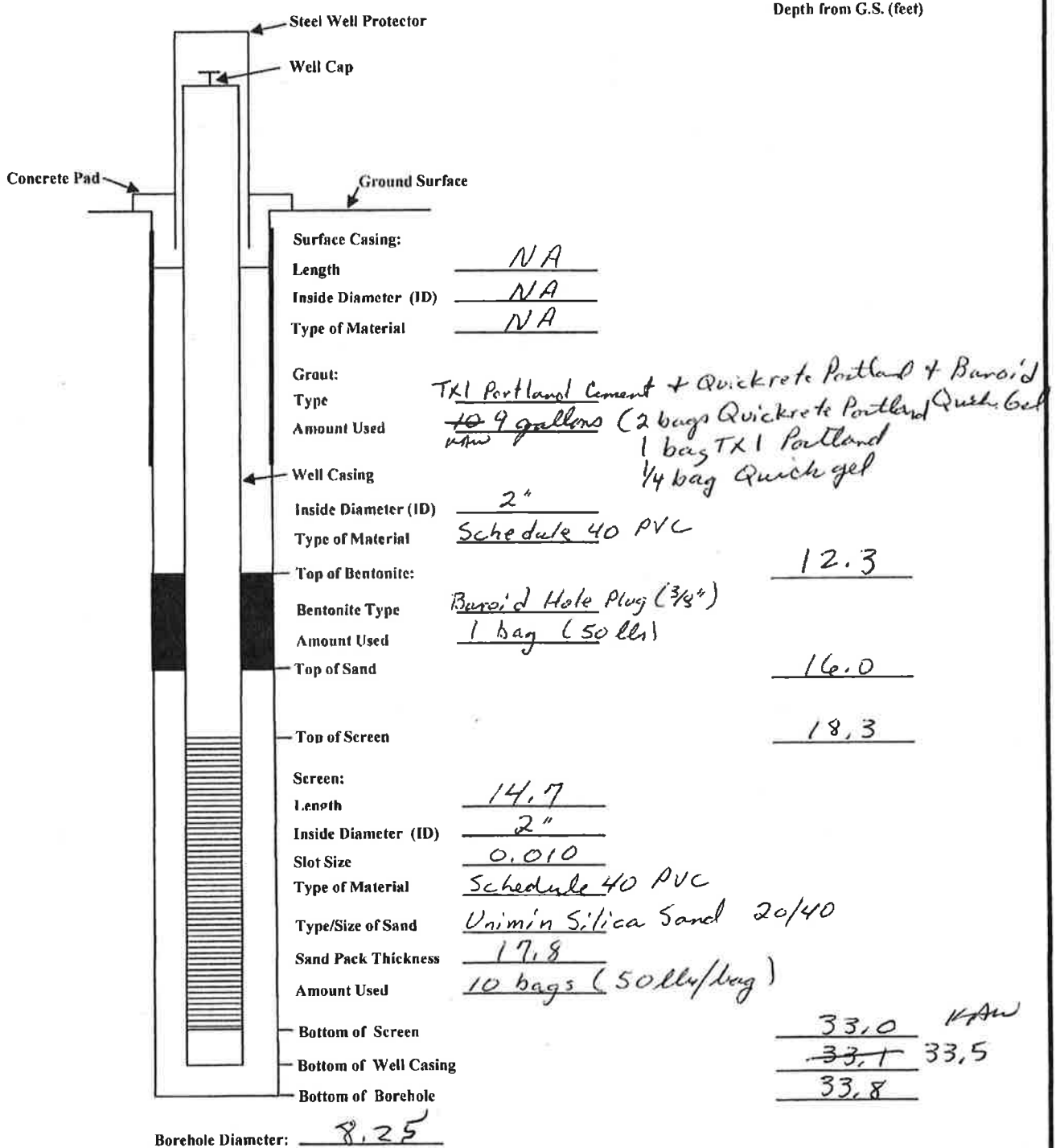
CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
2in	new	pvc screen	28.4ft to 13.9ft .010 slot
2in	new	pvc casing	13.9 to 0

**AZCOM**

Client: <u>USACE</u>	WELL ID: <u>35AWW20</u>
Project Number: <u>60256135</u>	Date Installed: <u>8/26/13</u>
Site Location: <u>SITE 58</u>	Borehole Diameter: <u>8.25</u>
Well Location: _____ Coords: _____	Contractor: <u>FUBRO</u>
Method: <u>HSA CME 75</u>	

**MONITORING WELL CONSTRUCTION DETAIL**



Comments: \_\_\_\_\_

Installation Observed By: Kurt Webber

## STATE OF TEXAS WELL REPORT for Tracking #352673

Owner: <b>Longhorn AAP-USACE</b>	Owner Well #: <b>35AWW20</b>
Address: <b>Highway 43 Karnack , TX 75661</b>	Grid #: <b>35-23-6</b>
Well Location: <b>Highway 43 Karnack , TX 75661</b>	Latitude: <b>32° 41' 08" N</b>
Well County: <b>Harrison</b>	Longitude: <b>094° 09' 23" W</b>
Elevation: <b>220 ft.</b>	GPS Brand Used: <b>No Data</b>
<hr/>	
Type of Work: <b>New Well</b>	Proposed Use: <b>Monitor</b>

Drilling Date: Started: **8/26/2013**  
Completed: **8/26/2013**

Diameter of Hole: Diameter: **8 in From Surface To 33.80 ft**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: Gravel Packed From: **33.8 ft to 16.0 ft**  
Gravel Pack Size: **20/40**

Annular Seal Data: 1st Interval: **From 33.8 ft to 16 ft with 10 sand (#sacks and material)**  
2nd Interval: **From 16 ft to 12.3 ft with 1 bentonite (#sacks and material)**  
3rd Interval: **From 12.3 ft to 0 ft with 2 Portland (#sacks and material)**  
Method Used: **Tremie**  
Cemented By: **Donald Edwards**  
Distance to Septic Field or other Concentrated Contamination: **No Data**  
Distance to Property Line: **No Data**  
Method of Verification: **No Data**  
Approved by Variance: **No Data**

Surface Completion: **Surface Slab Installed**

---

Water Level: Static level: **22.5 ft. below land surface on 8/26/2013**  
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

---

Water Quality: Type of Water: **No Data**  
Depth of Strata: **No Data**  
Chemical Analysis Made: **No Data**  
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **Fugro  
6105 Rookin St  
Houston , TX 77074**

Driller License Number: **56013**

Licensed Well Driller Signature: **Donald Edwards**

Registered Driller Apprentice Signature: **No Data**

Apprentice Registration Number: **No Data**


Comments: **No Data**

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**Texas Department of Licensing & Regulation**  
**P.O. Box 12157**  
**Austin, TX 78711**  
**(512) 463-7880** 

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DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description  
**0 to 33.8ft Gray /Brown clay with layers of sand**

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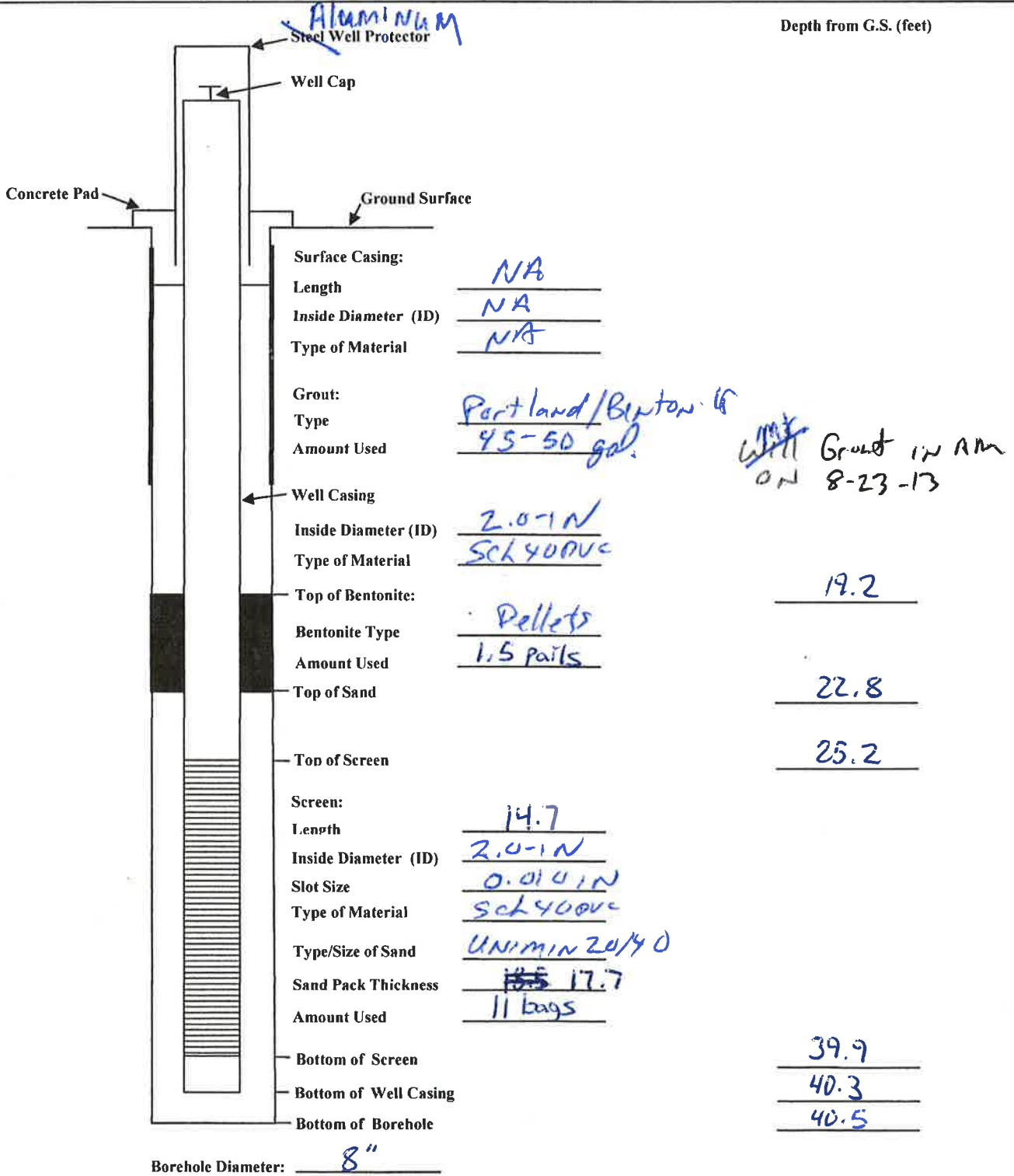
CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
<b>2in</b>	<b>new</b>	<b>pvc screen</b>	<b>33.8ft to 18.3ft .010 slot</b>
<b>2in</b>	<b>new</b>	<b>pvc casing</b>	<b>18.3ft to 0</b>

**A-2-COM**

Client: <u>USACE</u>	WELL ID: <u>35AWW21</u>
Project Number: <u>60256135</u>	Date Installed: <u>8-22-13</u>
Site Location: <u>SIG 58</u>	Borehole Diameter: <u>8" IN</u>
Well Location: _____ Coords: _____	Contractor: <u>FUGRO</u>
Method: <u>HSA</u>	

**MONITORING WELL CONSTRUCTION DETAIL**



Comments: \_\_\_\_\_

Installation Observed By: Hartford

## STATE OF TEXAS WELL REPORT for Tracking #352675

Owner:	Longhorn AAP- USACE	Owner Well #:	35AWW21
Address:	Highway 43 Karnack , TX 75661	Grid #:	35-23-6
Well Location:	Highway 43 Karnack , TX 75661	Latitude:	32° 41' 08" N
Well County:	Harrison	Longitude:	094° 09' 12" W
Elevation:	217 ft.	GPS Brand Used:	No Data
<hr/>			
Type of Work:	New Well	Proposed Use:	Monitor

Drilling Date: Started: **8/22/2013**  
Completed: **8/22/2013**

Diameter of Hole: Diameter: **(No Data) in From Surface To 40.5 ft**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: Gravel Packed From: **40.5 ft to 22.8 ft**  
Gravel Pack Size: **20/40**

Annular Seal Data: 1st Interval: **From 40.5 ft to 22.8 ft with 11 sand (#sacks and material)**  
2nd Interval: **From 22.8 ft to 19.2 ft with 1.5 Bentonite (#sacks and material)**  
3rd Interval: **From 19.2 ft to 0 ft with 3 Portland (#sacks and material)**  
Method Used: **Tremie**  
Cemented By: **Donald Edwards**  
Distance to Septic Field or other Concentrated Contamination: **No Data**  
Distance to Property Line: **No Data**  
Method of Verification: **No Data**  
Approved by Variance: **No Data**

Surface Completion: **Surface Slab Installed**

---

Water Level: Static level: **No Data**  
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

---

Water Quality: Type of Water: **No Data**  
Depth of Strata: **No Data**  
Chemical Analysis Made: **No Data**  
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **Fugro**  
**6105 Rookin St**  
**Houston , TX 77407**

Driller License Number: **56013**



Licensed Well Driller Signature: **Donald Edwards**

Registered Driller Apprentice Signature: **No Data**


Apprentice Registration Number: **No Data**

Comments: **No Data**

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**P.O. Box 12157**  
**Austin, TX 78711**  
**(512) 463-7880** 

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description  
**0 to 40.5ft Gray/Brown clay with layers of sand**

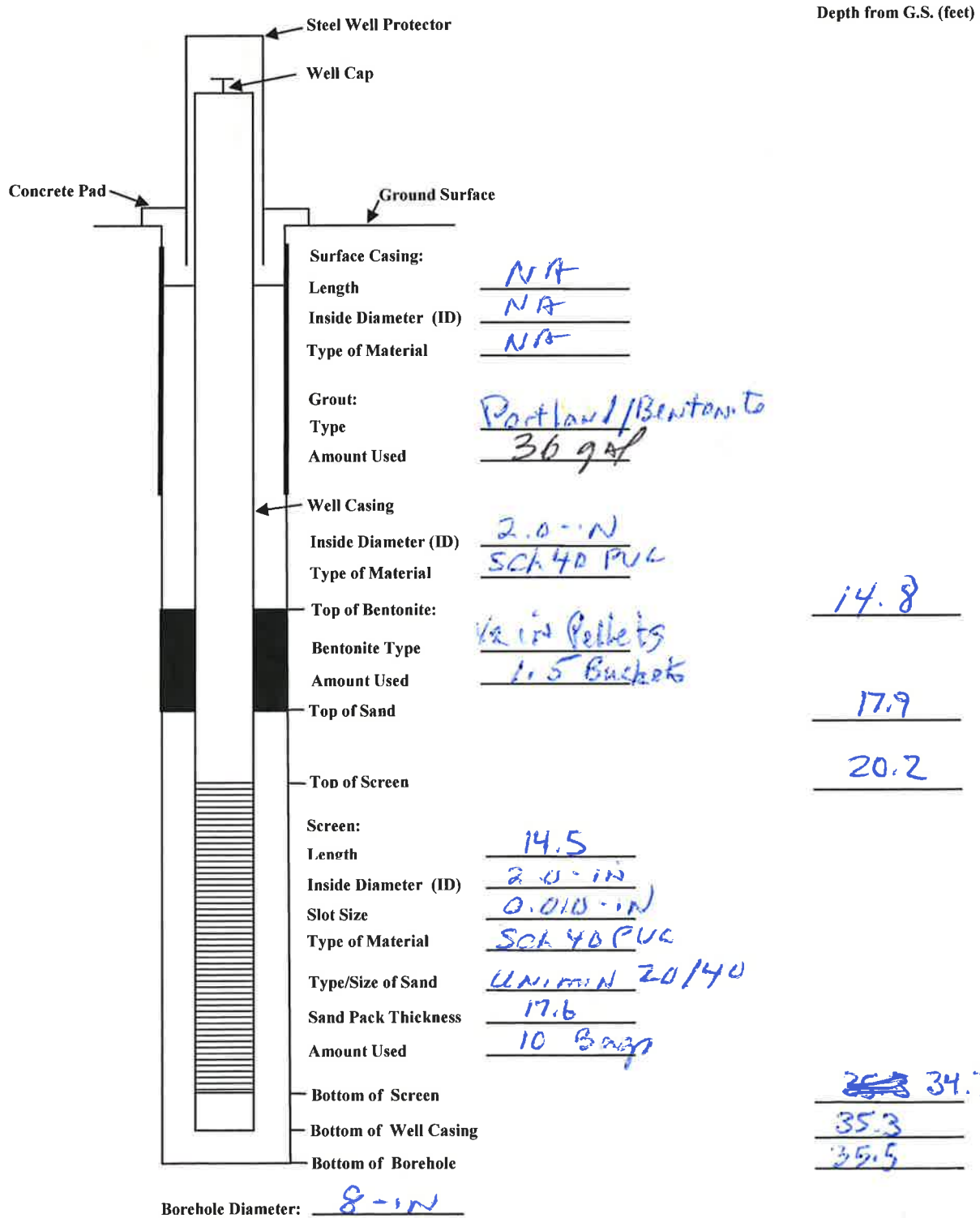
CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
2in	new	pvc screen	39.9ft to 25.2ft .010 slot
2in	new	casing	25.2ft to 0

**AECOM**

Client: <u>USACE</u>	WELL ID: <u>35AWW22</u>
Project Number: <u>60256135</u>	Date Installed:
Site Location: <u>S.O 58</u>	Borehole Diameter: <u>8-IN</u>
Well Location: <u>S10 58</u> Coords:	Contractor: <u>FUGRU</u>
Method: <u>HSA</u>	

**MONITORING WELL CONSTRUCTION DETAIL**



Comments:

Installation Observed By:

M. Hartford

## STATE OF TEXAS WELL REPORT for Tracking #352681

Owner: <b>Longhorn AAP-USACE</b>	Owner Well #: <b>35AWW22</b>
Address: <b>Highway 43 Karnack , TX 75661</b>	Grid #: <b>35-23-6</b>
Well Location: <b>Highway 43 Karnack , TX 75661</b>	Latitude: <b>32° 41' 11" N</b>
Well County: <b>Harrison</b>	Longitude: <b>094° 09' 12" W</b>
Elevation: <b>217 ft.</b>	GPS Brand Used: <b>No Data</b>
<hr/>	
Type of Work: <b>New Well</b>	Proposed Use: <b>Monitor</b>

Drilling Date: Started: **8/21/2013**  
Completed: **8/21/2013**

Diameter of Hole: Diameter: **8 in From Surface To 35.5 ft**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: Gravel Packed From: **35.5 ft to 17.9 ft**  
Gravel Pack Size: **20/40**

Annular Seal Data: 1st Interval: **From 35.5 ft to 17.9 ft with 10 sand (#sacks and material)**  
2nd Interval: **From 17.9 ft to 14.8 ft with 1.5 Bentonite (#sacks and material)**  
3rd Interval: **From 14.8 ft to 0 ft with 3 Portland (#sacks and material)**  
Method Used: **Tremie**  
Cemented By: **Donald Edwards**  
Distance to Septic Field or other Concentrated Contamination: **No Data**  
Distance to Property Line: **No Data**  
Method of Verification: **No Data**  
Approved by Variance: **No Data**

Surface Completion: **Surface Slab Installed**

---

Water Level: Static level: **No Data**  
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

---

Water Quality: Type of Water: **No Data**  
Depth of Strata: **No Data**  
Chemical Analysis Made: **No Data**  
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **Fugro**  
**6105 Rookin St**  
**Houston , TX 77407**

Driller License Number: **56013**

Licensed Well Driller Signature: **Donald Edwards**

Registered Driller Apprentice Signature: **No Data**


Apprentice Registration Number: **No Data**

Comments: **No Data**

**IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY**

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**Texas Department of Licensing & Regulation**  
**P.O. Box 12157**  
**Austin, TX 78711**  
**(512) 463-7880** 

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description  
**0 to 35.5ft Gray clay with layers of sand.**

CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
2in	new	pvc screen	39.7ft to 20.2ft .010 slot
2in	new	pvc casing	20.2ft to 0

## MONITORING WELL DEVELOPMENT FORM

<b>LOCATION</b>	Site: <u>58</u>	LocID: <u>35AWW07R</u>	Date: <u>9-4-13</u>								
	Project Name: Longhorn Army Ammunition Plant	Project #:	Recorded By: <u>RC:RO</u> Checked By:								
<b>EQUIPMENT</b>	Water Quality Meter Type/ID #: <u>Horiba 4-52 # 21191</u>	Water Level Indicator Type/ID #: <u>Solist # 212050</u>									
	Equipment Group:	Equipment Group:									
	Development Equipment: <u>Monsoon System # 023834</u>	Equipment Decon: <u>Alexor DI / DI Rinse</u>									
<b>WELL INFO</b>	Casing I.D. (in) [a]: <u>2"</u>	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: <u>26.95</u>								
	Total Well Depth (ft) [d]: <u>32.15 + .29 = 32.43</u>	Water Column Thickness (ft) [d-c]: <u>5.20</u>	Well Volume (gal) [(d-c) x b]: <u>0.83</u>								
	Ground Condition of Well: <u>OK / NOT completed</u>	Remarks: <u>Replacement Well</u>									
<b>CASING INFO</b>	Casing I.D. (in) [a]: <u>2"</u>	1.5	<u>2.0</u>	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/lin ft) [b]:	0.09	<u>0.16</u>	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	ORP - Sed. (mV/L)	Radiation ( )	Remarks (odor, clarity, etc.)
<u>9/4/13</u>	<u>1330</u>	<u>Surge</u>	<u>—</u>	<u>—</u>	<u>800 ml/min</u>	<u>25.42</u>	<u>8.32</u>	<u>0.423</u>	<u>4.93</u>	<u>&gt;1000</u>	<u>92</u>		<u>Tan cloudy water / No Flow Cell.</u>
	<u>1348</u>	<u>Bail</u>	<u>—</u>	<u>5 1/2</u>		<u>24.36</u>	<u>8.37</u>	<u>0.330</u>	<u>3.71</u>	<u>&gt;1000</u>	<u>108</u>		<u>No Flow Cell</u>
	<u>1410</u>	<u>Pump</u>	<u>—</u>	<u>10 + 1</u>		<u>28.58</u>	<u>8.46</u>	<u>0.260</u>	<u>2.85</u>	<u>&gt;1000</u>	<u>122</u>		<u>No Flow Cell</u>
	<u>1415</u>		<u>—</u>	<u>—</u>		<u>26.53</u>	<u>8.39</u>	<u>0.244</u>	<u>2.91</u>	<u>&gt;1000</u>	<u>114</u>		<u>" " "</u>
	<u>1420</u>		<u>—</u>	<u>+1.5</u>		<u>25.73</u>	<u>7.25</u>	<u>0.243</u>	<u>1.24</u>	<u>&gt;1000</u>	<u>93</u>		<u>✓ Flow Thru Cell</u>
	<u>1425</u>		<u>—</u>	<u>—</u>		<u>24.28</u>	<u>6.36</u>	<u>0.233</u>	<u>1.07</u>	<u>&gt;1000</u>	<u>86</u>		
	<u>1430</u>		<u>28.02</u>	<u>+2</u>		<u>23.03</u>	<u>6.25</u>	<u>0.234</u>	<u>1.11</u>	<u>623</u>	<u>88</u>		<u>Tan/clearing up.</u>
	<u>1435</u>		<u>—</u>	<u>—</u>		<u>22.80</u>	<u>6.15</u>	<u>0.225</u>	<u>0.96</u>	<u>256</u>	<u>92</u>		
	<u>1440</u>		<u>—</u>	<u>+3</u>		<u>22.87</u>	<u>6.09</u>	<u>0.221</u>	<u>0.84</u>	<u>98.9</u>	<u>91</u>		<u>Turbidity up &amp; down.</u>
	<u>1445</u>		<u>28.14</u>	<u>+1</u>		<u>22.81</u>	<u>6.04</u>	<u>0.219</u>	<u>0.75</u>	<u>43.3</u>	<u>92</u>		
	<u>1450</u>	<u>Finished Development</u>		<u>17.5</u>	<u>800 ml/min</u>								<u>total Volume</u>

**Development Criteria:** 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

## MONITORING WELL DEVELOPMENT FORM

<b>LOCATION</b>	Site: #58	LocID: 35AWW09	Date: 8-27-13								
	Project Name: Longhorn Army Ammunition Plant	Project#: 60256135 -	Recorded By: EC      Checked By:								
<b>EQUIPMENT</b>	Water Quality Meter Type/ID #: Haverba - U52 #21191	Water Level Indicator Type/ID #: S. Limst 212050									
	Equipment Group:	Equipment Group:									
	Development Equipment: Bailler & Monsoon System	Equipment Decon.: Alconox & Water / DI Rinse									
<b>WELL INFO</b>	Casing I.D. (in) [a]: 2"	Unit Casing Volume (gal/lin ft) [b]: 0.16	Initial Depth to Water (ft) [c]: 31.58'								
	Total Well Depth (ft) [d]: 41.51' + 28' = 42.09'	Water Column Thickness (ft) [d-c]: 10.51	Well Volume (gal) [(d-c) x b]: 1.68 gal								
	Ground Condition of Well: OK PAD / Incomplete		Remarks: Initially Soft Bottom of Well.								
<b>CASING INFO</b>	Casing I.D. (in) [a]: 2"	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	Radiation ( )	Remarks (odor, clarity, etc.)
8/27/13	1250	Bailler									NA	NA	Commenced Surging
	1300	Bailler		3 gals	—	23.88	6.49	6.64	6.31	21000			Tan very Silty
	1315	Bailler		5 gals	—	22.00	6.40	6.72	3.13	353			Removed a lot of Silt
	1325	—		—	—	—	—	—	—	—			Surge Well again 10 mins
	1350	Pump		6 gals	—	21.67	6.47	7.10	4.52	> 1000			Began Pump w/ Flow
	1410	Stopped. Pump		7.5 gals	—	—	—	—	—	—			through.
	1420	Pump		12 gal	1.25 gpm	21.04	5.76	6.91	3.12	0.0			Clearing up Good.
	1430	Pump		17 gals	1.0 gals	21.53	5.82	6.55	1.75	632			Surge up & Down w/ Pump
	1440	Pump	39.50	22 gals	1.5 gal/min	21.73	5.84	6.69	2.49	458			Issues w/ Turb.
	1450	Pump		25 gals	0.8 gal/min	21.13	5.84	6.87	3.39	0			Slightly Turbid.
	1500	Pump		27.5	0.5 gals	21.11	5.88	6.85	4.35	272			
	1510	Pump		29.0		21.13	5.88	6.85	4.66	233	✓	✓	

**Development Criteria:** 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND

4) remove water added during drilling and construction

\* (17) well <sup>casing</sup> volumes removed. { Very Dirty Well / Developed Good. }  
 { Strange how water was pumping constant then stopped pretty quick }  
 ↓





## MONITORING WELL DEVELOPMENT FORM

<b>LOCATION</b>	Site: <u>58</u>	LocID: <u>35AWW10</u>	Date: <u>8/27/13</u>								
	Project Name: Longhorn Army Ammunition Plant	Project #: <u>60256135</u>	Recorded By: <u>PC</u> Checked By:								
<b>EQUIPMENT</b>	Water Quality Meter Type/ID #: <u>Horiba U-52 # 21191</u>	Water Level Indicator Type/ID #: <u>Solinst 212050</u>									
	Equipment Group:	Equipment Group:									
	Development Equipment: <u>Bailer &amp; Monsion System</u>	Equipment Decon.: <u>Alconox &amp; water / DI Rinse</u>									
<b>WELL INFO</b>	Casing I.D. (in) [a]: <u>2"</u>	Unit Casing Volume (gal/lin ft) [b]: <u>2.24</u>	Initial Depth to Water (ft) [c]: <u><del>33.6</del> 19.63</u>								
	Total Well Depth (ft) [d]: <u>33.61</u>	Water Column Thickness (ft) [d-c]: <u><del>19.63</del> 13.98</u>	Well Volume (gal) {[d-c] x b}: <u>31.4</u>								
	Ground Condition of Well: <u>OK Did not completed Yet.</u>	Remarks:									
<b>CASING INFO</b>	Casing I.D. (in) [a]: <u>2"</u>	1.5	<u>2.0</u>	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/lin ft) [b]:	0.09	<u>0.16</u>	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	Radiation ( )	Remarks (odor, clarity, etc.)
<u>8/27/13</u>	<u>1550</u>	<u>Bailer</u>	<u>Commenced</u>	<u>Surge w/ Bailer</u>	<u>Block</u>						<u>NA</u>	<u>NA</u>	
	<u>1600</u>	<u>5 gals</u>	<u>Took</u>	<u>Water</u>	<u>Qual.</u>	<u>26.52</u>	<u>6.67</u>	<u>1.55</u>	<u>6.81</u>	<u>761</u>			<u>Commenced Bailing 5 gals</u>
	<u>1610</u>	<u>Bailer</u>	<u>6 gals</u>			<u>24.41</u>	<u>6.72</u>	<u>1.40</u>	<u>7.01</u>	<u>697</u>			<u>to Remove Tan w/ Silt.</u>
	<u>1615</u>	<u>Bailer</u>	<u>7 gals</u>			<u>24.79</u>	<u>6.32</u>	<u>1.31</u>	<u>7.49</u>	<u>488</u>			<u>Water looks slightly Tan</u>
	<u>1620</u>	<u>Pump</u>	<u>10 gals</u>			<u>24.58</u>	<u>6.20</u>	<u>1.56</u>	<u>6.87</u>	<u>764</u>			
	<u>1625</u>		<u>13 gals</u>			<u>25.53</u>	<u>6.43</u>	<u>2.24</u>	<u>4.49</u>	<u>89.5</u>			<u>clearing Good</u>
	<u>1630</u>		<u>15 gals</u>			<u>25.39</u>	<u>6.45</u>	<u>2.29</u>	<u>4.56</u>	<u>87.0</u>			<u>Well cavitated Dry</u>
	<u>1635</u>		<u>17 gals</u>	<u>17 gals</u>	<u>Total</u>								<u>Water looks tan</u>
	<u>1645</u>				<u>DRY.</u>								<u>slightly turbid.</u>
					<u>Depart Site 58</u>								

**Development Criteria:** 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

17.09 casing volumes removed. (This well will Low Flow Sample.)

## MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: 58	LocID: 35AWW11	Date: 9/5/13								
	Project Name: Longhorn Army Ammunition Plant	Project #: 60256135-0002GA	Recorded By: Re Checked By:								
EQUIPMENT	Water Quality Meter Type/ID #: 21191	Water Level Indicator Type/ID #: 212050									
	Equipment Group:	Equipment Group:									
	Development Equipment: 023824	Equipment Decon.: Alconox DI / DI Rinse									
WELL INFO	Casing I.D. (in) [a]: 2"	Unit Casing Volume (gal/lin ft) [b]: 1.05 gals	Initial Depth to Water (ft) [c]: 31.48'								
	Total Well Depth (ft) [d]: 37.75 + .28 = 38.03	Water Column Thickness (ft) [d-c]: 6.55'	Well Volume (gal) {[d-c] x b}: 6.86								
	Ground Condition of Well: OK / PAD NOT Completed	Remarks: No Pump used here.									
CASING INFO	Casing I.D. (in) [a]: 2"	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	ORP Sed. (mV/L)	Radiation ( )	Remarks (odor, clarity, etc.)
9-5-13	0920	Surge	AFTER*	NA	NA								Initial Surging.
	0930	Bail	Bail ↓	—	—	21.40	6.59	7.87	5.08	>1000	50		NO Flow cell
	0945	Bail	36.22	3.5 gals	—	21.07	6.80	7.61	5.00	>1000	32		Dark Brackish Water
	1025	Bailed	37.07	3.0 gals	—	21.54	6.70	7.28	3.19	>1000	7		NO Flow cell used Beaker
	1055 <sup>2</sup>												Seems to recharge to 90%
	1110	Bailed	37.13	2.5	NA	21.90	6.59	7.22	3.37	>1000	0		about every 40 mins
	1125	Break											to 1 hr.
	1225	Bailed	36.48	3 gals	NA	21.46	6.65	7.00	4.94	681	-44		Water is better does cell
	1345	Bailed	36.90	2.5 gals	NA	29.69	6.30	7.25	1.59	71.0			First Bailor / See Turbidity
													Moved to Next Well.
	1654	Bailed	NA	500cc	NA	24.31	6.49	7.08	1.77	31.0	-19		clear w/ slight hint of tan

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND

4) remove water added during drilling and construction

(14.5 gals total Purge)

### MONITORING WELL DEVELOPMENT FORM

<b>LOCATION</b>	Site: <b>58</b>	LocID: <b>35Aww12</b>	Date: <b>8/31/13</b>								
	Project Name: Longhorn Army Ammunition Plant	Project #: <b>6025b135.0002HA</b>	Recorded By: <b>Beesinger</b> Checked By:								
<b>EQUIPMENT</b>											
<b>EQUIPMENT</b>	Water Quality Meter Type/ID #: <b>HORIBA D-52 2191</b>	Water Level Indicator Type/ID #: <b>Solinst model 101</b>									
	Equipment Group:	Equipment Group:									
	Development Equipment:	Equipment Decon.:									
<b>WELL INFO</b>											
<b>WELL INFO</b>	Casing I.D. (in) [a]: <b>2.11</b>	Unit Casing Volume (gal/in ft) [b]: <b>1.25</b>	Initial Depth to Water (ft) [c]: <b>29.81 TOC</b>								
	Total Well Depth (ft) [d]: <b>37.65 TOC</b>	Water Column Thickness (ft) [d-c]: <b>7.84</b>	Well Volume (gal) [(d-c) x b]:								
	Ground Condition of Well:		Remarks:								
<b>CASING INFO</b>											
<b>CASING INFO</b>	Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/in ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	Radiation ( )	Remarks (odor, clarity, etc.)
8-31-13	1050	pump	33.65	0.0	.5	21.27	6.27	2.09	5.28	608			
8-31-13	1100	pump	34.00	8.5	.5	21.08	6.24	1.95	4.79	379			
8-31-13	1110	pump	35.11	11.0	.5	21.48	6.30	1.82	3.93	101			
8-31-13	1115	pump	36.00	13.5	.5	21.20	6.25	1.85	4.01	58.3			
8-31-13	1120	Pump	36.82	16.0	.5	21.17	6.22	1.83	4.08	32.5			
8-31-13	1125	Pump	37.43	18.5	.5	21.15	6.21	1.80	4.11	22.2			

**Development Criteria:** 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction



### MONITORING WELL DEVELOPMENT FORM

<b>LOCATION</b>	Site: <u>58</u>	LocID: <u>35 AWW 13</u>	Date: <u>9/4/13</u>								
	Project Name: Longhorn Army Ammunition Plant	Project #:	Recorded By: <u>RC: B</u> Checked By:								
<b>EQUIPMENT</b>	Water Quality Meter Type/ID #: <u>Hanna u-52 # 21191</u>	Water Level Indicator Type/ID #: <u>Solinst # 212850</u>									
	Equipment Group:	Equipment Group:									
	Development Equipment: <u>Monsoon System # 023834</u>	Equipment Decon.: <u>Alconox DE / DT Pince</u>									
<b>WELL INFO</b>	Casing I.D. (in) [a]: <u>2"</u>	Unit Casing Volume (gal/lin ft) [b]: <u>.16</u>	Initial Depth to Water (ft) [c]: <u>24.55</u>								
	Total Well Depth (ft) [d]: <u>39.90 + .28 = 40.18</u>	Water Column Thickness (ft) [d-c]: <u>15.63</u>	Well Volume (gal) {[d-c] x b}: <u>2.50 gal = 10.1</u>								
	Ground Condition of Well: <u>OK / PAD NOT DONE</u>		Remarks:								
<b>CASING INFO</b>	Casing I.D. (in) [a]: <u>2"</u>	1.5	<u>2.0</u>	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/lin ft) [b]:	0.09	<u>0.16</u>	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	ORP	Radiation ( )	Remarks (odor, clarity, etc.)
											<del>Sed. (mL/L)</del>		
9/4/13	1455	Surge	—	—	1000 mL/m	27.21	7.80	1.27	4.16	>1000	21		Dark Gray w/ Fines
	1515	Pump	—	—	1.0	27.43	7.60	1.71	2.14	>1000	64	Black water	No Flow cell
	1520	Pump	—	—	+2.5	26.69	7.22	1.79	2.73	>1000	19		No flow cell
	1525	Pump	—	—	+1.0	26.29	7.05	1.75	2.21	>1000	27		Cloudy Gray water.
* 16 min	1535	Pump	—	—	+3.0	27.36	7.20	1.77	2.35	>1000	-52		7.5 gals removed
	1545	Pump	28.31	—	—	28.40	6.51	2.08	2.82	>1000	13		Flow through connected.
	1600	Pump	—	—	+3.0	25.20	6.52	2.01	1.85	>1000	-9		
	1605	Pump	—	—	+2.5	24.72	6.51	2.22	1.67	>1000	-14		
	1610	Pump	—	—	+2.0	24.60	6.54	2.60	0.42	>1000	-30		14.5 gals removed.
	1615	Pump	—	—	+1.5	24.77	6.51	2.70	0.40	825	-29		
	1620	Pump	—	—	+1.5	24.80	6.51	2.72	0.41	351	-23	*	
	1625	Pump	—	—	+1.5	24.93	6.51	2.73	0.44	199	-16		<u>18 gals</u> total removed.

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

## MONITORING WELL DEVELOPMENT FORM

<b>LOCATION</b>	Site: <b>58</b>	LocID: <b>35AWW14</b>	Date: <b>9.5.13</b>								
	Project Name: Longhorn Army Ammunition Plant	Project #: <b>60256155 - 00026A</b>	Recorded By: _____ Checked By: _____								
<b>EQUIPMENT</b>	Water Quality Meter Type/ID #: <b>21191</b>	Water Level Indicator Type/ID #: <b>212050</b>									
	Equipment Group: _____	Equipment Group: _____									
	Development Equipment: <b># 023834</b>	Equipment Decon.: <b>Alconox DI / DI Rinse</b>									
<b>WELL INFO</b>	Casing I.D. (in) [a]: <b>2"</b>	Unit Casing Volume (gal/lin ft) [b]: <b>0.30</b>	Initial Depth to Water (ft) [c]: <b>30.55 to TIC</b>								
	Total Well Depth (ft) [d]: <b>32.13 + .28 = 32.41</b>	Water Column Thickness (ft) [d-c]: <b>1.86 *</b>	Well Volume (gal) [(d-c) x b]: <b>.16</b>								
	Ground Condition of Well: <b>OK / NOT completed</b>		Remarks: <b>NOTE: Water Hgt. (NO WATER) Bailed</b>								
<b>CASING INFO</b>	Casing I.D. (in) [a]: <b>2"</b>	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/lin ft) [b]: _____	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	SRP Sed. (mL/L)	Radiation ( )	Remarks (odor, clarity, etc.)
9.5.13	0805	Surge	30.55	NA	NA	21.50 <sup>20</sup>	5.92 <sup>6</sup>	4.48	4.58 <sup>20</sup>	>1000 <sup>20</sup>	95 <sup>20</sup>		
	0815	Bailer	30.56	1 Bailer	NA	21.50	5.92	4.48	4.58	>1000	95		Tan cloudy w/ Fine Sand
	0840	Bailer	30.90	1 Bailer	NA	21.29	6.40	4.39	5.75	>1000	107		Silt / Initial Photo.
	0900	Will Return Periodically to remove a Couple of 1/3 Full Disposable Baiters Full.											
	0950	Bailer	30.96	1500 mL	—	20.75	6.90	5.04	5.73	>1000	117		Tan Cloudy does
	1055	Bailer	31.33	1000 mL	NA	22.42	6.86	5.43	5.30	>1000	88		settle out.
	1258	Bailer	30.55	1500 mL	NA	25.95	7.20	5.37	4.62	1000	84		Lighter Tan water
	1340	Bailer	30.85	1200 mL	NA	25.65	7.04	5.57	4.09	829	88		" " "
	1635	Bailer	30.88	1500 mL	NA								
	1645	Bailer	NA	500 mL	NA	25.60	7.03	5.70	4.90	105	103		light tan

**Development Criteria:** 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction



## MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: 58	LocID: 35Aww15	Date: 9/6/13								
	Project Name: Longhorn Army Ammunition Plant	Project #: 60256135.0002GA	Recorded By: PC Checked By:								
EQUIPMENT	Water Quality Meter Type/ID #: 21191	Water Level Indicator Type/ID #: 212050									
	Equipment Group:	Equipment Group:									
	Development Equipment: Monsoon system # 023834	Equipment Decon.: Alconox DE/DE Rinse									
WELL INFO	Casing I.D. (in) [a]: 2"	Unit Casing Volume (gal/lin ft) [b]: 2.68 gal	Initial Depth to Water (ft) [c]: 20.98' (TOC)								
	Total Well Depth (ft) [d]: 37.46 + .28 = 37.74	Water Column Thickness (ft) [d-c]: 16.76	Well Volume (gal) [(d-c) x b]: .16								
	Ground Condition of Well: OK / well not completed.	Remarks:									
CASING INFO	Casing I.D. (in) [a]: 2"	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	ORP Sed. (mV/L)	Radiation ( )	Remarks (odor, clarity, etc.)
9-6-13	0828	Surge	—	—	—	23.32	6.14	6.25	1.36	>1000	-16		Very Cloudy Gray water
	0930	Bailed	—	4.5 gals	NA	23.10	6.70	7.64	1.37	>1000	-17	NO Flow Cell	Milky Thick water Gray
	0845	Bailed	—	4.5 gals	NA	23.67	6.64	7.48	1.71	>1000	1	NO Flow Cell	Still Milky thick Gray
	0900	Bailed	36.88'	4.5 gals	NA	23.59	6.92	7.00	2.17	763	1		Good sign with Turb. dropping
		Allows for recharge											
	0950	Pump	28.77'	—	—	24.35	6.74	7.60	0.96	7100	-75	NO Flow Cell	cloudy Gray with
	0955	"	—	—	—	25.61	6.64	7.16	0.45	7100	-97		Fine Sands + Silt.
	1000	"	—	4.5 gals	>1000	25.68	6.62	7.40	0.73	7100	-109		Suspended cloud.
		Increase flow to pump well dry											
	1050	—	—	4.0	>1000	25.44	6.45	8.58	1.32	>1000			
	1055	—	—	—	—	25.58	6.65	8.83	1.42	>1000	-48		
9-6-13	1100	Pump	—	—	—	25.38	6.41	9.14	1.08	>1000	-67		

## Development Criteria:

- 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND  
4) remove water added during drilling and construction





### MONITORING WELL DEVELOPMENT FORM

<b>LOCATION</b>	Site: <u>58</u>	LocID: <u>35AWW16</u>	Date: <u>8/31/13</u>								
	Project Name: <u>Longhorn Army Ammunition Plant</u>	Project #: <u>60256135.0002HA</u>	Recorded By: <u>Beising</u> Checked By:								
EQUIPMENT											
<b>EQUIPMENT</b>	Water Quality Meter Type/ID #: <u>U-52 HORIBA 21191</u>	Water Level Indicator Type/ID #: <u>Solinst model 101</u>									
	Equipment Group:	Equipment Group:									
	Development Equipment:	Equipment Decon.:									
WELL INFO											
<b>WELL INFO</b>	Casing I.D. (in) [a]: <u>2.11</u>	Unit Casing Volume (gal/in ft) [b]: <u>2.93</u>	Initial Depth to Water (ft) [c]: <u>19.12</u>								
	Total Well Depth (ft) [d]: <u>37.48</u>	Water Column Thickness (ft) [d-c]: <u>18.36</u>	Well Volume (gal) [(d-c) x b]:								
	Ground Condition of Well:		Remarks:								
CASING INFO											
<b>CASING INFO</b>	Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/in ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	Radiation ( )	Remarks (odor, clarity, etc.)
8/31/13	1325	Pump	22.65	11	1	21.60	6.74	7.50	1.71	1000+			
8/31/13	1335	Pump	23.75	<del>21</del> 21	1	21.21	6.69	8.22	1.99	748			
8/31/13	1345	Pump	24.36	<del>26</del> 26	.5	21.34	6.72	7.18	1.03	464			
8/31/13	1355	Pump	25.00	<del>31</del> 31	.5	21.18	6.74	6.16	0.73	319			
8/31/13	1405	Pump	26.30	36	.5	20.92	6.77	5.79	0.75	187			
8/31/13	1415	Pump	27.45	41	.5	20.97	6.84	4.85	0.41	113			
8/31/13	1425	Pump	28.02	46	.5	21.00	6.84	4.55	0.38	97.3			
8/31/13	1435	Pump	28.40	51	.5	21.10	6.86	4.27	0.35	40.1			
8/31/13	1440	Pump	29.11	56	.5	21.16	6.87	4.20	0.32	24.3			
8/31/13	1445	Pump	29.77	61	.5	21.25	6.86	4.11	0.30	22.1			
8/31/13	1450	Pump	30.33	66	.5	21.25	6.87	4.02	0.28	22.5			

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction



## MONITORING WELL DEVELOPMENT FORM

<b>LOCATION</b>	Site: <u>58</u>	LocID: <u>35AWW17</u>	Date: <u>8/30/13</u>
	Project Name: Longhorn Army Ammunition Plant	Project #: <u>60256135.0002HA</u>	Recorded By: <u>Reasinger</u> Checked By:

<b>EQUIPMENT</b>	Water Quality Meter Type/ID #: <u>HORIBA U-52 24191</u>	Water Level Indicator Type/ID #: <u>Solinit Model 101</u>
	Equipment Group:	Equipment Group:
	Development Equipment:	Equipment Decon.:

<b>WELL INFO</b>	Casing I.D. (in) [a]: <u>2"</u>	Unit Casing Volume (gal/in ft) [b]: <u>2.02</u>	Initial Depth to Water (ft) [c]: <u>29.65</u>
	Total Well Depth (ft) [d]: <u>42.28</u>	Water Column Thickness (ft) [d-c]: <u>12.63</u>	Well Volume (gal) [(d-c) x b]:
	Ground Condition of Well:		Remarks:

<b>CASING INFO</b>	Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/in ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	Radiation ( )	Remarks (odor, clarity, etc.)
8/30/13	1315	Surge	30.30	2		24.38	7.14	7.16	3.76	784			
8/30/13	1340	Pump	35.40	7	1 gpm	22.59	7.3	8.03	2.81	760			
8/30/13	1350	Pump	36.80	17	.5 gpm	22.90	6.97	8.34	1.66	161			
8/30/13	1355	Pump	37.00	20	.5 gpm	23.00	7.09	7.53	1.53	93.1			
8/30/13	1400	Pump	37.91	23	.5 gpm	23.90	7.02	7.09	1.25	60.0			
8/30/13	1405	Pump	38.25	25	.5 gpm	23.50	7.05	7.11	1.30	26.1			
8/30/13	1410	Pump	38.91	27	.5	23.45	7.08	7.20	1.31	20.2			
8/30/13	1415	Pump	39.50	30	.5	23.51	7.06	7.23	1.35	18.3			

**Development Criteria:** 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction



### MONITORING WELL DEVELOPMENT FORM

<b>LOCATION</b>	Site: <u>58</u>	LocID: <u>35AWW18</u>	Date: <u>8/30/13</u>								
	Project Name: Longhorn Army Ammunition Plant	Project #: <u>60256135.0002HA</u>	Recorded By: <u>B. Basinger</u> (Checked By: _____)								
<b>EQUIPMENT</b>	Water Quality Meter Type/ID #: <u>HORIBA U-52 21191</u>	Water Level Indicator Type/ID #: <u>Solinst model 100</u>									
	Equipment Group:	Equipment Group:									
	Development Equipment:	Equipment Decon.:									
<b>WELL INFO</b>	Casing I.D. (in) [a]: <u>2"</u>	Unit Casing Volume (gal/in ft) [b]: <u>2.24</u>	Initial Depth to Water (ft) [c]: <u>28.05</u>								
	Total Well Depth (ft) [d]: <del>41.80</del> <u>42.08</u>	Water Column Thickness (ft) [d-c]: <u>14.03</u>	Well Volume (gal) [(d-c) x b]:								
	Ground Condition of Well:	Remarks: <u>-</u>									
<b>CASING INFO</b>	Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/in ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	Radiation ( )	Remarks (odor, clarity, etc.)
8-30-13	1535	Pump	34.60	6	1 gpm	25.30	7.29	4.92	2.79	1000+			
8-30-13	1545	Pump	36.55	16	1	22.89	7.08	5.39	2.23	852			
8-30-13	1555	Pump	36.97	21	1	23.39	7.03	6.00	1.04	800			
8-30-13	1605	Pump	37.54	23.5	.5	24.08	7.02	6.46	0.67	736			
8-30-13	1615	Pump	37.91	26	.5	24.33	7.00	6.40	0.47	601			
8-30-13	1625	Pump	38.70	28.5	.5	24.60	7.05	6.25	0.30	459			
8-30-13	1635	Pump	38.99	31	.5	24.69	7.08	6.20	0.28	127.3			
8-30-13	1645	Pump	39.29	33.5	.5	24.75	7.04	6.17	0.27	75.5			
8-30-13	1655	Pump	39.78	36	.5	24.80	7.02	6.13	0.25	60.2			
8-30-13	1705	Pump	40.50	38.5	.5	24.85	7.01	6.10	0.22	40.1			

**Development Criteria:** 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction





## MONITORING WELL DEVELOPMENT FORM

<b>LOCATION</b>	Site: <u>58</u>	LocID: <u>35AWW19</u>	Date: <u>9/22/13</u>								
	Project Name: Longhorn Army Ammunition Plant	Project #: <u>60256135</u>	Recorded By: <u>GH</u> Checked By:								
<b>EQUIPMENT</b>	Water Quality Meter Type/ID #: <u>Horiba</u>	Water Level Indicator Type/ID #: <u>Solinst</u>									
	Equipment Group: <u>NA</u>	Equipment Group: <u>N/A</u>									
	Development Equipment: <u>Monsoon Pump</u>	Equipment Decon.: <u>Alconox &amp; DI Water</u>									
<b>WELL INFO</b>	Casing I.D. (in) [a]: <u>2"</u>	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: <u>30.50</u>								
	Total Well Depth (ft) [d]: <u>32.15 - 0.27 = 31.88</u>	Water Column Thickness (ft) [d-c]:	Well Volume (gal) [(d-c) x b]:								
	Ground Condition of Well:		Remarks:								
<b>CASING INFO</b>	Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	ORP Sed. (mV)	Radiation	Remarks (odor, clarity, etc.)
9/22/13	0835	BAIL	30.50	<del>1.5</del>		18.21	5.93	6.67	2.74	>1000	51		
	1520		30.51										Surge for 5 min
	1540			3.0		22.08	6.42	6.41	5.14	>1000	97		
	1645			30.80									
1818			30.59										Recharge
9/23/13	0813	BAIL	31.91	4.5		21.81	6.58	6.66	5.54	>1000	79		
	0845		30.52										Surge for 5 min

**Development Criteria:** 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

### MONITORING WELL DEVELOPMENT FORM

<b>LOCATION</b>	Site: <u>58</u>	LocID: <u>35AWW19</u>
	Project Name: <u>Longhorn Army Ammunition Plant</u>	Project #: <u>60256135</u>

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP Radiation (mV)	Remarks (odor, clarity, etc.)
9/23/13	0945	Ramp	30.65	<del>500</del>	<del>90</del>	19.96	6.04	6.72	7.44	>1000		99	Peristaltic Pump
	0950	"	30.68	450	90	20.41	6.11	6.42	6.68	>1000		90	
	0955	"	30.70	650		20.87	6.14	6.56	6.11	>1000		88	
	1000	"	30.76	1000		20.84	6.13	6.73	5.82	>1000		87	
	1005	"	NA	1600		20.71	6.11	6.93	5.76	>1000		86	
	1010	"	30.85	2150		20.71	6.10	7.02	2.58	>1000		87	
	1015	"	30.90	2700		20.74	6.09	6.99	2.63	855		87	Slows Down Pump
	1020	"	30.92	3250		20.90	6.08	6.94	2.52	319		88	
	1025	"	NA	3650		21.03	6.09	7.02	2.53	134		87	
	1030	"	31.00	4100		21.34	6.07	6.98	2.42	77		88	Slows Down Pump
	1035	"	31.01	4500		21.58	6.04	6.95	2.64	61		89	
	1040	"	31.02	4900		21.88	6.07	7.02	5.55	56		90	
	1045	"	31.03	5250		22.17	6.05	7.03	5.28	48		93	
					+400 For Flow Through Core								
	1050	Ramp	31.01	Flow thru 400								START	
	1057	"	NA	0		22.87	6.08	6.92	2.97	33		105	
	1102	"	31.02	350		22.97	6.06	6.86	6.08	25		104	
	1107	"	31.02	600		23.22	6.04	6.94	5.73	19		105	
	1112	"	31.02	900		23.62	6.02	6.98	5.41	17		107	
	1117	"	31.02	1250		24.06	6.01	7.00	6.99	13		109	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3% conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

2.91







## MONITORING WELL DEVELOPMENT FORM

<b>LOCATION</b>	Site: <u>58</u>	LocID: <u>35AWW21</u>	Date: <u>09/04/13</u>								
	Project Name: Longhorn Army Ammunition Plant	Project #: <u>60256135 - 0002GA</u>	Recorded By: <u>RC/R0</u> Checked By:								
<b>EQUIPMENT</b>	Water Quality Meter Type/ID #: <u>Hor. ba US2 21191</u>	Water Level Indicator Type/ID #: <u>Sohnst 212050</u>									
	Equipment Group:	Equipment Group:									
	Development Equipment: <u>monsoon # 023934</u>	Equipment Decon.: <u>Alconox Water / DI Rinse</u>									
<b>WELL INFO</b>	Casing I.D. (in) [a]: <u>2"</u>	Unit Casing Volume (gal/lin ft) [b]: <u>1.39 0.16</u>	Initial Depth to Water (ft) [c]: <u>34.16</u>								
	Total Well Depth (ft) [d]: <u>42.83</u>	Water Column Thickness (ft) [d-c]: <u>8.67</u>	Well Volume (gal) {[d-c] x b}: <u>1.39</u>								
	Ground Condition of Well: <u>New</u>		Remarks: <u>NO PAD YET</u>								
<b>CASING INFO</b>	Casing I.D. (in) [a]: <u>2"</u>	1.5	<u>2.0</u>	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/lin ft) [b]:	0.09	<u>0.16</u>	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	ORP Radiation ( )	Remarks (odor, clarity, etc.)	
9-4-13	0900	Surge	34.16	NA	NA		Surging Process						Very Gray Silty	
	0933	Surge	—		1	24.35	5.51	1.25	5.54	1000+			Gloss Bottom	
	0948	Bail	40.61	6.5 gal	1	23.55	5.91	1.12	5.90	1000+		193	NO Flow Cell	
	1025	Surge	35.06	NA	NA		Surging Process			>1000				
	1035	Bail	—	4 gal		23.69	5.79	0.992	6.47	>1000		258	NO Flow cell	
	1115	Pump	35.24	1 gal	600ml/min									Hard Bottom
	1120	Pump	—	—		27.39	7.08	0.905	4.51	>1000		121	NO Flow cell	
	1125	Pump	—	—		27.08	8.04	0.935	3.80	>1000		131	No flow cell	
	1130	Pump	—	1 gal		24.66	6.33	1.15	3.32	>1000		157	Flow Cell	
	1135	Pump	37.11	—		23.48	5.79	1.16	3.11	981		167		
9-4-13	1140	Pump	—	1 gal		24.88	5.75	1.14	2.71	978		166		
	1145	Pump	—	1 gal		23.91	5.80	1.15	2.44	860		155		

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

14.5 gals

### MONITORING WELL DEVELOPMENT FORM

<b>LOCATION</b>	Site: <u>58</u>	LocID: <u>35AWW21</u>
	Project Name: Longhorn Army Ammunition Plant	Project #:

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	<del>ORP</del> Radiation ( )	Remarks (odor, clarity, etc.)
9-4-13	1150	Pump	38.19	—	0.6	22.95	5.84	1.13	2.07	440		152	
	1155	Pump	—	1gal	0.6	22.28	5.94	1.07	2.70	NA		157	
	1200	Pump	—	—	0.6	22.47	6.00	1.06	2.30	NA		156	
	1205	Pump	—	1gal	0.60	22.49	6.03	1.03	2.33	NA		157	
9-4-13	1208	Development Complete											
				(17) gallons total									Fairly Clear took photo.

**Development Criteria:** 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

## MONITORING WELL DEVELOPMENT FORM

<b>LOCATION</b>	Site: <u>58</u>	LocID: <u>35AWW22</u>	Date: <u>8/30/13</u>								
	Project Name: Longhorn Army Ammunition Plant	Project #: <u>60256/35-0002HA</u>	Recorded By: <u>Beesinger</u> Checked By:								
EQUIPMENT											
<b>EQUIPMENT</b>	Water Quality Meter Type/ID #: <del>Solinst Model 101</del> <u>Heriberto 0-52</u>	Water Level Indicator Type/ID #: <u>Solinst Model 101</u>									
	Equipment Group:	Equipment Group:									
	Development Equipment: <u>Monsoon pump</u>	Equipment Decon.:									
WELL INFO											
<b>WELL INFO</b>	Casing I.D. (in) [a]: <u>2"</u>	Unit Casing Volume (gal/in ft) [b]: <u>0.92</u>	Initial Depth to Water (ft) [c]: <u>31.95 Tol</u>								
	Total Well Depth (ft) [d]: <u>37.73 Tol</u>	Water Column Thickness (ft) [d-c]: <u>5.78</u>	Well Volume (gal) [(d-c) x b]:								
	Ground Condition of Well:		Remarks:								
CASING INFO											
<b>CASING INFO</b>	Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/in ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	Radiation ( )	Remarks (odor, clarity, etc.)
8-30-13	0850	Surge	33.03	1.5		21.93	6.52	9.38	5.32	631			
8-30-13	0935	bail	34.10	3.5		22.41	6.50	9.47	5.11	282.5			
8-30-13	1000	bail	34.95	4.5		23.01	6.46	9.47	4.59	250.0			
8-31-13	0835	Pump	32.50	9.5	1	21.10	6.14	9.78	4.58	133.8			
8-31-13	0845	Pump	36.50	12	1.5	21.00	6.20	9.70	4.50	45.1			
8-31-13	0855	Pump	37.25	14.5	1.5	21.08	6.17	9.65	4.47	21.2			
8-31-13	0900	Pump	37.40	17.0	1.5	21.15	6.15	9.68	4.40	22.0			
8-31-13	0905	Pump	37.50	19.5	1.5	21.06	6.18	9.62	4.36	20.9			

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction





**APPENDIX E: Groundwater Sampling Forms**

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LOCATION	Site: 58	LocID: 35AWW09	Date: 8/29/2013									
	Project: Longhorn Army Ammunition Plant	Project No. 60256135.0002HA	Recorded By: Beesinger Checked By:									
EQUIPMENT	Water Quality Meter Type/ID #: Horiba U-52	Water Interface Probe: Water Level Indicator I.D.# <sup>solinst</sup> 101	Min Recharge Level = (TD-DTW(0.80)) - TD									
	Unit #: 21191	Sampling Equipment: Peristaltic/Bladder/Bailer ID#: mp-3pk-4P										
WELL INFO	Casing I.D. (in) [a]: 2"	Static Water Level Reading (ft) [c]: 42.18	Weather Conditions: CLEAR 93°F									
	Total Well Depth (ft) [d]: 31.85	Screened Interval/Pump placement: 24.6 - 39.2 35.00	Condition of Well/Remarks: NEW WELL NEEDS PAINT									
CASING INFO	Casing I.D. (in) [a]:	0.75	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/lin ft) [b]:	0.023	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Water Level (FTOC)	Pumping Rate (mL/min)	Temp. (°C)	pH	Cond (µS/cm)	DO (mg/L)	Turb. (NTU)	ORP (mv)	Total Fe (mg/L)	Ferrous Fe (mg/L)	Ferric Fe (mg/L)	Remarks (odor, clarity, etc.)
8-29-13	1025	31.87	100	32.79	7.32	6.51	2.88	73.7	104				
8-29-13	1030	31.88	100	30.88	6.38	6.83	2.57	67.1	99				
8-29-13	1035	31.89	100	29.40	6.35	6.90	2.11	59.4	100				
8-29-13	1040	31.90	100	29.16	6.32	6.98	1.89	52.9	106				
8-29-13	1045	31.91	100	29.35	6.30	7.08	1.85	38.1	108				
8-29-13	1050	31.92	100	28.43	6.29	7.14	1.80	27.5	109				
8-29-13	1055	31.93	100	28.35	6.29	7.16	1.75	23.2	109				
8-29-13	1100	31.94	100	28.25	6.29	7.17	1.74	19.4	109				
8-29-13	1105	31.95	100	28.13	6.31	7.20	1.71	21.0	109				
8-29-13	1110	31.96	100	27.83	6.31	7.20	1.67	21.0	109				
8-29-13	1115	31.97	100	27.80	6.32	7.20	1.65	21.2	108				
8-29-13	1120	31.98	100	27.75	6.32	7.21	1.64	20.9	108				
8-29-13	1125	31.99	100	27.73	6.32	7.20	1.63	20.8	108				
8-29-13	1130	32.00	100	27.70	6.32	7.20	1.62	20.8	108				
<del>8-29-13</del>													

Pump Rate: <=0.5 L/min Drawdown: <0.33 ft Measurements: 3-5 min Stabilization: +/-10% C, +/-0.1 pH, +/-3% Cond, +/-10% DO, +/-10%Turb(<=10 NTU ideal), for 4 consecutive readings

SAMPLE ID: 35AWW09-082913 TIME: 1130 DUPLICATE (D): YES/NO NP MATRIX SPIKE (MS): YES/NO NP MATRIX DUPLICATE (MD): YES/NO NO CO= LEL= OXY= H2S=	No. Containers/Volume/Type	Preserv.	Filter (Y/N)	Pump OR Bailer	Parameter(s)
	4-500ml Plastic	NA	N	Pump	DHC & DHB
	1-500ml Plastic	ZNAC/NO4	N	Pump	Sulfide
	1-250ml AMBER	H3PO4	N	Pump	VFA
	1-250ml AMBER	NA	N	Pump	FERROUS IRON
	1-250ml plastic	HNO3	Y	Pump	Dissolved metals
	1-250ml plastic	HNO3	Y	Pump	TOTAL metals
1-250ml plastic	NA	N	pump	ALCALINITY	

see back

1- 250 ml plastic	H2SO4	N	pump	TOC & TOTAL phosphorous
1-250 ml plastic	NA	N	pump	Anions
3- 40ml glass	HCL	N	pump	VOC
3- 20ml glass	NA	N	pump	GASES
3- 20 ml glass	NA	N	pump	Carbon Dioxide



LOCATION	Site: 58	LocID: 35AWW10	Date: 8/29/2013									
	Project: Longhorn Army Ammunition Plant	Project No. 60256135.0002HA	Recorded By: Beesinger Checked By:									
EQUIPMENT	Water Quality Meter Type/ID #: Horiba U-52	Water Interface Probe: Water Level Indicator I.D.# Solinst 10P	Min Recharge Level = (TD-DTW(0.80)) - TD									
	Unit #: 21191	Sampling Equipment: Peristaltic/Bladder/Bailer ID#: mp-50K-4P										
WELL INFO	Casing I.D. (in) [a]: 2"	Static Water Level Reading (ft) [c]: 19.75	Weather Conditions: CLEAR 80°F									
	Total Well Depth (ft) [d]: 33.61	Screened Interval/Pump placement: 16.1 - 30.7 24.00	Condition of Well/Remarks: NEW WELL NEEDS PAINT									
CASING INFO	Casing I.D. (in) [a]:	0.75	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/in ft) [b]:	0.023	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Water Level (FTOC)	Pumping Rate (mL/min)	Temp. (°C)	pH	Cond (µS/cm)	DO (mg/L)	Turb. (NTU)	ORP (mv)	Total Fe (mg/L)	Ferrous Fe (mg/L)	Ferric Fe (mg/L)	Remarks (odor, clarity, etc.)
8-29-13	0830	19.80	100	27.19	6.71	1.34	6.70	2.9	133				
8-29-13	0835	19.83	100	26.59	6.61	1.34	6.58	3.2	128				
8-29-13	0840	19.85	100	26.01	6.71	1.35	6.41	2.5	114				
8-29-13	0845	19.87	100	25.98	6.88	1.35	5.86	2.2	99				
8-29-13	0850	19.89	100	26.18	6.93	1.36	5.84	2.1	96				
8-29-13	0855	19.91	100	26.51	6.91	1.37	5.74	1.9	97				
8-29-13	0900	19.93	100	26.67	6.92	1.38	5.65	1.7	97				
8-29-13	0905	19.95	100	26.74	6.92	1.39	5.68	1.5	96				
8-29-13	0910	19.97	100	26.77	6.92	1.39	5.69	1.3	96				

Pump Rate: <=0.5 L/min Drawdown: <0.33 ft Measurements: 3-5 min Stabilization: +/-10% C, +/-0.1 pH, +/-3% Cond, +/-10% DO, +/-10%Turb(<=10 NTU Ideal), for 4 consecutive readings

SAMPLE ID: 35AWW10-082913 TIME: 0910 DUPLICATE (D): YES/NO NO MATRIX SPIKE (MS): YES/NO NO MATRIX DUPLICATE (MD): YES/NO NO CO= LEL= OXY= H2S=	No. Containers/Volume/Type	Preserv.	Filter (Y/N)	Pump OR Bailer	Parameter(s)
	4-500 ml plastic	NA	N	Pump	DHC & DAB
	1-500 ml plastic	TRAC9 NAOH	N	Pump	Sulfide
	1-250 ml Amber	H3PO4	N	Pump	VFA
	1-250 ml Amber	NA	N	Pump	Ferrous
	1-250 ml plastic	MNO3	Y	Pump	Dissolved metals
	1-250 ml plastic	NA	N	Pump	TOTAL metals
1-250 ml plastic	ITS94	N	Pump	TOL & total phosphorus	

See BACK



1- 250 ml plastic	NA	N	pump	Anions
3- 40 ml glass	HCL	N	pump	VOC
3- 20 ml glass	NA	N	pump	GASAS
3- 20 ml glass	NA	N	pump	Carbon Dioxide



LOCATION	Site: 58	LocID: 03WW01	Date: 8/20/13									
	Project: Longhorn Army Ammunition Plant	Project No. 60274185.0002HA	Recorded By: Beesinger Checked By:									
EQUIPMENT	Water Quality Meter Type/ID #: Horiba U-52	Water Interface Probe: Water Level Indicator I.D.# 611/ces/cevr	Min Recharge Level = (TD-DTW(0.80)) - TD									
	Unit #: 21191	Sampling Equipment: Peristaltic/Bladder/Bailer ID#: Bailer										
WELL INFO	Casing I.D. (in) [a]: 2"	Static Water Level Reading (ft) [c]: 29.03	Weather Conditions: CLEAR 75°F									
	Total Well Depth (ft) [d]: 33.35	Screened Interval/Pump placement:	Condition of Well/Remarks: NEEDS PAMT									
CASING INFO	Casing I.D. (in) [a]:	0.75	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/in ft) [b]:	0.023	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Water Level (FTOC)	Pumping Rate (mL/min)	Temp. (°C)	pH	Cond (µS/cm)	DO (mg/L)	Turb. (NTU)	ORP (mv)	Total Fe (mg/L)	Ferrous Fe (mg/L)	Ferric Fe (mg/L)	Remarks (odor, clarity, etc.)
8/20/13	0815	29.03											
8/20/13	0825	33.30											Bailed 2 gallons RAN DRY
8-20-13	1445	29.35	-	26.19	6.18	3.64	9.11	33.0	240		0.78		

Pump Rate: <=0.5 L/min Drawdown: <0.33 ft Measurements: 3-5 min Stabilization: +/-10% C, +/-0.1 pH, +/-3% Cond, +/-10% DO, +/-10%Turb(<=10 NTU Ideal), for 4 consecutive readings

SAMPLE ID: 03ww01-082013 TIME: 1445  DUPLICATE (D): YES/NO MATRIX SPIKE (MS): YES/NO MATRIX DUPLICATE (MD): YES/NO  CO=      LEL=      OXY=      H2S=	No. Containers/Volume/Type	Preserv.	Filter (Y/N)	Pump OR Bailer	Parameter(s)





LOCATION	Site: <b>58</b>	LocID: <b>35AWW02</b>	Date: <b>10/22/13</b>
	Project: Longhorn Army Ammunition Plant	Project No. <b>60256135.0002HA</b>	Recorded By: <b>Scott Beesinger</b> Checked By:

EQUIPMENT	Water Quality Meter Type/ID #: <b>Horiba U-52</b>	Water Interface Probe: <b>Water Level Indicator ID# Solinst 101</b>	Min Recharge Level = (TD-DTW(0.80)) - TD
	Unit #: <b>21191</b>	Sampling Equipment: <b>Peristaltic/Bladder/Bailer</b> ID#:	

WELL INFO	Casing I.D. (in) [a]: <b>4"</b>	Static Water Level Reading (ft) [c]: <b>42.30</b>	Weather Conditions: <b>Clear 65°F</b>
	Total Well Depth (ft) [d]: <b>139.83</b>	Screened Interval/Pump placement: <b>126-136</b> <b>131.00</b>	Condition of Well/Remarks: <b>NEEDS PAINT</b>

CASING INFO	Casing I.D. (in) [a]:	0.75	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/in ft) [b]:	0.023	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Water Level (FTOC)	Pumping Rate (mL/min)	Temp. (°C)	pH	Cond (mS/cm)	DO (mg/L)	Turb. (NTU)	ORP (mv)	Remarks (odor, clarity, etc.)
10-22-13	1300	42.31	100	23.78	7.76	1.00	4.14	4.7	120	
10-22-13	1305	42.33	100	22.96	8.10	0.962	2.31	8.5	112	
10-22-13	1310	42.35	100	22.85	8.13	0.955	2.04	8.1	109	
10-22-13	1315	42.36	100	22.78	8.13	0.911	1.73	9.0	107	
10-22-13	1320	42.37	100	22.72	8.14	0.878	1.54	9.9	102	
10-22-13	1325	42.38	100	22.81	8.13	0.877	1.36	7.7	100	
10-22-13	1330	42.39	100	22.79	8.12	0.876	1.35	7.9	99	
10-22-13	1335	42.40	100	22.75	8.12	0.876	1.32	7.1	98	
10-22-13	1340	42.41	100	22.72	8.12	0.875	1.30	7.3	98	

Pump Rate: <=0.5 L/min Drawdown: <0.33 ft Measurements: 3-5 min Stabilization: +/-10% C, +/-0.1 pH, +/-3% Cond, +/-10% DO, +/-10% Turb(<=10 NTU Ideal), for 4 consecutive readings

SAMPLE ID: <b>35AWW02-102213</b> TIME: <b>1340</b>	No. Containers/Volume/Type	Preserv.	Filter (Y/N)	Pump OR Bailer	Parameter(s)
	<b>3- 40 ml glass</b>	<b>HCL</b>	<b>N</b>	<b>Pump</b>	<del>ASAP-GLAS</del> <b>VOI</b>
DUPLICATE (D): YES/NO <b>NO</b>					
MATRIX SPIKE (MS): YES/NO <b>NO</b>					
MATRIX DUPLICATE (MD): YES/NO <b>NO</b>					
CO=	LEL=	OXY=	H2S=		

LOCATION	Site: 58	LocID: 35A WW05	Date: 10/16/13									
	Project: Longhorn Army Ammunition Plant	Project No. 60256135.0002HA	Recorded By: Scott Beesinger Checked By:									
EQUIPMENT	Water Quality Meter Type/ID #: Horiba U-52	Water Interface Probe: Water Level Indicator ID# Solinst 101	Min Recharge Level = (TD-DTW(0.80)) - TD									
	Unit #: 21191	Sampling Equipment: Peristaltic/Bladder/Bailer ID#:										
WELL INFO	Casing I.D. (in) [a]: 4"	Static Water Level Reading (ft) [c]: 43.70	Weather Conditions: Rain 63°F									
	Total Well Depth (ft) [d]: 71.75	Screened Interval/Pump placement: 61-71 66.00	Condition of Well/Remarks: needs paint									
CASING INFO	Casing I.D. (in) [a]:	0.75	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/in ft) [b]:	0.023	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Water Level (FTOC)	Pumping Rate (mL/min)	Temp. (°C)	pH	Cond (mS/cm)	DO (mg/L)	Turb. (NTU)	ORP (mv)	Remarks (odor, clarity, etc.)
10-16-13	1305	43.75	100	20.13	7.30	2.70	2.29	43.1	-132	
10-16-13	1310	43.76	100	20.48	7.21	2.73	1.57	31.8	-145	
10-16-13	1315	43.77	100	20.60	7.19	2.74	1.33	29.4	-148	
10-16-13	1320	43.78	100	20.71	7.17	2.76	1.16	28.5	-149	
10-16-13	1325	43.79	100	20.75	7.15	2.80	1.05	26.3	-148	
10-16-13	1330	43.80	100	20.79	7.12	2.84	0.94	31.2	-147	
10-16-13	1335	43.81	100	20.89	7.09	2.87	0.89	31.4	-146	
10-16-13	1340	43.82	100	20.90	7.07	2.91	0.83	29.8	-145	
10-16-13	1345	43.83	100	20.88	7.04	2.94	0.80	27.7	-143	
10-16-13	1350	43.84	100	21.01	7.01	2.98	0.75	24.3	-143	
10-16-13	1355	43.85	100	21.04	6.99	3.00	0.72	21.4	-142	
10-16-13	1400	43.86	100	21.03	6.97	3.02	0.70	16.5	-140	
10-16-13	1405	43.87	100	20.96	6.96	3.03	0.69	16.8	-140	
10-16-13	1410	43.88	100	20.96	6.96	3.04	0.68	16.3	-140	
10-16-13	1415	43.89	100	21.05	6.95	3.05	0.67	16.9	-141	

Pump Rate: <=0.5 L/min Drawdown: <0.33 ft Measurements: 3-5 min Stabilization: +/-10% C, +/-0.1 pH, +/-3% Cond, +/-10% DO, +/-10%Turb(<=10 NTU Ideal), for 4 consecutive readings

SAMPLE ID: 35A WW05-101613 TIME: 1415  DUPLICATE (D): YES/NO NO MATRIX SPIKE (MS): YES/NO NO MATRIX DUPLICATE (MD): YES/NO NO  CO=      LEL=      OXY=      H2S=	No. Containers/Volume/Type	Preserv.	Filter (Y/N)	Pump OR Bailer	Parameter(s)
	3-40ml glass	HCL	N	Pump	8260B-SIMS VPC



























LOCATION	Site: <b>58</b>	LocID: <b>35HW14</b>	Date: <b>10/18/13</b>
	Project: Longhorn Army Ammunition Plant	Project No. 60256135.0002HA	Recorded By: Scott Beesinger      Checked By:

EQUIPMENT	Water Quality Meter Type/ID #: Horiba U-52	Water Interface Probe: Water Level Indicator ID# Solinist 101	Min Recharge Level = (TD-DTW(0.80)) - TD
	Unit #: 21191	Sampling Equipment: Peristaltic/Bladder/Bailer ID#:	

WELL INFO	Casing I.D. (in) [a]: <b>2.11</b>	Static Water Level Reading (ft) [c]: <b>30.80</b>	Weather Conditions: <b>Clear 50°F</b>
	Total Well Depth (ft) [d]: <b>32.28</b>	Screened Interval/Pump placement: <b>14.8-29.5</b>	Condition of Well/Remarks: <b>GOOD</b>

CASING INFO	Casing I.D. (in) [a]:	0.75	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gall/in ft) [b]:	0.023	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Water Level (FTOC)	Pumping Rate (mL/min)	Temp. (°C)	pH	Cond (mS/cm)	DO (mg/L)	Turb. (NTU)	ORP (mv)	Remarks (odor, clarity, etc.)
10-18-13	0727	30.80	NA							1.5 ft water Bailing well
10-18-13	0737	32.20	NA							
10-18-13	1300	30.80	NA	19.37	6.89	6.73	10.50	6.0	1	

Pump Rate: <=0.5 L/min Drawdown: <0.33 ft Measurements: 3-5 min Stabilization: +/-10% C, +/-0.1 pH, +/-3% Cond, +/-10% DO, +/-10% Turb(<=10 NTU Ideal), for 4 consecutive readings

SAMPLE ID: <b>35AWW14-101813</b> TIME: <b>1300</b>	No. Containers/Volume/Type	Preserv.	Filter (Y/N)	Pump OR Bailer	Parameter(s)
	<b>3-40 ml glass</b>	<b>HCL</b>	<b>N</b>	<b>Bailer</b>	<b>BAILEY SIMS VOL</b>
DUPLICATE (D): YES/NO <b>NO</b>					
MATRIX SPIKE (MS): YES/NO <b>NO</b>					
MATRIX DUPLICATE (MD): YES/NO <b>NO</b>					
CO=      LEL=      OXY=      H2S=					







LOCATION	Site: <b>58</b>	LocID: <b>35 Aww 17</b>	Date: <b>10/18/13</b>									
	Project: Longhorn Army Ammunition Plant	Project No. 60256135.0002HA	Recorded By: Scott Beesinger      Checked By:									
EQUIPMENT	Water Quality Meter Type/ID #: Horiba U-52	Water Interface Probe: Water Level Indicator ID# Solinst 101	Min Recharge Level = (TD-DTW(0.80)) - TD									
	Unit #: 21191	Sampling Equipment: Peristaltic/Bladder/Bailer ID#:										
WELL INFO	Casing I.D. (in) [a]: <b>2"</b>	Static Water Level Reading (ft) [c]: <b>28.00</b>	Weather Conditions: <b>Clear 55°F</b>									
	Total Well Depth (ft) [d]: <b>42.33</b>	Screened Interval/Pump placement: <b>24.7-39.4 32.00</b>	Condition of Well/Remarks: <b>Good</b>									
CASING INFO	Casing I.D. (in) [a]:	0.75	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/in ft) [b]:	0.023	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Water Level (FTOC)	Pumping Rate (mL/min)	Temp. (°C)	pH	Cond (mS/cm)	DO (mg/L)	Turb. (NTU)	ORP (mv)	Remarks (odor, clarity, etc.)
10-18-13	0900	27.98	100	15.67	6.48	10.3	3.39	13.6	210	
10-18-13	0905	28.00	100	16.45	6.52	10.4	2.50	14.0	125	
10-18-13	0910	28.02	100	16.74	6.56	10.4	2.35	13.9	90	
10-18-13	0915	28.04	100	16.95	6.59	10.4	2.29	14.1	79	
10-18-13	0920	28.05	100	17.10	6.61	10.4	2.19	13.5	76	
10-18-13	0925	28.06	100	17.29	6.62	10.4	2.10	13.3	76	
10-18-13	0930	28.07	100	17.48	6.63	10.4	1.99	13.0	75	
10-18-13	0935	28.08	100	17.58	6.64	10.4	1.81	12.1	76	
10-18-13	0940	28.09	100	17.63	6.64	10.4	1.78	12.2	76	
10-18-13	0945	28.10	100	17.65	6.64	10.4	1.75	12.0	75	
10-18-13	0950	28.11	100	17.69	6.64	10.4	1.72	12.1	74	

Pump Rate: <=0.5 L/min Drawdown: <0.33 ft Measurements: 3-5 min Stabilization: +/-10% C, +/-0.1 pH, +/-3% Cond, +/-10% DO, +/-10%Turb(<=10 NTU Ideal), for 4 consecutive readings

SAMPLE ID: <b>35Aww17-101813</b> TIME: <b>0950</b>  DUPLICATE (D): YES/NO <b>NO</b> MATRIX SPIKE (MS): YES/NO <b>NO</b> MATRIX DUPLICATE (MD): YES/NO <b>NO</b>  CO=      LEL=      OXY=      H2S=	No. Containers/Volume/Type	Preserv.	Filter (Y/N)	Pump OR Bailer	Parameter(s)
	<b>3-40 ml glass</b>	<b>HCL</b>	<b>N</b>	<b>Pump</b>	<b>82000 SIMS - VOC</b>















LOCATION	Site: 58	LocID: 35Aww22	Date: 10/22/13									
	Project: Longhorn Army Ammunition Plant	Project No. 60256135.0002HA	Recorded By: Scott Beesinger Checked By:									
EQUIPMENT	Water Quality Meter Type/ID #: Horiba U-52	Water Interface Probe: Water Level Indicator ID# Solinist 101	Min Recharge Level = (TD-DTW(0.80)) - TD									
	Unit #: 21191	Sampling Equipment: Peristaltic/Bladder/Bailer ID#:										
WELL INFO	Casing I.D. (in) [a]: 2"	Static Water Level Reading (ft) [c]: 32.13	Weather Conditions: CLEAR 62°F									
	Total Well Depth (ft) [d]: 36.40	Screened Interval/Pump placement: 20.2-34.7	Condition of Well/Remarks: GOOD									
CASING INFO	Casing I.D. (in) [a]:	0.75	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/in ft) [b]:	0.023	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Water Level (FTOC)	Pumping Rate (mL/min)	Temp. (°C)	pH	Cond (mS/cm)	DO (mg/L)	Turb. (NTU)	ORP (mv)	Remarks (odor, clarity, etc.)
10-22-13	0835	32.13	NA							only 4.3 ft. water Bailing well
10-22-13	0845	36.31	NA							Bailed 2 gallons RANDLY
10-22-13	1055	32.13	NA	18.67	6.20	9.85	9.67	25.0	170	

Pump Rate: <=0.5 L/min Drawdown: <0.33 ft Measurements: 3-5 min Stabilization: +/-10% C, +/-0.1 pH, +/-3% Cond, +/-10% DO, +/-10% Turb(<=10 NTU Ideal), for 4 consecutive readings

SAMPLE ID: 35Aww22-102213 TIME: 1055  DUPLICATE (D): YES/NO NO MATRIX SPIKE (MS): YES/NO NO MATRIX DUPLICATE (MD): YES/NO NO  CO=      LEL=      OXY=      H2S=	No. Containers/Volume/Type	Preserv.	Filter (Y/N)	Pump OR Bailer	Parameter(s)
	3-40 ml glass	HCL	N	Bailer	82605 SIMS VOC











LOCATION	Site: 58	LocID: LHSmw07	Date: 10/15/13
	Project: Longhorn Army Ammunition Plant	Project No. 60256135.0002HA	Recorded By: Scott Beesinger Checked By:

EQUIPMENT	Water Quality Meter Type/ID #: Horiba U-52	Water Interface Probe: Water Level Indicator ID# Solinst 101	Min Recharge Level = (TD-DTW(0.80)) - TD
	Unit #: 21191	Sampling Equipment: Peristaltic/Bladder/Bailer ID#:	

WELL INFO	Casing I.D. (in) [a]: 4"	Static Water Level Reading (ft) [c]: 20.55	Weather Conditions: Cloudy/Drizzle 82°F
	Total Well Depth (ft) [d]: 30.48	Screened Interval/Pump placement: 17-27 23.00	Condition of Well/Remarks: Needs paint

CASING INFO	Casing I.D. (in) [a]:	0.75	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/in ft) [b]:	0.023	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Water Level (FTOC)	Pumping Rate (mL/min)	Temp. (°C)	pH	Cond (mS/cm)	DO (mg/L)	Turb. (NTU)	ORP (mv)	Remarks (odor, clarity, etc.)
10-15-13	10:50	20.58	100	24.01	6.51	12.2	2.37	11.6	111	
10-15-13	10:55	20.60	100	23.37	6.49	12.4	1.33	8.0	93	
10-15-13	11:00	20.61	100	23.23	6.49	12.4	1.15	9.1	87	
10-15-13	11:05	20.62	100	23.19	6.49	12.4	0.95	4.7	84	
10-15-13	11:10	20.63	100	23.13	6.49	12.5	0.85	4.3	82	
10-15-13	11:15	20.64	100	23.07	6.48	12.5	0.80	3.5	81	
10-15-13	11:20	20.65	100	23.07	6.48	12.5	0.77	2.8	81	
10-15-13	11:25	20.66	100	23.02	6.48	12.4	0.76	2.7	80	
10-15-13	11:30	20.67	100	23.04	6.48	12.5	0.75	1.8	79	

Pump Rate: <=0.5 L/min Drawdown: <0.33 ft Measurements: 3-5 min Stabilization: +/-10% C, +/-0.1 pH, +/-3% Cond, +/-10% DO, +/-10%Turb(<=10 NTU Ideal), for 4 consecutive readings

SAMPLE ID: LHSmw07-101513 TIME: 1130 DUPLICATE (D): YES/NO NO MATRIX SPIKE (MS): YES/NO NO MATRIX DUPLICATE (MD): YES/NO NO CO= LEL= OXY= H2S=	No. Containers/Volume/Type	Preserv.	Filter (Y/N)	Pump OR Bailer	Parameter(s)
	3-40 ml glass	HCL	N	Pump	8200B-SIMS VOL
	2-20 ml glass	HCL	N	"	ACES
	1-500 ml plastic	ZnAc, NaOH	N	"	Sulfide
	1-250 ml Amber	NA	N	"	Ferrous IRAN
	1-250 ml plastic	HNO3	Y	"	Dissolved metals
	1-250 ml plastic	HNO3	N	"	TOTAL metals
	1-250 ml plastic	H2SO4	N	"	TOTAL phosphorus
	1-250 ml plastic	NA	N	"	ANIONS
1-250 ml plastic	NA	N	"	Alkalinity	









LOCATION	Site: 58	LocID: 35AWW01	Date: 1/31/14									
	Project: Longhorn Army Ammunition Plant	Project No. 60256135.0002HA	Recorded By: Scott Beesinger									
EQUIPMENT	Water Quality Meter Type/ID #: Horiba U-52	Water Interface Probe: Water Level Indicator ID# Solinst 101	Min Recharge Level = (TD-DTW(0.80)) - TD									
	Unit #	Sampling Equipment: Peristaltic/Bladder/Bailer ID#:										
WELL INFO	Casing I.D. (in) [a]: 4.11	Static Water Level Reading (ft) [c]: 40.21	Weather Conditions: Cloudy 67°F									
	Total Well Depth (ft) [d]: 72.48	Screened Interval/Pump placement: 62.45-72.45 67.50	Condition of Well/Remarks: N44TS paint									
CASING INFO	Casing I.D. (in) [a]:	0.75	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/in ft) [b]:	0.023	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Water Level (FTOC)	Pumping Rate (mL/min)	Temp. (°C)	pH	Cond (mS/cm)	DO (mg/L)	Turb. (NTU)	ORP (mv)	Remarks (odor, clarity, etc.)
1/31/14	1500	40.22	100	20.82	7.67	1.28	6.59	204	-27	
1/31/14	1505	40.24	100	20.61	7.02	1.14	1.61	234	-31	
1/31/14	1510	40.25	100	20.61	7.10	0.830	0.81	205	-43	
1/31/14	1515	40.26	100	20.62	7.18	0.699	0.50	188	-59	
1/31/14	1520	40.27	100	20.53	7.18	0.683	0.35	175	-61	
1/31/14	1525	40.28	100	20.46	7.19	0.674	0.29	166	-63	
1/31/14	1530	40.29	100	20.48	7.19	0.665	0.25	180	-63	
1/31/14	1535	40.30	100	20.49	7.19	0.662	0.20	147	-64	
1/31/14	1540	40.31	100	20.51	7.18	0.659	0.18	130	-65	
1/31/14	1545	40.32	100	20.46	7.18	0.658	0.17	116	-65	
1/31/14	1550	40.33	100	20.41	7.19	0.657	0.15	103	-65	
1/31/14	1555	40.34	100	20.37	7.19	0.656	0.15	88.9	-66	
1/31/14	1600	40.35	100	20.38	7.19	0.656	0.15	88.0	-65	
1/31/14	1605	40.36	100	20.35	7.18	0.655	0.14	88.5	-65	
1/31/14	1610	40.37	100	20.36	7.18	0.655	0.14	88.1	-66	

Pump Rate: <=0.5 L/min Drawdown: <0.33 ft Measurements: 3-5 min Stabilization: +/-10% C, +/-0.1 pH, +/-3% Cond, +/-10% DO; +/-10% Turb(<=10 NTU Ideal), for 4 consecutive readings

SAMPLE ID: 35AWW01-013114	TIME: 1610	No. Containers/Volume/Type	Preserv.	Filter (Y/N)	Pump OR Bailer	Parameter(s)
		6 - 40 ml glass	HCL	N	Pump	NO <sub>2</sub>
		2 - 250 ml plastic	HNO <sub>3</sub>	Y	Pump	ARSENIC
DUPLICATE (D): YES/NO	yes					
MATRIX SPIKE (MS): YES/NO	no					
MATRIX DUPLICATE (MD): YES/NO	no					
CO=	LEL=	OXY=	H2S=			





LOCATION	Site: 58	LocID: 35AWW06	Date: 1/30/14									
	Project: Longhorn Army Ammunition Plant	Project No. 60256135.0002HA	Recorded By: Scott Beesinger									
EQUIPMENT	Water Quality Meter Type/ID #: Horiba U-52	Water Interface Probe: Water Level Indicator ID# Solinst 101	Min Recharge Level = (TD-DTW(0.80)) - TD									
	Unit #	Sampling Equipment: Peristaltic/Bladder/Bailer ID#:										
WELL INFO	Casing I.D. (in) [a]: 4"	Static Water Level Reading (ft) [c]: 21.14	Weather Conditions: CLEAR/COLD 27°F									
	Total Well Depth (ft) [d]: 30.40	Screened Interval/Pump placement: 17-27 24.00	Condition of Well/Remarks: NEEDS paint									
CASING INFO	Casing I.D. (in) [a]:	0.75	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/in ft) [b]:	0.023	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Water Level (FTOC)	Pumping Rate (mL/min)	Temp. (°C)	pH	Cond (mS/cm)	DO (mg/L)	Turb. (NTU)	ORP (mv)	Remarks (odor, clarity, etc.)
1/30/14	0805	21.15	100	12.25	6.75	6.31	2.1	21.1	177	
1/30/14	0810	21.17	100	14.12	6.81	6.36	1.21	22.6	163	
1/30/14	0815	21.19	100	14.75	6.81	6.42	0.80	19.5	159	
1/30/14	0820	21.21	100	15.22	6.81	6.46	0.47	17.4	154	
1/30/14	0825	21.23	100	15.67	6.83	6.44	0.33	9.6	153	
1/30/14	0830	21.25	100	15.75	6.82	6.45	0.32	4.2	154	
1/30/14	0835	21.27	100	15.79	6.82	6.45	0.31	1.0	154	
1/30/14	0840	21.29	100	15.83	6.81	6.45	0.30	0.5	154	

Pump Rate: <=0.5 L/min Drawdown: <0.33 ft Measurements: 3-5 min Stabilization: +/-10% C, +/-0.1 pH, +/-3% Cond, +/-10% DO; +/-10% Turb(<=10 NTU Ideal), for 4 consecutive readings

SAMPLE ID: 35AWW06-013014 TIME: 0840  DUPLICATE (D): YES/NO NO MATRIX SPIKE (MS): YES/NO NO MATRIX DUPLICATE (MD): YES/NO NO  CO= LEL= OXY= H2S=	No. Containers/Volume/Type	Preserv.	Filter (Y/N)	Pump OR Bailer	Parameter(s)
	3-40ml glass	HCL	N	Pump	VOC
	3-20ml glass	HCL	N	"	Gases / carbon dioxide
	1-500ml plastic	Zn Ac/NaOH	N	"	Sulfide
	1-250ml Amber	NA	N	"	Ferrous Iron
	1-250ml plastic	HNO3	N	"	Dissolved metals
	1-250ml plastic	HNO3	N	"	TOTAL metals
	1-250ml plastic	HNO3	N	"	Arsenic
	1-250ml plastic	PERSOL	N	"	FOC / Total phosphorus
	1-250ml plastic	NA	N	"	Ammonia

















LOCATION	Site: 58	LocID: LHSmw03	Date: 2/3/14									
	Project: Longhorn Army Ammunition Plant	Project No. 60256135.0002HA	Recorded By: Scott Beesinger									
EQUIPMENT	Water Quality Meter Type/ID #: Horiba U-52	Water Interface Probe: Water Level Indicator ID# Solinst 101	Min Recharge Level = (TD-DTW(0.80)) - TD									
	Unit #	Sampling Equipment: Peristaltic/Bladder/Bailer ID#:										
WELL INFO	Casing I.D. (in) [a]: 4.11	Static Water Level Reading (ft) [c]: 31.00	Weather Conditions: Cloudy/rainy/60°F									
	Total Well Depth (ft) [d]: 35.20	Screened Interval/Pump placement: 21.8-31.8		Condition of Well/Remarks: NEEDS paint								
CASING INFO	Casing I.D. (in) [a]:	0.75	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/in ft) [b]:	0.023	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Water Level (FTOC)	Pumping Rate (mL/min)	Temp. (°C)	pH	Cond (mS/cm)	DO (mg/L)	Turb. (NTU)	ORP (mv)	Remarks (odor, clarity, etc.)
2/3/14	0743	31.00	NA							only 4 ft. water Bailing well Bailed 3.5 gallons RANDAY
2/3/14	0750	35.15	NA							
2/4/14	0740	34.00	NA							well did not recharge to with 80% of original depth in 24 hours, well has to be called dry
Dry well										

Pump Rate: <=0.5 L/min Drawdown: <0.33 ft Measurements: 3-5 min Stabilization: +/-10% C, +/-0.1 pH, +/-3% Cond, +/-10% DO; +/-10% Turb(<=10 NTU Ideal), for 4 consecutive readings

SAMPLE ID:	TIME:	No. Containers/Volume/Type	Preserv.	Filter (Y/N)	Pump OR Bailer	Parameter(s)
DUPLICATE (D): YES/NO						
MATRIX SPIKE (MS): YES/NO						
MATRIX DUPLICATE (MD): YES/NO						
CO=	LEL=	OXY=	H2S=			









LOCATION	Site: 58	LocID: LHSmw07	Date: 1/30/14									
	Project: Longhorn Army Ammunition Plant	Project No. 60256135.0002HA	Recorded By: Scott Beesinger									
EQUIPMENT	Water Quality Meter Type/ID #: Horiba U-52	Water Interface Probe: Water Level Indicator ID# Solinst 101	Min Recharge Level = (TD-DTW(0.80)) - TD									
	Unit #	Sampling Equipment: Peristaltic/Bladder/Bailer ID#:										
WELL INFO	Casing I.D. (in) [a]: 4.11	Static Water Level Reading (ft) [c]: 20.25	Weather Conditions: CLEAR/WINDY/COLD 32°F									
	Total Well Depth (ft) [d]: 30.50	Screened Interval/Pump placement: 17-27 24.00	Condition of Well/Remarks: NUTS paint									
CASING INFO	Casing I.D. (in) [a]:	0.75	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/in ft) [b]:	0.023	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Water Level (FTOC)	Pumping Rate (mL/min)	Temp. (°C)	pH	Cond (mS/cm)	DO (mg/L)	Turb. (NTU)	ORP (mv)	Remarks (odor, clarity, etc.)
1/30/14	0930	20.27	100	12.64	6.76	11.1	1.33	12.9	153	
1/30/14	0935	20.29	100	13.81	6.74	11.1	0.77	11.8	139	
1/30/14	0940	20.31	100	14.70	6.73	11.2	0.50	11.0	126	
1/30/14	0945	20.33	100	14.54	6.69	11.4	0.35	8.5	117	
1/30/14	0950	20.35	100	14.30	6.67	11.4	0.27	7.3	116	
1/30/14	0955	20.37	100	14.22	6.67	11.5	0.25	6.4	116	
1/30/14	1000	20.39	100	14.17	6.67	11.4	0.26	4.6	115	
1/30/14	1005	20.41	100	14.13	6.67	11.4	0.25	4.2	115	

Pump Rate: <=0.5 L/min Drawdown: <0.33 ft Measurements: 3-5 min Stabilization: +/-10% C, +/-0.1 pH, +/-3% Cond, +/-10% DO; +/-10% Turb(<=10 NTU Ideal), for 4 consecutive readings

SAMPLE ID: LHSmw07-013014	TIME: 1005	No. Containers/Volume/Type	Preserv.	Filter (Y/N)	Pump OR Bailer	Parameter(s)
DUPLICATE (D): YES/NO NO		3-40ml glass	HCL	N	Pump	VOL
MATRIX SPIKE (MS): YES/NO NP		3-20ml glass	HCL	N	"	Bases/Carbon Dioxide
MATRIX DUPLICATE (MD): YES/NO NO		1-500ml plastic	Ascorbic	N	"	Sulfide
		1-250ml Amber	NA	N	"	Ferrous Iron
		1-250ml plastic	HNO3	N	"	Dissolved Metals
		1-250ml plastic	HNO3	N	"	TOTAL metals
		1-250ml plastic	HNO3	N	"	ARSENIC
		1-250ml plastic	H2SO4	N	"	TOC/TOTAL Phosphorous
		1-250ml plastic	NA	N	"	Ammonia
		1-250ml plastic	NA	N	"	

CO= LEL= OXY= H2S=



**APPENDIX F: Chain of Custody Forms, Data Validation Reports, Analytical Data Tables  
and Laboratory Reports**

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CHAIN-OF-CUSTODY RECORD

Company Name: <i>AECOM</i>						NUMBER OF CONTAINERS	Hold	VOC'S 82608	TOTAL # (LAB USE)	Program	
Project Contact: <i>David Walker/Linda Raabe</i>		Contact Phone #: <i>210-296-2000</i>		<input type="checkbox"/> CWA	<input type="checkbox"/> RCRA						
Turn Around Requirements: <i>Contact Standard - Linda Raabe</i>		Location: <i>LHAAP 58</i>		<input type="checkbox"/> DOD	<input type="checkbox"/> AFCEE						
Project ID: <i>60256135</i>		Signature: <i>Randy Morgan</i>		<input type="checkbox"/> Other _____	ADDITIONAL REQUIREMENTS						
Sampler (print): <i>Randy Morgan/Al Smith</i>		Signature: <i>Randy Morgan</i>									
Sample I.D. No.	Comp	Grab	Date	Time	Matrix*						
<i>TB 100813</i>			<i>08-10-13</i>		<i>Water</i>	<i>2</i>	<i>X</i>				
<i>58NPT19(31-35)100813</i>		<i>X</i>	<i>08-10-13</i>	<i>1415</i>	<i>GW</i>	<i>3</i>	<i>X</i>				
<i>58NPT24(31-35)100813</i>		<i>X</i>	<i>08-10-13</i>	<i>1525</i>	<i>GW</i>	<i>3</i>	<i>X</i>				
<i>58NPT18(31-35)120813</i>		<i>X</i>	<i>08-12-13</i>	<i>0805</i>	<i>GW</i>	<i>3</i>	<i>X</i>				
Relinquished by: (Signature) <i>Al Smith</i>			Date <i>8-12-13</i>	Time <i>1700</i>	Received by: (Signature)	Relinquished by: (Signature)		Date	Time	Received by: (Signature)	
Relinquished by: (Signature)			Date	Time	Received for Laboratory by: (Signature)	Date	Time	Remarks:			

\*Water (W), Soil (S), Solid Waste (SD), Unknown (X)





















# Chain of Custody Record

COC Number:

Laboratory: Microbac POC: Tony Long	Project Manager: Dave Wacker	Mail to: Linda Raabe 112 East Pecan STE. 400 San Antonio, TX 78205 210-296-2000
Address: 158 Starlite Drive Marietta, OH 45750	Phone/Fax Number: 210-296-2000	
Phone: 1-800-373-4071	Sampler (print): Scott Beesinger	
Client: AECOM	Signature: <i>Scott Beesinger</i>	Fed Ex Airbill No:
Address: 112 East Pecan Ste. 400 San Antonio, TX 78205	pH:	Program:
Turn Around Time: 14-day		
Project Name/Location: Longhorn		
Project Number: 60274185.0002HA		

Site Name	Sample ID/Location ID	SBD	SED	Date	Time	Comp	Grab	Matrix	Number of Containers	VOC 8260	Dissolved Gases RSK 175	Total Organic Carbon E415.1 RSK 175	Carbon Dioxide	Alkalinity E310.1	Dissolved Iron SW6010	Total Iron SW6010	Total Phosphorous	ERPIMS REQUIRED FIELDS				
																		SA CODE	Cooler ID	LOT CONTROL NUMBERS		
																				ABL OT	EBL OT	TBL OT
<b>SITE 58</b>	35AWW08-082013			8/20/13	1130		W	13	✓	✓	✓	✓	✓	✓	✓	✓						
	03WW01-082013			8/20/13	1445		W	13	✓	✓	✓	✓	✓	✓	✓	✓						

Comments:

Relinquished by: <i>Scott Beesinger</i>	Date: 8/20/13	Time: 1600	Received by: (Signature)	Received by: (Signature)	Date	Time	Relinquished by: (Signature)
Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Remarks:	

\*Homogenize all composite samples prior to analysis

Distribution: White to Laboratory, Canary to Project Manager, Pink QA/QC Manager







**REPORT TO:**

Name: LINDA RAABE  
 Company: A&Com  
 Address: 112 E. PEARL, Suite 400  
SAN ANTONIO, TX. 78205  
 email: linda.raabe@aecom.com  
 Phone: 210-253-7518  
 Fax: \_\_\_\_\_

Project Manager: DAVE WALKER  
 Project Name: LHAAP SITE 5B  
 Project No.: 60274185.0002HA

**INVOICE TO:** (For Invoices paid by a third party it is imperative that all information be provided)

Name: \_\_\_\_\_  
 Company: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 email: \_\_\_\_\_  
 Phone: \_\_\_\_\_  
 Fax: \_\_\_\_\_

Purchase Order No. \_\_\_\_\_  
 Subcontract No. \_\_\_\_\_  
 MI Quote No. \_\_\_\_\_



10515 Research Dr  
 Knoxville, TN 37932  
 865-573-8188  
 www.microbe.com

**Please Check One:**

- More samples to follow
- No Additional Samples

Report Type:  Standard (default)     Microbial Insights Level III raw data(15% surcharge)     Microbial Insights Level IV (25% surcharge)     Comprehensive Interpretive(15%)     Historical Interpretive (30%)  
 EDD type:  Microbial Insights Standard (default)     All other available EDDs (5% surcharge) Specify EDD Type: \_\_\_\_\_

Please contact us with any questions about the analyses or filling out the COC at (865) 573-8188 (9:00 am to 5:00 pm EST, M-F). After hours email: customerservice@microbe.com

Sample Information					Analyses				CENSUS: Please select the target organism/gene																												
MI ID <small>(Laboratory Use Only)</small>	Sample Name	Date Sampled	Time Sampled	Matrix	PLFA	DGGE+3ID	DGGE+5ID	QuantArray Chlor	QuantArray Petro	DHC (Dehalococoides)	DHC Functional genes <small>(bvs, lvs, vcr)</small>	DHB (Dehalobacter)	DSM (Desulfomonas)	DSB (Desulfobacterium)	EBAC (Total)	SRB	Sulfate Reducing Bacteria-APS	MGN (Methanogens)	MOB (Methanotrophs)	SMMO	DNF (Denitrifiers-nitS and nitK)	AOB	ammonia oxidizing bacteria	PM1 (MTBE aerobic)	RMC (Toluene Monooxygenase)	RDEG (Toluene Monooxygenase)	PHE (Phenol Hydroxylase)	NAH (Naphthalene-aerobic)	BSSA <small>(Toluene/Xylene-Aerobic)</small>	acid. qPCR:	add. qPCR:	RNA <small>Expression Option*</small>	Other:	Other:	Other:		
	35AW008-082013	8/20/13	1130	W																																	
	03W001-082013	8/20/13	1445	W																																	
				W/SB																																	
Relinquished by: <u>Jean Boosig</u>					Received by: _____				Date: <u>8/20/13 1600</u>																												

It is vital that chain of custody is filled out correctly & that all relative information is provided.  
 Failure to provide sufficient and/or correct information regarding reporting, Invoicing & analyses requested information may result in delays for which MI will not be liable.









# Chain of Custody Record

COC Number:

Laboratory: Microbac POC: Robert Brooks	Project Manager: Dave Wacker	Mail to: Linda Raabe 112 East Pecan STE. 400 San Antonio, TX 78205 210-296-2000
Address: 505 E. Broadway Ave. Maryville, TN. 37804	Phone/Fax Number: 210-296-2000	
Phone: 865-977-1200	Sampler (print): Scott Beesinger	
Client: AECOM	Signature: <i>Scott Beesinger</i>	Fed Ex Airbill No:
Address: 112 East Pecan Ste. 400 San Antonio, TX 78205	pH:	Program:
Turn Around Time: 14-day		
Project Name/Location: Longhorn		
Project Number: 60256135.0002HA		

**ERPIMS REQUIRED FIELDS**

Site Name	Sample ID/Location ID	SBD	SED	Date	Time	Comp	Grab	Matrix	Number of Containers	DHC including vcra reductase gene								SA CODE	Cooler ID	LOT CONTROL NUMBERS						
																				ABL0T	EBL0T	TBL0T				
<b>SITE 58</b>	35AWW10-082913			8/29/13	9:10	X	W		2	X																
	35AWW09-082913			8/29/13	11:30	X	W		2	X																

Comments:

Relinquished by: <i>Scott Beesinger</i>	Date: 8/29/13	Time: 1500	Received by: (Signature)	Received by: (Signature)	Date	Time	Relinquished by: (Signature)
Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Remarks:	

\*Homogenize all composite samples prior to analysis

Distribution: White to Laboratory, Canary to Project Manager, Pink QA/QC Manager

**REPORT TO:**

Name: LINDA RAABE  
 Company: AECOM  
 Address: 112 E. PACAN, Suite 400

email: linda.raabe@aecom.com  
 Phone: 210-253-7518  
 Fax:

Project Manager: DAVE WACKER  
 Project Name: LHAAP SITE 58  
 Project No.: 60256135.000 HA

**INVOICE TO:** (For Invoices paid by a third party it is imperative that all information be provided)

Name: \_\_\_\_\_  
 Company: \_\_\_\_\_  
 Address: \_\_\_\_\_

email: \_\_\_\_\_  
 Phone: \_\_\_\_\_  
 Fax: \_\_\_\_\_

Purchase Order No. \_\_\_\_\_  
 Subcontract No. \_\_\_\_\_  
 MI Quote No. \_\_\_\_\_



10515 Research Dr  
 Knoxville, TN 37932  
 865-573-8188  
 www.microbe.com

**Please Check One:**  
 More samples to follow  
 No Additional Samples

Report Type:  Standard (default)  Microbial Insights Level III raw data(15% surcharge)  Microbial Insights Level IV (25% surcharge)  Comprehensive Interpretive(15%)  Historical Interpretive (30%)  
 EDD type:  Microbial Insights Standard (default)  All other available EDDs (5% surcharge) Specify EDD Type: \_\_\_\_\_

Please contact us with any questions about the analyses or filling out the COC at (865) 573-8188 (9:00 am to 5:00 pm EST, M-F). After hours email: customerservice@microbe.com

Sample Information					Analyses				CENSUS: Please select the target organism/gene																												
MI ID (Laboratory Use Only)	Sample Name	Date Sampled	Time Sampled	Matrix	PLFA	DGGE+3ID	DGGE+5ID	QuantArray Chlor	QuantArray Petro	DHC (Dehalococoides)	DHC Functional genes (bvc, bca, vcr)	DHBT (Dehalobacter)	DSM (Desulfuromonas)	DSB (Desulfibacterium)	EBAC (Total)	SRB	Sulfate Reducing Bacteria-APS	MGN (Methanogens)	MOB (Methanotrophs)	SMMO	DNF (Denitrifiers-nitS and nitK)	AOB ammonia oxidizing bacteria	PMT (MTBE aerobic)	RMO (Toluene Monooxygenase)	RDEG (Toluene Monooxygenase)	PHE (Phenol Hydroxylase)	NAH (Napthalene-aerobic)	BSSA Toluene/Xylene-Amaerobic	acid. qPCR:	acid. qPCR:	RNA Expression Option)*	Other	Other	Other			
	35AWW09-082913	8/29/13	1130	W																																	
	35AWW09-082913	8/29/13	0910	W																																	

Relinquished by: Scotty Beesing 8/29/13 15:00

Received by: \_\_\_\_\_ Date \_\_\_\_\_

It is vital that chain of custody is filled out correctly & that all relative information is provided.  
 Failure to provide sufficient and/or correct information regarding reporting, invoicing & analyses requested information may result in delays for which MI will not be liable.



**REPORT TO:**

Name: LINDA RAABE  
 Company: Arcam  
 Address: 112 E. PECAN, Suite 400  
SAN ANTONIO, TX 78205  
 email: linda.raabe@arcam.com  
 Phone: 210-253-7518  
 Fax:

Project Manager: DAVE WACKER  
 Project Name: LHAP Site 58  
 Project No.: 60256135.0002HA

**INVOICE TO:** (For Invoices paid by a third party it is imperative that all information be provided)

Name: \_\_\_\_\_  
 Company: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 email: \_\_\_\_\_  
 Phone: \_\_\_\_\_  
 Fax: \_\_\_\_\_

Purchase Order No. \_\_\_\_\_  
 Subcontract No. \_\_\_\_\_  
 MI Quote No. \_\_\_\_\_



10515 Research Dr  
 Knoxville, TN 37932  
 865-573-8188  
 www.microbe.com

**Please Check One:**

- More samples to follow
- No Additional Samples

Report Type:  Standard (default)     Microbial Insights Level III raw data (15% surcharge)     Microbial Insights Level IV (25% surcharge)     Comprehensive Interpretive (15%)     Historical Interpretive (30%)  
 EDD type:  Microbial Insights Standard (default)     All other available EDDs (5% surcharge)    Specify EDD Type: \_\_\_\_\_

Please contact us with any questions about the analyses or filling out the COC at (865) 573-8188 (9:00 am to 5:00 pm EST, M-F). After hours email: customerservice@microbe.com

Sample Information					Analyses				CENSUS: Please select the target organism/gene																											
MI ID (Laboratory Use Only)	Sample Name	Date Sampled	Time Sampled	Matrix	PLFA	DGGE+3ID	DGGE+5ID	QuantArray Chlor	QuantArray Petro	DHC (Dehalococcolides)	DHC Functional genes (bnc, bse, wcf)	DHB1 (Dehalobacter)	DSM (Desulfuromonas)	DSB (Desulfobacterium)	EBAC (Total)	SRB	Sulfate Reducing Bacteria-APS	MGN (Methanogens)	MOB (Methanotrophs)	SMMO	DNF (Denitrifiers-nirS and nirK)	AOB ammonia oxidizing bacteria	PM1 (MTBE aerobic)	RMO (Toluene Monooxygenase)	RDEG (Toluene Monooxygenase)	PHE (Phenol Hydroxylase)	NAH (Naphthalene aerobic)	BSSA Toluene/Xylene-Anaerobic	add. qPCR:	add. qPCR:	RNA (Expression Option)*	Other:	Other:	Other:		
	35AWW08-101013	10/10/13	0800	W																																
	03WW01-101013	10/10/13	0920	W																																
	35AWW09-101013	10/10/13	1100	W																																
	35AWW10-101013	10/10/13	1400	W																																
Relinquished by:					Received by:				Date																											
<u>Scott Reese</u>									10/10/13 1530																											

It is vital that chain of custody is filled out correctly & that all relative information is provided.  
 Failure to provide sufficient and/or correct information regarding reporting, invoicing & analyses requested information may result in delays for which MI will not be liable.



# Chain of Custody Record

COC Number:

Laboratory: Microbac POC: Kathy Albertson	Project Manager: Dave Wacker	Mail to: Linda Raabe 112 East Pecan STE. 400 San Antonio, TX 78205 210-296-2000
Address: 158 Starlite Drive Marietta, OH 45750	Phone/Fax Number: 210-296-2000	
Phone: 1-800-373-4071	Sampler (print): Scott Beesinger	
Client: AECOM	Signature: <i>Scott Beesinger</i>	Fed Ex Airbill No:
Address: 112 East Pecan Ste. 400 San Antonio, TX 78205	pH:	Program:
Turn Around Time: STANDARD		
Project Name/Location: Longhorn		
Project Number: 60256135.0002HA		

**ERPIMS REQUIRED FIELDS**

Site Name	Sample ID/Location ID	SBD	SED	Date	Time	Comp	Grab	Matrix	Number of Containers	VOLATILE, FATTY ACIDS	Disinfectant Residues	SA CODE	Cooler ID	LOT CONTROL NUMBERS			
														ABL	EBL	TBL	
														ABL	EBL	TBL	
<b>SITE 58</b>	35Aww08-101013			10/10/13	0800		✓	W	1	✓							
	35Aww08F-101013			10/10/13	0800		✓	W	1		✓						
	03ww01-101013			10/10/13	0920		✓	W	1	✓							
	03ww01F-101013			10/10/13	0920		✓	W	1		✓						
	35Aww09-101013			10/10/13	1100		✓	W	1	✓							
	35Aww09F-101013			10/10/13	1100		✓	W	1		✓						
	35Aww09F-101013			10/10/13	1400		✓	W	1		✓						
	35Aww10-101013			10/10/13	1400		✓	W	1	✓							

Comments: **STANDARD TAT**

Relinquished by: (Signature) <i>Scott Beesinger</i>	Date: 10/10/13	Time: 1530	Received by: (Signature)	Received by: (Signature)	Date	Time	Relinquished by: (Signature)
Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Remarks:	

\*Homogenize all composite samples prior to analysis

Distribution: White to Laboratory, Canary to Project Manager, Pink QA/QC Manager





# Chain of Custody Record

COC Number:

Laboratory: Microbac POC: Kathy Albertson	Project Manager: Dave Wacker	Mail to: Linda Raabe 112 East Pecan STE. 400 San Antonio, TX 78205 210-296-2000
Address: 158 Starlite Drive Marietta, OH 45750	Phone/Fax Number: 210-296-2000	
Phone: 1-800-373-4071	Sampler (print): Scott Beesinger	
Client: AECOM	Signature: <i>Scott Beesinger</i>	Fed Ex Airbill No:
Address: 112 East Pecan Ste. 400 San Antonio, TX 78205	pH:	Program:
Turn Around Time: <b>STANDARD</b>		
Project Name/Location: Longhorn		
Project Number: 60256135.0002HA		

Site Name	Sample ID/Location ID	SBD	SED	Date	Time	Comp*	Grab	Matrix	Number of Containers	VOC	Dissolved Gases	ALKALINITY	ANIONS	Sulfide	TOC & TOTAL PHOSPHORUS	TOTAL IRON & MANGANESE	FERROUS IRON	SA CODE	Cooler ID	ERPIMS REQUIRED FIELDS			
																				LOT CONTROL NUMBERS			
																				ABLLOT	EBLOT	TBLLOT	
<b>SITE 58</b>	35AWW08-101013			10/10/13	0800		✓	W	12	✓	✓	✓	✓	✓	✓	✓	✓						
	03WW01-101013			10/10/13	0920		✓	W	12	✓	✓	✓	✓	✓	✓	✓	✓						
	35AWW09-101013			10/10/13	1100		✓	W	11	✓	✓	✓	✓	✓	✓	✓	✓						
	35AWW09F-101013			10/10/13	1100		✓	W	1														
	35AWW10-101013			10/10/13	1400		✓	W	12	✓	✓	✓	✓	✓	✓	✓	✓	✓					

Comments: **STANDARD TAT**

Relinquished by: <i>Scott Beesinger</i> (Signature)	Date: 10/10/13	Time: 1530	Received by: (Signature)	Received by: (Signature)	Date	Time	Relinquished by: (Signature)
Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Remarks:	

\*Homogenize all composite samples prior to analysis

Distribution: White to Laboratory, Canary to Project Manager, Pink QA/QC Manager













# Chain of Custody Record

COC Number:

Laboratory: Microbac POC: Kathy Albertson Address: 158 Starlite Drive Marietta, OH 45750 Phone: 1-800-373-4071 Client: AECOM Address: 112 East Pecan Ste. 400 San Antonio, TX 78205 Turn Around Time: <b>STANDARD</b> Project Name/Location: Longhorn Project Number: 60256135.0002HA	Project Manager: Dave Wacker Phone/Fax Number: 210-296-2000 Sampler (print): Scott Beesinger Signature: <i>Scott Beesinger</i> pH:	Mail to: Linda Raabe 112 East Pecan STE. 400 San Antonio, TX 78205 210-296-2000 Fed Ex Airbill No: Program:
--	--	--

**ERPIMS REQUIRED FIELDS**

Site Name	Sample ID/Location ID	SBD	SED	Date	Time	Comp*	Grab	Matrix	Number of Containers	LOT CONTROL NUMBERS								
										SA CODE	Cooler ID	ABL	EBL	TBL				
												ABL	EBL	TBL				
SITE 58	35Aww17-101813			10/18/13	0950		✓	W	3	✓								
	35Aww18-101813			10/18/13	1100		✓	W	3	✓								
	35Aww18ms-101813			10/18/13	1100		✓	W	3	✓								
	35Aww18msD-101813			10/18/13	1100		✓	W	3	✓								
	35Aww14-101813			10/18/13	1300		✓	W	3	✓								
	35Aww12-101813			10/18/13	1430		✓	W	3	✓								
	35Aww12FD-101813			10/18/13	1430		✓	W	3	✓								
	Equipment Rinser-102213			10/22/13	0810		✓	W	3	✓								
	35Aww16-102213			10/22/13	1000		✓	W	3	✓								
	35Aww19-102213			10/22/13	1025		✓	W	3	✓								
	35Aww22-102213			10/22/13	1055		✓	W	3	✓								
	Trip BLANK			10/22/13			✓	W	2	✓								

Comments: **STANDARD TAT**

Relinquished by: <i>Scott Beesinger</i>	Date: 10/22/13	Time: 1545	Received by: (Signature)	Received by: (Signature)	Date	Time	Relinquished by: (Signature)
Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Remarks:	

\*Homogenize all composite samples prior to analysis

Distribution: White to Laboratory, Canary to Project Manager, Pink QA/QC Manager





# Chain of Custody Record

COC Number:

Laboratory: Microbac POC: Kathy Albertson	Project Manager: Dave Wacker	Mail to: Linda Raabe 112 East Pecan STE. 400 San Antonio, TX 78205 210-296-2000
Address: 158 Starlite Drive Marietta, OH 45750	Phone/Fax Number: 210-296-2000	
Phone: 1-800-373-4071	Sampler (print): Scott Beesinger	
Client: AECOM	Signature: <i>Scott Beesinger</i>	Fed Ex Airbill No:
Address: 112 East Pecan Ste. 400 San Antonio, TX 78205	pH: _____ Number of Containers: <b>VOC</b>	Program:
Turn Around Time: <b>STANDARD</b>		
Project Name/Location: Longhorn		
Project Number: 60256135.0002HA		

**ERPIMS REQUIRED FIELDS**

Site Name	Sample ID/Location ID	SBD	SED	Date	Time	Comp*	Grab	Matrix	Number of Containers	VOC	SA CODE	Cooler ID	LOT CONTROL NUMBERS		
													ABL	EBL	TBL
													ABL	EBL	TBL
<b>SITE 58</b>	35AWW02-102213			10/22/13	1340		✓	W	3	✓					

Comments: **STANDARD TAT**

Relinquished by (Signature): <i>Scott Beesinger</i>	Date: 10/22/13	Time: 1545	Received by: (Signature)	Received by: (Signature)	Date	Time	Relinquished by: (Signature)
Relinquished by (Signature):	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Remarks:	

\*Homogenize all composite samples prior to analysis

Distribution: White to Laboratory, Canary to Project Manager, Pink QA/QC Manager



# Chain of Custody Record

COC Number:

Laboratory: Microbac POC: Kathy Albertson	Project Manager: Dave Wacker	Mail to: Linda Raabe 112 East Pecan STE. 400 San Antonio, TX 78205 210-296-2000
Address: 158 Starlite Drive Marietta, OH 45750	Phone/Fax Number: 210-296-2000	
Phone: 1-800-373-4071	Sampler (print): Scott Beesinger	
Client: AECOM	Signature: <i>Scott Beesinger</i>	Fed Ex Airbill No:
Address: 112 East Pecan Ste. 400 San Antonio, TX 78205	pH:	Program:
Turn Around Time: STANDARD		
Project Name/Location: Longhorn		
Project Number: 60256135.0002HA		

Site Name	Sample ID/Location ID	SBD	SED	Date	Time	Comp	Grab	Matrix	Number of Containers	ERPIMS REQUIRED FIELDS						
										SA CODE	Cooler ID	LOT CONTROL NUMBERS				
												ABL0T	EBL0T	TBL0T		
<b>SITE 58</b>	35AWW09F-012914			1/29/14	1010		✓	W	2	✓	✓					
	35AWW10F-012914			1/29/14	1230		✓	W	2	✓	✓					
	35AWW08F-012914			1/29/14	1320		✓	W	3	✓	✓	✓				
	03WW01F-012914			1/29/14	1420		✓	W	3	✓	✓	✓				

Comments: **STANDARD TAT**

Relinquished by: <i>Scott Beesinger</i>	Date: 1/29/14	Time: 1530	Received by: (Signature)	Received by: (Signature)	Date	Time	Relinquished by: (Signature)
Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Remarks:	

\*Homogenize all composite samples prior to analysis

Distribution: White to Laboratory, Canary to Project Manager, Pink QA/QC Manager





# Chain of Custody Record

COC Number:

Laboratory: Microbac POC: Kathy Albertson	Project Manager: Dave Wacker	Mail to: Linda Raabe 112 East Pecan STE. 400 San Antonio, TX 78205 210-296-2000									
Address: 158 Starlite Drive Marietta, OH 45750	Phone/Fax Number: 210-296-2000										
Phone: 1-800-373-4071	Sampler (print): Scott Beesinger										
Client: AECOM	Signature: <i>Scott Beesinger</i>	Fed Ex Airbill No:									
Address: 112 East Pecan Ste. 400 San Antonio, TX 78205	<p>pH:</p> <table border="1"> <tr><td>Number of Containers</td></tr> <tr><td>VOC</td></tr> <tr><td>Dissolved Gases Carbon Dioxide</td></tr> <tr><td>Sulfide</td></tr> <tr><td>Ferrous Iron</td></tr> <tr><td>Alkalinity</td></tr> <tr><td>NITRATE/NITRITE CHLORIDE/SULFATE</td></tr> <tr><td>TOC/TOTAL PHOSPHORUS</td></tr> <tr><td>ARSENIC</td></tr> </table>	Number of Containers	VOC	Dissolved Gases Carbon Dioxide	Sulfide	Ferrous Iron	Alkalinity	NITRATE/NITRITE CHLORIDE/SULFATE	TOC/TOTAL PHOSPHORUS	ARSENIC	Program:
Number of Containers											
VOC											
Dissolved Gases Carbon Dioxide											
Sulfide											
Ferrous Iron											
Alkalinity											
NITRATE/NITRITE CHLORIDE/SULFATE											
TOC/TOTAL PHOSPHORUS											
ARSENIC											
Turn Around Time: STANDARD		<p>ERPIMS REQUIRED FIELDS</p> <table border="1"> <tr> <th rowspan="2">SA CODE</th> <th rowspan="2">Cooler ID</th> <th colspan="3">LOT CONTROL NUMBERS</th> </tr> <tr> <th>ABL0T</th> <th>EBL0T</th> <th>TBL0T</th> </tr> </table>	SA CODE	Cooler ID	LOT CONTROL NUMBERS			ABL0T	EBL0T	TBL0T	
SA CODE	Cooler ID				LOT CONTROL NUMBERS						
			ABL0T	EBL0T	TBL0T						
Project Name/Location: Longhorn											
Project Number: 60256135.0002HA											

Site Name	Sample ID/Location ID	SBD	SED	Date	Time	Comp	Grab	Matrix	Number of Containers	VOC	Dissolved Gases Carbon Dioxide	Sulfide	Ferrous Iron	Alkalinity	NITRATE/NITRITE CHLORIDE/SULFATE	TOC/TOTAL PHOSPHORUS	ARSENIC	SA CODE	Cooler ID	LOT CONTROL NUMBERS					
																				ABL0T	EBL0T	TBL0T			
SITE 58	35AWW06-013014			1/30/14	0840		✓	W	12	✓	✓	✓	✓	✓	✓	✓	✓								
	LHSMW07-013014			1/30/14	1005		✓	W	12	✓	✓	✓	✓	✓	✓	✓	✓								
	TRIO BLANK			1/30/14			✓	W	2	✓															

Comments: STANDARD TAT

Relinquished by: <i>Scott Beesinger</i>	Date: 1/30/14	Time: 1300	Received by: (Signature)	Received by: (Signature)	Date	Time	Relinquished by: (Signature)
Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Remarks:	

\*Homogenize all composite samples prior to analysis

Distribution: White to Laboratory, Canary to Project Manager, Pink QA/QC Manager



# Chain of Custody Record

COC Number:

Laboratory: Microbac POC: Kathy Albertson Address: 158 Starlite Drive Marietta, OH 45750 Phone: 1-800-373-4071	Project Manager: Dave Wacker Phone/Fax Number: 210-296-2000 Sampler (print): Scott Beesinger Signature: <i>Scott Beesinger</i>	Mail to: Linda Raabe 112 East Pecan STE. 400 San Antonio, TX 78205 210-296-2000 Fed Ex Airbill No:
Client: AECOM Address: 112 East Pecan Ste. 400 San Antonio, TX 78205	Turn Around Time: <b>STANDARD</b> Project Name/Location: Longhorn Project Number: 60256135.0002HA	Program:

Site Name	Sample ID/Location ID	SBD	SED	Date	Time	Comp*	Grab	Matrix	Number of Containers	ERPIMS REQUIRED FIELDS					
										SA CODE	Cooler ID	LOT CONTROL NUMBERS			
												ABLOT	EBLOT	TBLOT	
SITE 58	LHSMW06-013114			1/31/14	0830		✓	W	3	✓					
	LHSMW06F-013114			1/31/14	0830		✓	W	1	✓					
	35A WW12-013114			1/31/14	1015		✓	W	3	✓					
	35A WW12FD-013114			1/31/14	1015		✓	W	3	✓					
	35A WW14-013114			1/31/14	1225		✓	W	3	✓					
	35A WW19-013114			1/21/14	1238		✓	W	3	✓					
	35A WW22-013114			1/31/14	1305		✓	W	3	✓					
	35A WW16-013114			1/31/14	1420		✓	W	3	✓					
	35A WW16MS-013114			1/31/14	1420		✓	W	3	✓					
	35A WW16MSD-013114			1/31/14	1420		✓	W	3	✓					
	35A WW01-013114			1/31/14	1610		✓	W	3	✓					
	35A WW01FDF-013114			1/31/14	1610		✓	W	3	✓					
	35A WW01FD-013114			1/31/14	1610		✓	W	3	✓					
	35A WW01F-013114			1/31/14	1610		✓	W	1	✓					

Comments: **STANDARD TAT**

Relinquished by: <i>Scott Beesinger</i>	Date: 2/3/14	Time: 1515	Received by: (Signature)	Received by: (Signature)	Date	Time	Relinquished by: (Signature)
Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Remarks:	

\*Homogenize all composite samples prior to analysis





**QUALITY CONTROL SUMMARY REPORT  
LHAAP-58 (AUGUST – OCTOBER 2013)  
FOR  
LONGHORN ARMY AMMUNITION PLANT  
KARNACK, TEXAS**

**Prepared For:**



**U.S. Army Corps of Engineers**

**Prepared By:**

**AECOM**

**AECOM Technical Services**

**January 2014**

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## 1 INTRODUCTION

AECOM reviewed ten data packages from Microbac Laboratory Services, Marietta, OH. One report, for screening direct push samples, was completed by CT Laboratories LLC, Baraboo, WI. Groundwater samples were collected August 5 through October 22, 2013 at Site 58 Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas. Data were reviewed for conformance to the requirements of the following guidance documents: Automated Data Review by Laboratory Data Consultants (ADR.net), United States Environmental Protection Agency (EPA) Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, (EPA, July 2002), and EPA Contract Laboratory Program National Functional Guidelines for Low Concentration Organic Data Review, (EPA, June 2001).

### 1.1 Intended Use of Data

The objective of this sampling event was to collect data for the Remedial Action Completion Report.

Analyses requested included:

- SW8260 – Volatiles by GC/MS
- RSK 175 – Dissolved gases (methane, ethane, ethene, CO<sub>2</sub>)
- 830MBA – Metabolic acids
- E365.4 – Total Phosphorus
- E415.1 – Total Organic Carbon
- SW6010 – Fe (total and dissolved) by ICP
- SW6020 – Mn (total and dissolved) by ICP/MS
- SW9056 – Common Anions by ion chromatography
- E310.1 - Alkalinity
- SM3500 Fe – Ferrous Iron
- E376.1 - Sulfide
- E353.2 – Nitrate-Nitrite

Table 2 lists the sample identifications and their associated laboratory identifications. Table 3 lists qualified results with the associated quality control parameter that was exceeded.

### 1.2 Preservation and Holding Times

Sample identification data were evaluated for agreement with the chain-of-custody (COC). All samples were received in appropriate containers, within the proper temperature range, in good condition, and with the required signatures.

### 1.3 Calibrations

Initial calibration criteria modification includes RSD < or = to 30%, two compounds allowed up to 40%. If the continuing calibration verification (CCV) compound exceeds 30% drift, the



compound is checked in the LCS, if both are outside recovery limits, the compound is rejected, R. If only the CCV exceeds recovery criteria and is less than  $\pm 40\%$  drift, then the compound is qualified J or UJ.

### 1.3.1 Continuing Calibration Verifications (CCV)

#### 1.3.1.1 SW8260

CCV WG442259-02 has bromomethane at 62.8%, naphthalene at 76.2%, and 1,2,3-trichlorobenzene at 75.8% in SDG L13080637. Associated samples are non-detect and are UJ qualified.

CCV WG442505-02 has Dichlorodifluoromethane at 57.8%, naphthalene at 78%, and 1,2,3-trichlorobenzene at 75.8% in SDG L13080772. Associated samples are non-detect and are UJ qualified.

CCV WG442613-02 has acetone at 79.2% in SDG L13080772. Associated samples are non-detect and are UJ qualified.

CCV WG443303-02 has chloromethane at 69% and dichlorodifluoromethane at 77.6% in SDG L13081083. Associated samples are non-detect and are UJ qualified.

CCV run on 8/29/13 at 8:40 has bromomethane at 71% in SDG L13081193 (subbed to CT labs). Associated samples are non-detect and are UJ qualified.

CCV WG443456-02 has bromomethane at 67% and dichlorodifluoromethane at 79.8% in SDG L13081330. Associated samples are non-detect and are UJ qualified.

CCV WG443657-02 has acetone at 77.6% in SDG L13081599. Associated samples are non-detect and are UJ qualified.

CCV WG443793-02 has chloromethane at 75.8%, acetone at 66.4%, and bromomethane at 72.6% in SDG L13081599. Associated samples are non-detect and are UJ qualified.

CCV WG444204-02 has bromomethane at 61.8%, 2-butanone at 76%, 1,2-dibromo-3-chloropropane at 79%, 2-hexanone at 69%, naphthalene at 72.4%, and 1,2,3-trichlorobenzene at 78.6% in SDG L13090311. Associated samples are non-detect and are UJ qualified.

CCV WG445082-02 has acetone at 73.8% in SDG L13090895. Associated samples are non-detect and are UJ qualified.

CCV WG450703-02 has 1,1,2,2-tetrachloroethane at 79.6%, acetone at 78.8%, bromomethane at 76.2%, 2-butanone at 79.6%, and 1,2-dibromo-3-chloropropane at 77.6% in SDG L13100824. Associated samples are non-detect and are UJ qualified.

CCV WG450356-02 has acetone 76.6% and 2-butanone at 77% in SDG L13101135. Associated samples are non-detect and are UJ qualified.

CCV WG450445-02 has acetone at 77%, 1,2-dibromo-3-chloropropane at 74.8%, 1,2,3-trichloropropane at 79.4% in SDG L13101240. Associated samples are non-detect and are UJ qualified.

CCV WG450449-02 has 1,2-dibromo-3-chloropropane at 78.4% in SDG L13101240. Associated samples are non-detect and are UJ qualified.

CCV WG450559-02 has 1,1,2,2-tetrachloroethane at 77.8%, acetone at 70.8%, 2-butanone at 71.2%, 1,2-dibromo-3-chloropropane at 71.8%, 2-hexanone at 75%, 4-methyl-2-pentanone at 73.4%, and 1,2,3-trichloropropane at 78.6% in SDG L13101240. Associated samples are non-detect and are UJ qualified.

CCV WG450703-02 has 1,1,2,2-tetrachloroethane at 79.6%, acetone at 78.8%, bromomethane at 76.2%, 2-butanone at 79.6% and 1,2-dibromo-3-chloropropane at 77.6% in SDG L13101240. Associated samples are non-detect and are UJ qualified.

CCV WG450746-02 has 2-hexanone at 78.8% in SDG L13101525. Associated samples are non-detect and are UJ qualified.

Table 3 shows qualified analytical data.

### 1.3.2 Blanks

Where contamination by a target analyte of one of the various blanks was found, if the sample result for an associated sample was non-detect or less than 5X (10X for common laboratory contaminants) the analyte concentration in the blank, the corresponding sample result for the analyte was qualified B. Where the sample result for the affected analyte was greater than 5X the amount in the blank, no qualifier was applied.

#### 1.3.2.1 RSK 175

Method blank 442474-01 has methane at 3.37 ug/L in SDG L13081083.

Method blank 442584-01 has methane at 3.82 ug/L in SDG L13081083.

Method blank 449106-01 has methane at 3.32 ug/L in SDG L13100824.

Method blank 449305-01 has methane at 3.56 ug/L in SDG L13101135.

#### 1.3.3 E376.1

Method blank WG448696-01 has sulfide at 0.960 mg/L in SDG L13100824.

Table 3 shows qualified analytical data.

### 1.3.4 Surrogates

#### 1.3.5 SW8260

35AWW08-101013 has 1,2-dichloroethane-d4 at 125%, limit are 70-120% in SDG L13100824. Positive detects are J qualified.

03WW01-101013 has 1,2-dichloroethane-d4 at 123% in SDG L13100824. Positive hits are J qualified.

35AWW20-101513 has dibromofluoromethane at 116% and 4-bromofluorobenzene at 122% in SDG L13101135. Positive hits are J qualified.

Table 3 shows qualified analytical data.

### 1.3.6 Laboratory Control Sample (LCS)

#### 1.3.6.1 SW8260

LCS WG441110-02 has 4-chlorotoluene at 74.6% for both the LCS and LCSD in SDG L13080429. Control limits are 75-130%. Associated samples are non-detect and are UJ qualified.

LCS WG444205-02 has 4-chlorotoluene at 72.9% and 78.1% for the LCS and LCSD in SDG L13090311.

LCS WG450357-02 has 1,2,3-trichloropropane at 71.1% for the LCS in SDG L13101135. Associated samples are non-detect and are UJ qualified.

### 1.3.7 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

#### 1.3.7.1 SW8260

35AWW15-101613 has 4-chlorotoluene at 73% for the MSD in SDG L13101240. Control limits are 75-130%. Parent sample is non-detect and is UJ qualified.

Table 3 shows qualified analytical data.

### 1.3.8 Field Duplicate Precision

All field duplicates are within control limits.

## 2 DATA USABILITY SUMMARY

The data are usable for the intended purposes of the project. The data quality objectives have been met for the project.

Table 1: Completeness by Method

Method	Total Analytes	No. of Rejected Results	% Completeness
SW8260	1876	0	100
SW6010	4	0	100
SW6020	4	0	100
RSK175	16	0	100
830MBA	28	0	100
SW9056	24	0	100
E310.1	4	0	100
SM3500 Fe	4	0	100
E365.4	4	0	100
E376.1	4	0	100
E415.1	4	0	100

**Table 2: Field Sample Identification and Laboratory Identification**

ClientSampleID	LabSampleID	SW8260	SW6010	SW6020	RSK 175	830 MBA	SW9056	E310.2	SM3500 Fe	E365.4 Phos	E376.1 Sulf	E415.1
TB-050813	L13080429-01	X										
58DPT20(36-40)050813	L13080429-02	X										
58DPT20(36-40)050813	L13080429-03	X										
58DPT27(26-30)060813	L13080429-04	X										
58DPT21(26-30)060813	L13080429-05	X										
TB100813	L13080637-01	X										
58DPT19(31-35)100813	L13080637-02	X										
58DPT24(31-35)100813	L13080637-03	X										
58DPT18(31-35)120813	L13080637-04	X										
TB130813	L13080772-01	X										
58DPT16(31-35)130813	L13080772-02	X										
58DPT17(36-40)130813	L13080772-03	X										
58DPT22(26-30)130813	L13080772-04	X										
35AWW08-082013	L13081083-01	X	X	X	X	X	X	X	X	X	X	X
35AWW08-082013	L13081083-02											
03WW01-082013	L13081083-03	X	X	X	X	X	X	X	X	X	X	X
Trip blank	L13081083-05	X										
58DPT12(23-27)200813	L13081193-01	X										
58DPT10(37-31)200813	L13081193-02	X										
58DPT11(20-24)210813	L13081193-03	X										
58DPT26(28-32)210813	L13081193-04	X										
EB-210813	L13081193-05	X										
58DPT13(18-22)220813	L13081193-06	X										
58DPT13(18-22)220813D	L13081193-07	X										
58DPT15(36-40)220813	L13081193-08	X										



ClientSampleID	LabSampleID	SW8260	SW6010	SW6020	RSK 175	830 MBA	SW9056	E310.2	SM3500 Fe	E365.4 Phos	E376.1 SuH	E415.1
TB-210813	L13081193-09	X										
58DPT25(36-40)230813	L13081330-01	X										
TB-230813	L13081330-02	X										
58DPT14(33-37)240813	L13081330-03	X										
35AWW10-082913	L13081599-01	X	X	X	X	X	X	X	X	X	X	X
35AWW10F-082913	L13081599-02											
35AWW09-092913	L13081599-03	X	X	X	X	X	X	X	X	X	X	X
35AWW09F-082913	L13081599-04											
Trip blank	L13081599-05	X										
TB060913-58	L13090311-01	X										
58DPT15A(28-38)060913	L13090311-02	X										
58DPT15B(18-28)170913	L13090895-01	X										
TB170913	L13090895-02	X										
35AWW08-101013	L13100824-01	X	X	X	X	X	X	X	X	X	X	X
35WW08F-101013	L13100824-02			X								
03WW01-101013	L13100824-03	X	X	X	X	X	X	X	X	X	X	X
03WW01F-101013	L13100824-04			X								
35AWW09-101013	L13100824-05	X			X	X	X	X	X	X	X	X
35AWW09F-101013	L13100824-06			X								
35AWW09F-101013	L13100824-07		X	X								
35AWW10-101013	L13100824-08	X	X	X	X	X	X	X	X	X	X	X
35AWW13-101113	L13101135-01	X										
35AWW13FD-101113	L13101135-02	X										
35AWW01-101113	L13101135-03	X										
35AWW11-101513	L13101135-04	X			X		X	X	X	X	X	X
35AWW11F-101513	L13101135-05		X									

ClientSampleID	LabSampleID	SW8260	SW6010	SW6020	RSK 175	830 MBA	SW9056	E310.2	SM3500 Fe	E365.4 Phos	E376.1 SuH	E415.1
35AWW11F-101513	L13101135-06		X									
35AWW06-101513	L13101135-07	X	X		X		X	X	X	X	X	X
35AWW06F-101513	L13101135-08		X									
LHSMW07-101513	L13101135-09	X	X		X		X	X	X	X	X	X
LHSMW07F-101513	L13101135-10		X									
35AWW20-101513	L13101135-11	X	X		X		X	X	X	X	X	X
35AWW20-101513	L13101135-12			X								
Trip blank	L13101135-13	X										
Equipment rinse	L13101240-01	X										
35AWW21-101613	L13101240-02	X										
35AWW21MS-101613	L13101240-03	X										
35AWW21MSD-101613	L13101240-04	X										
35AWW15-101613	L13101240-05	X										
35AWW15FD-101613	L13101240-06	X										
35AWW05-101613	L13101240-07	X										
35AWW07R-101613	L13101240-08	X										
LHSMW06-101713	L13101240-09	X										
35ASW03-101713	L13101240-10	X										
Trip blank	L13101240-11	X										
35AWW17-101813	L13101525-01	X										
35AWW18-101813	L13101525-02	X										
35AWW18MS-101813	L13101525-03	X										
35AWW18MSD-101813	L13101525-04	X										
35AWW14-101813	L13101525-05	X										
35AWW12-101813	L13101525-06	X										
35AWW12FD-101813	L13101525-07	X										

ClientSampleID	LabSampleID	SW8260	SW6010	SW6020	RSK 175	830 MBA	SW9056	E310.2	SM3500 Fe	E365.4 Phos	E376.1 Sulf	E415.1
Equipment rinse	L13101525-08	X										
35AWW19-102213	L13101525-09	X										
35AWW19-102213	L13101525-10	X										
35AWW22-102213	L13101525-11	X										
Trip blank	L13101525-12	X										
35AWW02-102213	L13101525-13	X										
35AWW17-101813	L13101525-01	X										
35AWW18-101813	L13101525-02	X										

Table 3: Qualified Analytical Data

ClientSampleID	LabSampleID	AnalyteName	DVQualOverall	Reason
58DPT20-(36-40)050813	L13080429-02	4-Chlorotoluene	UJ	LCS/LCSD below control limits
58DPT23(36-40)060813	L13080429-03	4-Chlorotoluene	UJ	LCS/LCSD below control limits
58DPT27(26-30)060813	L13080429-04	4-Chlorotoluene	UJ	LCS/LCSD below control limits
58DPT21(26-30)060813	L13080429-05	4-Chlorotoluene	UJ	LCS/LCSD below control limits
58DPT19(31-35)100813	L13080637-02	Bromomethane	UJ	CCV below control limits
		Naphthalene	UJ	CCV below control limits
		1,2,3-Trichlorobenzene	UJ	CCV below control limits
58DPT24(31-35)100813	L13080637-03	Bromomethane	UJ	CCV below control limits
		Naphthalene	UJ	CCV below control limits
		1,2,3-Trichlorobenzene	UJ	CCV below control limits
58DPT18(31-35)120813	L13080637-04	Bromomethane	UJ	CCV below control limits
		Naphthalene	UJ	CCV below control limits
		1,2,3-Trichlorobenzene	UJ	CCV below control limits

ClientSampleID	LabSampleID	AnalyteName	DVQualOverall	Reason
58DPT16(31-35)130813	L13080772-02	Dichlorodifluoromethane	UJ	CCV below control limits
		Naphthalene	UJ	CCV below control limits
		1,2,3-Trichlorobenzene	UJ	CCV below control limits
58DPT17(36-40)130813	L13080772-03	Dichlorodifluoromethane	UJ	CCV below control limits
		Naphthalene	UJ	CCV below control limits
		1,2,3-Trichlorobenzene	UJ	CCV below control limits
58DPT22(26-30)130813	L13080772-04	Dichlorodifluoromethane	UJ	CCV below control limits
		Naphthalene	UJ	CCV below control limits
		1,2,3-Trichlorobenzene	UJ	CCV below control limits
35AWW08-082013	L13081083-01	Chloromethane	UJ	CCV below control limits
		Dichlorodifluoromethane	UJ	CCV below control limits
		Methane	B	Method blank contamination
03WW01-082013	L13081083-03	Acetone	UJ	CCV below control limits
		Chloromethane	UJ	CCV below control limits
		Trichlorofluoromethane	UJ	CCV below control limits
		Methane	B	Method blank contamination
58DPT10(27-31)200813	349148 (L13081193)	Bromomethane	UJ	CCV below control limits
58DPT11(20-24)210813	349144 (L13081193)	Bromomethane	UJ	CCV below control limits
58DPT12(23-27)200813	349143 (L13081193)	Bromomethane	UJ	CCV below control limits
58DPT13(18-22)220813	349146 (L13081193)	Bromomethane	UJ	CCV below control limits
58DPT13(18-22)220813D	349147 (L13081193)	Bromomethane	UJ	CCV below control limits
58DPT15(36-40)220813	349145 (L13081193)	Bromomethane	UJ	CCV below control limits
58DPT26(28-32)210813	349149	Bromomethane	UJ	CCV below control limits



ClientSampleID	LabSampleID	AnalyteName	DVQualOverall	Reason
	(L13081193)			
58DPT25(36-40)230813	L13081330-01	Bromomethane	UJ	CCV below control limits
		Dichlorodifluoromethane	UJ	CCV below control limits
58DPT14(33-37)240813	L13081330-03	Bromomethane	UJ	CCV below control limits
		Dichlorodifluoromethane	UJ	CCV below control limits
35AWW10-082913	L13081599-01	Acetone	UJ	CCV below control limits
		Bromomethane	UJ	CCV below control limits
		Chloromethane	UJ	CCV below control limits
35AWW09-082913	L13081599-03	Acetone	UJ	CCV below control limits
		Bromomethane	UJ	CCV below control limits
		Chloromethane	UJ	CCV below control limits
58DPT15A(28-38)060913	L13090311-02	Bromomethane	UJ	CCV below control limits
		2-butanone	UJ	CCV below control limits
		1,2-dibromo-3-chloropropane	UJ	CCV below control limits
		4-chlorotoluene	UJ	LCS/LCSD below control limits
		2-Hexanone	UJ	CCV below control limits
		Naphthalene	UJ	CCV below control limits
		1,2,3-Trichlorobenzene	UJ	CCV below control limits
58DPT15B(18-28)170913	L13090895-01	Acetone	J	CCV below control limits
35AWW08-101013	L13100824-01	2-Butanone	J	Surrogate above control limits
		Tetrachloroethene	J	Surrogate above control limits
		Trichloroethene	J	Surrogate above control limits
		Methane	U	Method blank contamination
		Sulfide	J	Method blank contamination
03WW01-101013	L13100824-03	2-Butanone	J	Surrogate above control limits
		4-methyl-2-pentanone	J	Surrogate above control limits
		Tetrachloroethene	J	Surrogate above control limits
		Trichloroethene	J	Surrogate above control limits

ClientSampleID	LabSampleID	AnalyteName	DVQualOverall	Reason
		1,2,4-trimethylbenzene	J	Surrogate above control limits
		Sulfide	J	Method blank contamination
35AWW09-101013	L13100824-05	Acetone	UJ	CCV below control limits
		Bromomethane	UJ	CCV below control limits
		2-Butanone	UJ	CCV below control limits
		1,2-dibromo-3-chloropropane	UJ	CCV below control limits
		1,1,2,2-Tetrachloroethane	UJ	CCV below control limits
35AWW11-101513	L13101135-04	Acetone	UJ	CCV below control limits
		2-Butanone	UJ	CCV below control limits
		1,2,3-Trichloropropane	UJ	LCS below control limits
35AWW20-101513	L13101135-11	All positive 8260 hits	J	Surrogate above control limits
35AWW11-101513	L13101135-04	Methane	U	Method blank contamination
35AWW06-101513	L13101135-07	Methane	U	Method blank contamination
35AWW21-101613	L13101240-02	4-Chlorotoluene	UJ	MSD below control limits
		1,2-dibromo-3-chloropropane	UJ	CCV below control limits
35AWW15-101613	L13101240-05	Acetone	UJ	CCV below control limits
		1,2-dibromo-3-chloropropane	UJ	CCV below control limits
		1,2,3-Trichloropropane	UJ	CCV below control limits
35AWW15FD-101613	L13101240-06	Acetone	UJ	CCV below control limits
		1,2-dibromo-3-chloropropane	UJ	CCV below control limits
		1,2,3-Trichloropropane	UJ	CCV below control limits
35AWW05-101613	L13101240-07	Acetone	UJ	CCV below control limits
		1,2-dibromo-3-chloropropane	UJ	CCV below control limits
		1,2,3-Trichloropropane	UJ	CCV below control limits
35AWW07R-101613	L13101240-08	Acetone	UJ	CCV below control limits
		1,2-dibromo-3-chloropropane	UJ	CCV below control limits
		1,2,3-Trichloropropane	UJ	CCV below control limits

ClientSampleID	LabSampleID	AnalyteName	DVQualOverall	Reason
35ASW03-101713	L13101240-10	1,2-dibromo-3-chloropropane	UJ	CCV below control limits
LHSMW06-101713	L13101240-09	Acetone	UJ	CCV below control limits
		Bromomethane	UJ	CCV below control limits
		2-Butanone	UJ	CCV below control limits
		1,2-dibromo-3-chloropropane	UJ	CCV below control limits
		2-hexanone	UJ	CCV below control limits
		4-methyl-2-pentanone	UJ	CCV below control limits
		1,1,2,2-tetrachloroethane	UJ	CCV below control limits
		1.2.3-trichloropropane	UJ	CCV below control limits
35AWW17-101813	L13101525-01	2-hexanone	UJ	CCV below control limits
35AWW18-101813	L13101525-02	2-hexanone	UJ	CCV below control limits
35AWW14-101813	L13101525-05	2-hexanone	UJ	CCV below control limits
35AWW12-101813	L13101525-06	2-hexanone	UJ	CCV below control limits
35AWW12FD-101813	L13101525-07	2-hexanone	UJ	CCV below control limits
35AWW16-102213	L13101525-09	2-hexanone	UJ	CCV below control limits
35AWW19-102213	L13101525-10	2-hexanone	UJ	CCV below control limits
35AWW22-102213	L13101525-11	2-hexanone	UJ	CCV below control limits
35AWW02-102213	L13101525-13	2-hexanone	UJ	CCV below control limits

LHAAP-35A (58) Direct Push Technology Borings Volatile Organic Compounds - August/September 2013

Sample ID: Sample Date:	Units	Cleanup Level	58DPT10 (27-31')-200813 8/20/2013	58DPT11 (20-24')-210813 8/21/2013	58DPT12 (23-27')-200813 8/20/2013	58DPT13 (18-22')-220813 8/22/2013	58DPT13 (18-22')-220813D 8/22/2013	58DPT14(33-37)-240813 8/24/2013	58DPT15 (36-40')-220813 8/22/2013	58DPT15A(28-38)060913 9/6/2013	58DPT15B(18-28)170913 9/17/2013	58DPT16(31-35)130813 8/13/2013	58DPT17(36-40)130813 8/13/2013
<b>Volatile Organic Compounds (8260B)</b>													
1,1,1,2-Tetrachloroethane	µg/L	110	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1,1-Trichloroethane	µg/L	200	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1,2,2-Tetrachloroethane	µg/L	14	NA	NA	NA	NA	NA	<0.4 U	NA	<0.4 U	<0.4 U	<0.4 U	<0.4 U
1,1,2-Trichloroethane	µg/L	5	NA	NA	NA	NA	NA	<0.5 U	NA	0.368 J	<0.5 U	<0.5 U	<0.5 U
1,1-Dichloroethane	µg/L	10000	NA	NA	NA	NA	NA	<0.25 U	NA	20.9	0.434 J	<0.25 U	<0.25 U
1,1-Dichloroethene	µg/L	7	NA	NA	NA	NA	NA	<1 U	NA	49.6	0.86 J	<1 U	<1 U
1,1-Dichloropropene	µg/L	2.9	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2,3-Trichlorobenzene	µg/L	310	NA	NA	NA	NA	NA	<0.3 U	NA	<0.3 UJ	<0.3 U	<0.3 UJ	<0.3 U
1,2,3-Trichloropropane	µg/L	0.0041	NA	NA	NA	NA	NA	<1 U	NA	<1 U	<1 U	<1 U	<1 U
1,2,4-Trichlorobenzene	µg/L	70	NA	NA	NA	NA	NA	<0.4 U	NA	<0.4 U	<0.4 U	<0.4 U	<0.4 U
1,2,4-Trimethylbenzene	µg/L	5100	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2-Dibromo-3-Chloropropane	µg/L	0.2	NA	NA	NA	NA	NA	<2 U	NA	<2 UJ	<2 U	<2 U	<2 U
1,2-Dibromoethane	µg/L	0.005	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2-Dichlorobenzene	µg/L	600	NA	NA	NA	NA	NA	<0.25 U	NA	<0.25 U	<0.25 U	<0.25 U	<0.25 U
1,2-Dichloroethane	µg/L	5	NA	NA	NA	NA	NA	<0.5 U	NA	11.5	0.518 J	<0.5 U	<0.5 U
1,2-Dichloropropane	µg/L	5	NA	NA	NA	NA	NA	<0.4 U	NA	<0.4 U	<0.4 U	<0.4 U	<0.4 U
1,3,5-Trimethylbenzene	µg/L	5100	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,3-Dichlorobenzene	µg/L	3100	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,3-Dichloropropane	µg/L	29	NA	NA	NA	NA	NA	<0.4 U	NA	<0.4 U	<0.4 U	<0.4 U	<0.4 U
1,4-Dichlorobenzene	µg/L	75	NA	NA	NA	NA	NA	<0.25 U	NA	<0.25 U	<0.25 U	<0.25 U	<0.25 U
2,2-Dichloropropane	µg/L	42	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
2-Butanone	µg/L	61000	NA	NA	NA	NA	NA	5.09 J	NA	<5 UJ	4.46 J	<5 U	4.56 J
2-Chlorotoluene	µg/L	2000	NA	NA	NA	NA	NA	<0.25 U	NA	<0.25 U	<0.25 U	<0.25 U	<0.25 U
2-Hexanone	µg/L	6100	NA	NA	NA	NA	NA	<5 U	NA	<5 UJ	<5 U	<5 U	<5 U
4-Chlorotoluene	µg/L	2000	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 UJ	<0.5 U	<0.5 U	<0.5 U
4-Methyl-2-Pentanone	µg/L	8200	NA	NA	NA	NA	NA	<5 U	NA	<5 U	<5 U	<5 U	<5 U
Acetone	µg/L	92000	NA	NA	NA	NA	NA	30.2	NA	<5 U	29.3 J	7.79 J	19.5
Benzene	µg/L	5	NA	NA	NA	NA	NA	<0.25 U	NA	0.393 J	<0.25 U	<0.25 U	1.05
Bromobenzene	µg/L	2000	NA	NA	NA	NA	NA	<0.25 U	NA	<0.25 U	<0.25 U	<0.25 U	<0.25 U
Bromochloromethane	µg/L	4100	NA	NA	NA	NA	NA	<0.4 U	NA	<0.4 U	<0.4 U	<0.4 U	<0.4 U
Bromodichloromethane	µg/L	4.6	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Bromoform	µg/L	36	NA	NA	NA	NA	NA	<1 U	NA	<1 U	<1 U	<1 U	<1 U
Bromomethane	µg/L	140	NA	NA	NA	NA	NA	<1 UJ	NA	<1 UJ	<1 U	<1 U	<1 U
Carbon Disulfide	µg/L	10000	NA	NA	NA	NA	NA	<1 U	NA	<1 U	<1 U	<1 U	<1 U
Carbon Tetrachloride	µg/L	5	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Chlorobenzene	µg/L	100	NA	NA	NA	NA	NA	<0.25 U	NA	<0.25 U	<0.25 U	<0.25 U	<0.25 U
Chloroethane	µg/L	41000	NA	NA	NA	NA	NA	<1 U	NA	<1 U	<1 U	<1 U	<1 U
Chloroform	µg/L	1000	NA	NA	NA	NA	NA	<0.25 U	NA	<0.25 U	<0.25 U	<0.25 U	<0.25 U
Chloromethane	µg/L	220	NA	NA	NA	NA	NA	<1 U	NA	<1 U	<1 U	<1 U	<1 U
cis-1,2-Dichloroethene	µg/L	70	NA	NA	NA	NA	NA	<0.5 U	NA	1.42	<0.5 U	<0.5 U	<0.5 U
cis-1,3-Dichloropropene	µg/L	5.3	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Dibromochloromethane	µg/L	34	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Dibromomethane	µg/L	380	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Dichlorodifluoromethane	µg/L	20000	NA	NA	NA	NA	NA	<0.5 UJ	NA	<0.5 U	<0.5 U	<0.5 UJ	<0.5 U
Ethylbenzene	µg/L	700	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Hexachlorobutadiene	µg/L	20	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Isopropylbenzene	µg/L	1000	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
m,p-Xylene	µg/L	10000	NA	NA	NA	NA	NA	<1 U	NA	<1 U	<1 U	<1 U	<1 U
Methylene Chloride	µg/L	5	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Naphthalene	µg/L	2000	NA	NA	NA	NA	NA	<0.4 U	NA	<0.4 UJ	<0.4 U	<0.4 UJ	<0.4 U

LHAAP-35A (58) Direct Push Technology Borings Volatile Organic Compounds - August/September 2013

Sample ID: Sample Date:	Units	Cleanup Level	58DPT10 (27-31')-200813 8/20/2013	58DPT11 (20-24')-210813 8/21/2013	58DPT12 (23-27')-200813 8/20/2013	58DPT13 (18-22')-220813 8/22/2013	58DPT13 (18-22')-220813D 8/22/2013	58DPT14(33-37)-240813 8/24/2013	58DPT15 (36-40')-220813 8/22/2013	58DPT15A(28-38)060913 9/6/2013	58DPT15B(18-28)170913 9/17/2013	58DPT16(31-35)130813 8/13/2013	58DPT17(36-40)130813 8/13/2013
n-Butylbenzene	µg/L	4100	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
n-Propylbenzene	µg/L	4100	NA	NA	NA	NA	NA	<0.25 U	NA	<0.25 U	<0.25 U	<0.25 U	<0.25 U
o-Xylene	µg/L	10000	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
p-Isopropyltoluene	µg/L	10000	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
sec-Butylbenzene	µg/L	4100	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Styrene	µg/L	100	NA	NA	NA	NA	NA	<0.25 U	NA	<0.25 U	<0.25 U	<0.25 U	<0.25 U
tert-Butylbenzene	µg/L	4100	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Tetrachloroethene	µg/L	5	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Toluene	µg/L	1000	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	0.711 J
trans-1,2-Dichloroethene	µg/L	100	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
trans-1,3-Dichloropropene	µg/L	29	NA	NA	NA	NA	NA	<1 U	NA	<1 U	<1 U	<1 U	<1 U
Trichloroethene	µg/L	5	NA	NA	NA	NA	NA	<0.5 U	NA	6.82	<0.5 U	<0.5 U	<0.5 U
Trichlorofluoromethane	µg/L	31000	NA	NA	NA	NA	NA	<0.5 U	NA	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Vinyl Chloride	µg/L	2	NA	NA	NA	NA	NA	<0.5 U	NA	0.302 J	<0.5 U	<0.5 U	<0.5 U
<b>Volatile Organic Compounds (8260C)</b>													
1,1,1,2-Tetrachloroethane	µg/L	110	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
1,1,1-Trichloroethane	µg/L	200	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	µg/L	14	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
1,1,2-Trichloroethane	µg/L	5	1.3	<1 U	13	<1 U	<1 U	NA	1.9	NA	NA	NA	NA
1,1-Dichloroethane	µg/L	10000	42	<0.5 U	250	0.26 J	0.34 J	NA	57	NA	NA	NA	NA
1,1-Dichloroethene	µg/L	7	11	<0.5 U	790	<0.5 U	<0.5 U	NA	63	NA	NA	NA	NA
1,1-Dichloropropene	µg/L	2.9	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
1,2,3-Trichlorobenzene	µg/L	310	<1 U	<1 U	<1 U	<1 U	<1 U	NA	<1 U	NA	NA	NA	NA
1,2,3-Trichloropropane	µg/L	0.0041	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
1,2,4-Trichlorobenzene	µg/L	70	<1 U	<1 U	<1 U	<1 U	<1 U	NA	<1 U	NA	NA	NA	NA
1,2,4-Trimethylbenzene	µg/L	5100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane	µg/L	0.2	<1 U	<1 U	<1 U	<1 U	<1 U	NA	<1 U	NA	NA	NA	NA
1,2-Dibromoethane	µg/L	0.005	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
1,2-Dichlorobenzene	µg/L	600	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
1,2-Dichloroethane	µg/L	5	0.92 J	<1 U	11	<1 U	<1 U	NA	9	NA	NA	NA	NA
1,2-Dichloropropane	µg/L	5	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
1,3,5-Trimethylbenzene	µg/L	5100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
1,3-Dichlorobenzene	µg/L	3100	<1 U	<1 U	<1 U	<1 U	<1 U	NA	<1 U	NA	NA	NA	NA
1,3-Dichloropropane	µg/L	29	<1 U	<1 U	<1 U	<1 U	<1 U	NA	<1 U	NA	NA	NA	NA
1,4-Dichlorobenzene	µg/L	75	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
2,2-Dichloropropane	µg/L	42	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
2-Butanone	µg/L	61000	<5 U	<5 U	<5 U	<5 U	<5 U	NA	12	NA	NA	NA	NA
2-Chlorotoluene	µg/L	2000	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
2-Hexanone	µg/L	6100	<10 U	<10 U	<10 U	<10 U	<10 U	NA	<10 U	NA	NA	NA	NA
4-Chlorotoluene	µg/L	2000	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
4-Methyl-2-pentanone	µg/L	8200	<10 U	<10 U	<10 U	<10 U	<10 U	NA	<10 U	NA	NA	NA	NA
Acetone	µg/L	92000	12	5.6 J	<10 U	16	18	NA	81	NA	NA	NA	NA
Benzene	µg/L	5	0.54	<0.5 U	1.6	<0.5 U	<0.5 U	NA	0.76	NA	NA	NA	NA
Bromobenzene	µg/L	2000	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
Bromochloromethane	µg/L	4100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
Bromodichloromethane	µg/L	4.6	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
Bromoform	µg/L	36	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
Bromomethane	µg/L	140	<1 UJ	<1 UJ	<1 UJ	<1 UJ	<1 UJ	NA	<1 UJ	NA	NA	NA	NA
Carbon disulfide	µg/L	10000	<1 U	<1 U	<1 U	<1 U	<1 U	NA	<1 U	NA	NA	NA	NA
Carbon tetrachloride	µg/L	5	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
Chlorobenzene	µg/L	100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA



LHAAP-35A (58) Direct Push Technology Borings Volatile Organic Compounds - August/September 2013

Sample ID: Sample Date:	Units	Cleanup Level	58DPT10 (27-31')-200813 8/20/2013	58DPT11 (20-24')-210813 8/21/2013	58DPT12 (23-27')-200813 8/20/2013	58DPT13 (18-22')-220813 8/22/2013	58DPT13 (18-22')-220813D 8/22/2013	58DPT14(33-37)-240813 8/24/2013	58DPT15 (36-40')-220813 8/22/2013	58DPT15A(28-38)060913 9/6/2013	58DPT15B(18-28)170913 9/17/2013	58DPT16(31-35)130813 8/13/2013	58DPT17(36-40)130813 8/13/2013
Chloroethane	µg/L	41000	<1 U	<1 U	0.63 J	<1 U	<1 U	NA	<1 U	NA	NA	NA	NA
Chloroform	µg/L	1000	<0.5 U	<0.5 U	0.28 J	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
Chloromethane	µg/L	220	<1 U	<1 U	<1 U	<1 U	<1 U	NA	<1 U	NA	NA	NA	NA
cis-1,2-Dichloroethene	µg/L	70	20	<0.5 U	240	<0.5 U	<0.5 U	NA	8.7	NA	NA	NA	NA
cis-1,3-Dichloropropene	µg/L	5.3	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
Dibromochloromethane	µg/L	34	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
Dibromomethane	µg/L	380	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
Dichlorodifluoromethane	µg/L	20000	<1 U	<1 U	<1 U	<1 U	<1 U	NA	<1 U	NA	NA	NA	NA
Ethylbenzene	µg/L	700	<0.5 U	<0.5 U	4	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
Hexachlorobutadiene	µg/L	20	<1 U	<1 U	<1 U	<1 U	<1 U	NA	<1 U	NA	NA	NA	NA
Isopropylbenzene	µg/L	1000	<0.5 U	<0.5 U	1.1	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
m,p-Xylenes	µg/L	10000	<1 U	<1 U	0.65 J	<1 U	<1 U	NA	<1 U	NA	NA	NA	NA
Methylene chloride	µg/L	5	<2 U	<2 U	<2 U	<2 U	<2 U	NA	<2 U	NA	NA	NA	NA
Naphthalene	µg/L	2000	<1 U	<1 U	<1 U	<1 U	<1 U	NA	<1 U	NA	NA	NA	NA
n-Butylbenzene	µg/L	4100	<0.5 U	<0.5 U	1.2	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
n-Propylbenzene	µg/L	4100	<0.5 U	<0.5 U	3	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
o-Xylene	µg/L	10000	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
p-Isopropyltoluene	µg/L	10000	<0.5 U	<0.5 U	0.25 J	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
sec-Butylbenzene	µg/L	4100	<0.5 U	<0.5 U	0.81	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
Styrene	µg/L	100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
tert-Butylbenzene	µg/L	4100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
Tetrachloroethene	µg/L	5	<1 U	<1 U	0.47 J	<1 U	<1 U	NA	<1 U	NA	NA	NA	NA
Toluene	µg/L	1000	0.57	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
trans-1,2-Dichloroethene	µg/L	100	0.39 J	<0.5 U	5.1	<0.5 U	<0.5 U	NA	0.31 J	NA	NA	NA	NA
trans-1,3-Dichloropropene	µg/L	29	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
Trichloroethene	µg/L	5	<0.5 U	<0.5 U	61	<0.5 U	<0.5 U	NA	6	NA	NA	NA	NA
Trichlorofluoromethane	µg/L	31000	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U	NA	NA	NA	NA
Vinyl chloride	µg/L	2	12	<0.5 U	24	<0.5 U	<0.5 U	NA	11	NA	NA	NA	NA

Blue Highlighting Indicates Analyte Detected Above Cleanup Level

J - Estimated value; analyte concentration was less than the limit of quantification

NA - not analyzed

U - Analyte was not detected. The concentration is below the reported limit of detection.

µg/L - microgram per liter

UJ - The analysis was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. 'UJ' not detects are not definite; the analyte may be present.

LHAAP-35A (58) Direct Push Technology Borings Volatile Organic Compounds - August/September 2013

Sample ID: Sample Date:	Units	Cleanup Level	58DPT18(31-35)120813 8/12/2013	58DPT19(31-35)100813 8/10/2013	58DPT20(36-40)050813 8/5/2013	58DPT21(26-30)060813 8/6/2013	58DPT22(26-30)130813 8/13/2013	58DPT23(36-40)060813 8/6/2013	58DPT24(31-35)100813 8/10/2013	58DPT25(36-40)-230813 8/23/2013	58DPT26 (28-32')-210813 8/21/2013	58DPT27(26-30)060813 8/6/2013
<b>Volatile Organic Compounds (8260B)</b>												
1,1,1,2-Tetrachloroethane	µg/L	110	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
1,1,1-Trichloroethane	µg/L	200	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
1,1,2,2-Tetrachloroethane	µg/L	14	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	NA	<0.4 U
1,1,2-Trichloroethane	µg/L	5	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
1,1-Dichloroethane	µg/L	10000	0.334 J	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	NA	<0.25 U
1,1-Dichloroethene	µg/L	7	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	NA	<1 U
1,1-Dichloropropene	µg/L	2.9	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
1,2,3-Trichlorobenzene	µg/L	310	<0.3 UJ	<0.3 UJ	<0.3 U	<0.3 U	<0.3 U	<0.3 U	<0.3 UJ	<0.3 U	NA	<0.3 U
1,2,3-Trichloropropane	µg/L	0.0041	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	NA	<1 U
1,2,4-Trichlorobenzene	µg/L	70	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	NA	<0.4 U
1,2,4-Trimethylbenzene	µg/L	5100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
1,2-Dibromo-3-Chloropropane	µg/L	0.2	<2 U	<2 U	<2 U	<2 U	<2 U	<2 U	<2 U	<2 U	NA	<2 U
1,2-Dibromoethane	µg/L	0.005	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
1,2-Dichlorobenzene	µg/L	600	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	NA	<0.25 U
1,2-Dichloroethane	µg/L	5	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
1,2-Dichloropropane	µg/L	5	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	NA	<0.4 U
1,3,5-Trimethylbenzene	µg/L	5100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
1,3-Dichlorobenzene	µg/L	3100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
1,3-Dichloropropane	µg/L	29	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	NA	<0.4 U
1,4-Dichlorobenzene	µg/L	75	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	NA	<0.25 U
2,2-Dichloropropane	µg/L	42	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
2-Butanone	µg/L	61000	4.06 J	<5 U	<5 U	<5 U	<5 U	<5 U	4 J	11.8	NA	<5 U
2-Chlorotoluene	µg/L	2000	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	NA	<0.25 U
2-Hexanone	µg/L	6100	<5 U	<5 U	<5 U	<5 U	<5 U	<5 U	<5 U	<5 U	NA	<5 U
4-Chlorotoluene	µg/L	2000	<0.5 U	<0.5 U	<0.5 UJ	<0.5 UJ	<0.5 U	<0.5 UJ	<0.5 U	<0.5 U	NA	<0.5 UJ
4-Methyl-2-Pentanone	µg/L	8200	<5 U	<5 U	<5 U	<5 U	<5 U	<5 U	<5 U	<5 U	NA	<5 U
Acetone	µg/L	92000	42.1	3.92 J	4.09 J	7.6 J	4.51 J	<5 U	13.9	90.6	NA	4.24 J
Benzene	µg/L	5	<0.25 U	0.159 J	<0.25 U	0.279 J	<0.25 U	<0.25 U	1.54	0.203 J	NA	<0.25 U
Bromobenzene	µg/L	2000	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	NA	<0.25 U
Bromochloromethane	µg/L	4100	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	NA	<0.4 U
Bromodichloromethane	µg/L	4.6	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
Bromoform	µg/L	36	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	NA	<1 U
Bromomethane	µg/L	140	<1 UJ	<1 UJ	<1 U	<1 U	<1 U	<1 U	<1 UJ	<1 UJ	NA	<1 U
Carbon Disulfide	µg/L	10000	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	NA	<1 U
Carbon Tetrachloride	µg/L	5	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
Chlorobenzene	µg/L	100	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	NA	<0.25 U
Chloroethane	µg/L	41000	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	NA	<1 U
Chloroform	µg/L	1000	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	NA	<0.25 U
Chloromethane	µg/L	220	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	NA	<1 U
cis-1,2-Dichloroethene	µg/L	70	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
cis-1,3-Dichloropropene	µg/L	5.3	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
Dibromochloromethane	µg/L	34	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
Dibromomethane	µg/L	380	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
Dichlorodifluoromethane	µg/L	20000	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 UJ	NA	<0.5 U
Ethylbenzene	µg/L	700	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
Hexachlorobutadiene	µg/L	20	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
Isopropylbenzene	µg/L	1000	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
m,p-Xylene	µg/L	10000	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	NA	<1 U
Methylene Chloride	µg/L	5	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
Naphthalene	µg/L	2000	<0.4 UJ	<0.4 UJ	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 UJ	<0.4 U	NA	<0.4 U

LHAAP-35A (58) Direct Push Technology Borings Volatile Organic Compounds - August/September 2013

Sample ID: Sample Date:	Units	Cleanup Level	58DPT18(31-35)120813 8/12/2013	58DPT19(31-35)100813 8/10/2013	58DPT20(36-40)050813 8/5/2013	58DPT21(26-30)060813 8/6/2013	58DPT22(26-30)130813 8/13/2013	58DPT23(36-40)060813 8/6/2013	58DPT24(31-35)100813 8/10/2013	58DPT25(36-40)-230813 8/23/2013	58DPT26 (28-32')-210813 8/21/2013	58DPT27(26-30)060813 8/6/2013
n-Butylbenzene	µg/L	4100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
n-Propylbenzene	µg/L	4100	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	NA	<0.25 U
o-Xylene	µg/L	10000	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
p-Isopropyltoluene	µg/L	10000	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
sec-Butylbenzene	µg/L	4100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
Styrene	µg/L	100	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	NA	<0.25 U
tert-Butylbenzene	µg/L	4100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
Tetrachloroethene	µg/L	5	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
Toluene	µg/L	1000	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.02	<0.5 U	NA	<0.5 U
trans-1,2-Dichloroethene	µg/L	100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
trans-1,3-Dichloropropene	µg/L	29	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	NA	<1 U
Trichloroethene	µg/L	5	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
Trichlorofluoromethane	µg/L	31000	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
Vinyl Chloride	µg/L	2	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	NA	<0.5 U
<b>Volatile Organic Compounds (8260C)</b>												
1,1,1,2-Tetrachloroethane	µg/L	110	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
1,1,1-Trichloroethane	µg/L	200	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
1,1,2,2-Tetrachloroethane	µg/L	14	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
1,1,2-Trichloroethane	µg/L	5	NA	NA	NA	NA	NA	NA	NA	NA	<1 U	NA
1,1-Dichloroethane	µg/L	10000	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
1,1-Dichloroethene	µg/L	7	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
1,1-Dichloropropene	µg/L	2.9	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
1,2,3-Trichlorobenzene	µg/L	310	NA	NA	NA	NA	NA	NA	NA	NA	<1 U	NA
1,2,3-Trichloropropane	µg/L	0.0041	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
1,2,4-Trichlorobenzene	µg/L	70	NA	NA	NA	NA	NA	NA	NA	NA	<1 U	NA
1,2,4-Trimethylbenzene	µg/L	5100	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
1,2-Dibromo-3-chloropropane	µg/L	0.2	NA	NA	NA	NA	NA	NA	NA	NA	<1 U	NA
1,2-Dibromoethane	µg/L	0.005	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
1,2-Dichlorobenzene	µg/L	600	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
1,2-Dichloroethane	µg/L	5	NA	NA	NA	NA	NA	NA	NA	NA	<1 U	NA
1,2-Dichloropropane	µg/L	5	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
1,3,5-Trimethylbenzene	µg/L	5100	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
1,3-Dichlorobenzene	µg/L	3100	NA	NA	NA	NA	NA	NA	NA	NA	<1 U	NA
1,3-Dichloropropane	µg/L	29	NA	NA	NA	NA	NA	NA	NA	NA	<1 U	NA
1,4-Dichlorobenzene	µg/L	75	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
2,2-Dichloropropane	µg/L	42	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
2-Butanone	µg/L	61000	NA	NA	NA	NA	NA	NA	NA	NA	<5 U	NA
2-Chlorotoluene	µg/L	2000	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
2-Hexanone	µg/L	6100	NA	NA	NA	NA	NA	NA	NA	NA	<10 U	NA
4-Chlorotoluene	µg/L	2000	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
4-Methyl-2-pentanone	µg/L	8200	NA	NA	NA	NA	NA	NA	NA	NA	<10 U	NA
Acetone	µg/L	92000	NA	NA	NA	NA	NA	NA	NA	NA	11	NA
Benzene	µg/L	5	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
Bromobenzene	µg/L	2000	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
Bromochloromethane	µg/L	4100	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
Bromodichloromethane	µg/L	4.6	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
Bromoform	µg/L	36	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
Bromomethane	µg/L	140	NA	NA	NA	NA	NA	NA	NA	NA	<1 UJ	NA
Carbon disulfide	µg/L	10000	NA	NA	NA	NA	NA	NA	NA	NA	<1 U	NA
Carbon tetrachloride	µg/L	5	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
Chlorobenzene	µg/L	100	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA

LHAAP-35A (58) Direct Push Technology Borings Volatile Organic Compounds - August/September 2013

Sample ID: Sample Date:	Units	Cleanup Level	58DPT18(31-35)120813 8/12/2013	58DPT19(31-35)100813 8/10/2013	58DPT20(36-40)050813 8/5/2013	58DPT21(26-30)060813 8/6/2013	58DPT22(26-30)130813 8/13/2013	58DPT23(36-40)060813 8/6/2013	58DPT24(31-35)100813 8/10/2013	58DPT25(36-40)-230813 8/23/2013	58DPT26 (28-32')-210813 8/21/2013	58DPT27(26-30)060813 8/6/2013
Chloroethane	µg/L	41000	NA	NA	NA	NA	NA	NA	NA	NA	<1 U	NA
Chloroform	µg/L	1000	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
Chloromethane	µg/L	220	NA	NA	NA	NA	NA	NA	NA	NA	<1 U	NA
cis-1,2-Dichloroethene	µg/L	70	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
cis-1,3-Dichloropropene	µg/L	5.3	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
Dibromochloromethane	µg/L	34	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
Dibromomethane	µg/L	380	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
Dichlorodifluoromethane	µg/L	20000	NA	NA	NA	NA	NA	NA	NA	NA	<1 U	NA
Ethylbenzene	µg/L	700	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
Hexachlorobutadiene	µg/L	20	NA	NA	NA	NA	NA	NA	NA	NA	<1 U	NA
Isopropylbenzene	µg/L	1000	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
m,p-Xylenes	µg/L	10000	NA	NA	NA	NA	NA	NA	NA	NA	<1 U	NA
Methylene chloride	µg/L	5	NA	NA	NA	NA	NA	NA	NA	NA	<2 U	NA
Naphthalene	µg/L	2000	NA	NA	NA	NA	NA	NA	NA	NA	<1 U	NA
n-Butylbenzene	µg/L	4100	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
n-Propylbenzene	µg/L	4100	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
o-Xylene	µg/L	10000	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
p-Isopropyltoluene	µg/L	10000	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
sec-Butylbenzene	µg/L	4100	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
Styrene	µg/L	100	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
tert-Butylbenzene	µg/L	4100	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
Tetrachloroethene	µg/L	5	NA	NA	NA	NA	NA	NA	NA	NA	<1 U	NA
Toluene	µg/L	1000	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
trans-1,2-Dichloroethene	µg/L	100	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
trans-1,3-Dichloropropene	µg/L	29	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
Trichloroethene	µg/L	5	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
Trichlorofluoromethane	µg/L	31000	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA
Vinyl chloride	µg/L	2	NA	NA	NA	NA	NA	NA	NA	NA	<0.5 U	NA

Blue Highlighting Indicates Analyte Detected Above Cleanup Level

J - Estimated value; analyte concentration was less than the limit of quantification

NA - not analyzed

U - Analyte was not detected. The concentration is below the reported limit of detection.

µg/L - microgram per liter

UU - The analysis was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. 'UU' not detects are not definite; the analyte may be present.

LHAAP-58 Field Parameters and Biogeochemical Data - August 2013

Sample ID:	Units	03WW01-082013	35Aww08-082013	35Aww09-082913	35Aww09F-082913	35Aww10-082913	35Aww10F-082913
Sample Date:		8/20/2013	8/20/2013	8/29/2013	8/29/2013	8/29/2013	8/29/2013
<b>Water Quality Parameters</b>							
Temperature	°C	26.19	23.44	27.7	NA	26.77	NA
pH	pH Units	6.18	6.05	6.32	NA	6.92	NA
Conductivity	mS/cm	3.64	8.23	7.2	NA	1.39	NA
Dissolved Oxygen	mg/L	9.11	9.84	1.62	NA	5.69	NA
Turbidity	NTU	33	26.9	20.8	NA	1.3	NA
Oxidation Reduction Potential	mV	240	112	108	NA	96	NA
Ferrous Iron, Field	mg/L	0.78	0.52	NA	NA	NA	NA
<b>Alkalinity (310.2)</b>							
Alkalinity, Total	mg/L	142	174	250	NA	379	NA
<b>Nitrogen (353.2)</b>							
Nitrogen, Nitrate-Nitrite	mg/L	NA	NA	0.201	NA	0.455	NA
<b>Phosphorus (365.4)</b>							
Phosphorus	mg/L	<0.2 U	0.178 J	0.351 J	NA	0.412	NA
<b>Sulfide (376.1)</b>							
Sulfide	mg/L	<1 U	1.2 J	1.75 J	NA	<1 U	NA
<b>Total Organic Carbon (415.1)</b>							
Total Organic Carbon (TOC)	mg/L	10.5	16.5	5.77	NA	3.84	NA
<b>Metals (6010C)</b>							
Iron	mg/L	<0.1 U	4.2	<0.1 U	NA	<0.1 U	NA
<b>Dissolved Metals (6010C)</b>							
Iron	mg/L	<0.1 U	4.75	NA	<0.1 U	NA	<0.1 U
<b>Metals (6020A)</b>							
Manganese	mg/L	0.0589	5.67	0.361	NA	0.0814	NA
<b>Dissolved Metals (6020A)</b>							
Manganese	mg/L	0.0561	5.71	NA	0.341	NA	0.0739
<b>Volatile Fatty Acids (830-MBA)</b>							
Acetic Acid	mg/L	<1 U	<1 U	<1 U	NA	<1 U	NA
Butyric Acid	mg/L	<1 U	<1 U	<1 U	NA	<1 U	NA
Lactic Acid	mg/L	<1 U	<1 U	<1 U	NA	<1 U	NA
Propionic Acid	mg/L	<10 U	<10 U	<10 U	NA	<10 U	NA
Pyruvic Acid	mg/L	<0.1 U	<0.1 U	<0.1 U	NA	<0.1 U	NA



### LHAAP-58 Field Parameters and Biogeochemical Data - August 2013

Sample ID:	Units	03WW01-082013	35AWW08-082013	35AWW09-082913	35AWW09F-082913	35AWW10-082913	35AWW10F-082913
Sample Date:		8/20/2013	8/20/2013	8/29/2013	8/29/2013	8/29/2013	8/29/2013
<b>Anions (9056)</b>							
Chloride	mg/L	892	2510	1970	NA	135	NA
Nitrate	mg/L	<1 U	<4 U	<1 U	NA	<1 U	NA
Nitrite	mg/L	<1 U	<4 U	<1 U	NA	<1 U	NA
Sulfate	mg/L	534	1480	1070	NA	209	NA
<b>Dechlorinating Bacteria</b>							
Dehalococcoides	CEQ/mL	1.2	<0.9	10.4	NA	31.1	NA
tceA Reductase	CEQ/mL	<0.5	<0.9	<0.5	NA	<0.5	NA
BAV1 Vinyl Chloride Reductase	CEQ/mL	<0.5	<0.9	<0.5	NA	<0.5	NA
Vinyl Chloride Reductase	CEQ/mL	<0.5	<0.9	<0.5	NA	0.2 J	NA
Dehalobacter spp.	CEQ/mL	0.4 J	<5.3	0.3 J	NA	1.8 J	NA
<b>Dissolved Gases (RSK-175)</b>							
Carbon Dioxide	ug/L	143000	143000	150000	NA	61000	NA
Ethane	ug/L	<2 U	<2 U	<2 U	NA	<2 U	NA
Ethene	ug/L	<2 U	<2 U	<2 U	NA	<2 U	NA
Methane	ug/L	<2 U	<2 U	31.5	NA	<2 U	NA
<b>Ferrous Iron (SM3500FE)</b>							
Ferrous Iron	mg/L	<0.04 U	<0.04 U	<0.04 U	NA	<0.04 U	NA

**Note:** Samples were not collected for LHSMW04 as it was dry.

°C - degrees celsius

CEQ/ml - cells equivalent per milliliter

J - Estimated value; analyte concentration was less than the limit of quantification

mg/L - milligram per liter

mS/cm - millisiemens per centimeter

mV - millivolt

NA - not analyzed

NTU - Nephelometric turbidity unit

U - Analyte was not detected. The concentration is below the reported limit of detection.

µg/L - microgram per liter

LHAAP-35A (58) Monitoring Well Field Parameters and Biogeochemical Data - October 2013

Sample ID:	Units	03WW01-101013	03WW01F-101013	35AWW01-101113	35AWW02-102213	35AWW05-101613	35AWW06-101513	35AWW06F-101513	35AWW07R-101613	35AWW08-101013	35AWW08F-101013	35AWW09-101013
Sample Date:		10/10/2013	10/10/2013	10/11/2013	10/22/2013	10/16/2013	10/15/2013	10/15/2013	10/16/2013	10/10/2013	10/10/2013	10/10/2013
<b>Water Quality Parameters</b>												
Temperature	°C	17.4	NA	25.58	22.72	21.05	21.39	NA	20.83	16.82	NA	19.67
pH	pH Units	6.55	NA	7.08	8.12	6.95	6.56	NA	7.54	6.7	NA	5.43
Conductivity	mS/cm	39.2	NA	0.576	0.875	3.05	6.73	NA	0.205	47.7	NA	7.68
Dissolved Oxygen	mg/L	9.72	NA	0.85	1.3	0.67	1.05	NA	8.86	9.57	NA	1.53
Turbidity	NTU	10	NA	131	7.3	16.9	0	NA	197	4.1	NA	40.5
Oxidation Reduction Potential	mV	-235	NA	23	98	-141	96	NA	108	-100	NA	182
<b>Alkalinity (310.2)</b>												
Alkalinity, Total	mg/L	39700	NA	NA	NA	NA	592	NA	NA	35600	NA	235
<b>Nitrogen (353.2)</b>												
Nitrogen, Nitrate-Nitrite	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<b>Phosphorus (365.4)</b>												
Phosphorus	mg/L	243	NA	NA	NA	NA	<0.2 U	NA	NA	361	NA	<0.2 U
<b>Sulfide (376.1)</b>												
Sulfide	mg/L	<1 U	NA	NA	NA	NA	<1 U	NA	NA	<1 U	NA	<1 U
<b>Total Organic Carbon (415.1)</b>												
Total Organic Carbon (TOC)	mg/L	49200	NA	NA	NA	NA	6.33	NA	NA	66400	NA	9.83
<b>Metals (6010C)</b>												
Iron	mg/L	36.6	NA	NA	NA	NA	0.159 J	NA	NA	29.7	NA	NA
<b>Dissolved Metals (6010C)</b>												
Iron	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<b>Metals (6020A)</b>												
Manganese	mg/L	60.4	NA	NA	NA	NA	0.278	NA	NA	45.8	NA	NA
<b>Dissolved Metals (6020A)</b>												
Manganese	mg/L	NA	65.2	NA	NA	NA	NA	0.191	NA	NA	40.7	NA
<b>Volatile Fatty Acids (830-MBA)</b>												
Acetic Acid	mg/L	946	NA	NA	NA	NA	NA	NA	NA	776	NA	<1 U
Butyric Acid	mg/L	<100 U	NA	NA	NA	NA	NA	NA	NA	<100 U	NA	<1 U
Lactic Acid	mg/L	97100	NA	NA	NA	NA	NA	NA	NA	89700	NA	<1 U
Propionic Acid	mg/L	<1000 U	NA	NA	NA	NA	NA	NA	NA	<1000 U	NA	<10 U
Pyruvic Acid	mg/L	61.5	NA	NA	NA	NA	NA	NA	NA	61.7	NA	<0.1 U
<b>Anions (9056)</b>												
Chloride	mg/L	398	NA	NA	NA	NA	1120	NA	NA	905	NA	1730
Nitrate	mg/L	<20 U	NA	NA	NA	NA	<4 U	NA	NA	12.3 J	NA	<2 U
Nitrite	mg/L	<20 U	NA	NA	NA	NA	<4 U	NA	NA	<20 U	NA	<2 U
Sulfate	mg/L	487	NA	NA	NA	NA	1660	NA	NA	703	NA	1170

LHAAP-35A (58) Monitoring Well Field Parameters and Biogeochemical Data - October 2013

Sample ID:	Units	03WW01-101013	03WW01F-101013	35AWW01-101113	35AWW02-102213	35AWW05-101613	35AWW06-101513	35AWW06F-101513	35AWW07R-101613	35AWW08-101013	35AWW08F-101013	35AWW09-101013
Sample Date:		10/10/2013	10/10/2013	10/11/2013	10/22/2013	10/16/2013	10/15/2013	10/15/2013	10/16/2013	10/10/2013	10/10/2013	10/10/2013
<b>Dechlorinating Bacteria</b>												
Dehalococcoides	CEQ/mL	<2.1	NA	NA	NA	NA	NA	NA	NA	3.6	NA	4
tceA Reductase	CEQ/mL	<2.1	NA	NA	NA	NA	NA	NA	NA	2.65	NA	0.3 J
BAV1 Vinyl Chloride Reductase	CEQ/mL	<2.1	NA	NA	NA	NA	NA	NA	NA	<2.2	NA	<0.5
Vinyl Chloride Reductase	CEQ/mL	<2.1	NA	NA	NA	NA	NA	NA	NA	<2.2	NA	<0.5
Dehalobacter spp.	CEQ/mL	15.7 J	NA	NA	NA	NA	NA	NA	NA	1300	NA	<4.7
<b>Dissolved Gases (RSK-175)</b>												
Carbon Dioxide	ug/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethane	ug/L	<2 U	NA	NA	NA	NA	<2 U	NA	NA	<2 U	NA	<2 U
Ethene	ug/L	<2 U	NA	NA	NA	NA	<2 U	NA	NA	<2 U	NA	<2 U
Methane	ug/L	<2 U	NA	NA	NA	NA	<2 UJ	NA	NA	<2 UJ	NA	<2 U
<b>Ferrous Iron (SM3500FE)</b>												
Ferrous Iron	mg/L	35.4 J	NA	NA	NA	NA	<0.04 U	NA	NA	52.4 J	NA	<0.04 U

**Note:** Samples were not collected for LHSMW04 and LHSMW05 as they were dry.

°C - degrees celsius

CEQ/ml - cells equivalent per milliliter

J - Estimated value; analyte concentration was less than the limit of quantification

mg/L - milligram per liter

mS/cm - millisiemens per centimeter

mV - millivolt

NA - not analyzed

NTU - Nephelometric turbidity unit

U - Analyte was not detected. The concentration is below the reported limit of detection.

µg/L - microgram per liter

UJ - The analysis was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. 'UJ' not detects are not definite; the analyte may be present.

LHAAP-35A (58) Monitoring Well Field Parameters and Biogeochemical Data - October 2013

Sample ID:	Units	35AWW09F-101013	35AWW10-101013	35AWW10F-101013	35AWW11-101513	35AWW11F-101513	35AWW12-101813	35AWW13-101113	35AWW14-101813	35AWW15-101613	35AWW16-102213	35AWW17-101813
Sample Date:		10/10/2013	10/10/2013	10/10/2013	10/15/2013	10/15/2013	10/18/2013	10/11/2013	10/18/2013	10/16/2013	10/22/2013	10/18/2013
<b>Water Quality Parameters</b>												
Temperature	°C	NA	25.41	NA	21.17	NA	20.93	22.45	19.37	21.88	19.32	17.69
pH	pH Units	NA	6.1	NA	6.12	NA	6.05	6.5	6.89	6.39	6.39	6.64
Conductivity	mS/cm	NA	0.322	NA	9.75	NA	2.6	1.66	6.73	14.9	10.7	10.4
Dissolved Oxygen	mg/L	NA	5.36	NA	4.24	NA	1.29	0.96	10.5	0.65	5	1.72
Turbidity	NTU	NA	5.1	NA	25.8	NA	17.3	22.5	6	19	37.1	12.1
Oxidation Reduction Potential	mV	NA	420	NA	125	NA	153	-68	1	-99	58	74
<b>Alkalinity (310.2)</b>												
Alkalinity, Total	mg/L	NA	128	NA	392	NA	NA	NA	NA	NA	NA	NA
<b>Nitrogen (353.2)</b>												
Nitrogen, Nitrate-Nitrite	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<b>Phosphorus (365.4)</b>												
Phosphorus	mg/L	NA	<0.2 U	NA	0.22 J	NA	NA	NA	NA	NA	NA	NA
<b>Sulfide (376.1)</b>												
Sulfide	mg/L	NA	<1 U	NA	<1 U	NA	NA	NA	NA	NA	NA	NA
<b>Total Organic Carbon (415.1)</b>												
Total Organic Carbon (TOC)	mg/L	NA	5.42	NA	17	NA	NA	NA	NA	NA	NA	NA
<b>Metals (6010C)</b>												
Iron	mg/L	<0.1 U	0.155 J	NA	NA	1.16	NA	NA	NA	NA	NA	NA
<b>Dissolved Metals (6010C)</b>												
Iron	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<b>Metals (6020A)</b>												
Manganese	mg/L	0.23	0.0811	NA	NA	1.07	NA	NA	NA	NA	NA	NA
<b>Dissolved Metals (6020A)</b>												
Manganese	mg/L	0.234	NA	0.0681	NA	1.01	NA	NA	NA	NA	NA	NA
<b>Volatile Fatty Acids (830-MBA)</b>												
Acetic Acid	mg/L	NA	<1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Butyric Acid	mg/L	NA	<1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lactic Acid	mg/L	NA	<1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Propionic Acid	mg/L	NA	<10 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyruvic Acid	mg/L	NA	<0.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
<b>Anions (9056)</b>												
Chloride	mg/L	NA	16.5	NA	2350	NA	NA	NA	NA	NA	NA	NA
Nitrate	mg/L	NA	0.11 J	NA	<4 UJ	NA	NA	NA	NA	NA	NA	NA
Nitrite	mg/L	NA	<0.2 U	NA	<4 UJ	NA	NA	NA	NA	NA	NA	NA
Sulfate	mg/L	NA	66.2	NA	1360	NA	NA	NA	NA	NA	NA	NA

LHAAP-35A (58) Monitoring Well Field Parameters and Biogeochemical Data - October 2013

Sample ID:	Units	35AWW09F-101013	35AWW10-101013	35AWW10F-101013	35AWW11-101513	35AWW11F-101513	35AWW12-101813	35AWW13-101113	35AWW14-101813	35AWW15-101613	35AWW16-102213	35AWW17-101813
Sample Date:		10/10/2013	10/10/2013	10/10/2013	10/15/2013	10/15/2013	10/18/2013	10/11/2013	10/18/2013	10/16/2013	10/22/2013	10/18/2013
<b>Dechlorinating Bacteria</b>												
Dehalococcoides	CEQ/mL	NA	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
tceA Reductase	CEQ/mL	NA	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAV1 Vinyl Chloride Reductase	CEQ/mL	NA	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride Reductase	CEQ/mL	NA	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dehalobacter spp.	CEQ/mL	NA	3.4 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
<b>Dissolved Gases (RSK-175)</b>												
Carbon Dioxide	ug/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethane	ug/L	NA	<2 U	NA	<2 U	NA	NA	NA	NA	NA	NA	NA
Ethene	ug/L	NA	<2 U	NA	<2 U	NA	NA	NA	NA	NA	NA	NA
Methane	ug/L	NA	<2 U	NA	<2 UJ	NA	NA	NA	NA	NA	NA	NA
<b>Ferrous Iron (SM3500FE)</b>												
Ferrous Iron	mg/L	NA	<0.04 U	NA	<0.04 U	NA	NA	NA	NA	NA	NA	NA

**Note:** Samples were not collected for LHSMW04 and LHSMW05 as they were dry.

°C - degrees celsius

CEQ/ml - cells equivalent per milliliter

J - Estimated value; analyte concentration was less than the limit of quantification

mg/L - milligram per liter

mS/cm - millisiemens per centimeter

mV - millivolt

NA - not analyzed

NTU - Nephelometric turbidity unit

U - Analyte was not detected. The concentration is below the reported limit of detection.

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LHAAP-35A (58) Monitoring Well Field Parameters and Biogeochemical Data - October 2013

Sample ID:	Units	35AWW18-101813	35AWW19-102213	35AWW20-101513	35AWW21-101613	35AWW22-102213	LHSMW06-101713	LHSMW07-101513	LHSMW07F-101513
Sample Date:		10/18/2013	10/22/2013	10/15/2013	10/16/2013	10/22/2013	10/17/2013	10/15/2013	10/15/2013
<b>Water Quality Parameters</b>									
Temperature	°C	18.7	18.75	26.17	20.7	18.67	20.46	23.04	NA
pH	pH Units	6.67	6.44	6.55	5.72	6.2	6.82	6.48	NA
Conductivity	mS/cm	10.1	6.95	11.4	1.05	9.85	3.65	12.5	NA
Dissolved Oxygen	mg/L	1.4	9.67	1.55	1.44	9.67	10	0.75	NA
Turbidity	NTU	22.9	475	6.7	21.3	25	1	1.8	NA
Oxidation Reduction Potential	mV	104	106	441	213	170	157	79	NA
<b>Alkalinity (310.2)</b>									
Alkalinity, Total	mg/L	NA	NA	786	NA	NA	NA	597	NA
<b>Nitrogen (353.2)</b>									
Nitrogen, Nitrate-Nitrite	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
<b>Phosphorus (365.4)</b>									
Phosphorus	mg/L	NA	NA	<0.2 U	NA	NA	NA	<0.2 U	NA
<b>Sulfide (376.1)</b>									
Sulfide	mg/L	NA	NA	<1 U	NA	NA	NA	<1 U	NA
<b>Total Organic Carbon (415.1)</b>									
Total Organic Carbon (TOC)	mg/L	NA	NA	13.1	NA	NA	NA	9.22	NA
<b>Metals (6010C)</b>									
Iron	mg/L	NA	NA	0.339	NA	NA	NA	1.55	NA
<b>Dissolved Metals (6010C)</b>									
Iron	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
<b>Metals (6020A)</b>									
Manganese	mg/L	NA	NA	2.8	NA	NA	NA	0.101	NA
<b>Dissolved Metals (6020A)</b>									
Manganese	mg/L	NA	NA	2.54	NA	NA	NA	NA	0.0961
<b>Volatile Fatty Acids (830-MBA)</b>									
Acetic Acid	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Butyric Acid	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Lactic Acid	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Propionic Acid	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Pyruvic Acid	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
<b>Anions (9056)</b>									
Chloride	mg/L	NA	NA	2360	NA	NA	NA	2670	NA
Nitrate	mg/L	NA	NA	<4 U	NA	NA	NA	<4 UJ	NA
Nitrite	mg/L	NA	NA	<4 U	NA	NA	NA	<4 UJ	NA
Sulfate	mg/L	NA	NA	2290	NA	NA	NA	2630	NA

LHAAP-35A (58) Monitoring Well Field Parameters and Biogeochemical Data - October 2013

Sample ID:	Units	35AWW18-101813	35AWW19-102213	35AWW20-101513	35AWW21-101613	35AWW22-102213	LHSMW06-101713	LHSMW07-101513	LHSMW07F-101513
Sample Date:		10/18/2013	10/22/2013	10/15/2013	10/16/2013	10/22/2013	10/17/2013	10/15/2013	10/15/2013
<b>Dechlorinating Bacteria</b>									
Dehalococcoides	CEQ/mL	NA	NA	NA	NA	NA	NA	NA	NA
tceA Reductase	CEQ/mL	NA	NA	NA	NA	NA	NA	NA	NA
BAV1 Vinyl Chloride Reductase	CEQ/mL	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride Reductase	CEQ/mL	NA	NA	NA	NA	NA	NA	NA	NA
Dehalobacter spp.	CEQ/mL	NA	NA	NA	NA	NA	NA	NA	NA
<b>Dissolved Gases (RSK-175)</b>									
Carbon Dioxide	ug/L	NA	NA	NA	NA	NA	NA	NA	NA
Ethane	ug/L	NA	NA	1.19 J	NA	NA	NA	<2 U	NA
Ethene	ug/L	NA	NA	<2 U	NA	NA	NA	<2 U	NA
Methane	ug/L	NA	NA	118	NA	NA	NA	204	NA
<b>Ferrous Iron (SM3500FE)</b>									
Ferrous Iron	mg/L	NA	NA	<0.04 U	NA	NA	NA	<0.04 U	NA

**Note:** Samples were not collected for LHSMW04 and LHSMW05 as they were dry.

°C - degrees celsius

CEQ/ml - cells equivalent per milliliter

J - Estimated value; analyte concentration was less than the limit of quantification

mg/L - milligram per liter

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LHAAP-35A (58) Monitoring Well Volatile Organic Compound Data - August 2013

Sample ID: Sample Date:	Units	MCL	03WW01- 082013 8/20/2013	35AWW08- 082013 8/20/2013	35AWW09- 082913 8/29/2013	35AWW10- 082913 8/29/2013
<b>Volatile Organic Compounds (8260B)</b>						
1,1,1,2-Tetrachloroethane	ug/L	110	<1 U	<5 U	<0.5 U	<0.5 U
1,1,1-Trichloroethane	ug/L	200	<1 U	<5 U	<0.5 U	<0.5 U
1,1,2,2-Tetrachloroethane	ug/L	14	<0.8 U	<4 U	<0.4 U	<0.4 U
1,1,2-Trichloroethane	ug/L	5	<1 U	<5 U	<0.5 U	<0.5 U
1,1-Dichloroethane	ug/L	10000	1.14 J	<2.5 U	<0.25 U	<0.25 U
1,1-Dichloroethene	ug/L	7	<2 U	<10 U	<1 U	<1 U
1,1-Dichloropropene	ug/L	2.9	<1 U	<5 U	<0.5 U	<0.5 U
1,2,3-Trichlorobenzene	ug/L	310	<0.6 U	<3 U	<0.3 U	<0.3 U
1,2,3-Trichloropropane	ug/L	0.004	<2 U	<10 U	<1 U	<1 U
1,2,4-Trichlorobenzene	ug/L	70	<0.8 U	<4 U	<0.4 U	<0.4 U
1,2,4-Trimethylbenzene	ug/L	5100	<1 U	<5 U	<0.5 U	<0.5 U
1,2-Dibromo-3-Chloropropane	ug/L	0.2	<4 U	<20 U	<2 U	<2 U
1,2-Dibromoethane	ug/L	0.005	<1 U	<5 U	<0.5 U	<0.5 U
1,2-Dichlorobenzene	ug/L	600	<0.5 U	<2.5 U	<0.25 U	<0.25 U
1,2-Dichloroethane	ug/L	5	<1 U	<5 U	<0.5 U	<0.5 U
1,2-Dichloropropane	ug/L	5	<0.8 U	<4 U	<0.4 U	<0.4 U
1,3,5-Trimethylbenzene	ug/L	5100	<1 U	<5 U	<0.5 U	<0.5 U
1,3-Dichlorobenzene	ug/L	3100	<1 U	<5 U	<0.5 U	<0.5 U
1,3-Dichloropropane	ug/L	29	<0.8 U	<4 U	<0.4 U	<0.4 U
1,4-Dichlorobenzene	ug/L	75	<0.5 U	<2.5 U	<0.25 U	<0.25 U
2,2-Dichloropropane	ug/L	42	<1 U	<5 U	<0.5 U	<0.5 U
2-Butanone	ug/L	61000	<10 U	<50 U	<5 U	<5 U
2-Chlorotoluene	ug/L	2000	<0.5 U	<2.5 U	<0.25 U	<0.25 U
2-Hexanone	ug/L	6100	<10 U	<50 U	<5 U	<5 U
4-Chlorotoluene	ug/L	2000	<1 U	<5 U	<0.5 U	<0.5 U
4-Methyl-2-Pentanone	ug/L	8200	<10 U	<50 U	<5 U	<5 U
Acetone	ug/L	92000	<10 UJ	<50 U	<5 UJ	<5 UJ
Benzene	ug/L	5	<0.5 U	<2.5 U	<0.25 U	<0.25 U
Bromobenzene	ug/L	2000	<0.5 U	<2.5 U	<0.25 U	<0.25 U
Bromochloromethane	ug/L	4100	<0.8 U	<4 U	<0.4 U	<0.4 U
Bromodichloromethane	ug/L	4.6	<1 U	<5 U	<0.5 U	<0.5 U
Bromoform	ug/L	36	<2 U	<10 U	<1 U	<1 U
Bromomethane	ug/L	140	<2 U	<10 U	<1 UJ	<1 UJ
Carbon Disulfide	ug/L	10000	<2 U	<10 U	<1 U	<1 U
Carbon Tetrachloride	ug/L	5	<1 U	<5 U	<0.5 U	<0.5 U
Chlorobenzene	ug/L	100	<0.5 U	<2.5 U	<0.25 U	<0.25 U
Chloroethane	ug/L	41000	<2 U	<10 U	<1 U	<1 UJ
Chloroform	ug/L	1000	<0.5 U	<2.5 U	<0.25 U	<0.25 U
Chloromethane	ug/L	220	<2 UJ	<10 UJ	<1 UJ	<1 U
cis-1,2-Dichloroethene	ug/L	70	0.978 J	9.35 J	<0.5 U	<0.5 U
cis-1,3-Dichloropropene	ug/L	5.3	<1 U	<5 U	<0.5 U	<0.5 U
Dibromochloromethane	ug/L	34	<1 U	<5 U	<0.5 U	<0.5 U
Dibromomethane	ug/L	380	<1 U	<5 U	<0.5 U	<0.5 U
Dichlorodifluoromethane	ug/L	20000	<1 U	<5 UJ	<0.5 U	<0.5 U
Ethylbenzene	ug/L	700	<1 U	<5 U	<0.5 U	<0.5 U
Hexachlorobutadiene	ug/L	20	<1 U	<5 U	<0.5 U	<0.5 U
Isopropylbenzene	ug/L	1000	<1 U	<5 U	<0.5 U	<0.5 U
m,p-Xylene	ug/L	10000	<2 U	<10 U	<1 U	<1 U
Methylene Chloride	ug/L	5	<1 U	<5 U	<0.5 U	<0.5 U
Naphthalene	ug/L	2000	<0.8 U	<4 U	<0.4 U	<0.4 U
n-Butylbenzene	ug/L	4100	<1 U	<5 U	<0.5 U	<0.5 U
n-Propylbenzene	ug/L	4100	<0.5 U	<2.5 U	<0.25 U	<0.25 U
o-Xylene	ug/L	10000	<1 U	<5 U	<0.5 U	<0.5 U
p-Isopropyltoluene	ug/L	10000	<1 U	<5 U	<0.5 U	<0.5 U
sec-Butylbenzene	ug/L	4100	<1 U	<5 U	<0.5 U	<0.5 U
Styrene	ug/L	100	<0.5 U	<2.5 U	<0.25 U	<0.25 U

## LHAAP-35A (58) Monitoring Well Volatile Organic Compound Data - August 2013

Sample ID: Sample Date:	Units	MCL	03WW01- 082013 8/20/2013	35AWW08- 082013 8/20/2013	35AWW09- 082913 8/29/2013	35AWW10- 082913 8/29/2013
tert-Butylbenzene	ug/L	4100	<1 U	<5 U	<0.5 U	<0.5 U
Tetrachloroethene	ug/L	5	368	1640	21.9	<0.5 U
Toluene	ug/L	1000	<1 U	<5 U	<0.5 U	<0.5 U
trans-1,2-Dichloroethene	ug/L	100	<1 U	<5 U	<0.5 U	<0.5 U
trans-1,3-Dichloropropene	ug/L	29	<2 U	<10 U	<1 U	<1 U
Trichloroethene	ug/L	5	94.8	544	11.9	<0.5 U
Trichlorofluoromethane	ug/L	31000	<1 UJ	<5 U	<0.5 U	<0.5 U
Vinyl Chloride	ug/L	2	<1 U	<5 U	<0.5 U	<0.5 U

Blue Highlighting Indicates Analyte Detected Above Regulatory Limit

J - Estimated value; analyte concentration was less than the limit of quantification

MCL - maximum contaminant level

NA - not analyzed

U - Analyte was not detected. The concentration is below the reported limit of detection.

UJ - The analysis was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. 'UJ' not detects are not definite; the analyte may be present.

LHAAP-35A (58) Monitoring Well Volatile Organic Compound Data - October 2013

Sample ID:	Units	MCL	03WW01-101013 10/10/2013	35ASW03-101713 10/17/2013	35AWW01-101113 10/11/2013	35AWW02-102213 10/22/2013	35AWW05-101613 10/16/2013	35AWW06-101513 10/15/2013	35AWW07R-101613 10/16/2013	35AWW08-101013 10/10/2013	35AWW09-101013 10/10/2013	35AWW10-101013 10/10/2013	35AWW11-101513 10/15/2013
Sample Date:													
<b>Volatile Organic Compounds (8260B)</b>													
1,1,1,2-Tetrachloroethane	ug/L	110	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
1,1,1-Trichloroethane	ug/L	200	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
1,1,2,2-Tetrachloroethane	ug/L	14	<2 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<4 U	<0.4 UJ	<0.4 U	<0.4 U
1,1,2-Trichloroethane	ug/L	5	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
1,1-Dichloroethane	ug/L	10000	<1.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	2.27	<0.25 U	<2.5 U	<0.25 UJ	<0.25 U
1,1-Dichloroethene	ug/L	7	<5 U	<1 U	<1 U	<1 U	<1 U	<1 U	15.8	<1 U	<10 U	<1 UJ	<1 U
1,1-Dichloropropene	ug/L	2.9	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
1,2,3-Trichlorobenzene	ug/L	310	<1.5 U	<0.3 U	<0.3 U	<0.3 U	<0.3 U	<0.3 U	<0.3 U	<3 U	<0.3 UJ	<0.3 U	<0.3 U
1,2,3-Trichloropropane	ug/L	0.004	<5 U	<1 U	<1 U	<1 U	<1 UJ	<1 U	<1 UJ	<10 U	<1 UJ	<1 U	<1 UJ
1,2,4-Trichlorobenzene	ug/L	70	<2 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<4 U	<0.4 UJ	<0.4 U	<0.4 U
1,2,4-Trimethylbenzene	ug/L	5100	1.39 J	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
1,2-Dibromo-3-Chloropropane	ug/L	0.2	<10 U	<2 UJ	<2 U	<2 U	<2 UJ	<2 U	<2 UJ	<20 U	<2 UJ	<2 U	<2 U
1,2-Dibromoethane	ug/L	0.005	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
1,2-Dichlorobenzene	ug/L	600	<1.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<2.5 U	<0.25 UJ	<0.25 U	<0.25 U
1,2-Dichloroethane	ug/L	5	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
1,2-Dichloropropane	ug/L	5	<2 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<4 U	<0.4 UJ	<0.4 U	<0.4 U
1,3,5-Trimethylbenzene	ug/L	5100	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
1,3-Dichlorobenzene	ug/L	3100	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
1,3-Dichloropropane	ug/L	29	<2 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<4 U	<0.4 UJ	<0.4 U	<0.4 U
1,4-Dichlorobenzene	ug/L	75	<1.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<2.5 U	<0.25 UJ	<0.25 U	<0.25 U
2,2-Dichloropropane	ug/L	42	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
2-Butanone	ug/L	61000	1250 J	<5 U	<5 U	<5 U	<5 U	<5 U	<5 U	1440 J	<5 UJ	<5 U	<5 UJ
2-Chlorotoluene	ug/L	2000	<1.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<2.5 U	<0.25 UJ	<0.25 U	<0.25 U
2-Hexanone	ug/L	6100	<25 U	<5 U	<5 U	<5 UJ	<5 U	<5 U	<5 U	<50 U	<5 UJ	<5 U	<5 U
4-Chlorotoluene	ug/L	2000	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
4-Methyl-2-Pentanone	ug/L	8200	12.7 J	<5 U	<5 U	<5 U	<5 U	<5 U	<5 U	<50 U	<5 UJ	<5 U	<5 U
Acetone	ug/L	92000	1910 J	3.86 J	<5 U	<5 U	<5 UJ	<5 U	<5 UJ	2570 J	<5 UJ	<5 U	<5 UJ
Benzene	ug/L	5	<1.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<2.5 U	<0.25 UJ	<0.25 U	<0.25 U
Bromobenzene	ug/L	2000	<1.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<2.5 U	<0.25 UJ	<0.25 U	<0.25 U
Bromochloromethane	ug/L	4100	<2 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<4 U	<0.4 UJ	<0.4 U	<0.4 U
Bromodichloromethane	ug/L	4.6	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
Bromoform	ug/L	36	<5 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<10 U	<1 UJ	<1 U	<1 U
Bromomethane	ug/L	140	<5 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<10 U	<1 UJ	<1 U	<1 U
Carbon Disulfide	ug/L	10000	<5 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<10 U	<1 UJ	<1 U	<1 U
Carbon Tetrachloride	ug/L	5	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
Chlorobenzene	ug/L	100	<1.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<2.5 U	<0.25 UJ	<0.25 U	<0.25 U
Chloroethane	ug/L	41000	<5 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<10 U	<1 UJ	<1 U	<1 U
Chloroform	ug/L	1000	<1.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<2.5 U	<0.25 UJ	<0.25 U	<0.25 U
Chloromethane	ug/L	220	<5 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<10 U	<1 UJ	<1 U	<1 U
cis-1,2-Dichloroethene	ug/L	70	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.709 J	<5 U	<0.5 UJ	<0.5 U	<0.5 U
cis-1,3-Dichloropropene	ug/L	5.3	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
Dibromochloromethane	ug/L	34	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
Dibromomethane	ug/L	380	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
Dichlorodifluoromethane	ug/L	20000	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
Ethylbenzene	ug/L	700	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
Hexachlorobutadiene	ug/L	20	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
Isopropylbenzene	ug/L	1000	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
m,p-Xylene	ug/L	10000	<5 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<10 U	<1 UJ	<1 U	<1 U
Methylene Chloride	ug/L	5	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
Naphthalene	ug/L	2000	<2 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<4 U	<0.4 UJ	<0.4 U	<0.4 U



LHAAP-35A (58) Monitoring Well Volatile Organic Compound Data - October 2013

Sample ID:	Units	MCL	03WW01-101013 10/10/2013	35ASW03-101713 10/17/2013	35AWW01-101113 10/11/2013	35AWW02-102213 10/22/2013	35AWW05-101613 10/16/2013	35AWW06-101513 10/15/2013	35AWW07R-101613 10/16/2013	35AWW08-101013 10/10/2013	35AWW09-101013 10/10/2013	35AWW10-101013 10/10/2013	35AWW11-101513 10/15/2013
<b>Volatile Organic Compounds (8260B)</b>													
n-Butylbenzene	ug/L	4100	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
n-Propylbenzene	ug/L	4100	<1.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<2.5 U	<0.25 UJ	<0.25 U	<0.25 U
o-Xylene	ug/L	10000	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
p-Isopropyltoluene	ug/L	10000	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
sec-Butylbenzene	ug/L	4100	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
Styrene	ug/L	100	<1.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<2.5 U	<0.25 UJ	<0.25 U	<0.25 U
tert-Butylbenzene	ug/L	4100	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
Tetrachloroethene	ug/L	5	172 J	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.586 J	603 J	57.6 J	<0.5 U	<0.5 U
Toluene	ug/L	1000	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
trans-1,2-Dichloroethene	ug/L	100	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
trans-1,3-Dichloropropene	ug/L	29	<5 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<10 U	<1 UJ	<1 U	<1 U
Trichloroethene	ug/L	5	42.1 J	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.03	149 J	8.97 J	<0.5 U	<0.5 U
Trichlorofluoromethane	ug/L	31000	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	<0.5 U
Vinyl Chloride	ug/L	2	<2.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	<0.5 UJ	<0.5 U	0.442 J

**Note:** Samples were not collected for LHSMW04 and LHSMW05 as they were dry. 35ASW03-101713 is a surface water sample.

Blue Highlighting Indicates Analyte Detected Above Regulatory Limit

FD - field duplicate

J - Estimated value; analyte concentration was less than the limit of quantification

MCL - maximum contaminant level

NA - not analyzed

U - Analyte was not detected. The concentration is below the reported limit of detection.

ug/L - microgram per liter

UJ - The analysis was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. 'UJ' not detects are not definite; the analyte may be present.

LHAAP-35A (58) Monitoring Well Volatile Organic Compound Data - October 2013

Sample ID:	Units	MCL	35AWW12-101813 10/18/2013	35AWW12FD-101813 10/18/2013	35AWW13-101113 10/11/2013	35AWW13FD-101113 10/11/2013	35AWW14-101813 10/18/2013	35AWW15-101613 10/16/2013	35AWW15FD-101613 10/16/2013	35AWW16-102213 10/22/2013	35AWW17-101813 10/18/2013	35AWW18-101813 10/18/2013	35AWW19-102213 10/22/2013
<b>Volatile Organic Compounds (8260B)</b>													
1,1,1,2-Tetrachloroethane	ug/L	110	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1,1-Trichloroethane	ug/L	200	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1,2,2-Tetrachloroethane	ug/L	14	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U
1,1,2-Trichloroethane	ug/L	5	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1-Dichloroethane	ug/L	10000	<0.25 U	<0.25 U	<0.25 U	<0.25 U	3.18	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	1.71
1,1-Dichloroethene	ug/L	7	<1 U	<1 U	<1 U	<1 U	1.63 J	<1 U	<1 U	<1 U	<1 U	<1 U	6.45
1,1-Dichloropropene	ug/L	2.9	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2,3-Trichlorobenzene	ug/L	310	<0.3 U	<0.3 U	<0.3 U	<0.3 U	<0.3 U	<0.3 U	<0.3 U	<0.3 U	<0.3 U	<0.3 U	<0.3 U
1,2,3-Trichloropropane	ug/L	0.004	<1 U	<1 U	<1 U	<1 U	<1 U	<1 UJ	<1 UJ	<1 U	<1 U	<1 U	<1 U
1,2,4-Trichlorobenzene	ug/L	70	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U
1,2,4-Trimethylbenzene	ug/L	5100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2-Dibromo-3-Chloropropane	ug/L	0.2	<2 U	<2 U	<2 U	<2 U	<2 U	<2 UJ	<2 UJ	<2 U	<2 U	<2 U	<2 U
1,2-Dibromoethane	ug/L	0.005	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2-Dichlorobenzene	ug/L	600	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
1,2-Dichloroethane	ug/L	5	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.83
1,2-Dichloropropane	ug/L	5	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U
1,3,5-Trimethylbenzene	ug/L	5100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,3-Dichlorobenzene	ug/L	3100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,3-Dichloropropane	ug/L	29	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U
1,4-Dichlorobenzene	ug/L	75	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
2,2-Dichloropropane	ug/L	42	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
2-Butanone	ug/L	61000	<5 U	<5 U	<5 U	<5 U	<5 U	<5 U	<5 U	<5 U	<5 U	<5 U	<5 U
2-Chlorotoluene	ug/L	2000	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
2-Hexanone	ug/L	6100	<5 UJ	<5 UJ	<5 U	<5 U	<5 UJ	<5 U	<5 U	<5 UJ	<5 UJ	<5 UJ	<5 UJ
4-Chlorotoluene	ug/L	2000	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
4-Methyl-2-Pentanone	ug/L	8200	<5 U	<5 U	<5 U	<5 U	<5 U	<5 U	<5 U	<5 U	<5 U	<5 U	<5 U
Acetone	ug/L	92000	<5 U	<5 U	<5 U	<5 U	<5 U	<5 UJ	<5 UJ	<5 U	<5 U	<5 U	<5 U
Benzene	ug/L	5	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
Bromobenzene	ug/L	2000	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
Bromochloromethane	ug/L	4100	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U
Bromodichloromethane	ug/L	4.6	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Bromoform	ug/L	36	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U
Bromomethane	ug/L	140	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U
Carbon Disulfide	ug/L	10000	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U
Carbon Tetrachloride	ug/L	5	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Chlorobenzene	ug/L	100	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
Chloroethane	ug/L	41000	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U
Chloroform	ug/L	1000	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
Chloromethane	ug/L	220	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U
cis-1,2-Dichloroethene	ug/L	70	<0.5 U	<0.5 U	<0.5 U	<0.5 U	2.04	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
cis-1,3-Dichloropropene	ug/L	5.3	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Dibromochloromethane	ug/L	34	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Dibromomethane	ug/L	380	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Dichlorodifluoromethane	ug/L	20000	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Ethylbenzene	ug/L	700	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Hexachlorobutadiene	ug/L	20	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Isopropylbenzene	ug/L	1000	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
m,p-Xylene	ug/L	10000	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U
Methylene Chloride	ug/L	5	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Naphthalene	ug/L	2000	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U

LHAAP-35A (58) Monitoring Well Volatile Organic Compound Data - October 2013

Sample ID:	Units	MCL	35AWW12-101813 10/18/2013	35AWW12FD-101813 10/18/2013	35AWW13-101113 10/11/2013	35AWW13FD-101113 10/11/2013	35AWW14-101813 10/18/2013	35AWW15-101613 10/16/2013	35AWW15FD-101613 10/16/2013	35AWW16-102213 10/22/2013	35AWW17-101813 10/18/2013	35AWW18-101813 10/18/2013	35AWW19-102213 10/22/2013
<b>Volatile Organic Compounds (8260B)</b>													
n-Butylbenzene	ug/L	4100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
n-Propylbenzene	ug/L	4100	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
o-Xylene	ug/L	10000	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
p-Isopropyltoluene	ug/L	10000	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
sec-Butylbenzene	ug/L	4100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Styrene	ug/L	100	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
tert-Butylbenzene	ug/L	4100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Tetrachloroethene	ug/L	5	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Toluene	ug/L	1000	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
trans-1,2-Dichloroethene	ug/L	100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
trans-1,3-Dichloropropene	ug/L	29	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U
Trichloroethene	ug/L	5	<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.663 J	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.379 J
Trichlorofluoromethane	ug/L	31000	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Vinyl Chloride	ug/L	2	<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.272 J	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U

**Note:** Samples were not collected for LHSMW04 and LHSMW05 as they were dry. 35ASW03-101713 is a surface water sample.

Blue Highlighting Indicates Analyte Detected Above Regulatory Limit

FD - field duplicate

J - Estimated value; analyte concentration was less than the limit of quantification

MCL - maximum contaminant level

NA - not analyzed

U - Analyte was not detected. The concentration is below the reported limit of detection.

ug/L - microgram per liter

UJ - The analysis was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. 'UJ' not detects are not definite; the analyte may be present.

LHAAP-35A (58) Monitoring Well Volatile Organic Compound Data - October 2013

Sample ID: Sample Date:	Units	MCL	35AWW20- 101513 10/15/2013	35AWW21- 101613 10/16/2013	35AWW22- 102213 10/22/2013	LHSMW06- 101713 10/17/2013	LHSMW07- 101513 10/15/2013
<b>Volatile Organic Compounds (8260B)</b>							
1,1,1,2-Tetrachloroethane	ug/L	110	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1,1-Trichloroethane	ug/L	200	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,1,2,2-Tetrachloroethane	ug/L	14	<0.4 U	<0.4 U	<0.4 U	<0.4 UJ	<0.4 U
1,1,2-Trichloroethane	ug/L	5	52.4	<0.5 U	<0.5 U	<0.5 U	0.922 J
1,1-Dichloroethane	ug/L	10000	327	<0.25 U	<0.25 U	2	45.8
1,1-Dichloroethene	ug/L	7	3230	<1 U	<1 U	1.23 J	396
1,1-Dichloropropene	ug/L	2.9	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2,3-Trichlorobenzene	ug/L	310	<0.3 U	<0.3 U	<0.3 U	<0.3 U	<0.3 U
1,2,3-Trichloropropane	ug/L	0.004	<1 U	<1 U	<1 U	<1 UJ	<1 U
1,2,4-Trichlorobenzene	ug/L	70	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U
1,2,4-Trimethylbenzene	ug/L	5100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2-Dibromo-3-Chloropropane	ug/L	0.2	<2 U	<2 UJ	<2 U	<2 UJ	<2 U
1,2-Dibromoethane	ug/L	0.005	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2-Dichlorobenzene	ug/L	600	3.23	<0.25 U	<0.25 U	<0.25 U	<0.25 U
1,2-Dichloroethane	ug/L	5	20.3	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,2-Dichloropropane	ug/L	5	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U
1,3,5-Trimethylbenzene	ug/L	5100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,3-Dichlorobenzene	ug/L	3100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
1,3-Dichloropropane	ug/L	29	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U
1,4-Dichlorobenzene	ug/L	75	0.637 J	<0.25 U	<0.25 U	<0.25 U	<0.25 U
2,2-Dichloropropane	ug/L	42	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
2-Butanone	ug/L	61000	<5 U	<5 U	<5 U	<5 UJ	<5 U
2-Chlorotoluene	ug/L	2000	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
2-Hexanone	ug/L	6100	<5 U	<5 U	<5 UJ	<5 UJ	<5 U
4-Chlorotoluene	ug/L	2000	<0.5 U	<0.5 UJ	<0.5 U	<0.5 U	<0.5 U
4-Methyl-2-Pentanone	ug/L	8200	<5 U	<5 U	<5 U	<5 UJ	<5 U
Acetone	ug/L	92000	<5 U	<5 U	<5 U	<5 UJ	<5 U
Benzene	ug/L	5	4.91	<0.25 U	<0.25 U	<0.25 U	0.303 J
Bromobenzene	ug/L	2000	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
Bromochloromethane	ug/L	4100	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U
Bromodichloromethane	ug/L	4.6	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Bromoform	ug/L	36	<1 U	<1 U	<1 U	<1 U	<1 U
Bromomethane	ug/L	140	<1 U	<1 U	<1 U	<1 UJ	<1 U
Carbon Disulfide	ug/L	10000	<1 U	<1 U	<1 U	<1 U	<1 U
Carbon Tetrachloride	ug/L	5	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Chlorobenzene	ug/L	100	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
Chloroethane	ug/L	41000	<1 U	<1 U	<1 U	<1 U	<1 U
Chloroform	ug/L	1000	0.762 J	<0.25 U	<0.25 U	<0.25 U	<0.25 U
Chloromethane	ug/L	220	<1 U	0.518 J	<1 U	<1 U	<1 U
cis-1,2-Dichloroethene	ug/L	70	110	<0.5 U	<0.5 U	4.01	6.1
cis-1,3-Dichloropropene	ug/L	5.3	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Dibromochloromethane	ug/L	34	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Dibromomethane	ug/L	380	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Dichlorodifluoromethane	ug/L	20000	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Ethylbenzene	ug/L	700	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Hexachlorobutadiene	ug/L	20	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Isopropylbenzene	ug/L	1000	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
m,p-Xylene	ug/L	10000	<1 U	<1 U	<1 U	<1 U	<1 U
Methylene Chloride	ug/L	5	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Naphthalene	ug/L	2000	<0.4 U	<0.4 U	<0.4 U	<0.4 U	<0.4 U

LHAAP-35A (58) Monitoring Well Volatile Organic Compound Data - October 2013

Sample ID:	Units	MCL	35AWW20-101513 10/15/2013	35AWW21-101613 10/16/2013	35AWW22-102213 10/22/2013	LHSMW06-101713 10/17/2013	LHSMW07-101513 10/15/2013
<b>Volatile Organic Compounds (8260B)</b>							
n-Butylbenzene	ug/L	4100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
n-Propylbenzene	ug/L	4100	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
o-Xylene	ug/L	10000	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
p-Isopropyltoluene	ug/L	10000	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
sec-Butylbenzene	ug/L	4100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Styrene	ug/L	100	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
tert-Butylbenzene	ug/L	4100	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Tetrachloroethene	ug/L	5	1.65	<0.5 U	<0.5 U	0.663 J	<0.5 U
Toluene	ug/L	1000	0.447 J	<0.5 U	<0.5 U	<0.5 U	<0.5 U
trans-1,2-Dichloroethene	ug/L	100	3.77	<0.5 U	<0.5 U	<0.5 U	0.282 J
trans-1,3-Dichloropropene	ug/L	29	<1 U	<1 U	<1 U	<1 U	<1 U
Trichloroethene	ug/L	5	513	<0.5 U	<0.5 U	1.87	23.9
Trichlorofluoromethane	ug/L	31000	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
Vinyl Chloride	ug/L	2	105	<0.5 U	<0.5 U	0.627 J	15.9

**Note:** Samples were not collected for LHSMW04 and LHSMW05 as they were dry. 35ASW03-101713 is a surface water sample.

Blue Highlighting Indicates Analyte Detected Above Regulatory Limit

FD - field duplicate

J - Estimated value; analyte concentration was less than the limit of quantification

MCL - maximum contaminant level

NA - not analyzed

U - Analyte was not detected. The concentration is below the reported limit of detection.

ug/L - microgram per liter

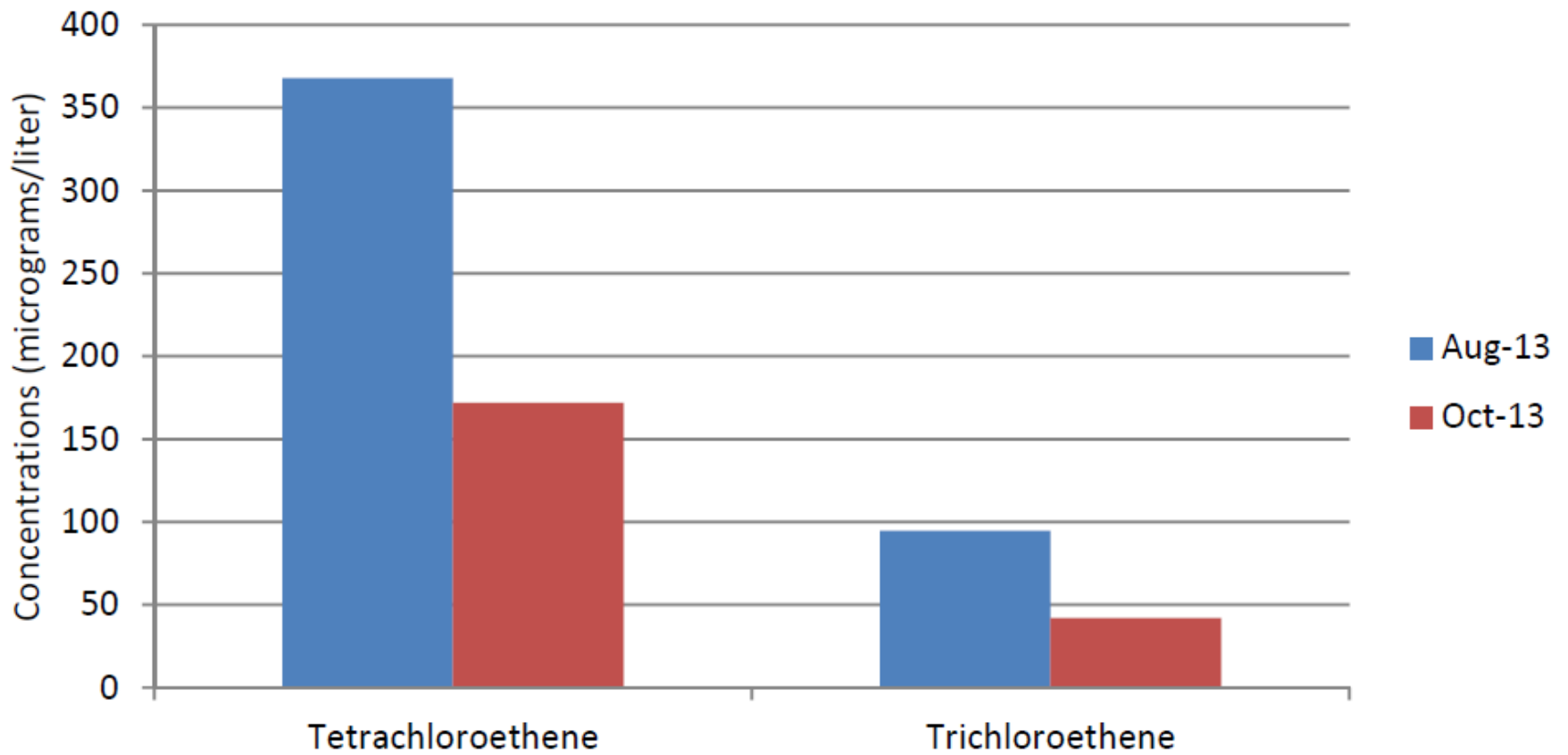
UJ - The analysis was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. 'UJ' not detects are not definite; the analyte may be present.



*Laboratory data packages will be included in a separate file.*

**APPENDIX G: PCE and TCE Concentration Trends in Eastern Plume Shallow Zone  
Groundwater (EISB Treatment Area)**

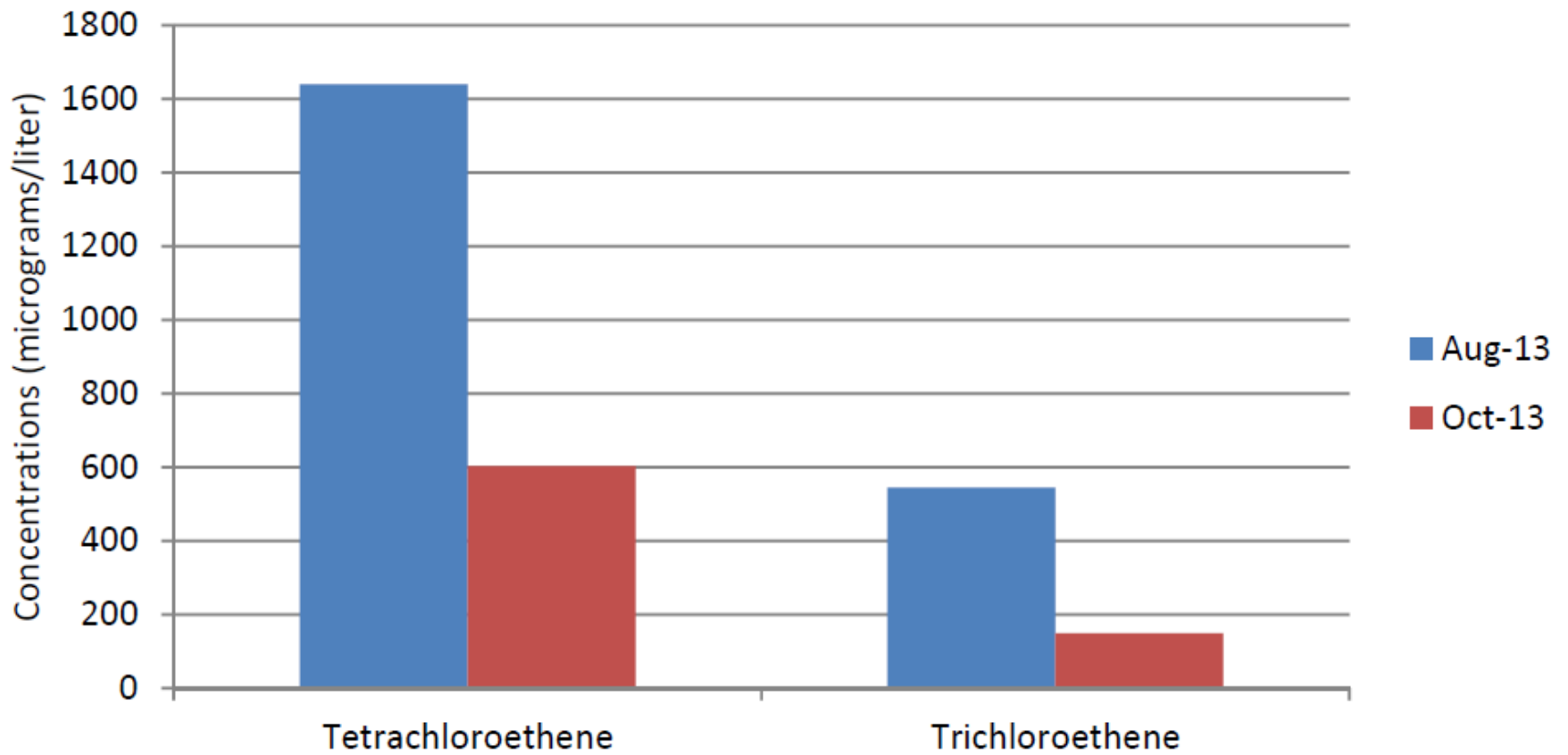
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**Appendix G: Tetrachloroethene and Trichloroethene Concentrations in Shallow Zone Well 03WW01**  
Longhorn Army Ammunition Plant, Karnack, Texas

60256135

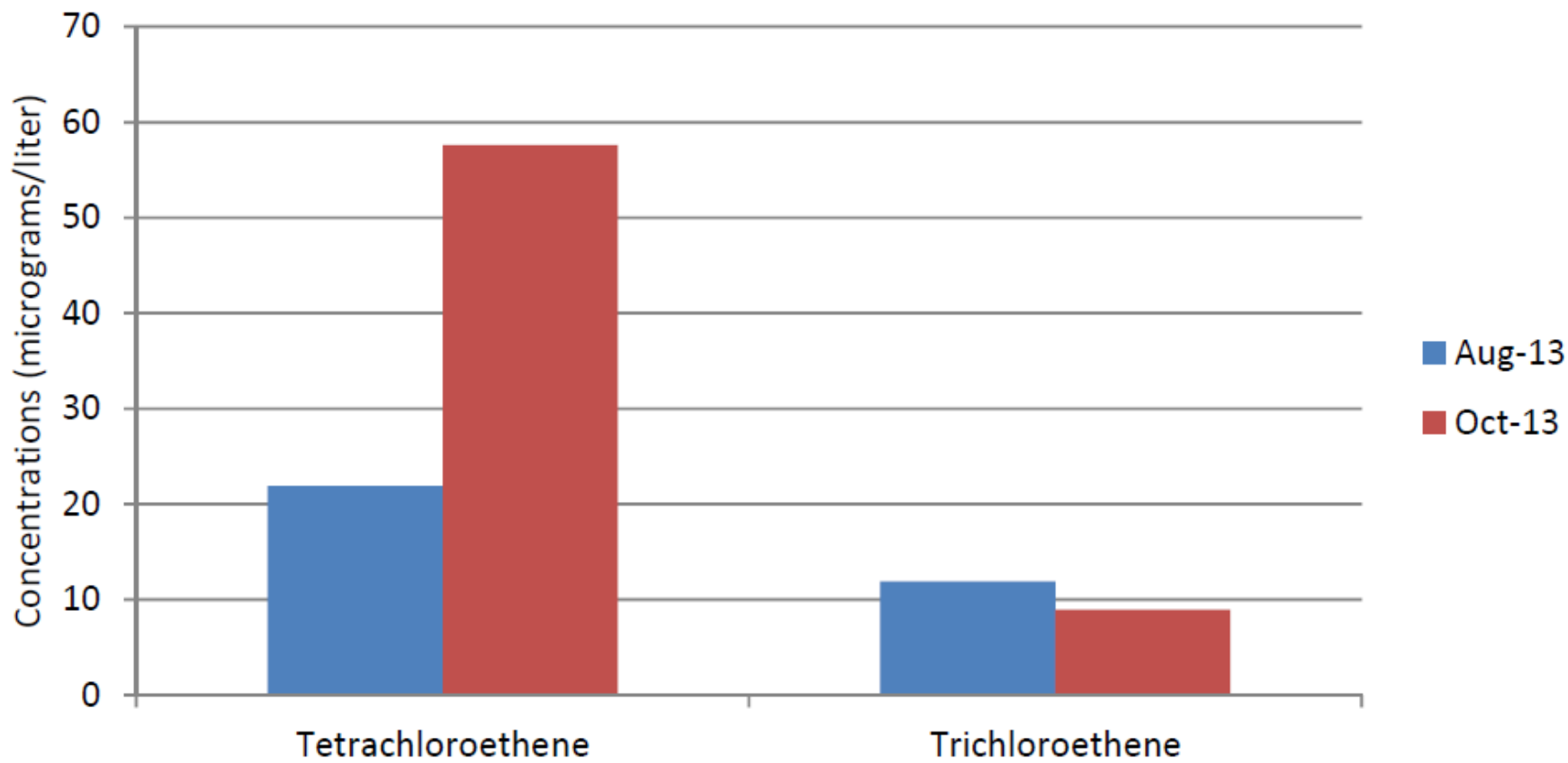
March 2014



**Appendix G: Tetrachloroethene and Trichloroethene Concentrations in Shallow Zone Well 35AWW08**  
Longhorn Army Ammunition Plant, Karnack, Texas

60256135

March 2014

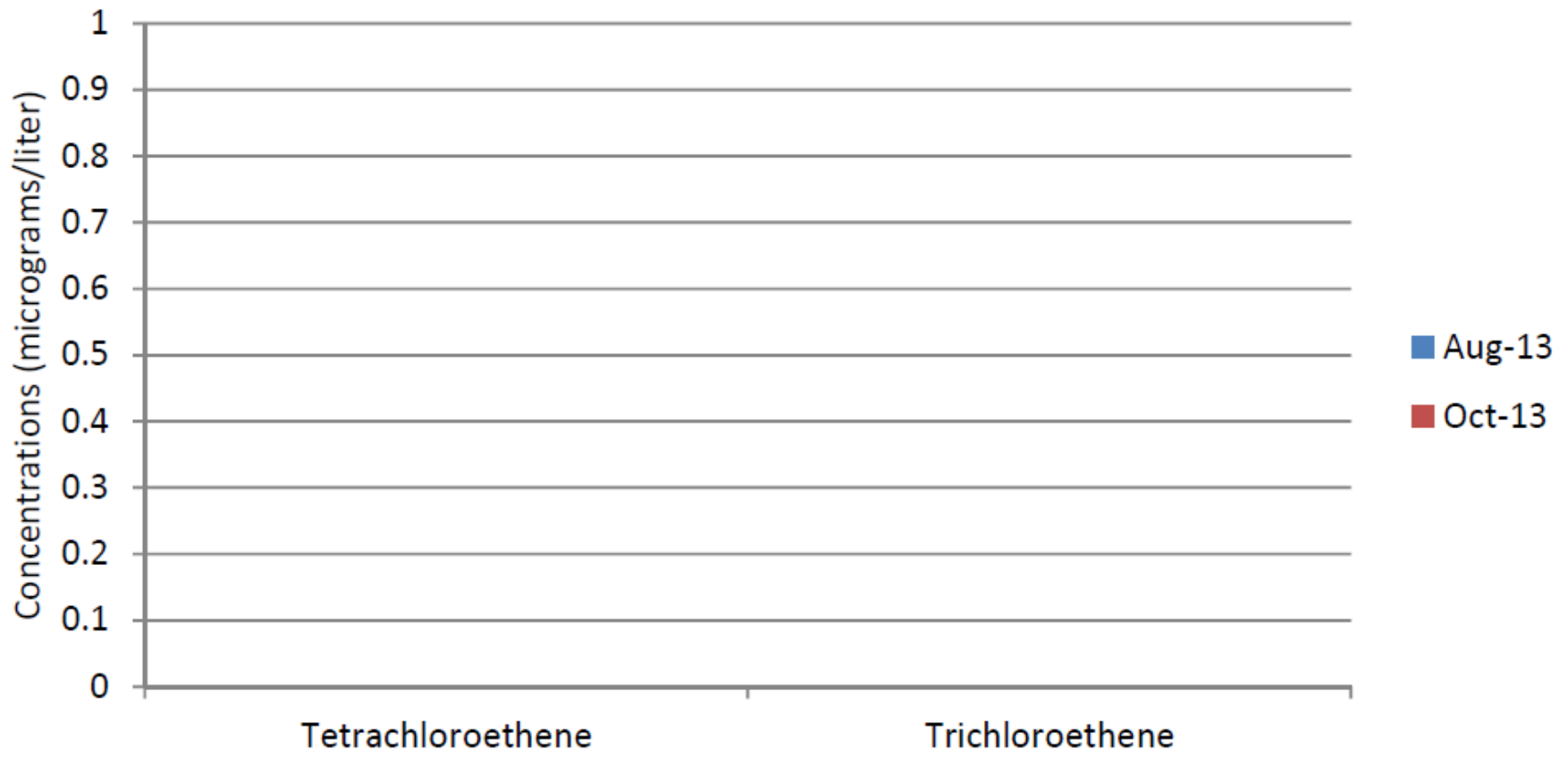


**Appendix G: Tetrachloroethene and Trichloroethene Concentrations in Shallow Zone Well 35AWW09**  
Longhorn Army Ammunition Plant, Karnack, Texas

60256135

March 2014





**Appendix G: Tetrachloroethene and Trichloroethene Concentrations in Shallow Zone Well 35AWW10**  
 Longhorn Army Ammunition Plant, Karnack, Texas